UNIVERSITY OF FRIBOURG

On Economic Resilience:

A Theoretical Investigation of the Influence of Clusters

DOCTORAL THESIS

Presented to the Faculty of Management, Economics and Social Sciences
at the University of Fribourg (Switzerland), in fulfillment of the requirements for the
degree of Doctor of Economics and Social Sciences (Dr. rer. pol.)

by

MATHIEU RESBEUT

from Reffuveille (France)

Accepted by the Faculty of Management, Economics and Social Sciences
on March 1st, 2021, at the proposal of

Prof. Dr. Philippe Gugler (First Advisor) and of
Prof. Dr. Fernando Alberti (Second Advisor)

Fribourg, 2021

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To those who might find some bits and pieces that help their research

Acknowledgements

Contents

List of figures

List of tables

List of abbreviations

&	and
BC	Business Cycles
CHF	Swiss franc
CSA	Country-Specific Advantages
e.g.	exempli gratia
EM	East Midlands
ESPON	European Spatial Planning Observation Network
ESS	European Social Survey
ET	East of England
et al.	et alii
etc.	et cetera
EU	European Union
EUR	Euro
FSA	Firm-Specific Advantages
GCI LM	Labour Market Efficiency indicator of the Global Competitiveness Institute
GCI PM	Product Market Efficiency Indicator of the Global Competitiveness Institute
GDP	Gross Domestic Product
GVA	Gross Value Added
i.a.	inter alia
i.e.	id est
ICT	Information and Communication Technologies
IMF	International Monetary Fund
ISC	Institute for Strategy and Competitiveness

L-advantages	Location-Specific Advantages
LN	London
MAR	Marshall-Arrow-Romer
MNE	Multinational Enterprise
MOC	Microeconomic of Competitiveness
MSA	Metropolitan Statistical Area
NE	North East
NI	Northern Ireland
NIH	National Institute of Health
NUTS	Nomencalture of Territorial Units for Statistics
NW	Nort West
OECD	Organisation for Economic Co-operation and Development
OLI	Ownership, Location and Internationalisation
p.	page
pp.	pages
Prod.	Productivity
R&D	Research and Development
RBC	Real Business Cycles
RTA	Revealed Technological Advantage
SC	Scotland
SE	South East
SME	Small and Medium Enterprise
Std.	Standard
SW	South West
UK	United Kingdom
U.S.	United States of America
US	United States of America
USA	United States of America
WEF	World Economic Forum
WL	Wales
WM	West Midlands
YH	Yorkshire and the Humber

Introduction

As a consequence of the recent financial crisis, and the subsequent Great Recession, the concept of economic resilience has gained attention in the academic world. The financial crisis has brought to light the heterogeneity of the economic responsiveness of locations to the crisis as much in Europe as in the US. Since the Great Recession, many papers and books have been published (amongst others: Christopherson et al., 2010; Martin, 2012; Boschma, 2015; Kahl and Hundt, 2015; Bristow and Healy, 2018a) and Special Issues released in scientific journals such as the *Cambridge Journal of Regions, Economy and Society* (2010), *Raumforschung und Raumordnung* (2014) or in *The Annals of Regional Science* (2018). Moreover, the term resilience has been picked up by international economic organisations. The concept was mentioned in the 2017-2018 Global Competitiveness Review (WEF, 2018) and by the IMF (2019). In 2020, the World Economic Forum (WEF) has published a ranking of the most resilient countries (WEF, 2020). These examples are only a glimpse at the increasing popularity of the concept in the scientific community.

A decade after the Great Recession, a wave of works on the concept of economic resilience has emerged, building on the increased availability of data and focusing on the determinants affecting the resilience of locations (Bristow and Healy, 2018b). While the determinants driving the growth process of economies have been extensively studied, there are still ongoing questions as to whether these drivers also impact economic resilience (Rocchetta and Mina, 2019, p. 1430). For example, in their book *Economic Crisis and the Resilience of Regions*, Bristow and Healy (2018a, p. 1) ask: "What is it that makes some economies more resilient to economic shocks than others?". This question gives rise to more: What does economic resilience mean? What are the most

important determinants characterising resilient economies? Di Caro and Fratesi (2018, p. 235) observe that an open issue in the literature is the identification of the drivers, or so-called determinants, affecting economic resilience. Similarly to the study of economic growth, understanding the economic resilience of locations may have critical importance in regard to economic policy. In fact, implementing the right policies may help mitigate the effect of shocks and increase the well-being of economic agents. Sensier (2018, pp. 11-12) argues that there is "a social value as there is a tendency in the minds of the public and politicians to regard the possession of a job as a strong indication of the well-being of an economy". Therefore, not only growth matters, but also how to reduce the volatility of an economy regarding "both economy-wide and industry specific shocks" (Delgado and Porter, 2018, p. 1)

In this thesis, an investigation of the concept of economic resilience will be carried out by looking at clusters and the impact that they may have on economic resilience. During a presentation at the Microeconomics of Competitiveness (MOC) Faculty Workshop on December 2018, Michael Porter stressed the importance of the depth and breadth of clusters in developing economic resilience (Porter, 2018). Many studies have shown that clusters increase the performance of firms in terms of productivity and growth (amongst others: Porter, 2003; Delgado et al., 2010; Delgado et al., 2014; Resbeut and Gugler, 2016). In other words, clusters increase the competitiveness and prosperity of the locations that host them. In fact, prosperity is created by the activities of firms and depends on the firms' ability to increase productivity (Gugler, 2019, p. 18). In turn, firms are influenced by the surrounding economic environment and the competitive advantages of locations. Hence, the economic environment around clusters may also be of importance regarding the economic resilience of locations. However, few studies have focused on the impact of these clusters when the economic situation is declining.

Do clusters increase the economic resilience of locations in times of crisis and consequently strengthen their prosperity even more? This would contradict the popular belief that you should not put all your eggs in one basket. In economic terms, if a location is specialised in one cluster, does it weaken the competitiveness and reduce the prosperity of that location in times of economic downturn? And does a location hosting a larger array of clusters perform better in the face of an external shock? Or is it the co-location of related clusters that could play a positive role on economic resilience?

In fact, recent works have found diverging results regarding the influence of the 'industrial mix' on the resilience of locations. While some studies stress the importance of specialisation (Brakman et al., 2014; Cuadrado-Roura and Maroto, 2016), related diversity (Hane-Weijman et al., 2017; Pudelko and Hundt, 2017), clusters (Kahl and Hundt, 2015; Wrobel, 2015) or of the co-location of related clusters (Delgado and Porter, 2018), others have highlighted the fact that it is the diversity of a location's economic structure that increase resilience (Brown and Greenbaum, 2016; Sagan and Masik, 2018; Cainelli et al., 2019). This may rise the question of what types of agglomeration increase economic resilience? Other works highlight the role of innovation (Clark et al., 2010; Hannigan et al., 2015), the regional and national context (Fratesi and Perucca, 2018; Sondermann, 2018), entrepreneurship (Hundt and Sternberg, 2014; Huggins and Thompson, 2015; Sagan and Masik, 2018; Bishop, 2019) or the quality of human capital (Glaeser et al., 2014; Diodato and Weterings, 2015; Weinstein and Patrick, 2019) to explain the economic resilience of locations.

By focusing on clusters and their underlying mechanisms as drivers of prosperity, this investigation may give more fruitful insight about the determinants of economic resilience and offer a new dimension on the competitiveness and prosperity of locations. In fact, the concept of competitiveness is well established in the economic literature and has been addressed since many centuries by policy makers in order to "understand the drivers of economic prosperity and social welfare" (Gugler, 2019, p. 18). Hence, the aim of this thesis is to investigate more thoroughly the influence of clusters on the economic resilience of locations from a conceptual standpoint and understand if they influence the economic resilience of locations.

In this regard, while the theories on the competitiveness and prosperity of locations are well established, the theory around economic resilience has not yet reached a general understanding. Hence, there are two key aspects to be elucidated: (1) how resilience can be analysed in the economic context, (2) and what determinants influence economic resilience.

The methodology applied in this thesis is based on the complex literature review (Machi and McEvoy, 2016, p.3). The goal of a complex literature review is to perform a review of the literature as a basis for arguing a case and identifying further research problems. In

this thesis, the idea is to use the current knowledge about two subjects: economic resilience and clusters. By crossing two different concepts, it defines an issue for further analysis by providing a case for argumentation with a solid theoretical background. Figure 0.1 presents the methodological path taken in this thesis following the complex literature review. The point of departure is the literature reviews on the concepts of economic resilience and clusters that are performed in chapters 1 and 2, respectively. Then, based on the conclusions of these two literature reviews, it was found that a further investigation of the theories of growth and business cycles, in regard to the concepts of economic resilience and clusters, was needed in order to understand if clusters can influence economic resilience. These two supplementary literature reviews are tackled in chapter 3 and 4, respectively. Finally, by putting together the conclusions of the four literature reviews carried out, the determinants and mechanisms through which clusters influence economic resilience are identified.

Figure 0.1: The methodological path taken in this thesis.
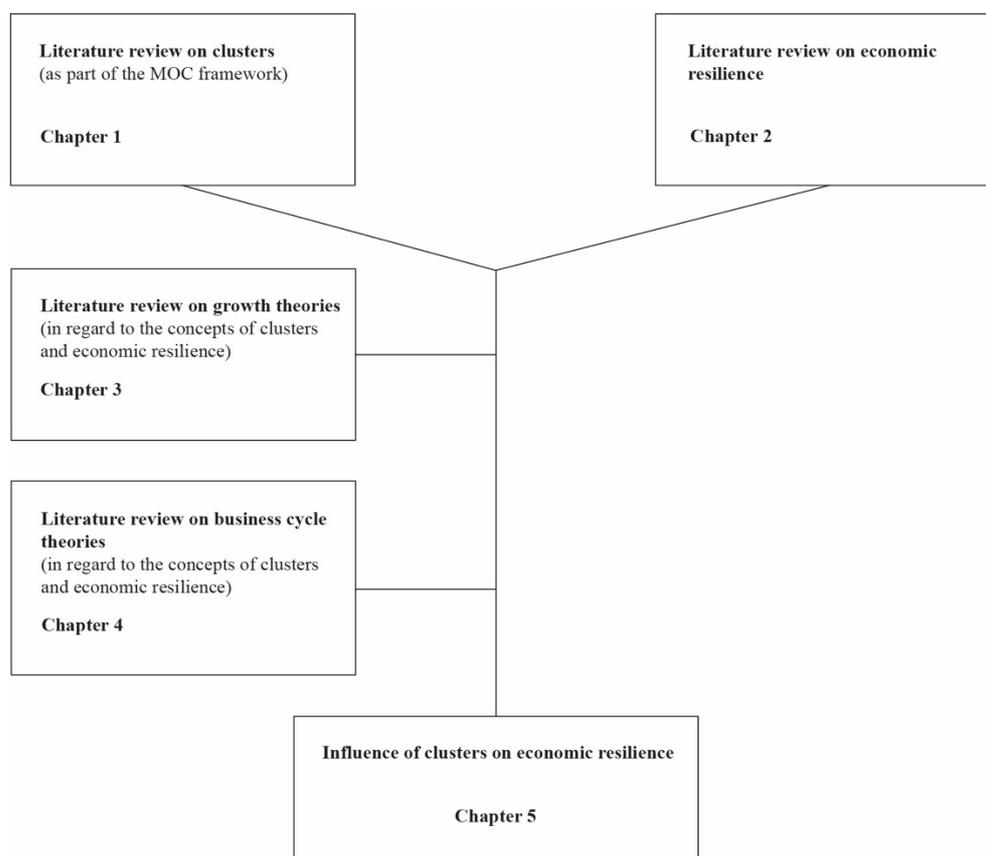
Source: Personal elaboration.

Following the methodology described above, the thesis is structured in five chapters. The first one presents the microeconomics of competitiveness (MOC) framework which encompasses the concept of clusters in order to understand how clusters influence the prosperity of locations. The second chapter investigates the literature on economic resilience and introduces conceptual issues as well as potential determinants. Based on the conclusions of chapters 1 and 2, growth theories and business cycle theories are investigated in chapters 3 and 4, respectively. The growth and business cycle theories analysed are selected based on the determinants found in the first and second chapters. Building on the conclusions of chapters 1 to 4, the final analysis is conducted in the fifth chapter. It presents the determinants and mechanisms of clusters that influence the economic resilience of locations.

Chapter 1

The determinants affecting the prosperity of locations: A cluster perspective

The aim of this chapter is to understand how clusters affect the prosperity of locations from a theoretical and empirical point of view. It will lay grounds for the analysis carried out in the following chapters to determine whether clusters can play a role in increasing the economic resilience of locations. In this chapter, the underlying mechanisms and determinants of clusters affecting the prosperity of locations are identified. This chapter is structured as follows. The microeconomics of competitiveness framework, of which the concept of clusters is a part, is presented in section 1.1 from a theoretical standpoint. In section 1.2, an examination of the literature is conducted focusing on works that have statistically and empirically analysed the influence of clusters, and their underlying mechanisms and determinants, on the prosperity of locations. Finally, there is a synthesis in section 1.3, identifying the determinants affecting the prosperity of location.

1.1 The concept of clusters from a Porterian approach: A theoretical examination

This first section presents the theoretical basis for identifying the determinants of clusters that affect the prosperity of locations. Michael. E. Porter introduces his understanding of the concept of clusters in a first book published in 1990, *The Competitive Advantage of Nations*, and continues the analysis in various articles (Porter, 1998; Porter, 2000; Porter,

2003; Porter, 2009; Delgado et al., 2010; Delgado et al. 2014) as well as in a second book published in 2008, *On Competition*.

The concept of clusters *per se* was not introduced by Porter. In fact, theoretical antecedents of clusters can be found in the literature, notably in economic geography. Authors such as Marshall, Krugman and Glaeser have also investigated concepts close to the one proposed by Porter, whether it is industrial districts, external economies or agglomeration forces. The theoretical antecedents of cluster are the focus of subsection 1.1.3. Nevertheless, this thesis will build on Porter's understanding of clusters.

The concept of clusters falls within the microeconomics of competitiveness framework and represents one of the drivers of the prosperity of locations. The prosperity of locations depends on the firms' activities and more precisely on their productivity, with which factors of production are employed and upgraded over time (Gugler, 2019, pp. 18-20). The prosperity of a location is based on three levels of drivers as showed in figure 1.1: the endowments of a location, the macroeconomic competitiveness level and the microeconomic competitiveness level. While the endowments "create a foundation for prosperity" and the macroeconomic competitiveness level "sets the potential for high productivity", prosperity ultimately depends on the productivity with which the "human, capital and natural endowments are used" (ISC, 2020). Hence, productivity is created at the microeconomic competitiveness level and depends on "improving the microeconomic capability of the economy and the sophistication of local competition" (ISC, 2020).

Endowments can be natural resources (e.g. oil, minerals), a given geographic location (e.g. a port situated on an important trade route) or the size of a location (e.g. in terms of population). Macroeconomic competitiveness encompasses sound monetary and fiscal policies (i.a. low level of inflation) as well as effective institutions and higher human development levels (i.a. basic education and health care, rule of law, stable political and governmental organisations) (ISC, 2020). While endowments and macroeconomic competitiveness provide the foundation and potential for prosperity, they are not sufficient. It is at the microeconomic level that productivity and, *in fine*, prosperity are created.

The microeconomic level is composed of three dimensions: (1) the quality of the business environment which can be analysed through the lens of the "diamond" model, (2) the

state of cluster development, and (3) the sophistication of company operations and strategy, namely the skills, capabilities and strategies adopted by firms (see figure 1.1) (ISC, 2020). Hence, it is the microeconomic competitiveness level which is of importance in this thesis, and in particular the state of cluster development.

Consequently, this first section is structured as follows: subsection 1.1.1 focuses on the microeconomic business environment, subsection 1.1.2 analyses the role played by firms, and the concept of clusters is developed in subsection 1.1.3.

Figure 1.1: Drivers of the prosperity of locations.
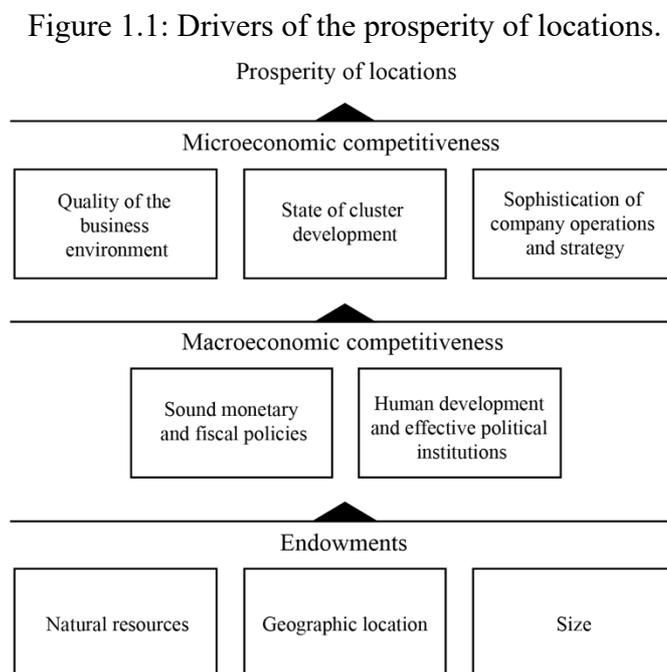
Source: Personal elaboration based on ISC (2020) and Ketels (2016, p. 14).

1.1.1   Quality of the business environment

Porter's aim is to understand, from a microeconomic perspective, how industries are able to create and sustain a competitive advantage. He notably asks:

> Why are certain companies based in certain nations capable of consistent innovation? Why do they ruthlessly pursue improvements, seeking an ever more sophisticated source of competitive advantage? Why are they able to overcome the

substantial barriers to change and innovation that so often accompany success? (Porter, 2008, p. 182)

Therefore, this subsection focuses on how the quality of the business environment impacts the firms' capacity to create and sustain competitive advantages.

i   From absolute and comparative advantage to competitive advantage

Firstly, it is important to distinguish competitive advantages with the more traditional absolute advantages and comparative advantages introduced by Smith and Ricardo, respectively.

In his book *An Inquiry into the Nature and Causes of the Wealth of Nations*, published in 1776, Adam Smith advances a notion that is known nowadays as "absolute advantage", where each country exports a good if it can produce it at lower cost. In fact, Smith (1776, p. 457) writes:

> If a foreign country can supply us with a commodity cheaper than we ourselves can make it, better buy it of them with some part of the produce of our own industry employed in a way in which we have some advantage.

Hence, a country will be "left to find out the way in which it can be employed with the greatest advantage" and this is the case when "directed towards an object which it can buy cheaper than it can make" (Smith, 1776, p. 457). Consequently, a country will only produce a good for which it has an absolute cost advantage.

In Ricardo's vision, explained in his book *Principles of Political Economy and Taxation*, published in 1817, comparative advantages arise, under the assumption of perfectly free commerce, when "each country naturally devotes its capital and labour to such employments as are most beneficial to each" (Ricardo, 1817a, p. 152). Put differently, each country specialises in the production of goods for which the factors of production are used "most effectively and most economically" (Ricardo, 1817a, p. 152). Hence, Ricardo advances the hypothesis of differences in productivity of factors of production. This induces an opportunity cost in producing a given good that is different in each country depending on "the peculiar powers bestowed by nature" (Ricardo, 1817a, p. 152).

Hence, a country has a comparative advantage in the production of a given good if its opportunity cost is lower than that of other countries (Krugman and Obstfeld, 2009, p. 29). This notion of comparative advantage has been the prevailing version in later economic theories.

While in Smith's view it is the country that can offer the good at the lower cost that gains an advantage, Ricardo further improves this explanation by arguing that countries produce the goods for which they are most productive. Hence, a country may have an absolute advantage in the production of a given good but will produce another good for which the opportunity cost is lower. Or in other words, a country without an absolute advantage may still have an interest in trade as its opportunity cost to produce a given good may be lower than in other countries.

Porter's idea of competitive advantage diverges slightly from the notion of comparative advantage. In fact, in Porter's view, comparative advantage based on differences in factors of production is not sufficient to explain trade, notably as it is based on strong hypotheses (i.a. no economies of scale, uniform technology) (Porter, 1990, p. 12). Consequently, comparative advantages do not explain actual patterns of trade since they do not take into account differences in the use of advanced technologies or specialised factors of productions (Porter, 1990, pp. 12-13). Also, change in technology and specialised factors of production is continuous and differs widely between locations.

Consequently, Porter (1990) proposes a new paradigm of a dynamic notion of competitive advantage based on a "highly localized process" that permits understanding of how firms achieve international success. It takes into account differences in "national structures, values, cultures, institutions and histories" that constantly evolve (Porter, 1990, p. 19). Hence, a notion of competitive advantage should: (1) encompass "segmented markets, differentiated products, technology differences, and economies of scale", (2) be "dynamic and evolving", (3) make "improvement and innovation in methods and technology a central element", and (4) include the role played by firms in creating competitive advantages (Porter, 1990, pp. 20-21).

ii   The diamond framework: Explaining the business environment

Firms create and sustain competitive advantages through a "highly localized process", hence highlighting the role of the microeconomic business environment. For Porter (2008, p. 182), the explanation lies in the so-called 'diamond' of national advantage which represents the 'four broad attributes' (i.e. determinants) of a nation that affect the international competitive success of firms (see figure 1.2). Each point of the diamond represents one "broad attribute" and they are linked to one another and interact. Porter (2008, p. 199) adds that: "the diamond creates an environment that promotes clusters of competitive industries". Hence, the 'diamond' represents a dynamic explanation of the international success of nations and helps understand the microeconomic environment that surrounds the creation of competitive industries as well as the formation of clusters (Porter, 2008, p. 199).

Porter (1990, p. 131; 2008, p. 198) also puts forward two essential ingredients in shaping the diamond into a system: (1) domestic rivalry, and (2) geographic concentration. While domestic rivalry "promotes improvement in all other determinants", geographic concentration increases the interactions amongst the determinants (Porter, 2008, p. 198).

Figure 1.2: The diamond model representing the determinants of national advantage.
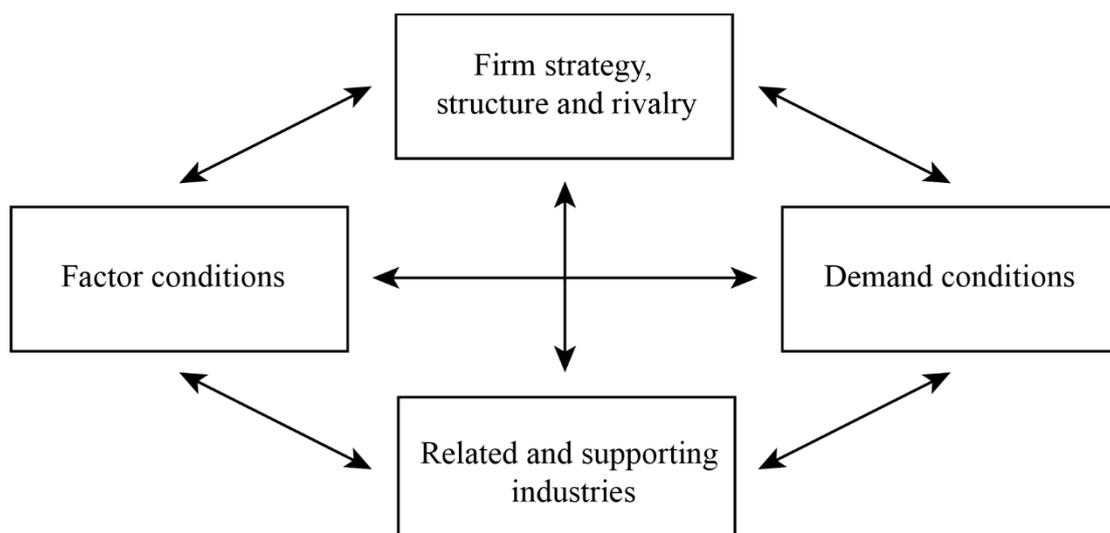
Source: Personal elaboration based on Porter (1990, p. 72).

The self-reinforcing process of the determinants

Each point of the diamond is influenced by the other points which consequently stimulate the competitive advantage of firms and, ultimately, of industries. Hence, the influence that the four determinants exert on each other are explained.

The impact on *factor creation* is analysed first. Generalised factors are necessary but not sufficient for creating a competitive advantage (Porter, 1990, p. 132). In fact, these generalised factors are necessary for creating advanced and specialised factors which competitive industries need such as skilled labour, specific infrastructure or scientific knowledge in a particular domain. According to Porter (1990, p. 134), these advanced and specialised factors are primarily influenced by domestic rivalry. The strong competition between a certain number of local firms not only increases the investment made by firms in specialised factors but it also sets in motion specific programs in universities and government or private institutes for example, as well as activities including tailored training and apprenticeship programmes. The strong competition in a specific industry alerts public- and private-sector actors to potential needs in terms of factors of production, consequently reducing the risk for the competing firms of investing in the creation of these specific factors of production (Porter, 1990, p. 134).

Related and supporting industries as well as demand conditions also amplify the creation of factors. In fact, some related and supporting industries (i.a. suppliers, service providers) may require similar advanced and specialised factors, which increases their demand and supply (Porter, 1990, p. 135). Demand conditions also influence factor creation when there is a "disproportionate" amount of demand for a specific good. In this case, the demand will "channel" investments that will satisfy the demand and create, over time, pools of specialised factors (Porter, 1990, pp. 135-136).

Demand conditions are also influenced by the other points of the diamond, and particularly by domestic rivalry. In fact, strong competition results, among other things, in aggressive pricing, greater variety and earlier launching of products (Porter, 1990, pp. 136-137). Further, domestic rivalry also raises awareness of the industry: local buyers are becoming more sophisticated and foreign buyers get word of the industry, thereby increasing foreign demand (Porter, 1990, p. 137). Regarding increasing foreign demand, Porter (1990, p. 137) specifies that strong domestic rivalry "builds a national image" and

reduces buyer's risk thanks to the availability of numerous suppliers. This national image may also be the result of the reputation of related and supporting industries. Less important, in comparison to the other two broad attributes of the diamond, is the role of factor conditions on the internationalisation of home demand. Nonetheless, Porter (1990, p. 138) argues that sophisticated factors attract foreign firms which helps spread home demand.

Domestic rivalry is also the most important determinant influencing related and supporting industries. In fact, an internationally successful industry also increases the demand for tailored services that can be provided by suppliers (Porter, 1990, pp. 138-139). Due to the strong competition in the internationally successful industry, suppliers must innovate in order to satisfy their customers who face strong competition. The large presence of customers not only weakens the bargaining power of suppliers, but it also reduces their risk as they face a larger market. Consequently, increased investment and specialisation amongst the suppliers leads to more "potential centers of development" (Porter, 1990, p. 140). This, in turn, widens sales possibilities and reduces the risk for the suppliers.

Factor conditions also influence supporting industries through spillovers and synergies in terms of, *inter alia*, common technologies, skills and knowledge (Porter, 1990, p. 138). Similarly to the elements above regarding the influence of domestic rivalry, the suppliers may benefit from the advanced factor-creation mechanisms triggered by an internationally successful industry. Finally, the bigger the home demand, the more specialised the supporting industries. This is the consequence of economies of scale which increase the efficiency of suppliers (Porter, 1990, p. 138).

Finally, while domestic rivalry has the strongest influence on each of the other points of the diamond, it can also be affected in various ways. Related and supporting industries stimulate firm creation. In fact, firms active in related or supporting industries may enter the base industry (Porter, 1990, p. 140). They not only have lower barriers to entry as some advanced factors of production may share strong similarities but they also bring new technologies and resources that may reshape the competition. Consequently, it preserves incentives for new innovations and sustains the competitive advantage. This process is called related diversification and it mostly takes place when the industry is

saturated or in decline (Porter, 1990, p. 142). Nonetheless, according to Porter (1990, p. 143), competitive advantage is the most "vibrant" when different related or supporting industries converge towards a new industry. In this scenario, a variety of "approaches to competing" and advanced factors are brought together (Porter, 1990, p. 143).

Sophisticated buyers (i.e. demand conditions) also increase domestic rivalry. They seek multiple sources of supply and therefore encourage new entries (Porter, 1990, p. 141). To a certain extent, buyers may also enter the industry and bring an "acute understanding of the buyer needs", which enhances the competitive advantage. Finally, advanced factor creation mechanisms also provoke new entries, for example, when workers with specific training and skills decide to enter the industry as entrepreneurs. Usually, they are well informed about opportunities, technologies and market conditions.

Overall, a strengthening of domestic rivalry, mostly through new entrants, increase the competition in an industry. This increased competition, in turn, will affect the other points of the diamond through the mechanisms described in this subsection. This self-reinforcing mechanism creates and sustains the competitive advantage in an industry. The influence of domestic rivalry is also known in economic theory as external economies where an increase in the industry diminishes the cost of doing business for the firms competing in that industry. According to Porter (1990, p. 144), these external economies are particularly important in the process of innovation and also benefit related and supporting industries.

How geographic concentration influences the diamond

The geographical concentration influences the national diamond by increasing the interactions amongst the determinants. Porter (1990, p. 154) notes: "Competitors in many internationally successful industries, and often entire clusters of industries, are often located in a single town or region within a nation".

Geographic concentration influences the national diamond in the following ways. First, competitors notice the success of close rivals and tend to be 'jealous', hence increasing their motivation to compete. Second, a group of close competitors are more easily noticed by universities, research institutes and other supporting institutions, that may adapt in order to satisfy the needs of domestic firms. Firms are also keener to finance local

universities (Porter, 1990, p. 157). Hence, a common interest emerges from this geographic concentration. This mechanism also creates an environment attractive to talented people and other resources. And third, information is more concentrated and flows more easily between the various actors.

In spite of that, Porter (1990, p. 157) mentions that this geographic concentration can become an economic risk if firms do not internationalise, that is, if they limit their sales to the local market and do not develop ties outside of the core industry.

On an ending note, it can be said that while the primary focus of the national diamond is the 'nation', it can be transposed to the regional or city level as the determinants are also found at smaller geographical units of analysis. However, Porter argues that: "it is the combination of national and intensely local conditions that fosters competitive advantage" (Porter, 1990, p. 158).

1.1.2   The sophistication of company operations and strategy

The previous subsection focused on the importance of the microeconomic business environment, and notably on the 'four broad attributes' of a nation that enable firms to create and sustain competitive advantage. In fact, it is firms and not nations, or more generally locations, that compete (Porter, 1990, p. 33). It is the strategies that firms implement in order to organise and perform activities that result in competitive advantages. Consequently, this second subsection concentrates on the role played by firms as well as their strategies.

i   Competitive strategy of firms

Firms compete in industries that are the "arena in which competitive advantage is won or lost" (Porter, 1990, p. 34). By implementing competitive strategies, firms within these industries choose an approach to competing. There are two dimensions that influence the choice of a strategy: (1) the nature of competition within an industry, and (2) the position within the industry (Porter, 1990, p. 34). First, firms continuously influence industries'

structure and competitive position by influencing and adapting to their surrounding environment. Second, firms position themselves in relation to their competitors. There are two important variables that influence the position: (1) the nature of competitive advantage, namely low cost or differentiation, and (2) the competitive scope (i.a. the range of good produced, the various distribution channels employed) (Porter, 1990, pp. 37-38).

Firms gain a competitive advantage by innovating, or to put it another way, by finding better ways to compete, for example by implementing new technologies or new ways to conduct activities, shifting towards new industry segments or using different inputs (Porter, 1990, pp. 45-47). Hence, firms that can perceive and implement these new ways to compete gain a competitive advantage. This approach is akin to Schumpeter who puts forward the strategic position of firms and the role of entrepreneurs who execute new combinations. In Schumpeter's view, entrepreneurs rearrange factors of production (i.e. innovate) in order to create a monopolistic position and benefit from higher profits (Schumpeter, 1944). It is the search for higher profits that drives the firm's decision to innovate and 'move early' (i.e. to anticipate). In order to move early (i.e. perceive new ways to compete) and to build an advantage, firms must gather knowledge about an opportunity. Consequently, information plays an important role in the process of innovation, and notably information that is not available to other firms (Porter, 1990, pp. 48-49).

Once a competitive advantage is created, it has to be sustained over time. According to Porter (1990, pp. 49-51), this sustainability depends on three conditions: (1) the source of the advantage (2) the number of distinct sources, and (3) constant improvement and upgrading. First, some sources of competitive advantage are more sustainable. "Higher order" advantages such as product differentiation or the development of advanced technology depend on a history of cumulative investment (i.a. reputation, customer relationships, specialised knowledge) (Porter, 1990, p. 50). Second, if a firm has a higher number of distinct sources of advantages, it increases the difficulty for competitors to replicate the competitive situation (Porter, 1990, p. 51). Third, and most importantly, it is the constant improvement and upgrading that is key in sustaining advantage, as the firm 'stays ahead' of competitors. However, this third condition is only valid if the constant improvement and upgrading is aimed at diversifying the sources of advantage and

"moving up the hierarchy" towards higher order advantages (i.e. towards improving the two other conditions) (Porter, 1990, p. 51). This process requires change which can be "unnatural" or "painful" for a successful firm. In general, it is change rather than stability which could cause uncertainty. In Porter's view, it is the competitive pressure that pushes firms to enter this process where it has to "destroy old advantages to create new, higher-order ones" in order to sustain a competitive position (Porter, 1990, p. 51). This process can be traced back to the notion of "creative destruction" proposed by Schumpeter (1944). Hence, the quality of the business environment challenges the firms and stimulates innovation.

To summarise, it can be said that (1) it is firms that compete and not locations, (2) the pressure for innovating is provoked by the business environment (3) competitive advantage arises from innovations and changes implemented by firms, and (4) competitive advantage is sustained through "relentless improvement" (Porter, 1990, p. 577).

ii The relationship between firms' competitive strategy and the quality of the business environment

As written above, firms react upon and influence their environment. The business environment not only creates pressure for firms to innovate but also gives firms better insight into industry changes. In the previous subsection, the influence of the four determinants of national advantage on firms was presented. Therefore, firms' competitive strategy should take advantage of the quality of the business environment (e.g. seek out the most sophisticated buyers, investigate new channels, develop strong ties with innovative suppliers).

Firms can also play a role in improving the surrounding business environment. In fact, a firm can invest in factor creation, participate in the cluster development and acknowledge the importance of domestic rivalry. Consequently, a competitive strategy should take this role into account. First, a competitive strategy can focus on factor creation through investment in training schools or training programmes, in developing physical infrastructure and in getting involved with government-led projects (Porter, 1990, p. 593).

Hence, a competitive strategy can lead to more specialised and customised factors of production and ultimately lead to higher levels of productivity. Second, by favouring local suppliers, firms contribute to the formation and development of clusters (Porter, 1990, p. 596). A competitive strategy that helps the development of local suppliers and buyers increases both the size and scope of the cluster, which in turn favours the firm's own advantages. In fact, strong competition between suppliers increases the rate of innovation and consequently the sophistication of the cluster. The previous subsection highlighted the fact that domestic rivalry has the strongest influence on each of the determinants of national advantage. By acknowledging the importance of domestic rivalry in their strategy, firms contribute to the improvement of the business environment. Hence, the competitive strategy should be aimed at expanding the domestic market through foreign acquisition or the development of spin-offs rather than favouring domestic acquisitions (Porter, 1990, p. 598).

Consequently, by further developing the national diamond through their competitive strategy, it becomes harder for foreign firms to replicate the competitive advantage. Instead, foreign firms would rather be part of the cluster which, as a result, further increases the strength of the local business environment.

iii Competing internationally

An internationally successful industry, as described in subsection 1.1.1, encompasses firms that are competing internationally. Hence, competing internationally requires a global strategy, namely a strategy in which "a firm sells its product in many nations and employs an integrated worldwide approach to doing so" (Porter, 1990, p. 54). By implementing a global competitive strategy, firms further expand their competitive advantage at home.

A firm steps up internationally in segments where it has a competitive advantage that was created at home. Initially, a firm takes advantage of economies of scale and reputation resulting from worldwide sales. Then it may locate activities outside the home base to build on or to exploit the advantages of different locations (Porter, 1990, p. 63; Gugler, 2019, p. 23). In fact, globalised firms may require, amongst other things, complementary

technology, different buyer needs or specific infrastructure in order to move early and sustain their competitive position at home (Porter, 1990, p. 65). Consequently, a global strategy encompasses two dimensions: (1) configuration (i.e. concentrating or dispersing activities in different locations), and (2) coordination (i.e. between the activities situated in different locations) (Porter, 1990, p. 54).

The importance of building on the various competitive advantages that different locations may offer has been largely accepted in the economic literature, and particularly in the international business theories (amongst others: Dunning, 1980, 1998; Rugman and Verbeke, 2001; Dunning and Lundan, 2008; Rugman, 2009; Gugler, 2019). Particular attention will be given to the OLI paradigm (ownership, location and internationalisation) developed by Dunning and the FSAs/CSAs framework (firm-specific advantages and country-specific advantages) proposed by Rugman.

Dunning (1980, p. 9) proposes the OLI paradigm which evaluates the geographical patterns of industries. His paradigm aims at analysing the location choice of firms and of their activities in a globalised world (Dunning, 1998). Of particular interest in this thesis are the L-advantages (i.e. location-specific advantages), namely the advantages, or assets, that the host location offers, and which drive a firm strategy in investing in this specific location (Dunning, 1998, p. 45). Firms seek out various types of advantages such as resources, markets, advanced infrastructure or other strategic assets (i.a. "clusters externalities" and "innovative capabilities") (Dunning, 1998, p. 50; Gugler, 2019, pp. 25-26). Consequently, a firm may decide to locate specific activities of its value chain in different locations depending on the L-advantages that a host location can offer.

Rugman proposes a complementary framework which regroups firm-specific advantages (FSAs) and country-specific advantages (CSAs) (Rugman, 2009). FSAs are "firm-specific factors that determine the competitive advantage of an organization" which are proprietary to the firm, while CSAs are defined as "country factors, unique to the business in each country" (Rugman, 2009, p. 50). FSAs are related to "the firm's ability to coordinate the use of the advantage in production, marketing, or the customization of services" and CSAs "form the basis of the global platform from which the multinational firm derives a home-base 'diamond' advantage in global competition" (Rugman, 2009, p. 51). Hence, for Rugman (2009, p. 50), multinational entreprises should develop a

strategy based on the relationship between FSAs and CSAs in order to propose a unique competitive position. By combining its FSAs with the CSAs that different locations offer, the firm "makes decisions about the efficient global configuration and coordination between segments of its value chain" whether it is sales, marketing, R&D or production, for example (Rugman, 2009, p. 51).

Consequently, a firm's global strategy is not only built on the advantages that the home location provides, but also takes into account the advantages that host locations can offer for the various activities of the firm. By taking advantage of the national determinants of host locations, a firm is able to both sustain its initial advantage and, most importantly, to evolve and develop new advantages. This way, a firm multiplies the sources of competitive advantage and moves towards higher order advantages for its various activities.

1.1.3   The state of cluster development

The previous subsections have focused on two dimensions of the microeconomic competitiveness level: the quality of the business environment and sophistication of company operations and strategy. The third dimension is the state of the cluster development.

Porter (Porter, 2008, pp. 213-214) defines clusters as:

> Geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate.

He also adds that clusters can be found in "virtually every" economically advanced nation and that they are important to the firms' performance (Porter, 2008, p. 214). While clusters may also be present in developing economies, the more advanced clusters, with deeper complexities and more advanced factor conditions, suppliers and related industries, are found mostly in developed economies. Hence, clusters vary in terms of size, degree of specialisation and state of development.

These differences can also be explained through the lens of the national diamond. In the definition of clusters provided above, many elements can be traced back to the determinants of the national diamond. In fact, clusters are a particular expression of the national diamond (Porter, 2008, p. 229). The degree of development and combination of the determinants as well as their interactions influence the breadth and depth of clusters.

Porter (2008, p. 221) argues that the advantage of analysing economies with the concept of clusters, as opposed to the more traditional industry or sector classifications, is that they "align better with the nature of competition and the sources of competitive advantage" and that they "capture important linkages, complementarities, and spillovers of technology, skills, information, marketing, and customer needs that cut across firms and industries".

Clusters also have a locational dimension as firms, suppliers and other actors are geographically concentrated. Thus, locations are of particular importance in fostering competitive advantage, notably through competition. It has been explained that competition is dynamic since the determinants of the national diamond are self-reinforcing. On the role of location, Porter (2008, p. 225) specifies: "In this broader and more dynamic view of competition, location affects competitive advantage through its influence on productivity and especially on productivity growth". The productivity represents the value which is created per unit of factors of production such as work or capital. Hence, competitive advantage depends on how these factors of production are "used and upgraded in a particular location" (Porter, 2008, p. 225). The business environment in a location strongly influences competition. In turn, the competition in a particular location affects the productivity and prosperity of the firms in a given industry. It forces firms to innovate and upgrade their productivity, thereby developing and sustaining their competitive advantage. Hence, the information gathered in the previous subsections helps understand how clusters forge competitive advantages.

i   Cluster theory in the economic literature

The co-location of similar or related activities and the agglomeration of particular industries are not new in the economic literature. At the beginning of the 20th century, the pioneering work of Alfred Marshall laid the ground for the development of theories in economic geography. Marshall (1920) notably introduced the notions of internal and external economies as well as industrial districts. These economies arise from the division of labour, and therefore the use of specialised skills and machinery (Marshall, 1920, p. 264). Marshall (1920, p. 266) separated economies of scale into two classes: internal and external economies. Internal economies are "those dependent on the resources of the individual houses of business engaged in it" and external economies are "those dependent on the general development of the industry" (Marshall 1920, p. 266). It is the second class of economies that is of interest in the study of clusters. Marshall (1920, p. 271) also proposed examples of external economies such as the use of "highly specialized" and "expensive" machinery or local market of special skills. These specialised means of production are "gathered" within industrial districts (Marshall, 1920, p. 271).

Building on Marshall, Krugman (1991, p. 483) argues that countries can become differentiated into "an industrialized 'core' and an agricultural 'periphery'". He shows that firms locate where the market is relatively large and industrial production is concentrated (Krugman, 1991, pp. 495-496). Hence, the size of the market is key (1) in the location choice of firms, and (2) in creating economies of scale that are important for the agglomeration of industries. Krugman (1920, p. 498) is aware that his model does not explain why particular industries locate together. However it helps "to formalize and sharpen the insights" and acts as a "stimulus to a revival of research into regional economics and economic geography" (Krugman, 1991, p. 498).

Following these leading authors, a stream of literature in economic geography has emerged in order to understand how industries locate and why they co-locate. Most studies have focused on the role played by agglomeration economies. Glaeser, amongst others, has focused on urban agglomeration and the role of cities (Glaeser et al. 1992; Glaeser and Gottlieb, 2009; Glaeser and Kerr, 2009; Ellison et al., 2010; Glaeser and Resseger, 2010; Glaeser, 2011) and shows that productivity rises in dense urban agglomerations, and notably those that encompass higher levels of skills. Other prominent

authors such as Henderson (1994), McCann (1995), Fujita and Thisse (1996), Black and Henderson (1999), Iammarino and McCann (2006) as well as McCann (2008) have investigated various types of agglomeration economies. For example, Henderson (1994) analyses the relationship between agglomeration economies and transportation costs while Iammarino and McCann (2006) focus on the relationship between location patterns, innovation processes and industrial clusters.

Overall, most works investigate various relationships and causes that explain the co-location of firms active in similar or related activities (i.a. economies of scale, division of labour, knowledge spillovers) and in different contexts (i.a. urban agglomeration, patterns of industries and skills in cities, perfect versus monopolistic competition). Nonetheless, they do not directly tackle the concept of clusters but rather address many of the underlying mechanisms raised by Porter in his conception of clusters.

ii   How clusters affect competition

Clusters are a particular manifestation of the national diamond. According to Porter (2008, p. 229), clusters influence competition in the following ways: (1) "by increasing the productivity of constituent firms or industries", (2) "by increasing their capacity for innovation and thus productivity growth", and (3) "by stimulating new business formation that supports innovation and expands the cluster". These three influences will be developed below.

First, the cluster environment increases the productivity of the firms competing in the cluster. Regarding factor conditions, firms have access to specialised input at a lower cost as it may be sourced from other actors within the cluster. This option, as opposed to more traditional strategies such as vertical integration or importing output from "a distant location", reduces transaction costs, tailoring costs, inventory and delays (Porter, 2008, p. 230). In fact, if the demand for specialised input is substantial enough, related and supporting industries will step in and provide firms in the cluster with the needed input. At a certain point, strong competition between suppliers occurs, which increases the incentives for satisfying the demand. This also applies for specialised workers. If the demand for such skills and experience is high, universities or special training programs

provide an outsourcing alternative to in-house training. This scenario makes inputs a public good (Porter, 2008, p. 234). Porter (2008, p. 232) goes on to argue that such demand has the potential to increase the supply:

> Where a cluster exists, the availability of specialized personnel, services, and components and the number of entities creating them usually far exceeds the levels at other locations, a distinct benefit, despite the greater competition.

Public investment also plays an important role in this mechanism by developing specialised infrastructure, educational programmes, etc. These investments are justified and supported by the number of actors in the clusters who benefit from it (Porter, 2008, p. 235).

Cluster participants have better access to information on specialised input, on the advancement of technologies and on buyer needs (Porter, 2008, p. 233). This access is facilitated by the proximity amongst cluster participants and reduces both the costs of acquiring the information and the uncertainty linked to a lack of information. Facilitated access to information is also crucial for financial institutions which can more easily monitor firms and have a more accurate view of the economic health of the cluster. This, in turn, facilitates loan and financing decisions and consequently reduces the associated risk (Porter, 2008, p. 236).

As highlighted in the previous subsections, the concentration of related firms also enhances the reputation of a location for a given product, thereby increasing the efficiency of marketing.

Domestic rivalry influences productivity by increasing the incentives arising from the constant comparison between rivals (Porter, 2008, p. 235). Firms can compare their performance with rivals and implement adjustments more precisely.

The productivity advantages presented above result from "location-specific public goods or benefits that depend on physical proximity, face-to-face contact, close or ongoing relationships, and 'insider' access to information" (Porter, 2008, p. 236). In other words, they are the result of external economies that benefits all actors of the cluster.

Second, clusters also improve innovation and therefore productivity growth. The mechanisms here are akin to the mechanisms increasing productivity, notably regarding

the outsourcing of components, incentives brought by fierce rivalry and access to information. Firms can more easily outsource new components or services which they need to implement innovation. Close suppliers are able to customise and get involved in the process (Porter, 2008, p. 237). Hence, not only is the firm competing in the base industry able to implement its innovation, but the supplier also innovates in producing a new product or service. In this mechanism, both the base firm and the supplier develop new competences and distinguish themselves from their rivals (i.e. the other supplier in the cluster). Innovation is triggered by the fierce rivalry both in the industry where the base firm is competing and amongst the suppliers, each of them having an incentive to differentiate themselves from their competitors. Information available to cluster participants enables them to anticipate new trends and needs, hence gaining an advantage "in perceiving new technological, operating, or delivery possibilities" (Porter, 2008, p. 237).

And third, Porter (2008, p. 240) argues that new firm formation has a higher occurrence in clusters as opposed to isolated locations. Information flow is also a central factor in creating new businesses. Firms and other actors within the cluster are better informed about opportunities. Barriers to entry are also lower at the cluster level: assets, skills and specific inputs are already available and new firms can more easily use them. As a consequence, the lower barriers to entry combined with better information on the economic situation within the cluster make loans less risky for financial institutions. From the firm's perspective, access to investment is cheaper (Porter, 2008, p. 240).

Since clusters are a manifestation of the interactions amongst the determinants of the national diamond, which are continually evolving in a mutually self-reinforcing process, the chances are that a competitive industry, at some point in the process, will create new related industries that share similar needs (Porter, 1990, p. 149). These new entrants can be local entrepreneurs (e.g. skilled workers who were already active in the cluster and who have perceived an opportunity), outside entrepreneurs that are attracted by the lower entry barriers, or established firms active in a related industry (Porter, 1990, p. 149; Porter, 2008, p. 240).

As a consequence, these new entrants increase the innovation and, thereby, productivity growth within the cluster. They also boost competition, leading to more incentives to

innovate and differentiate by developing new products, services or ways of producing. This process expands the breadth and depth of the cluster which further improves and sustains the competitive advantage. The greater scope and sophistication of a cluster stimulates diversity in R&D and encourages new ways of competing by assembling factors of production in new ways (Porter, 1990, p. 151). This, in turn, leads to new opportunities and innovations.

This developing "related diversity" prevents the cluster from "inward focus, inertia, inflexibility, and accommodation among rivals" that impede competitive upgrading (Porter, 1990, p. 151). Hence, this "related diversity" reinforces and sustains the advantage.

The above analysis explains how clusters influence competition through three different mechanisms: increase in the level of productivity, increase in innovation capacity (i.e. productivity growth) and stimulating new business formation. A common and central feature which appears in each of the three ways is the importance of information, whether it is about opportunities, buyer needs, the existence of specialised inputs or tailored services. Two dimensions are of particular importance in increasing the flow of information: (1) the role of locations, and (2) the role of formal and informal networks (Porter, 2008, p. 253; p. 274).

The first dimension is the role of locations. While global communication technology has been extensively developed, Porter (2008, p. 253) argues that it only "mitigates disadvantages, it does not create advantages". In fact, even though general information is more easily accessible, it is the more advanced and sophisticated information that is of importance for developing and sustaining competitive advantage. The agglomeration and concentration of, *inter alia*, specialised skills, knowledge or related business in a particular location increase the concentration of specialised information and reinforce the probability of dissemination amongst the cluster participants. The location dimension also has repercussions for corporate location choices. In fact, it is preferable to group linked activities in the same location as it facilitates internal information flow, which leads to externalities and spillovers (see subsections 1.1.2 and 1.2.2) (Porter, 2008, p. 277).

This first dimension calls for a second one, namely the importance of informal networks (e.g. community ties arising from schooling, military service or scientific community)

and more formal networks (e.g. trade associations and consortiums) as vectors of information in clusters (Porter, 1990, p. 151; p. 153).

In conclusion, following the national diamond framework, a cluster "magnifies and accelerates" the development and sophistication of each of the determinants of the diamond. It not only improves the advantage that an industry may have at a certain point in time, but it also sustains and evolves into new advantages through its ties to related activities. Hence, the following section will focus on the evolution of clusters.

iii The life cycle of clusters: Birth, development and potential sources of decline

A cluster often arises from the evolution of a competitive industry that has attracted actors in related fields. A good starting point for understanding the evolution of clusters is to analyse the birth of a competitive industry.

Generally, an advantage in one of the three determinants – factor conditions, related and supporting industries or demand conditions – is the seed for the formation of a competitive industry (Porter, 1990, p. 159). However, the chance that this seed will grow into a competitive industry depends on the development of the other determinants. In subsection 1.1.1, the role of domestic rivalry has been recognised as having the greatest influence on the other determinants. Hence, the capacity to move from the initial seed to a competitive advantage highly depends on domestic rivalry. Domestic rivalry forces firms to innovate and distinguish themselves from their rivals. Therefore, in order to sustain and upgrade their competitive advantage, firms have to reorganise their resources or "undermine their initial bases" (Porter, 1990, p. 162). Clusters derive from this process of upgrading. Momentum is created around a critical mass of firms active in a competitive industry. Nonetheless, the process of upgrading a competitive advantage is slow and difficult to replicate for other locations (Porter, 1990, p. 163).

Regarding the process of cluster development, Porter (2008, p. 256) highlights three critical points: (1) the intensity of local competition, (2) the environment for the formation of new business, and (3) the role of formal and informal linkages amongst the cluster

participants. Put differently, it is the 'entrepreneurial climate' and the response by local and other institutions that are important for the development of a cluster. However, a critical mass of firms is necessary for creating this climate, as is an influence on public and private institutions, and on economic policies (Porter, 2008, p. 257).

A turning point in the development of clusters is the inter-section between them, namely when the development of two distinct clusters crosses each other's path and eventually merge. This way, different skills, technologies and ways of competing come together, further encouraging innovation and stimulating new business creation (Porter, 2008, p. 257).

However, this growth process is not guaranteed. In fact, factors triggering the cluster's decline are also found in the diamond: may they be endogenous (i.a. internal rigidities, regulatory inflexibility, formation of cartel behaviour, introduction of barriers to competition) or exogenous (i.a. technological discontinuities, divergence from local demands and needs) (Porter, 2008, pp. 259-260).

Internal rigidities are associated with a reduced rate of innovation and an increase in costs of doing business that lead to inertia. The decline due to internal rigidities is not immediately perceived and the loss of advantage, similarly to its gain, is slow because the self-reinforcing process "works in reverse" (Porter, 1990, p. 170). A reduction in competition and domestic rivalry weakens the incentives to innovate as well as weakening the dynamism and momentum of the industry. The lack of pressure and incentives to adjust and innovate increase the opportunity cost of innovating. A firm may stick to its skills, technology and past strategies. In comparison, the opportunity cost of entry for a new firm is lower.

Technological discontinuities and the emergence of divergent global needs that are not perceived by local competitors "neutralise" cluster advantages as skills, knowledge and other factors of production become inadequate (Porter, 1990, p. 166). However, technological discontinuities are less likely to happen thanks to globalised communication technologies which reduce the risk of missing opportunities. Technological discontinuities create the need for new competitive advantages that require new skills, knowledge and infrastructure, and most importantly, new related industries

(Porter, 1990, p. 167). The conditions offered by the diamond are no longer aligned with the need to create and sustain a new advantage.

The loss of advantage in one industry of a cluster impacts related and supporting industries, eventually leading to the degradation of the local business environment. This process in accentuated when a cluster is dependent on one important industry and when all related and supporting industries rely on it. Moreover, if the firms in that cluster lack a global strategy with ramifications outside of the cluster, the risk of failure is higher (Porter, 1990, p. 172).

More generally, clusters begin to decline when the determinants of the diamond "no longer support and stimulate investment and innovation to match the industry's evolving structure" (Porter, 1990, p. 166). Porter (Porter, 1990, p. 173) concludes with the following:

> The systemic character of national advantage carries both a blessing and a curse. The blessing is that positive reinforcement among the determinants creates momentum to upgrade an economy as well as to widen and deepen clusters. The curse is that the same momentum works in reverse.

1.2   Assessing the impact of clusters on the economic prosperity of locations

The first section focused on the theoretical basis of the microeconomic competitiveness level and particularly on clusters. The role of this second section is to go over studies that have empirically analysed the impact of clusters on the prosperity of locations, and consequently to understand if the theoretical mechanisms presented above have a real impact on prosperity. The first subsection will begin with studies that have focused on the overall impact of clusters. The second subsection will concentrate on studies that have analysed key aspects of clusters highlighted in the first section, namely relatedness amongst firms and industries, knowledge spillovers, and intra- and inter-firm linkages.

1.2.1   Influence of clusters on the prosperity of location

Many studies have aimed at analysing the impact that clusters, or agglomeration economies, have on the prosperity of location, notably through their influence on specific economic performance measures (i.a. employment growth, new business formation, gross domestic product). However, the results of these studies are heterogenous, ranging from a strong positive influence of clusters or agglomeration economies on economic outcome, to no statistical influence, or even to a negative influence.

Porter (2003), Delgado et al. (2010), Greenstone et al. (2010), Spencer et al. (2010), Delgado et al. (2014) Resbeut and Gugler (2016), Slaper et al. (2018) as well as Claver-Cortés et al. (2019) and Resbeut et al. (2019), amongst others, have found a strong positive influence of clusters on economic performance indicators, particularly on income, productivity, employment growth and new business formation. Other studies such as Lu et al. (2016) and Mendoza-Velazquez (2017) find mitigated results of the influence of clusters. On the other end of the spectrum, studies such as Lall et al. (2004), Lopez and Südekum (2009), Lin (2011), Martin and Sunley (2011), Hausmann et al. (2012) and Kerr et al. (2013) do not find a strong positive influence of clusters. Instead, they find that clusters do not increase the prosperity of locations, whether due to reasons such as congestion costs (i.e. in large urban areas) or because the agglomeration of specific industries or the development of particular relationships is of more importance.

Ketels (2013, p. 275) points out that: "The literature on the impact of cluster presence on economic outcomes has produced a wide range of results from finding very little if any positive impact […] to meaningful positive effects". This situation is due to the various empirical interpretations of clusters. If clusters are too narrowly defined in terms of industry specialisation, then a convergence effect occurs and consequently leads to incorrect results (Ketels, 2013, p. 275). It is the related industries within a cluster, as described by Porter's definition, which give rise to higher performance. Hence, it is the cluster's specialisation rather than the industry's specialisation that is of importance. This situation has been brought to light in an article by Delgado et al. in 2010 and further analysed in a second article published by the same authors in 2014.

This section will not take the form of an in-depth literature review and go over all the studies mentioned above. Rather, a handful of studies are selected based on the robustness of their methodologies, the angle of approach and their closeness to the concept of clusters developed by Porter.

Hence, in this subsection, three papers are tackled. Two articles by Delgado et al. (2010; 2014) are built on an extensive cluster mapping, namely the US Cluster Mapping Project, which provides a comprehensive and broad dataset based on Porter's definition of clusters. They show strong results of the impact of clusters on the prosperity of locations through different performance indicators and have served as a basis for upcoming studies. An article by Slaper et al. (2018) provides an interesting alternative in terms of analysis in comparison to the studies by Delgado et al. (2010; 2014).

The article by Delgado et al. (2010) analyses the influence of clusters on entrepreneurship. In the first section, it has been explained that clusters spark firm creation as a result, primarily, of increased domestic rivalry and lower entry barriers. The new entrants may be entrepreneurs or result from the formation of new establishments by existing firms (Delgado et al., 2010, p. 495). These new entrants further enhance competition, push the incentives to innovate and increase productivity growth. Therefore, they are an important driver in the development of clusters.

The key in their methodology is that they are able to disentangle convergence from agglomeration forces, which is a weakness of many studies that show mitigated results on the influence of clusters. They argue that convergence forces appear at the industry level while agglomeration forces are present at the cluster level. If these two forces are not separated, the aggregated result will show a balancing of the two effects (Delgado et al., 2010, p. 496). Delgado et al. (2010, p. 496) define convergence forces as arising "when, due to diminishing returns, the potential for growth is 'declining' in the level of economic activity". The opposite is true for agglomeration forces. Therefore, entrepreneurship is an important driver of "cluster-driven" agglomeration forces (Delgado et al., 2010, p. 496). In fact, as a cluster grows, new opportunities for innovation open up and the cost of doing business decreases. The complementarities across related industries result in external economies. Hence, the breadth and depth of a cluster is further

extended, which also increases agglomeration forces and their benefits (Delgado et al., 2010, p. 496).

The authors find that industries located in strong clusters (i.e. "large presence of other related industries") have higher rates of firm creation as well as a greater growth in start-up employment (Delgado et al., 2010, p. 495). New firm creation by existing companies is also positively influenced by the presence of a strong cluster environment (Delgado et al., 2010, p. 497). The last part of their analysis focuses on the survival rate of start-ups. They find that a strong cluster environment also improves the medium-term (five years) survival rate (Delgado et al., 2010, p. 497). In fact, the employment level of young start-ups is higher in a strong cluster.

In the second paper, *Clusters, convergence, and economic performance*, the authors analyse the role of clusters on industry performance (Delgado et al., 2014, p. 1785). Similarly to the previous study, they also disentangle convergence from agglomeration forces. They analyse agglomeration effects arising at the cluster level in terms of employment and patenting growth after controlling for convergence at the industry level.

They find that the growth of employment is declining in the initial level of employment at the region-industry level. This means that the higher the level of employment of a particular industry in a given region is, the lower the employment growth rate will be. Further, the employment growth rate is increasing in the level of employment strength at the cluster level, which highlight the agglomeration effect (Delgado et al., 2014, p. 1787). When focusing on cluster strength in neighbouring locations, they find that it also leads to the development of new industries in the region. This result highlights the spillovers that arise between neighbouring locations and their importance in shaping the development of clusters (Delgado et al., 2014, p. 1787).

The authors further deepen the analysis by specifying the characteristics of (1) regions, (2) clusters, and (3) industries (Delgado et al., 2014, p. 1793). First, bigger regions, in terms of employment, may lead to economies of scale. Hence, agglomeration forces in larger regions may result in greater effects. They find that the convergence effect is higher in larger regions since larger industries have, on average, a higher level of employment. Consequently, they find that the impact of clusters is also greater in larger regions. The authors explain this result through the role played by the size of the local market, the

economies of scale in specialised inputs, the presence of larger universities or other public institutions (Delgado et al., 2014, p. 1793). This result corroborates Krugman's (1991) argument that market size is an important driver of agglomeration. Second, the heterogeneity of clusters in terms of size may also impact convergence and agglomeration effects. Similarly to the size of a location, larger clusters may also induce economies of scale as well as economies of scope due to the presence of industries with related activities. They find that convergence and agglomeration forces appear in both small and large clusters. Nonetheless, the agglomeration effect is higher in larger clusters. This is explained by the larger arrays of industries and their bigger size (Delgado et al., 2014, p. 1793). Third, the authors also analyse the heterogeneity of the industries. They distinguish industries in three categories: (1) services, (2) low-tech manufacturing industries, and (3) high-tech manufacturing industries. Service industries have a higher variety of consumer while the propensity to patent is higher in manufacturing industries (Delgado et al., 2014, p. 1794). They find that while agglomeration effects influence all three types of industries, they are higher in high-tech manufacturing industries. Convergence forces are also lower for this type of industry (Delgado et al., 2014, p. 1794).

In parallel, they also analyse the role of innovation. They find that the patenting strength of a cluster has a positive effect on employment growth at the region-industry level, meaning that a higher innovation rate in a cluster "facilitates employment creation" (Delgado et al., 2014, p. 1786). On the other hand, they also analyse whether or not the cluster environment increases the patenting growth at the industry level. They find that a stronger cluster, in terms of patenting, is associated with an increase of patenting growth, hence highlighting the role of knowledge externalities in a location (Delgado et al., 2014, p. 1795). Based on these two results regarding patents, they further analyse the complementarities between employment and patenting strength of a cluster and the role of these complementarities on patenting rate in the industries composing the cluster. The results show that they both influence the patenting rate and that there is no statistical difference between the two distinct influences. The authors argue that these results confirm the "broad set of externalities arising in clusters, related clusters, and neighbouring clusters" (Delgado et al., 2014, p. 1795).

Another study focusing on the overall influence of clusters on the prosperity of locations is worth mentioning. Slaper et al. (2018) assess the benefits of clusters on traditional

measures of economic performance. More precisely, they investigate the relationship between cluster performance measures (i.e. cluster strength, cluster diversity and the identification of regional growth clusters) and traditional performance measures such as growth in gross domestic product, productivity per employee, compensation per employee, and personal income (Slaper et al., 2018, p. 44).

The study categorises US clusters using six measures: (1) traded cluster growth, (2) local cluster growth, (3) traded cluster diversity, (4) local cluster diversity, (5) traded cluster strength, and (6) local cluster strength (Slaper et al., 2018, p. 55). They use data from 366 metropolitan statistical areas (MSAs) in the US from 2002 to 2013 (Slaper et al., 2018, p. 46).

They find that of the six measures, five have a significant impact on at least one performance measure, namely traded and local cluster growth, traded and local cluster strength as well as local cluster diversity and that "40% to 60% of the variation in the dependent variables is explained by the cluster development measures" (Slaper et al., 2018, p. 56). It is also interesting to note that traded and local cluster growth are the most statistically significant measures and explain the greater part of the variation of the dependant variables (Slaper et al., 2018, p. 54). Further, traded cluster strength is statistically significant with productivity and compensation per employee, which shows that export-oriented clusters increase the prosperity of a location (Slaper et al., 2018, p. 54). This result is also consistent with the observation that traded clusters have more incentives to innovate than local clusters (Slaper et al., 2018, p. 49). Overall, the fact that the measures of cluster strength and diversification are statistically less significant than cluster growth may be explained by the methods used to compute them.

In comparison to the two previous studies analysed, this last article is less convincing both in terms of statistical results and in its conclusions. The fact that convergence and agglomeration forces are not disentangled may be one reason. Also, they do not tackle in more detail the microeconomic environment and instead focus on economic outcomes. While this is useful in assessing the overall economic impact of clusters, it does not bring detailed insight into the characteristics or determinants of clusters on economic performance.

Overall, two main conclusions can be drawn from these studies. First, they statistically show the higher economic performance of clusters. Second, these benefits are found across various types of locations, clusters and industries. These two conclusions confirm that important externalities take place in clusters. However, they do not investigate the mechanisms within clusters that drive the economic performance. Nonetheless, the first two studies suggested some leads notably by investigating the influences of entrepreneurship and innovation. In the theoretical section focusing on the cluster life cycle, two elements were of importance in the development of a cluster: (1) the entrepreneurial environment which depends on the intensity of the local competition as well as the formal and informal linkages, and (2) the intersection of industries and clusters which opens up new opportunities. Building on the relationship between the two main conclusions and the two above-mentioned key elements, the following subsection will focus on two mechanisms that are of importance in clusters, namely the principle of relatedness as well as the role of networks and other linkages.

1.2.2 Influence of particular cluster aspects on the prosperity of locations

The focus of the previous subsection was the assessment of the overall effect of clusters on the prosperity of locations. In this section, however, the focus is on two key mechanisms of clusters that are of importance for the prosperity of locations. A key aspect is the relatedness not only between firms and industries composing a cluster but also between distinct clusters. As it will be shown, relatedness can take various forms that are found at the cluster level, for example, input-output linkages, similar knowledge or skills, and complementarities in technologies. The principle of relatedness, focusing on the probability that two distinct activities converge, is tackled in the first part, and the role of networks and other types of linkages are analysed in the second part. These linkages are important drivers that enhance the principle of relatedness, notably in terms of knowledge flow.

i   The principle of relatedness applied to clusters

Relatedness is not new in the economic literature. In fact, it relates to the concept of externalities proposed by Marshall in 1920 and further expanded by the works of Jacob (1969) and Porter (1990, 2008), amongst others. Building on Smith and Marshall, Jacob (1969) argues that the emergence of new industries is facilitated by the deep division of labour taking place in large urban agglomerations, or put differently, by local diversity. On the other hand, the MAR (i.e. Marshall–Arrow–Romer) externalities emphasise the role of local specialisation (Neffke et al., 2018, p. 26). These types of externalities illustrate one aspect of relatedness. A large stream of literature, principally in economic geography, focuses on the relatedness between firms (and industries), such as Essletzbichler (2007), Frenken et al. (2007), Boschma and Iammarino (2009) as well as Bishop and Gripaios (2010) and Boschma et al. (2012). In particular, they show that variety amongst related industries is accompanied by higher knowledge spillovers and greater employment growth, *in fine*. Other studies have shown that firms diversify technologically to move towards more profitable positions (Jaffe, 1986; Klevorick et al., 1995; Laursen, 1999) or mitigate risks (Koren and Tenreyro, 2007). Also, studies have shown that the more related entities and activities are (in terms of, for example, technologies, skills and human capital), the easier it is for firms to take advantage of it (see amongst others: Breschi et al., 2003; Neffke et al., 2011; Hidalgo et al., 2018). Furthermore, the more related two entities or activities are, the lower the entry barriers will be (Perez and Soete, 1988). This last affirmation is corroborated by Murray et al. (2016) (see below) as well as Boschma et al. (2013), Colombelli et al. (2014), Rigby (2015) and Tanner (2016) who also find that the emergence of new industries is facilitated by their relatedness to the local industrial structure.

In this section, four articles will be subject to an in-depth analysis. First of all, an article by Hidalgo et al. (2018) is tackled as it defines the "principle of relatedness". Secondly, an analysis conducted by Neffke et al. (2011) investigates the evolution of industrial structure based on technological relatedness. This analysis is completed with the one by Petralia et al. (2017). In fact, technological relatedness is at the core, not only of clusters, but of most articles found in the literature on relatedness. Another critical aspect of clusters, namely relatedness in terms of skills and advanced labour, is tackled in an article

by Neffke et al. (2017). Finally, the fourth article by Murray et al. (2016) focuses on access to knowledge. In fact, easier access to knowledge (i.e. lower barriers to acquisition of knowledge) facilitates the relatedness.

Hidalgo et al. (2018, p. 451) propose a new synthesis: the "principle of relatedness", which is an "empirical principle describing the probability that a region enters (or exits) an economic activity as a function of the number of related activities present in that location". Fifteen scholars are listed as co-authors of this article. This "agglomeration" of experts enabled them to build on each other's work and to gather a comprehensive literature basis for making the case of the principle (Hidalgo et al., 2018, p. 456). The robustness of this principle is therefore found in the growing literature.

Relatedness happen when two entities or activities (i.a. a product, firm, industry, research areas) "require similar knowledge or inputs" (Hidalgo et al., 2018, p. 451). This relatedness can be observed through various complementarities such as input-output linkages, co-export of products or shared labour pools. The authors add that "the high degree of reproducibility of this principle hints at something fundamental: the variety of mechanisms by which economies and organizations learn" (Hidalgo et al., 2018, p. 454). The importance of these mechanisms may also vary with time. For example, material input-output relationships become less important with the reduction of transportation costs, but the cost of moving knowledge has increased relative to the cost of moving the "fruits of knowledge" (i.e. the good itself) (Hidalgo et al., 2018, p. 454). Hence, the concentration and flow of knowledge have gained in relative importance. However, they also emphasise that relatedness "is not about overspecialisation" but rather "about understanding the unique paths that lead to diversification" (Hidalgo et al., 2018, p. 454).

A conclusion emerging from their extensive literature review is that economies that implemented policies focusing on "collective learning" have experienced greater economic performance (Hidalgo et al., 2018, p. 455). In fact, economies with intensive knowledge flows grow faster in terms of employment and entrepreneurship than other economies, all things being equal (i.e. same level of income, human capital and similar institutions) (Hidalgo et al., 2018, p. 455). Also, they find that relatedness amongst industries increases robustness to shocks as workers may more easily change to a related industry (Hidalgo et al., 2018, pp. 455-456).

This perspective has also been adopted by Neffke et al. (2011). When analysing the economic evolution of 70 Swedish regions from 1969 to 2002, they find that the probability of an industry entering a region is higher if that industry is technologically related to existing industries. Industries with lower relatedness had a higher probability of exiting the region (Neffke et al., 2011, p. 237). Hence, they show that regions diversify in 'branching out' into technologically related industries. The point of departure for their analysis is the concept of creative destruction developed by Schumpeter and whether this concept is affected by industrial relatedness (Neffke et al., 2011, p. 247).

The relatedness is based on the "revealed relatedness" index which estimates the co-occurrence of products of different industries (Neffke et al., 2011, p. 243). The index is therefore a measure of possible economies of scope between industries.

Overall, 55% of the industries listed in 1969 were still active in 2002, whereas 68.7% of the industries in 2002 already existed in 1969 (Neffke et al., 2011, p. 247). This shows the extent of the evolution of the economic structure over 30 years. More specifically, they observe that new firms are less closely related to the industrial "portfolio" than existing members of that portfolio. Consequently, their entry decreases technological cohesion by bringing novelties and new activities. Hence, there is a shift in the industrial portfolio. In contrast, exits were also further away from the "portfolio" which tends to increase the overall cohesion (Neffke et al., 2011, p. 250). It is the more 'peripheral' industries (i.e. less technologically related industries) that tend to exit the region. In turn, industries that were related to the industries that died out were more likely to leave the region since they became "peripheral". Therefore, industries leaving a region triggers other exits (Neffke et al., 2011, p. 261). This process of entry and exit of technologically related industries shapes the industrial evolution of regions.

Similarly to Neffke et al. (2011), Petralia et al. (2017) also analyse the patterns of technological specialisation and diversification on the development process. The idea behind this study is that the firms' capacity to accumulate and develop new technologies depends on prior capabilities. Economies of scope may also play an important role as "one piece of knowledge" can be used in multiple technological fields (Petralia et al., 2017, p. 958). Consequently, the authors argue that:

> The more related two technological fields the bigger the share of common heuristics and scientific principles they rely on […] and consequently, the bigger the possibility to take advantage of the already acquired knowledge. (Petralia et al., 2017, p. 958)

Nonetheless, the knowledge accumulation and economies of scope are influenced by factors lying outside of the firm. The economic environment at regional or country level also plays a role for firms to "take advantage of the economies of scale in the use of knowledge" (Petralia et al., 2017, p. 958).

In their analysis, the authors rely on data on patenting activity from the Patent Network Dataverse and identify 344 technologies throughout 65 countries over a period of 15 years (Petralia et al., 2017, p. 964). The relatedness is measured through the co-occurrences of technologies amongst patents. The Revealed Technological Advantage (RTA) is used to assess each country's specialisation patterns (Petralia et al., 2017, p. 959).

Their results show that technological diversification has a higher probability of happening when new technologies are related to the country's "existing profile of competence (Petralia et al., 2017, p. 956). In fact, the analysis shows that there is a significant "reinforcement of having developed related capabilities" (Petralia et al., 2017, p. 962). This means that existing capabilities in related technologies are an important factor in the use and development of new technologies. At the country level, the authors also find that countries follow a development path with specific patterns of specialisation and move towards more complex and "valuable" technologies (Petralia et al., 2017, p. 956).

Overall, these results mean, first, that technological development tends to cluster and, second, that related technological diversity, whether at the firm or country level, is a driver of firms' capacity of "combining and recombining their stock of existing knowledge" and consequently triggers new innovations (Petralia et al., 2017, p. 958).

Neffke et al. (2017) also investigates worker displacement in Germany. Using employment data for Germany, they are able to study inter-industry labour mobility with the aim of understanding which industries share similar human capital requirements (Neffke et al., 2017, p. 275). Overall, they find that industries are connected through a "sparce network" of labour flows which can be interpreted as industrial relatedness (Neffke et al., 2017, p. 275).

The authors focus on human capital movement for two main reasons: (1) technology and demand shocks within industries generate a transfer of factors of production from "shrinking to growing industries", and (2) labour mobility is a vector of knowledge spillovers across industries and locations (Neffke et al., 2017, p. 275).

They find seven stylised facts: (1) workers often cross industry borders, (2) "labor flows are channelled along tight paths" and hence highly structured, (3) local and long-distance labour flows have similar skill-relatedness, meaning that industrial co-location patterns are not the primary driver, (4) workers with different skills share similar skill-relatedness networks which means that firms in a given industry are connected by labour flows regardless of the types of workers, (5) there is no rapid change in skill relatedness, (6) skill relatedness has more influence on economic performance (i.e. industrial regional growth) than input-output and co-location based relatedness, and (7) skill-related industries show different growth rates which can be explained by the fact that workers may lose a job in a shrinking industry and find a new one in a growing industry (Neffke et al., 2017, pp. 281-290).

Most interestingly, the combination of two stylised facts shed some light on an underlying mechanism of clusters. Related industries, which represent 5% of German employment, "absorb 60% of an industry's total worker outflow" (Neffke et al., 2017, p. 290). Combining this observation with the fourth stylised fact, namely that most underlying network flows are independent of the workers' skills, indicate that labour flows "are guided by a non-negligible industry-specific component in human capital" (Neffke et al., 2017, p. 290). This means that human capital at various levels of the value chain is highly industry-specific, whether in engineering, production or administrative divisions.

An important conclusion of this study is that more than skills, it is the industry-specific knowledge that comes alongside the skills that is of importance regarding labour linkages between industries. For example, the experience and knowledge gained by a salesman in a particular industry would be more valuable to another firm in that same industry than to a firm competing in another industry even though he may have the required skills.

Finally, Murray et al. (2016) investigate the openness of innovation and more precisely the access to existing research. They argue that easier access can "enhance both early and late stage innovation through greater exploration of novel research directions" (Murray

et al., 2016, p. 212). In fact, intellectual property rights may create a trade-off. With stronger intellectual property rights, researchers can protect and monetise their work with access fees. This creates two opposing effects. On the one hand, it promotes early-stage research. On the other hand, it impedes the development of follow-on research.

To perform their analysis, they do a natural experiment based on the National Institute of Health (NIH) agreements in the 90s that aimed at reducing academics' access costs regarding "genetically engineered mice" (Murray et al., 2016, p. 212). This natural experiment has three advantages: (1) each engineered mouse is associated with a journal article, (2) the timing and scope of NIH agreements were unanticipated, and (3) data on bibliometric performance measures is available (Murray et al., 2016, p. 214).

Building on this data, the authors find that NIH agreements are associated with a higher level of follow-on research and that these researches are associated with new researchers and institutions (Murray et al., 2016, p. 215). Hence, the NIH agreements triggered an increase in the diversity of follow-on research (i.a. diversity of journals, keywords). These results suggest, according to the authors, that on the one hand, the agreements had an impact both on the flow of research and on the diversity of follow-on research, and on the other hand, they did not impede the flow of early-stage research.

Transposed to the economic context, these results suggest that "openness and exploration are primary drivers of the research process" (Murray et al., 2016, p. 250). This means that excessive intellectual property protections could become counterproductive as they impede the development and diversity of innovation resulting from early-stage research. The total value of an innovation may be lost in the process with overly strict intellectual property protections, but overall, easier access to knowledge increases follow-on research and therefore innovation.

The four works analysed shed some light on the mechanisms of relatedness at various levels. Different types of complementarities have been highlighted such as labour, skills, knowledge and technologies. It was also shown that factors including antecedent technological capabilities, barriers to accumulation of knowledge, and intra-industry knowledge accumulation impact the principle of relatedness. Most importantly, the principle of relatedness gives insight into the capacity of firms to find new sources for innovating.

However, these complementarities need to be linked to one another in certain ways. For example, knowledge needs to flow from one agent to another. Geographical closeness is an important aspect but not sufficient. Hence, the second part of this subsection will focus of the vectors that links these complementarities.

ii   Role of networks and firm linkages in facilitating complementarities

This second part focuses on the role of knowledge exchanges, notably between firms, whether start-ups or multinationals. It was highlighted that start-ups and new entrants are important drivers in the development of clusters. Also, studies focusing on intra- and inter-firm linkages are tackled. In fact, the location choice of firms may affect internal and external agglomerations along the value chain and consequently be of importance in terms of knowledge flows. These agglomerations also facilitate the complementarities highlighted above. The intra- and inter-firm linkages are of importance in the internationalisation process. This aspect has been highlighted as an important competitive strategy of firms for sustaining and developing new competitive advantages. Consequently, it also contributes to increasing the breadth and depth of the cluster and, therefore, its sophistication.

The role of networks

There is an extensive literature in economics focusing on the role of networks and knowledge exchange in the agglomeration process of industries as well as in the formation of new businesses. Vicente and Suire (2007) find that informal networks such as observational learning are an important driver of industry formation, while formal networks such as interactive learning play a role in the stability of industries. Informal networks that facilitate knowledge spillovers, have been at the core of research in explaining the spatial agglomeration of firms and industries (amongst others: Appold, 1995; Dahl and Pedersen, 2004; Johansson and Quigley, 2004; Minniti, 2005; Camagni et al., 2015; Della Peruta et al., 2018). Other studies have focused on the role of networks on innovation and entrepreneurship (amongst others: Elfring and Hulsink, 2003; Kenney

and Patton, 2005, Presutti et al., 2011) as well as on the creation of new venture and start-ups (amongst others: Gompers et al., 2005; Teece, 2010; Pangarkar and Wu, 2012; Kask and Linton, 2013; Perez et al., 2013).

Of particular interest for this study are the works of Alberti and Pizzurno (2015; 2017) who investigate the role of innovation networks as well as open-innovation networks in the context of clusters.

Alberti and Pizzurno (2015) investigate the role of innovation networks. More precisely, they are interested in (1) the type of knowledge exchanged (i.e. market, technological or managerial knowledge), and (2) the role played by the cluster actors. In fact, knowledge flows may be facilitated in clusters and lead to more innovation (Alberti and Pizzurno, 2015, p. 259).

The authors build their analysis on data gathered at the firm level in a particular cluster in the northwest of Italy, namely the aerospace cluster. This cluster is considered as knowledge-intensive and therefore a fertile ground for the analysis conducted (Alberti and Pizzurno, 2015, p. 260). They also differentiate three types of knowledge (i.e. technological, managerial and market) and five types of brokerage roles (i.e. coordinator, gatekeeper, liaison, representative and consultant) (Alberti and Pizzurno, 2015, p. 260).

They find that different types of knowledge are transmitted through different networks. Notably, technological knowledge networks have a higher density than market or managerial knowledge networks. The means, according to the authors, that "cluster actors are prevailingly involved in the exchange of technological knowledge more than any other type of knowledge" (Alberti and Pizzurno, 2015, p. 272). Interestingly, they compare this result with another study that focused on the shoe cluster in Italy, which found that market knowledge exchanges were dominant. Consequently, Alberti and Pizzurno (2015, p. 272) argue that the nature of clusters (i.e. composed of low-tech or high-tech industries) also influences the type of knowledge exchanged and their importance. Hence, they conclude that "market knowledge exchanges are denser in low-tech industries, and vice-versa technological knowledge exchanges are denser in high-tech industries" (Alberti and Pizzurno, 2015, pp. 272-273).

The authors also focused on the role played by various actors (i.a. large firms, small and medium-sized enterprises, research centres, universities) in disseminating knowledge

(Alberti and Pizzurno, 2015, p. 260). They show that the brokerage of knowledge is limited to some actors and is therefore heterogenous in a cluster. In fact, technological and managerial knowledge is brokered only by firms but market knowledge is also brokered by universities and research centres (Alberti and Pizzurno, 2015, p. 279). This unexpected result led the authors to the two following interpretations: (1) the knowledge developed within some firms is more developed and specific (i.e. due to significant investment in R&D) than the knowledge developed within universities, and (2) universities may also have knowledge in market analyses (Alberti and Pizzurno, 2015, p. 279). However, this result may also be correlated with the specific cluster analysed in this study, namely the aerospace cluster.

In a follow-up article, also focusing on the aerospace cluster in Italy, Alberti and Pizzurno (2017) analyse the role of start-ups in open innovation processes. In this article they focus on knowledge leaks regarding the three types of knowledge described in the previous article (Alberti and Pizzurno, 2017, p. 51).

The results confirm previous studies, namely (1) various types of knowledge are exchanged, (2) the flows of knowledge are unevenly distributed amongst the participants, and (3) participants play a different role depending on the type of knowledge (Alberti and Pizzurno, 2017, p. 72). More interestingly, they also find that start-ups active in open innovation networks absorb knowledge on technology, market or managerial practices from larger firms and other actors (Alberti and Pizzurno, 2017, p. 72). This means, according to the authors, that start-ups act as "external starts" that are "not sharing their specialised technological expertise but absorbing general technological knowledge from the cluster environment" (Alberti and Pizzurno, 2017, p. 72). Start-ups absorb knowledge leaking from other actors. Nonetheless, start-ups also contribute to knowledge leaks towards larger firms. The authors highlight the fact that start-ups are immature in terms of managerial processes and instead collaborate with important actors for acquiring technical knowledge. Consequently, they "leak" knowledge to these key players (Alberti and Pizzurno, 2017, p. 72).

Based on their results, the authors propose a definition of a "knowledge leak" which is "an involuntary and sometimes unconscious exchange of types of knowledge other than the one meant for exchange in open innovation networks" (Alberti and Pizzurno, 2017,

pp. 72-73). In comparison, knowledge spillovers include voluntary exchange of information, which is not the case of knowledge "leaks".

Overall, these two studies on the role of knowledge flow and leaks not only confirms the results found throughout the literature (see also Alberti and Pizzurno (2015) for an extended review of the literature) but they also shed some new light on two key aspects: the type of knowledge and the role played by the various cluster actors and notably by start-ups (i.e. which can be assimilated to the new entrants in the cluster theory).

The role of intra- and inter-firm linkages

Another key aspect is the linkages between and within firms, so-called internal and external agglomerations, as they impact both the location choice of firms and the cluster development. This aspect was notably brought forward in the subsection focusing on the global strategies of firms. In fact, these externalities are of particular importance in the internationalisation process of firms. The flow of knowledge and the role played by networks have been highlighted above, notably in driving the performance of firms and their location choice. However, intra- and inter-firm linkages not only take into account these flows of knowledge and networks but also complementarities in terms of specialised labour or suppliers that may be present in a location. In the first section of this chapter, it was explained that both the advantages of the firm and the advantages that a given location can offer should be taken into consideration in a firm's global strategy (Dunning, 1998; Rugman, 2009). Hence, various activities of the value chain may be located in different places in order to build on specific advantages that different locations offer. The intra- and inter-firm linkages are therefore of importance, notably between different levels of activities of the value chain (Alcácer and Delgado, 2016).

Regarding internal agglomerations, studies have found strong complementarities between different activities of the value chain such as the exchange of information between R&D and production activities (Cohen and Levinthal, 1990; Adams and Jaffe, 1996; Ketokivi, 2006) or between R&D and intellectual property specialists (Di Minin and Bianchi, 2011) as well as the sharing of specialised labour (Hamilton et al. 2003, Tate and Yang 2015). These results suggest that firms should co-locate their activities in order to profit from these internal agglomeration benefits.

In this first chapter, the focus has been mainly on external agglomerations, notably by following on from the works of Marshall (1920), Porter (1990; 2008) and Krugman (1991). The concept of relatedness and the role of networks developed above are crucial mechanisms of external agglomerations. Some studies have highlighted the importance of external agglomerations for smaller firms and start-ups (Henderson, 2003; Glaeser and Kerr, 2009; Delgado et al., 2010; Rosenthal and Strange, 2010). Most studies focusing on the impact of clusters on the prosperity of location, notably those mentioned in subsection 1.2.1 (amongst others: Porter, 2003; Delgado et al., 2010; Greenstone et al., 2010; Delgado et al., 2014; Resbeut and Gugler, 2016; Slaper et al., 2018; Resbeut et al., 2019) and the studies concentrating on relatedness cited in subsection 1.2.2 (amongst others: Breschi et al., 2003; Boschma and Iammarino, 2009; Neffke et al. 2011; Rigby, 2015; Petralia et al., 2017; Hidalgo et al., 2018) tackle the notion of external agglomerations. They insist on the positive impact of external agglomerations on economic performance. The importance of knowledge flows (i.e. one aspect of external agglomerations) in the internationalisation process of firms has also been brought forward in various articles, notably by providing access to foreign know-how (Rugman and Verbeke, 2003; Wolfe and Gertler, 2004; Awate and Mudambi, 2017) which, in turn, increase the innovation capabilities of local firms (Bathelt et al., 2004; Hannigan et al., 2015; Cano-Kollmann et al., 2016; Scalera et al., 2018).

In this part, two studies are analysed in more detail: (1) Alcácer and Delgado (2016) focus on the impact of intra- and inter-firm linkages on the firms' location choice, and (2) Turkina and Van Assche (2018) analyse two types of inter-firm linkage, namely horizontal and vertical linkages. Of particular interest for this study is that both articles build on Porter's definition of clusters as well as on the international business theories developed in subsection 1.1.2 (Dunning, 1980, 1998; Dunning and Lundan, 2008; Rugman, 2009).

First, Alcácer and Delgado (2016) examine how intra-firm linkages (i.e. internal agglomerations) and inter-firm linkages (i.e. external agglomerations) affect the firms' location choice. More precisely, they scrutinise the location choice for different activities of the value chain (i.e. R&D, production and sales) (Alcácer and Delgado, 2016, p. 3231). The authors expect that "internal agglomerations […] do exist and that they prompt firms to co-locate activities across the value chain" (Alcácer and Delgado, 2016, p. 3213).

Moreover, they argue that three types of external agglomeration take place within firms and not only between firms, namely access to knowledge spillovers, specialised labour, and specialised suppliers (Alcácer and Delgado, 2016, p. 3213).

The first striking feature of this article is the conceptualisation of these agglomeration forces. Internal and external agglomerations are regarded as separate forces. The relationship between them depends on whether the firm is located within or outside of a cluster. If a firm is located outside of a cluster, external agglomerations will lead the firm to disperse its activities and internal agglomerations will drive the co-location of activities. However, if a firm is located within a cluster, they both "work in the same direction" (Alcácer and Delgado, 2016, p. 3214). In fact, the authors interpret this positive relationship in the following way: "when […] a firm is already located in the best external environment: internal and external agglomerations would induce collocation [*sic*]" (Alcácer and Delgado, 2016, p. 3217).

The analysis is based on data from the Longitudinal Business Database of the Census Bureau in the US from 1993 to 2005. They focus on the analysis on biopharmaceutical firms for different activities of the value chain, namely R&D, production and sales (Alcácer and Delgado, 2016, p. 3214). The second striking feature of the article is the separation of the various activities of the value chain. In fact, it enables differentiation between the co-location of different activities and therefore solves the omitted variable problem in which the co-location of two activities may be biased because of the existing co-location of another activity (Alcácer and Delgado, 2016, p. 3214).

They find that internal agglomerations have an overall positive effect on location (Alcácer and Delgado, 2016, p. 3213). However, they vary depending on the activity of the value chain. In fact, internal agglomeration effects are larger for R&D and manufacturing activities than for sales (Alcácer and Delgado, 2016, p. 3214). The co-location of activities within a firm takes place both across activities (e.g. between sales and manufacturing) and within an activity (e.g. between plants). Perhaps more interestingly, they find that the effect of external agglomerations declines with the inclusion of variables controlling for internal agglomerations (Alcácer and Delgado, 2016, p. 3214). This means, according to the authors, that external agglomerations have been overestimated in the literature. An alternative explanation would be that internal and external

agglomeration effects are positively related and that firms located in a cluster can exploit both as the authors argue in their theoretical development (Alcácer and Delgado, 2016, p. 3231).

Overall, the authors conclude that "internal agglomerations are, in fact, an important driver of location choices that has [*sic*] been overlooked in the literature" (Alcácer and Delgado, 2016, p. 3214). From a cluster perspective, these results also highlight the importance of clusters in regard to two dimensions: (1) the implantation of new establishments by existing firms, and (2) the positive association of both internal and external agglomeration forces in clusters.

While Alcácer and Delgado have focused on both internal and external agglomerations, Turkina and Van Assche (2018) concentrate on external agglomerations only, through two distinct associations: (1) "horizontal partnership linkages between firms specialized in similar value chain activities", and (2) "vertical buyer–supplier connections between companies specialized in different value chain stages" (Turkina and Van Assche, 2018, p. 707). Ultimately, the aim of their article is to assess the effect of the cluster's international connectedness on its innovation performance (Turkina and Van Assche, 2018, p. 707). Hence, their analysis is at the crossroads between international business theory and microeconomics. In fact, they build on the concept of "global cluster network" in which exchanges span multiple clusters in opposition to the view that clusters are isolated systems (Turkina and Van Assche, 2018, p. 708). They argue that "successful clusters are those in which firms are effective at building a broad network of organization-based linkages for accessing relevant foreign knowledge capabilities" (Turkina and Van Assche, 2018, p. 708). This is in line with Porter's point of view that internationalisation of firms within a cluster not only reduces economic risk but also increases the sophistication of its determinants (Porter, 1990, p. 157).

The authors analyse the types of value chain activities that the cluster specialises in, and the types of international linkages that increase local innovation (Turkina and Van Assche, 2018, p. 707). To do so, Turkina and Van Assche (2018, p. 708) base their analysis on a hand-collected dataset encompassing 154 clusters of three knowledge intensive industries (aerospace, biopharma, and ICT) over the period 2002-2014. They also use patenting as an innovation measure.

They find that innovation in knowledge-intensive clusters "disproportionately benefits" from an increase in horizontal centrality, which means that innovation "at home" takes advantage of the firms' lateral connectedness to other external "knowledge hotspots" (Turkina and Van Assche, 2018, p. 723). Indeed, clusters compete to gain and retain knowledge-intensive activities and therefore, gaining new knowledge through "lateral connectivity […] improve their chances to do so" (Turkina and Van Assche, 2018, p. 723). On the other hand, innovation in labour-intensive clusters gains from "strengthening centrality in the vertical sub-network" which means that it is the vertical linkages that increase innovation (Turkina and Van Assche, 2018, p. 723). In fact, according to the authors "innovation catch-up depends on the ability to climb up the value chain ladder" which is affected by the connectedness to actors along the value chain (Turkina and Van Assche, 2018, pp. 723-724).

According to the authors, it is also important to note that the position of clusters is not static. In fact, labour-intensive clusters, when improving their vertical centrality, move towards more knowledge-intensive value chain activities. In turn, they gain incentives to diversify horizontally to acquire new knowledge (Turkina and Van Assche, 2018, p. 724).

Their study shows how horizontal and vertical linkages in external agglomerations affect the performance of clusters (i.e. in terms of innovation). It also highlights the importance of clusters' internationalisation both in gaining new knowledge and upgrading their competitive advantage by moving up the value chain.

1.3   Synthesis: What determinants affect the prosperity of locations?

This concluding section will synthesise the theoretical development of section 1.1 in light of the empirical results highlighted in section 1.2. It brings to light key mechanisms and determinants of clusters that influence prosperity.

This first chapter started with Porter's view on how industries develop and sustain a competitive advantage. Analysing the development of a competitive industry is a good starting point for understanding the concept of clusters and notably their birth and

evolution. Section 1.2 examined empirical investigations found in the economic literature regarding the overall impact of clusters on prosperity as well as some underlying key mechanisms and determinants.

Prosperity is the result of firms' activities and productivity. Of particular importance in raising the level of productivity is the microeconomic competitiveness level, which is composed of three dimensions: (1) the quality of the business environment, (2) the sophistication of company operations and strategy, and (3) the state of cluster development.

The first dimension of the microeconomic competitiveness level is the quality of the business environment. It was shown that the development and sustainability of a competitive advantage lies notably in the so-called 'diamond' of national advantage where each of the four determinants represents a broad attribute of a nation, namely factor conditions, demand conditions, related and supporting industries as well as domestic rivalry. Not only do each of these four points of the diamond interact in a self-reinforcing process, but they are also influenced by two essential 'ingredients': (1) domestic rivalry which is the point of the diamond that has the greatest influence, and (2) geographic concentration.

Domestic rivalry has the most important impact on the other three extremities (i.e. determinants). First, intense competition provides incentives to invest in specialised factors both by firms and by public or private actors. It raises the needs in terms of factor conditions and some of the supply can be transferred from firms to public or private actors and consequently reduces the risk of investing. Second, domestic rivalry also impacts demand conditions notably by building a national image that arises in particular from greater variety and earlier launch of products. Further, this strong competition increases the number of suppliers, which in turn reduces the risk for buyers as they can shift from one supplier to another. Third, the impact of domestic rivalry on related and supporting industries takes the form of an increase in innovation among suppliers who must satisfy more demanding customers (i.e. firms competing in the base industry). This large presence of customers reduces both the bargaining power of firms competing in the base industry (i.e. the customers) and the risk for suppliers since they face a bigger market. Fourth, domestic rivalry is also influenced by the other determinants and eventually

increases. This, in turn, will positively affect the other determinants in a self-reinforcing process. The upgrading of domestic rivalry results, essentially, in firm creation by lowering entry barriers as well as bringing new technologies, resources and knowledge. These new entrants introduce new ways of competing which lead to the diversification the competitive industry. Overall, the analysis concluded that domestic rivalry is similar to the concept of external economies.

Geographic concentration boosts the interaction among the determinants and consequently (1) increases the firms' motivation to compete, (2) raises awareness among third parties who more easily take notice of special needs, (3) strengthen the flow of information. Geographic concentration can also induce an economic risk if the firms do not internationalise, but rather limit themselves to the local market.

The second dimension of the microeconomic competitiveness level is the sophistication of company operations and strategy. This dimension is also of importance in creating and sustaining competitive advantages. It was explained that firms gain a competitive advantage by innovating and sustain their advantage by constant improvement and upgrading, notably by enlarging the number of sources of advantage and by moving towards higher-order advantages.

It is the quality of the business environment that provides pressure to innovate. It also gives firms insight about opportunities and industry changes. Nonetheless, firms also influence their environment. Hence, it was highlighted that a firm's competitive strategy should also be aimed at improving the surrounding business environment, and notably by influencing the four determinants of the diamond (i.a. investing in factor creation, favouring local suppliers, expanding the domestic market).

A firm's competitive strategy also encompasses an international dimension. In fact, a competitive industry is internationally successful if the firms of that industry compete internationally. Theories of international business, notably following the theories developed by Dunning and Rugman, have provided an understanding of how firms compete internationally and how they locate different activities of their value chain. Building on the competitive advantage created in their home location, internationally competing firms take into account the various advantages that each location has to offer. This way, a firm is able to further develop and sustain its competitive advantages.

Consequently, it can be said that the sophistication of firms and their strategies depend on the quality of the business environment in which they compete and that influences their productivity.

Building on the analysis of the national diamond and on the sophistication of company operations and strategy, the chapter then explains the concept of clusters. Clusters are a particular expression of the national diamond. More specifically, it is the sophistication and development of the four determinants of the national diamond, in conjunction with the intensity of the domestic rivalry and the geographical concentration, that shapes the breadth and depth of clusters. It 'magnifies and accelerates' the sophistication of the diamond, notably by developing new and related advantages. Consequently, it is the quality of the economic environment in a location (i.e. the cluster environment) that matters, notably in raising (1) the level of productivity, (2) productivity growth, and (3) new business formation.

Firstly, it has been explained that productivity is increased through access to specialised inputs at a lower cost, better access to knowledge, increased efficiency in marketing, and more incentives to compete. Overall, productivity depends on external efficiencies. Second, clusters also improve the capacity of innovation and therefore productivity growth. Intense competition both in the internationally competitive industry and in the related and supporting industries increases innovation by developing new competencies or products. Hence, firms are stimulated to distinguish themselves from their rivals. And third, new firm formation is also higher in clusters thanks to more concentrated information flows (e.g. about new opportunities) and lower barriers to entry (e.g. specialised inputs are already available). This situation lowers both the opportunity cost of entering the industry and the risk for the new firm and for financial institutions.

As new firms enter the cluster, there is a higher chance of developing the cluster into related activities that share common needs and consequently, increasing the breadth and depth of the cluster. This "related diversity" prevents the cluster from becoming lethargic, which would deter the progress and sustainability of the competitive advantage.

An important feature that came out of the analysis is the role of information (i.a. about specialised inputs, opportunities and new trends, outsourcing possibilities). Two dimensions that increase the flow of information (i.e. knowledge) are the role of location

and of informal and formal networks. The geographical agglomeration of actors increases the probability of acquiring advanced and sophisticated information. The information is then conveyed through formal and informal networks within the cluster.

Overall, the mechanisms behind the clustering of activities helps to sustain and create new competitive advantages by encouraging the development of related activities. Hence, the next point presented was the lifecycle of a cluster, or put differently, the explanation of how a cluster evolves.

A cluster grows from a competitive industry in a slow process of upgrading the competitive advantage. In this process, the entrepreneurial climate is essential and primarily depends on three factors (1) the intensity of local competition (i.e. domestic rivalry), (2) the formation of new businesses, and (3) the role of linkages. This leads to the convergence of distinct but related clusters. This convergence further develops new skills, opens up new opportunities, and creates new ways of competing. In sum, it further stimulates and encourages innovation and business creation.

However, this process is not guaranteed. Endogenous factors (i.a. internal rigidities, cartel behaviour) may impede this process by reducing the rate of innovation or increasing the costs of doing business. Exogenous factors (i.a. technological discontinuities, diverging global needs) can 'neutralise' and render inadequate the determinants. As a consequence, the cluster fails to sustain the competitive advantage or create a new one. This negative process is accentuated if a cluster heavily depends on one central industry that has lost its competitive advantage and if there is a lack of ramifications outside of the cluster. In this scenario, related and supporting industries have more difficulties to cope with the deteriorating business environment. Overall, a cluster declines when (1) the economic environment does not provide incentives to compete and innovate, and (2) the determinants are no longer consistent with the global needs and demand.

Based on this brief summary of the theory, the following synthesis can be made. Clusters arise from a competitive industry which attracts related and supporting industries in a dynamic process of "related diversity". Two ingredients help the development of a competitive industry: (1) strong domestic rivalry, and (2) geographic concentration. Then, a cluster raises the prosperity of a location by affecting competition in three ways: (1) by increasing productivity, (2) by fostering productivity growth (i.e. through innovation) as

well as (3) new business formation. These three dimensions affect competition, thereby further improving the economic environment, which leads to new and related competitive advantages. The cluster then evolves and merges with related clusters, further strengthening the three dimensions. The role of information (i.e. knowledge) is also central in fostering the three abovementioned influences on competition. Two mechanisms help the flow of information, (1) geographical concentration, and (2) formal and informal networks.

In section 1.2 of this chapter, empirical studies focusing on the elements and mechanisms described in the above synthesis were investigated. Firstly, three studies that assess the impact of clusters on prosperity were analysed. Each of the three studies find strong evidence of the positive influence of clusters on prosperity. Secondly, the analysis focused on studies that empirically test the two elements (role of information, and role of location and networks) that foster the three dimensions.

In the first article, Delgado et al. (2010) analyse the impact of clusters on entrepreneurship, or new business formation, which is one of the three dimensions highlighted above (besides increasing productivity and fostering productivity growth). They find that clusters increase the rate of firm creation, establishment of start-ups and employment. The survival rate of start-ups in the medium-term (five years) is also positively influenced by clusters.

In the second article, Delgado et al. (2014) assess the impact of clusters on industry performance in terms of employment growth. They push the investigation further by controlling for various characteristics of regions, clusters and industries. Finally, they also consider the impact of innovation on performance. In fact, the theory presented in section 1.1 has also brought forward the role of innovation in fostering productivity growth. They find that clusters increase employment growth in the industries composing the clusters in a given location. Likewise, clusters in neighbouring locations also positively impact home industries, which further accentuates the role of geographical proximity. Regarding the size of both locations and clusters, the authors find that they have a positive influence on performance. This highlights the role played by economies of scale and scope. The larger presence of actors within a region and a cluster, both in terms of size and number, further increases the performance of clusters. Nonetheless, this result does not mean that smaller

clusters or clusters in smaller locations have no positive impacts. The heterogeneity of industries also plays a role. Agglomeration effects are higher in high-tech manufacturing industries than in low-tech manufacturing and service industries. This can be explained by the fact that innovation is higher in those industries, and therefore, that clustering of related industries has more importance. Finally, they also find that the patenting strength of a cluster also positively influences employment growth. Moreover, the stronger the cluster environment, the higher the patenting rate. In conclusion, the strength of a cluster positively influences innovation (and therefore productivity growth) and the prosperity of a location, *in fine*.

Finally, Slaper et al. (2018) adopt a different methodology and angle. They assess the benefits of clusters on traditional measures of performance such as the growth of domestic product, productivity per employee, compensation per employee and personal income. They also test six different cluster performance measures. While the overall results confirm the two studies mentioned above, the results are less striking. This is certainly due to the methodology that fails to disentangle convergence from agglomeration forces. However, they do find some interesting results. Notably, they find that traded cluster strength (one of the measures of clusters used) positively influences productivity and compensation per employee, hence increasing the prosperity of a location. In the theory, it was highlighted that clusters without international ties have more chance of inertia and lower incentives to compete and innovate. This statement seems to be corroborated by these results.

Overall, these three studies have confirmed the theory not only by assessing the overall positive impact of clusters on the prosperity of locations, but Delgado et al. (2010) and Delgado et al. (2014) have also examined some important dimensions behind clusters, namely the creation of new businesses and the role innovations.

Then studies focusing on relatedness and information flows were examined. Following the theoretical investigations, both dimensions were of importance. Relatedness is key for sustaining a competitive advantage and moving towards new advantages through the incorporation of related industries and the agglomeration of related clusters. Information is also an important dimension that fosters the three ways affecting competition in a cluster.

First, the study by Hidalgo et al. (2018) builds on the works of fifteen scholars and proposes the "principle of relatedness" that describes the probability of a location entering an economic activity as a function of the number of related activities in that location. Transposed into the cluster framework, it can be adapted in the following way: it is the probability of a location entering a new cluster as a function of the number of related industries and clusters present in that location. Relatedness can take the form of complementarities in terms of, *inter alia*, input-output relations, co-exports of products, shared labour pools. Nonetheless, the authors highlight the relative importance of knowledge flows in comparison to tangible assets. They conclude, based on their extensive literature analysis, that economies with extensive knowledge flows have higher performance levels in terms of employment and entrepreneurship growth. This is consistent with the theoretical part as well as with the results of Delgado et al. (2014).

Second, Neffke et al. (2011), Petralia et al. (2017), Neffke et al. (2017) and Murray et al. (2016) examined this relatedness through product relatedness, technological relatedness, labour flows and follow-on innovation, respectively. Neffke et al. (2011) show that industries which share similar technological levels (defined through the co-occurrence of products) have a higher chance of entering the region. As the mix of technologies shifts with the entry of related industries, some 'old' industries leave the region as their relatedness diminishes. These results show how a cluster may evolve over time as industries enter and leave a location depending on the relatedness of their technologies. This highlights the economies of scope that can emerge in clusters. This dimension (of economies of scope) has also been put forward by Delgado et al. (2014) when examining the effect of the size of locations and clusters.

Petralia et al. (2017) also focus on technological relatedness. However, they analyse the role of specialisation and diversification on the development of economic structures. In fact, firms accumulate knowledge and know-how on in-house technologies which enables them to develop and exploit new technologies. They also argue that the sophistication of the environment surrounding the firm also influences its capacity to acquire new technologies. This intuition is confirmed by their results which show that a country follows a development path with specific patterns of technological specialisation. Their results not only confirm those found by Neffke et al. (2011), but also add new insight regarding the clustering of technologies. While the authors focus on countries, it could

also be transposed to other geographical levels. Hence, locations and clusters follow their own path and diversify their technological know-how by building on prior capabilities. This process leads to new opportunities and innovations in clusters.

Third, Neffke et al. (2017) focus on human capital and find that labour flow primarily takes place within related industries. This confirms the role of human capital as vector of knowledge. It also corroborates the cluster theory which highlights the importance of pools of similar factors of production. It relates to the factor condition dimension of the diamond and its sophistication.

Finally, Murray et al. (2016) use an interesting angle by building their analysis on a natural experiment. They argued that follow-on research depends on access to existing research. Follow-on innovations are of importance in the development of clusters as innovations increase productivity growth (i.e. the second way that competition is affected in clusters) and new business formation (i.e. the third way that competition is affected in clusters). They find that better access to existing knowledge and research increases follow-on innovation both in terms of quantity and diversity. It does not impede the volume of early-stage research and innovation. Consequently, easier access to knowledge fosters both the level of competition in a cluster and the development of a cluster towards related activities.

Overall, it can be said that relatedness, mainly in terms of knowledge, but also in terms of other complementarities, facilitates the development of clusters towards related activities and helps sustain competitive advantage and move towards prospects of new competitive advantages.

Accordingly, the last part of the section focuses on the means of carrying knowledge. Alberti and Pizzurno (2015; 2017) focus on the role of innovation networks and start-ups, while Alcácer and Delgado (2016) as well as Turkina and Van Assche (2018) examine how firms' location choice depends on these complementarities.

First, Alberti and Pizzurno (2015) investigate the type of knowledge and the role of the different actors in facilitating knowledge flows in innovation networks. They find that technological knowledge has a higher density than managerial or market knowledge. However, this may be due to the fact that the study focuses on a high-tech cluster. Alberti and Pizzurno (2015) mention that other authors have found that market knowledge is

dominant in low-tech clusters. Hence, the nature of the activities in clusters influences the type of knowledge exchanged. Alberti and Pizzurno (2015) also find that the dissemination of knowledge is not uniform in a cluster. This dimension is further examined in a follow-up article (Alberti and Pizzurno, 2017) focusing on the role of start-ups. They find that start-ups mostly absorb technical, managerial and market knowledge. This is consistent with the cluster theory in the sense that start-ups and new businesses in clusters take advantage of new opportunities and existing innovation. However, the authors also find that start-ups are immature and, therefore, willing to collaborate with established actors in clusters in order to acquire knowledge. This, in turn, facilitates knowledge leaks from start-ups. Consequently, start-ups, who take advantage of opportunities created by the cluster environment, play a role in generating knowledge that further benefits other cluster actors. Hence, the entry of start-ups keeps the process of cluster development in motion.

Alcácer and Delgado (2016) as well as Turkina and Van Assche (2018) further investigate the linkages within and between firms, by focusing on so-called internal and external agglomerations. Alcácer and Delgado (2016) examine the location choice for the different activities of the value chain. In fact, these agglomerations take many complementarities into account (i.a. knowledge, skilled labour, intermediary products) depending on the activity considered. Based on their results, they argue that internal agglomerations can work in the same direction as external agglomerations in a cluster and that they are more important than the economic literature suggests. Therefore, when combining these results with those found regarding the principle of relatedness, it can be concluded that intra-firm and inter-firm linkages foster the implementation of new businesses in a cluster. Firms value these complementarities when choosing a location and clusters can provide them with these complementarities. Therefore, as a cluster grows and diversifies into related activities, it attracts new businesses which in turn strengthen the competitive advantage and the prospect of cluster development.

Finally, Turkina and Van Assche (2018) concentrate on external agglomerations through horizontal (similar activities of the value chain) and vertical relationships (different activities of the value chain) with a focus on the internationalisation of clusters. An interesting angle of the paper is the interrelation between firms of related clusters. They take Porter's view that firms should build a broad network that is not limited to the cluster.

They find that knowledge-intensive clusters benefit from extensive horizontal connections by gathering external knowledge, whereas labour-intensive clusters benefit from vertical networking. Nonetheless, this situation is not static for labour-intensive clusters. As they develop and move towards more knowledge-intensive activities, they should establish horizontal linkages outside of the cluster. These results confirm the importance for firms, and by aggregation for clusters, of developing ties outside the cluster in order to acquire new knowledge, which in turn sparks new innovations. These new innovations further increase productivity growth and the formation of new businesses. They prevent inertia in the cluster and mean that there is no divergence from global demand and needs.

The twelve empirical studies examined in this chapter provide evidence (1) of the benefits of clusters on the overall economic performance of locations, (2) of the three ways in which clusters influence competition (i.e. these three ways are themselves affected by relatedness and linkages), and (3) of the importance of location (i.e. geographical concentration). Hence, it can be said that clusters positively affect the prosperity of locations by influencing competition. This impact is encountered across various types of clusters. In this process, innovations and the mechanisms favouring the development of innovation are of particular importance. In fact, innovation increases productivity growth and sparks new business formations. It has also been shown that innovation is stimulated by factors including technological relatedness, easier access to knowledge, increased geographic concentration of knowledge, intra- and inter-firm linkages and horizontal diversification.

In order to sustain their positive influence on locations, clusters need to sustain their competitive advantage. In this sense, clusters have to evolve, develop related activities and eventually merge with related clusters. This process of related diversification is also facilitated by innovations not only in core industries of the cluster but also in supporting and related industries. By developing ties outside of the cluster, firms in both the core and in supporting and related industries are able to acquire new knowledge, build on related and complementary factors of production and take advantage of new sale possibilities. These elements trigger new innovations and prevent the cluster from withdrawing into itself.

The following chapters will build on this synthesis in order to understand if clusters can play a role in the economic resilience of locations. Some light have already been shed on how clusters may sustain and develop competitive advantage and increase the resilience of locations. Nonetheless, the following chapter will broaden the analysis by investigating the literature on economic resilience.

Table 1.1: Recapitulation table of the mechanisms and determinants found in chapter 1 (classified by authors).

Authors	Main determinant(s)	Mechanisms/Characteristics
Microeconomic Competitiveness framework according to Porter		
Porter (2000; 2008)	Quality of the business environment	The 'diamond' of national advantage represents each of the four 'broad attributes' (i.e. determinants) of a nation, namely factor conditions, demand conditions, related and supporting industries as well as domestic rivalry. These determinants are influenced by domestic rivalry and geographic concentration. Domestic rivalry provides incentives to invest in specialised factors of production and in innovation, in building a national image, increases the number of suppliers and the creation of new businesses. Geographic concentration increases the firms' motivation to compete, raises the awareness by third parties who take more easily notice of special needs and strengthen the flow of information.
Porter (2000; 2008)	Sophistication of company and operations and strategy	A firm's competitive strategy should be aimed at improving their surrounding business environment (i.a. investing in factor creation, favouring local suppliers, expanding the domestic market).

		A firm's competitive strategy should also encompass an international dimension. In fact, a competitive industry is internationally successful if the firms of that industry compete internationally.
		Building on the competitive advantage created in their home location, internationally competing firms take into account the various advantages that each location has to offer.
Porter (2000; 2008)	State of cluster development	Clusters magnify and accelerate the sophistication of the diamond, notably by developing new and related advantages.
		The cluster environment raises (1) the level of productivity (through external efficiencies such as access to specialised inputs at a lower cost, better access to knowledge), (2) productivity growth (through increased innovation that is stimulated by intense local and international competition), and (3) new business formation (through concentrated information flow and lower barriers to entry).
		New firm creation diversifies the clusters into new related activities (i.e. related diversity) that increase the breadth and depth of the cluster and, *in fine*, expand the sources of competitive advantage as well as prevent lethargic behaviour of cluster participants.
		The diversification of clusters (i.e. increase in sophistication) is a slow process of upgrading the competitive advantage where the entrepreneurial environment is essential and primarily depends on three factors (1) the intensity of local competition (i.e. domestic rivalry), (2) the formation of new businesses, and (3) the role of linkages.

		The flow of information (i.a. about specialised inputs, opportunities and new trends, outsourcing possibilities) is an important dimension in clusters. The flow is increased by geographic concentration and networks.
		Clusters raise from a competitive industry which attract related and supporting industries in a dynamic process of 'related' diversification.
		The cluster then evolves and merges with related clusters further strengthening the three dimensions.
Assessing the impact of clusters on prosperity of location		
Delgado et al. (2010)	Clusters increase firm creation, start-ups establishments and employment.	**Methodology:** The authors argue that convergence forces appear at the industry level while agglomeration forces are present at the cluster level. Strong cluster environments have higher rates of firm creation from both start-ups and already existing firms. They find that a strong cluster environment also improves the medium-term (five year) survival rate.
Delgado et al. (2014)	Clusters increase industry performance. Patenting-strength of clusters (i.e. innovation) increase both patenting and employment.	**Methodology:** The authors argue that convergence forces appear at the industry level while agglomeration forces are present at the cluster level. They find that the employment growth rate is increasing in the level of employment strength at the cluster level.

		They also find that cluster strength in neighbouring locations leads to the development of new industries in the region.
		Agglomeration forces taking place in larger regions or in larger clusters result in greater effects due to economies of scale.
		Agglomeration effects are higher in high-tech manufacturing industries than in low-tech manufacturing or service industries.
		Higher innovation rates in a cluster facilitates employment creation.
		Stronger cluster environments, in terms of patenting, is associated with an increase of patenting growth.
Slaper et al. (2018)	Some cluster measures (i.a. traded and local cluster growth traded cluster strength) are associated with greater performance.	"40% to 60% of the variation in the dependent variables is explained by the cluster development measures" (Slaper et al., 2018, p. 56). Traded cluster strength positively influences productivity and compensation per employee.
Other studies finding a positive overall impact of clusters on prosperity: Porter (2003), Greenstone et al. (2010), Spencer et al. (2010), Resbeut and Gugler (2016), Claver- Cortés et al. (2019), Resbeut et al. (2019).		

The principle of relatedness applied to clusters		
Hidalgo et al. (2018)	Economies with extensive knowledge flows have higher performance levels in terms of employment and entrepreneurship growth	Principle of relatedness: probability that a location enters an economic activity as a function of the number of related activities in that location. Relatedness can take the form of complementarities in terms of, *inter alia*, input-output relations, co-exports of products or shared labour pools.
Neffke et al. (2011)	Industries that share similar technological levels have a higher chance of entering the regions.	Cluster may evolve over time as industries enter and leave a location depending on the relatedness of their technologies. This highlights the economies of scope that can emerge in clusters.
Petralia et al. (2017)	Countries follow a development path with specific patterns of technological specialisation.	Firms accumulate knowledge and know-how on in-house technologies which enable them to develop and exploit new technologies. Further, the sophistication of the environment surrounding the firm also influence its capacity to acquire new technologies. Hence, locations and clusters follow their own path and diversify their technological know-how by building on prior capabilities. This process leads to new opportunities and innovations.

Neffke et al. (2017)	Labour flow primarily takes place within related industries.	Human capital is a vector of knowledge. They find that labour flows "are guided by a non-negligible industry-specific component in human capital" (Neffke et al., 2017, p. 290). More than skills, it is the industry-specific knowledge which comes alongside the skills that is of importance regarding labour linkages between industries
Murray et al. (2016)	Follow-on research depends on the access to existing research.	Better access to existing knowledge and research increases follow-on innovation both in terms of number and diversity. Further, it does not impede the volume of early-stage research and innovation. Openness and exploration are primary drivers of the research process. Hence, easier access to knowledge fosters both the level of competition in a cluster and the development of a cluster towards related activities.

Relatedness between firms (or industries) are accompanied by higher knowledge spillovers and employment growth: Essletzbichler (2007), Frenken et al. (2007), Boschma and Iammarino (2009) as well as Bishop and Gripaios (2010) and Boschma et al. (2012)

Technological diversification helps move towards more profitable activities and mitigates risks: Jaffe (1986), Klevorick et al. (1995), Laursen (1999) as well as Koren and Tenreyro (2007)

Relatedness reduce entry barriers: Perez and Soete (1988), Murray et al. (2016), Boschma et al. (2013), Colombelli et al. (2014), Rigby (2015) and Tanner (2016)

The influence networks and firm linkages		
Alberti and Pizzurno (2015; 2017)	The nature of the activities in clusters influences the type of knowledge exchanged. The dissemination of knowledge is not uniform in a cluster.	Technological knowledge has a higher density than managerial or market knowledge. Start-ups mostly absorb technical, managerial and market knowledge. However, start-ups are immature and, therefore, willing to collaborate with established actors in clusters in order to acquire knowledge. In turn, it facilitates knowledge leaks from start-ups.
Informal networks increase industry formation and formal network increase industry stability: Vicente and Suire (2007) **Informal networks explain the agglomeration of firms and industries:** Appold (1995), Dahl and Pedersen (2004), Johansson and Quigley (2004), Minniti (2005), Camagni et al. (2015), Della Peruta et al. (2018) **Networks influence innovation and entrepreneurship:** Elfring and Hulsink (2003), Kenney and Patton (2005), Presutti et al. (2011) **Networks influence creation of new venture and start-ups:** Gompers et al. (2005), Teece (2010), Pangarkar and Wu (2012), Kask and Linton (2013), Perez et al. (2013)		
Alcácer and Delgado (2016)	Internal agglomerations have a positive effect on location. The effect of external agglomerations declines with the inclusion of variables controlling for internal agglomerations.	If a firm is located outside of a cluster, external agglomerations will lead the firm to disperse its activities and internal agglomerations will drive the collocation of activities. However, if a firm is located within a cluster, they both "work in the same direction". Internal agglomeration effects are larger for R&D and manufacturing activities than for sales.

		The collocation of activities within a firm takes place both across activities and within an activity (e.g. amongst plants). **Conclusions:** Internal agglomerations are, in fact, an important driver of location choices that has been overlooked in the literature. It highlights the importance of clusters on (1) the implantation of new establishments by existing firms, and (2) the positive association of both internal and external agglomeration forces in clusters
Turkina and Van Assche (2018)	Knowledge-intensive clusters benefit from extensive horizontal connections by gathering external knowledge. Labour-intensive clusters benefit from vertical networking.	The situation for labour-intensive clusters is not static. As they develop and move towards more knowledge-intensive activities, they should establish horizontal linkages outside of the cluster. It highlights the importance for firms (and by aggregation for clusters) of developing ties outside the cluster in order to acquire new knowledge, which in turn spark new innovations.
Complementarities (i.a. exchange of information or sharing of specialised workers) between R&D and production activities or between R&D and intellectual property specialists: Cohen and Levinthal (1990), Adams and Jaffe (1996), Ketokivi (2006), Di Minin and Bianchi (2011), Hamilton et al. (2003), Tate and Yang (2015).		

Importance of external agglomerations for smaller firms and start-ups: Henderson (2003), Glaeser and Kerr (2009), Delgado et al. (2010), Rosenthal and Strange (2010).

Importance of knowledge flow (i.e. one aspect of external agglomerations) in the internationalisation process of firms through access to know-how or the capabilities of local firms: Rugman and Verbeke (2003), Bathelt et al. (2004), Wolfe and Gertler (2004), Hannigan et al. (2015), Cano-Kollmann et al. (2016), Awate and Mudambi (2017), Scalera et al. (2018).

Source: Personal elaboration.

Chapter 2

The concept of economic resilience: Presentation, state of knowledge and determinants

Regarding the concept of resilience in social sciences, three main groups of research can be identified: (1) adaptive capacity of ecosystems, (2) regional variation in economic resilience, and (3) social resilience of disadvantaged communities (Mai and Chain, 2020, p. 876). The first group deals with the capacity of physical and ecological systems to anticipate and react to disasters. It concentrates on an interdisciplinary understanding of resilience from a social and natural perspective. The second group deals with the spatial variation in economic response to shocks. The third group of research analyses the social resilience of vulnerable communities, notably towards chronic stress and persistent challenges (Mai and Chan, 2020, p. 882). It is the second of these groups that is of importance in this study.

The debate around resilience has not only taken place in social sciences but also in various fields such as engineering, ecology and psychology (Bristow and Healy, 2018b, p. 6). According to Mai and Chan (2020, p. 877), the term was already used by Webster in 1824 in the field of classical physics in order to describe "the ability of a material to return to its initial condition after deformation". In economics, resilience has gained considerable attention in the aftermath of the Great Recession, particularly in the field of economic geography. Overall, resilience has become "an umbrella term that expresses the conceptual underpinnings that permit survival of a certain system under adverse conditions" (Mai and Chan, 2020, p. 877).

Since the concept has been borrowed from other scientific disciplines, it can lead to a problem of analogy. This is a problem when talking about resilience in an economic context – one cannot simply transpose a concept and its framework from a certain scientific field or domain of study into another one. An example is provided by Swanstrom (2008, p. 13):

> Ecological studies provide some insight into this issue by emphasizing that diversity of animals and plants helps ecosystems to adapt by providing them with more alternatives. Regional economists have long advocated the need for diverse economies that will be less vulnerable to shake-ups on [*sic*] one industry.

While this may be true for a firm when talking about diversifying its number of suppliers, or in finance when spreading the risks of an asset portfolio, it may not hold in other economic fields. In fact, the hypotheses, underlying theory and surrounding conceptual framework in one scientific field are not necessarily appropriate in another field. According to Martin (2012, p. 2), this has led to a lack of consensus regarding the adoption of different definitions and their various applications.

Bristow and Healy (2018b, p. 6) also highlight two challenges of transposing the concept to an economic context: (1) the identification of the system that is subject to the shock (i.a. an individual, a region, a socio-ecological system), and (2) the identification of the shock or disturbance, namely "its source, severity, temporal dimension and so on". This can be summarised with the title of an article by Carpenter et al. (2001) *From Metaphor to Measurement: Resilience of What to What?*. Hence, it opens the need for a debate of what resilience means for local economies, how can it be measured and what influences it.

So far, most academics that have dealt with the subject of economic resilience came from the field of evolutionary economic geography and regional economic development (amongst others: Bristow, 2010; Simmie and Martin, 2010; Fingleton et al., 2012; Martin, 2012; Boschma, 2015; Martin and Sunley, 2015; Evenhuis, 2017; Bristow and Healy, 2018a). The core question of economic geography is to understand "why some regional economies manage to renew themselves or to lock themselves out, whereas others are more locked in decline" (Hassink, 2010, p. 45). Bristow and Healy (2018b, p. 7) describe evolutionary economics as the understanding of economies having "complex adaptive

systems characterised by highly complex, non-linear and path-dependent system dynamics", therefore rejecting the hypothesis of traditional theories that view economies as having a linear dynamic or a static equilibrium. In evolutionary thinking, dimensions such as history and geography are central, notably in taking into account location specific aspects. For evolutionary economic geography, economies have different mixes of assets or economic structures and agents that interact in complex ways and as such, react differently to change (Bristow and Healy, 2018b, p. 7). In this sense, Reggiani et al. (2002) argue, in an early article on the discussion of economic resilience, that the concept should be included in the debate on the dynamics of spatial economic analysis. By comparing the aim of evolutionary thinking and of economic geography, it becomes clearer why that particular field has focused on the concept of economic resilience.

The first section of this chapter introduces the concept of economic resilience by presenting the different definitions that can be found throughout the economic literature and the subsequent lack of consensus regarding both the definition of the concept and the analytical framework. Building on the conceptual elements gathered in this first section, the statistical records are presented in order to give the reader an idea of the heterogeneity of economic resilience.

In the second section, a search through the works on economic resilience will be carried out with the aim of highlighting potential determinants affecting the resilience of locations. While a first wave of research has put the subject of economic resilience on the academic agenda by focusing on the understanding of the locational heterogeneity of economic resilience, a second wave of research focusing on the determinants of economic resilience has emerged thanks to the availability of data following the Great Recession that hit the world's economy in the late 2000s. Most of these works try to shed light on the determinants that spur economic resilience. Therefore, it is a good starting point to 'go round the table' and acquaint oneself with the ideas and intuitions that have been looked at by academics working on the subject. It may also bring the first insight into potential determinants of clusters affecting economic resilience.

The last section of this chapter will draw up a synthesis of the determinants found in the second section and will serve as a guide for the investigation carried out in chapters 3 and 4.

2.1 Presentation of the concept of economic resilience: Definitions, conceptualisation and statistical records

This section is divided into three subsections and will concentrate on (1) the various definitions that can be encountered in the literature, (2) issues regarding the conceptualisation of economic resilience, and (3) the records of economic resilience.

2.1.1 The various definitions of the concept of economic resilience

Many definitions of resilience can be found in the literature, each author developing their own interpretation of the concept or taking over an already existing definition. The definitions that recur most often are the notions of "engineering", "ecological" and "adaptive" resilience (Holling, 1973; Martin, 2012; Angulo et al., 2018). While "engineering" and "ecological" resilience focus on the growth path before and after a shock, "adaptive" resilience refers to the capacity of an economy to reconfigure itself, namely to "adapt its structure" (Martin, 2012, p. 10).

Firstly, the notion of "engineering" resilience is associated with the rebound of the economy to its pre-existing level or ongoing path before the shock (Holling, 1996, p. 33; Angulo et al., 2018, p. 350). Martin (2012, p. 4) insists on the fact that the focus of "engineering" resilience is on the resistance of the economy to the shock and on the speed of return to the pre-shock level. The two key elements of this particular definition are: (1) that the economy is in equilibrium before the shock, and (2) that the economy shows stability around its pre-shock equilibrium (i.e. known in growth theory as the steady state). Martin (2012, p. 4) also notes that this definition "resonates with the idea (assumption) of self-correcting forces in mainstream economics". Consequently, the shock has no permanent effect on the economy which will eventually recover its pre-shock growth path.

The second definition considers resilience from an ecological point of view. In this approach, the economy will, as a consequence of a shock, reconfigure itself into another constellation, a new equilibrium (Holling, 1996, p. 33). Angulo et al. (2018, p. 351) add

that this approach to resilience can be associated with the concept of "hysteresis" where an external event permanently affects the path of a system, in this case an economy. In fact, the economy is pushed "beyond its elasticity threshold" and, as a consequence, will move towards a different state of growth (Martin, 2012, p. 7). Therefore, the economy is able to absorb to a certain degree the shock before 'moving' towards another growth path. "Ecological" resilience can be measured by comparing the growth path before and after the shock. In fact, the "projected" growth rate of an economy (i.e. the hypothetical growth path that an economy would have followed without the shock) is compared to the actual growth path (Fingleton and Palombi, 2013, p. 649).

A third proposition of resilience has been made by Martin (2012): "adaptive" resilience. This interpretation of resilience is closely related to the "ecological" perspective as it puts forward the capacity of an economy to "reconfigure, that is adapt, its structure (firms, industries, technologies and institutions) so as to maintain an acceptable growth path in output, employment and wealth over time" (Martin, 2012, p. 10). In this case, however, the process is path dependent. Namely, the adaptation depends on the pre-shock nature of the economy, such as entrepreneurship, the innovativeness of firms or access to investment possibilities (Martin, 2012, p. 10). This evolutionary approach brings to mind the Schumpeterian approach of "creative destruction". In fact, the shock may trigger a shift from outdated goods or methods of production to new opportunities. More generally said, this "adaptive" notion of resilience is the "ecological" interpretation of resilience in the economic context.

Building on, or parallel to, these definitions of resilience, many authors have come up with their own interpretations. Perhaps the most simplified view of economic resilience is given by Hill et al. (2008, p. 2) for whom economic resilience is "the ability of a region […] to recover successfully from shocks". In the same way, Christopherson et al., (2010, p. 6) define economic resilience as the capacity "to withstand the shock of an economic crisis". This is the most common and intuitive definition. However, what does "recover successfully" and "withstand" mean? It is interesting to note that they diverge from the previously explained definitions (i.e. "engineering", "ecological" and "adaptive") in the sense that they do not include suggestions for measuring it. For example, the "engineering" interpretation implies that the economy is resilient if it reaches its pre-shock level, while the "ecological" definition suggests that the economy is pushed

towards a new growth path, therefore implying that the post-shock growth path will be different to the pre-shock equilibrium.

In their definition of the concept, Duval and Vogel (2008, p. 3) highlight "the ability to maintain output close to potential in the aftermath of shocks". In comparison to the previous definitions, they specify the way of withstanding the shock by introducing two dimensions: the dampening of the shock and the speed of returning to a normal situation (Duval and Vogel, 2008, p. 3). Bristow and Healy (2018c, p. 273) define economic resilience "as the ability of an economy to resist a shock and maintain existing levels of economic activity, in this case employment levels, or to recover to the pre-shock peak within a given period of time." In these cases, the definition is clarified by mentioning that economies should reach at least the same economic activity level as prior to the shock. These meanings of resilience are akin to the "engineering" definition of resilience.

In the same logic as "adaptive" resilience, Foster (2007, p. 14) adds that economic resilience is also the "ability of a region to anticipate, prepare for, respond to, and recover from a disturbance". In this definition, Foster (2007) separates economic resilience into four dimensions happening in phases before and after the shock. This reflection is also encountered in an article by Martin (2012, p. 11) who identifies four dimensions of economic resilience in his interpretation of regional resilience: resistance, recovery, re-orientation and renewal. Akin to these definitions, Bristow and Healy (2018b, p. 7) define resilience as "the capacity of a regional or local economy to withstand, recover from and reorganise in the face of market, competitive and environmental shocks to its developmental growth path" while Boschma (2015, p. 733) defines economic resilience "not just as the ability of a region to accommodate shocks, but extends it to the long-term ability of regions to develop new growth paths". These interpretations of economic resilience are oriented toward evolutionary economics and add a long-term dimension.

The definitions reviewed above all share one feature: the fact that an economy will have to "recover" from the shock, implying that the level of the performance measure has fallen. However, a resilient economy may also never record a decline in output. In the definition by Kahl and Hundt (2015, p. 373), they interpret economic resilience as "the ability to sustain or augment employment performance during crisis [*sic*] as compared to a previous level of employment prior to the crisis". It allows for a scenario where an

economy does not 'suffer' from the shock (i.e. record negative growth) and continues to follow the pre-shock growth path or develop a new, better path. These scenarios do not exclude any "adaptive" process of the economy (i.e. being able to adapt its structure so as to maintain an acceptable growth path) as long as growth is not negative. However, it excludes scenarios where an economy is subject to a period of negative growth but that can be categorised as resilient in comparison to other economies. This gives rise to another debate on measurement: should the concept be measured in absolute or relative terms?

While there is a lack of consensus between these definitions, it is interesting to note that they tend to lean towards the "adaptive" approach. For Martin (2012, p. 2), this lack of a commonly agreed definition "reflects the different uses and interpretations of the notion of resilience found across the social sciences, and indeed across the natural, physical and biological sciences". As a consequence, it results in a weak framework with open questions such as the relationship between long-term versus short-term horizons, the nature and magnitude of the shock (i.e. what defines a shock), the measurement of the response. Put more generally, it jeopardises the applicability of the concept.

2.1.2   Reflections on the conceptualisation of economic resilience

i   The concept of resilience in other disciplines

As noted previously, resilience is not an economic concept *per se*. The term 'resilience' is a declension of the Latin verb *resilio*, which has three meanings in the French-Latin dictionary Gaffiot (1934, p. 1351). It firstly means to leap back or to jump backwards, to bounce back, to reflect on somebody or to affect somebody adversely. *Resilio* also means to turn in on ourselves. The last meaning is to step back swiftly from something. The dictionary illustrates the first meaning of *resilio* with a citation of Cicero "so that you see the charges bouncing away from my client" (Gaffiot, 1934, p. 1351). In this citation, *resilio* is used in the sense of bouncing away or giving a new twist to the plot. This interpretation combined with the third meaning of swiftly stepping back from something gives us a clue as to the definition of resilience in social sciences. It can be understood as

the capacity of an economy to bounce away from a shock, or in other words, to dodge a shock. However, while it provides important insight regarding the direction that the economic definition should take, and consequently consolidates the general meaning of some of the definitions proposed in the previous subsection, it does not give technical information on, for example, the magnitude of the economy's answer to the shock and its measurement.

When looking in other scientific disciplines, the term resilience has been mostly used in engineering, psychology or ecological systems. In physics, Webster introduced the term to define the capacity of a material to regain its initial condition (i.e. after a shock) (Mai and Chan, 2020, p. 877). Resilience has also been used in psychology and psychiatry as well as ecology and disaster studies, notably to understand how individuals deal with life events, respectively how ecological systems react in the face of changes (Hassink, 2010, p. 45; Tóth, 2015, p. 70). In ecological research, Holling (1973) defines resilience as an ability to persist in the face of a change thanks to multiple stable equilibria. A resilient system is able to shift towards a new equilibrium (Tóth, 2015, p. 70). Luthar et al. (2000) highlight the problems in defining the concept of resilience in psychology which leads to variations in measurements.

Walker et al. (2004) bring a new perspective into the debate by comparing resilience with concepts such as "justice" or "wellbeing" and argue that: "it can be counterproductive to seek definitions that are too narrow. Because different groups adopt different interpretations to fit their understanding and purpose […]" (Walker et al., 2004, p. XX). This may shed light on the confusion between the different meanings and interpretations and also confirm the analysis resulting from the Latin definition given above which proposes a general meaning with various sub-meanings. When juxtaposing this reflection with the economic sense of resilience, it can be observed that the general meaning is identical through the various economic trends and theories. However, the divergence in meaning becomes apparent when a more precise definition is offered.

Mitchell's reflection on the construction of definitions is also worth noting:

> Yet the words we use set traps for us. Starting with a vague conception of a group of seemingly related phenomena which we wish to study, we name it. That step is

necessary, but dangerous. The definiteness of the name may conceal from us the indefiniteness of our knowledge. (Mitchell, 1927, p. 454)

He continues by adding that: "Even now, we can do no more than frame a working definition to use in trying to learn more—a definition which presumably will require modification as knowledge grows" (Mitchell, 1927, p. 455). This reflection may also explain the lack of consensus not only in economics but also in other fields regarding a definition of resilience. Not only does the term resilience restrict the scope of potential approaches or lines of thought, but a definition may also evolve with the accumulation of knowledge and new insight.

Nonetheless, there are some features that link the broad definitions of resilience of each scientific field. Whether in psychology, ecological systems or economics, the concept of resilience deals with the reaction of a system (e.g. a person, an environment, a location or an economy) to changes and shocks. Regarding economic resilience, there is a certitude that it deals with shocks, whether endogenous or exogenous.

Intuitively, these elements combined remind us of the theories of business cycle, which concentrate on the "fluctuating behaviour of an economy" (Gabisch and Lorenz, 1989, p. 2). If an economy reacts to a given shock or a sudden change in economic conditions, a fluctuation of the economy is expected, whatever the measured aggregate is. From this perspective, business cycle theories would be of some help in measuring economic resilience and investigating the mechanisms behind fluctuations. Sensier et al. (2016, p. 145) also add that a shock may not hit economies at the same time, and from this perspective, the business cycle approach may shed some light on the dynamic behaviour of economies. Besides, business cycle theories have many similarities to growth theories. Indeed, Valdés (1999, p. 5) poses the question: "How do we separates the trend from the cycles in a […] time series?" while Fatás (2002, p. 2) suggests that "characteristics of the business cycle are not independent of the growth process". Hence, growth theories and business cycle theories may be an interesting starting point for further investigating the concept of economic resilience.

ii   Issues regarding the conceptualisation of economic resilience

Yet, the following remains vague. Who or what system reacts to the shocks? Are we talking about firms, regional and national economies or consumers? What form does the reaction take? Or put differently, how can the reaction be identified? This leads to the question: how is the reaction measured? What is the time span during which the shock and the reaction take place? Do governments seek to implement policies in order to dampen, prevent or recover from a shock? More precisely, does a shock affect an economy differently depending on the economic policy that a government was pursuing when the shock struck the economy? The cluster perspective and the microeconomics of competitiveness framework may shed some light on some of these questions.

Firstly, the issue of the main target or "of what" (e.g. firms, regional or national economies). It is important to understand that the performance of an economy is the result of the performance of the firms competing in the given economy and the firms' performance is influenced by the relationship between them and between the economic agents present in the economy (e.g. workers, institutions and governments) (Evenhuis, 2017, p. 2; ISC, 2020). As a consequence, it is fair to propose the following statement: while the performance of an economy depends on the underlying firms, the economic resilience of that same economy depends on the capacity of the underlying firms and economic actors to be resilient in the face of a shock. Moreover, the resilience in one location may be influenced by the resilience of neighbouring locations due to various linkages that exist between locations (e.g. input-output and labour flows) (Sensier et al., 2016, p. 147). For example, a firm that relies on given intermediary goods purchased in a neighbouring region will be affected by a shock hitting that particular region (i.e. it may affect the availability or cost of the particular good).

Secondly, the reaction needs to be identified. In the microeconomics of competitiveness framework, Porter (2000; 2003; 2008) stresses the importance of productivity which translates to an increase of employment or gross output. Therefore, a firm that has a competitive advantage will most likely show higher values in terms of these indicators. Hence, and building on the previous paragraph, the performance of an economy is therefore the aggregation of these performance indicators at the firm level. The shock can

therefore be measured in terms of variations in growth rates of employment or gross output.

These two points may answer the questions of the resilience "of what?". In this case, it would be the reaction of an economy through its underlying firms and economic actors. However, the question of resilience 'to what?' still needs to be answered.

Thirdly, the question 'to what?' refers to the shock itself. For Faggian et al. (2018, p. 395), there is a need to determine what constitutes a "shock". In fact, shocks may be of economic nature (e.g. the financial crisis in 2006, competitive shock such as the removal of the CHF/EUR exchange rate floor in 2015, or structural changes) or exogenous to the economic system (e.g. environmental shock such as hurricane Katrina in 2005 or a pandemic such as Covid-19 in 2020). Economic actors will show different reactions towards different shocks, and consequently require different capacities of resilience. While there are some articles focusing on the resilience of economies to the impact of natural disasters, most works have focused on the resilience of economies to the recent financial crisis, also known as the Great Recession.

A key component of a shock is the economic downturn that follows. However, one can argue that if all economies are resilient to the shock, there may not be any economic downturn. So how can the shock be identified. Is there a threshold above which the disturbance can be categorised as a shock? What is the magnitude of the loss and its duration? Also, are slowly developing challenges such as shifts in technology or deindustrialisation considered to be shocks? Are economies that adapt to those slow-moving changes considered to be resilient (Hassink, 2010, p. 47)? Consequently, there are two dimensions to be considered: (1) the amplitude in terms of a performance measure, and (2) the duration of the loss. However, it is also important to keep in mind the purpose of this study and of the study of economic resilience. Indeed, the aim of studying economic resilience is to understand why some economies do not suffer from a shock as much as others. The focus is on understanding what drives resilience. Or put differently, the interest is in the determinants of economic resilience. In this sense, the elements that characterise a shock are not essential *per se*. However, the shock needs to be (1) sufficiently broad in order to impact a large number of economies, and (2) sufficiently severe to impose an economic downturn on a number of economies. This

makes it possible to highlight the spatial heterogeneity of the response of the economies to the shock and, consequently, to put forward the differences in terms of determinants between economies that suffered from the shock and those that did not. The Great Recession is a fertile ground for analysing economic resilience thanks to both its globalised scale (country- and industry-wide) and severity. However, there is still an issue regarding the identification of the heterogeneity of the response in the face of the shock.

Not all economies are affected at the same point in time, which complexifies the identification of shocks across economies (Sensier et al., 2016, p. 133). In order to counter this issue, the economic resilience of a particular location can also be measured relative to its own "norms" such as the pre-shock levels or patterns of fluctuations over time (Sensier et al., 2016, p. 133).

Hence, there is another question that can be added: resilience "over what period?". This brings a further issue: should the analysis focus on the short-term or on the long-term? Sensier (2018, pp. 22-23) distinguishes short-term "adaptive capacity" when an economy will "resist" and "recover" from the shock, and long-term "adaptive capacity" which is characterised by the economy's ability to "re-orientate" and "transform" its structure. Others such as Kakderi and Tasopoulou (2018, p. 108) argue that resilience should be analysed in a framework of long-term processes of change where historical development needs to be considered. Hill et al. (2011, p. 3) consider a location to be resilient if it returns to its pre-shock state within four years. However, when looking at economic resilience through the lens of clusters, as is the aim in this study, the long-term versus short-term debate may be of little importance when searching for determinants. Some authors such as Martin and Sunley (2015, p. 23) have argued that the capacity for short-term resilience has "to be understood as constitutive of long-term regional growth paths and development trajectories". There are, however, some advantages to focusing on the short-term. According to Sensier (2018, p. 12), focusing on short-term resistance and recoverability has the advantage of being less challenging to measure than long-term re-orientation. There is also a social dimension to considering economic resilience from a short-term perspective: the social costs, in terms of job loss or reduced income, are lower or inexistent for economies that have "resisted to" or "recovered from" the shock in the short run.

Finally, there is a fifth issue, namely self-reliance. The literature on economic resilience has mostly analysed the "natural" reaction to a perturbation or shock through market processes and let aside analyses on the influence of any policy implications or government interventions (Evenhuis, 2017, p. 2). Instead, the literature has focused principally on the adaptive capacity of a regional economy and not on government interventions in the face of a shock. There are, however, policy measures that can be taken in order to promote adaptive capacity, which has also been highlighted in the literature (Evenhuis, 2017, p. 2).

iii Concluding reflections on the conceptualisation of economic resilience

While the reflexion conducted in subsections 2.1.1 and 2.1.2 has not led to the development of a framework, it has sketched out some suggestions of how economic resilience should be conceptualised and what the important issues are. Some authors have proposed various phases occurring before, during and after the shock. Duval and Vogel (2008, p. 3) argue that resilience has two dimensions, namely (1) the dampening of the shock, and (2) the speed of return. Foster (2007, p. 14) proposes four dimensions: (1) anticipate, (2) prepare for, (3) respond to, and (4) recover from. These four dimensions are akin to those suggested by Martin (2012, p. 11), namely (1) resistance, (2) recovery, (3) re-orientation and (4) renewal. Further, in Bristow and Healy (2018b, p. 7), three dimensions are identified: (1) withstand, (2) recover from, and (3) reorganise. These are some examples drawn from the literature on economic resilience. Overall, two distinct characteristics stand out: (1) the degree of preparedness, and (2) the capacity to recover (Modica and Reggiani, 2015, p. 212). While the terms used and the phases identified are different, the various conceptualisations share strong similarities. As Mitchell (1927, p. 454) wrote, "the words we use set traps" – naming the potential dimensions and closely defining each step of economic resilience may restrict the growing knowledge on the subject and lead to strong differences between the theoretical development path of various scholars.

Therefore, the path taken in this analysis is to keep the reflection as open minded as possible by postulating, as a first step, that resilience is an underlying capacity of economic actors to cope with disturbances and changes in economic conditions. Based on the analysis in subsections 2.1.1 and 2.1.2, it can also be noted that economic resilience "has to be inferred from studying actual adaptation processes, and from analysing the underlying factors that appear important for successful adaptation" (Evenhuis, 2017, p. 3). While a shock is episodic (at a certain point in time), resilience is about coping with the changes that the given shock brings to the economic environment. Hence, the resilience of economic actors is not temporary or acquired "on the spot" but is rather present continuously or built up over time. This in turn has a critical repercussion on identifying the shock, since different locations have a different capacity of anticipation and different responses. While this conclusion has strong ties with the evolutionary approach of economic geography, Tóth (2015, p. 71) argues that it is also rooted in growth and competition theories, notably in the Schumpeterian and innovation approaches.

Consequently, a following step in the analysis conducted in this chapter is to concentrate on the mechanisms that take place in resilient economies, or more precisely, on the factors and determinants that affect the capacity of firms to adapt to changing business conditions. However, scholars with distinctive backgrounds may interpret resilience in different ways, which then translates into a larger array of explanations regarding the determinants of resilience (Tóth, 2015, p. 73). Hence, section 2.2 will review the determinants that have been highlighted in the literature on economic resilience and take into account the scholars' different backgrounds.

2.1.3   Records of economic resilience

Based on the reflections made in subsection 2.1.2, the following analysis will try to highlight the records of economic resilience. The 2007-2008 financial crisis and the global recession that followed have been an ideal source for studies aiming at revealing the heterogeneity of the economic performance of locations in the aftermath of the shock. Amongst others, Han and Goetz (2015), Faggian et al. (2018), Ringwood et al. (2018), Sensier (2018), Pontarollo and Serpieri (2020) or Sensier and Devine (2020) have tried

to identify the disparities in economic resilience, whether in Europe, Italy, the United Kingdom or the US. These six studies are presented in this subsection.

The analysis conducted by Sensier (2018, pp. 12-13) is based on a measure of resilience in terms of absolute falls in economic activity (i.e. in terms of employment and output). An economy can either resist to (no downturns), recover from (returned to the pre-shock level after experiencing a contraction by 2011) or not recover from the economic shock (is experiencing positive growth but has not yet returned to the pre-shock level or was still experiencing negative growth by 2011).

The results are presented in figure 2.1. The effect of the crisis strongly differs between countries. In fact, southern European countries such as Greece, Spain, Portugal and Bulgaria are less resilient than those in central and northern Europe. This may be the result of institutional differences. However, another hypothesis is that this differing resilience could also be the result of a lack of policies focusing on the microeconomic environment in southern European countries in comparison to other countries. In fact, it can be seen that there is also significant heterogeneity within countries. In some countries, such as Germany or Poland, all four measures of resilience are present (ranging from "resistant" to "not yet recovered"), highlighting the divergence in responses to the crisis. This observation stresses the locational dimension and microeconomic context of resilience. It highlights the fact that different regions react differently in the face of a common economic shock, not only between countries but also within national economies. Therefore, it raises questions about why certain regions were more able to dodge the shock.

Overall, Sensier (2018, p. 17) finds that slightly more than a third of European regions were resilient to the economic shock (either resistant or recovered by 2011). The analysis also shows that the employment indicator was more resilient than the output indicator (Sensier, 2018, p. 17).

Figure 2.1: Economic resilience in terms of employment variations in 2011 (NUTS[1]-3).
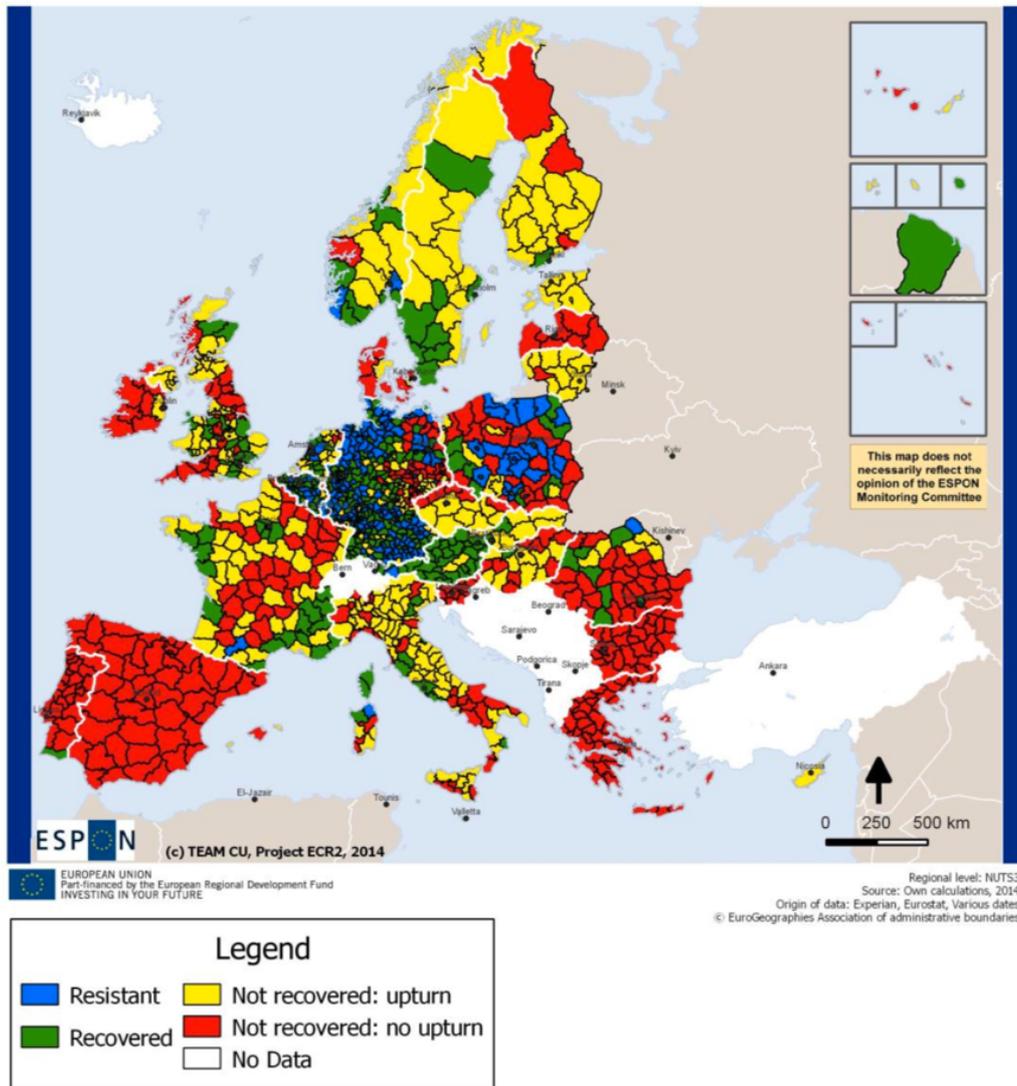
Note: Last data is from 2011, consequently, regions have recovered or not yet recovered by 2011.
Source: ESPON and Cardiff University (2014, p. 28).

Second, Pontarollo and Serpieri (2020) also focus on the EU NUTS-2 regions and find strong patterns of heterogeneity. The authors develop a composite Regional Economic Resilience Indicator which accounts for several resilience capacities (Pontarollo and Serpieri, 2020, p. 8). It is defined by two dimensions: (1) a measure of a location's long-term capacity of resilience, and (2) a measure of "the immediate exposure and reaction capacity to an unexpected shock" (Pontarollo and Serpieri, 2020, p. 4). The first

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[1] NUTS : Nomenclature of Territorial Units for Statistics

dimension is composed of the average level of the steady-state behaviour previous to the shock and the growth trend over the whole period (i.e. pre and post shock), and the second dimension considers the maximum impact of the crisis (i.e. difference between peak to trough at the time of the shock) and the difference in level between the pre shock and post shock maximum levels (Pontarollo and Serpieri, 2020, p. 4). They analyse the resilience over the period 2000-2015.

They find that there is a strong heterogeneity amongst EU regions (Pontarollo and Serpieri, 2020, p. 7) (see figure 2.2). Mediterranean countries are characterised by lower resilience than northern countries. Baltic countries that were experiencing rapid growth prior to the crisis were able to recover quickly. Nevertheless, the results not only show heterogeneity between but also within countries. Countries including Portugal, Spain, Italy and Belgium have a strong north–south disparity. Countries with a finer resolution of NUTS-2 regions (i.a. Germany, UK, Belgium and Austria) have stronger heterogeneity between cities and more rural regions (Pontarollo and Serpieri, 2020, p. 7).

In comparing these results with those found by Sensier (2018), the overall conclusions are confirmed, namely that there is strong heterogeneity both between and within countries as well as a north-south disparity. However, differences in methodology, regional demarcation levels (i.e. NUTS-2 vs NUTS-3 levels) and timespan (i.e. until 2011 for Sensier and 2015 for Pontarollo and Serpieri) may account for differences between both analyses.

Figure 2.2: Regional Economic Resilience Indicator over the period 2000–2015 (NUTS-2).
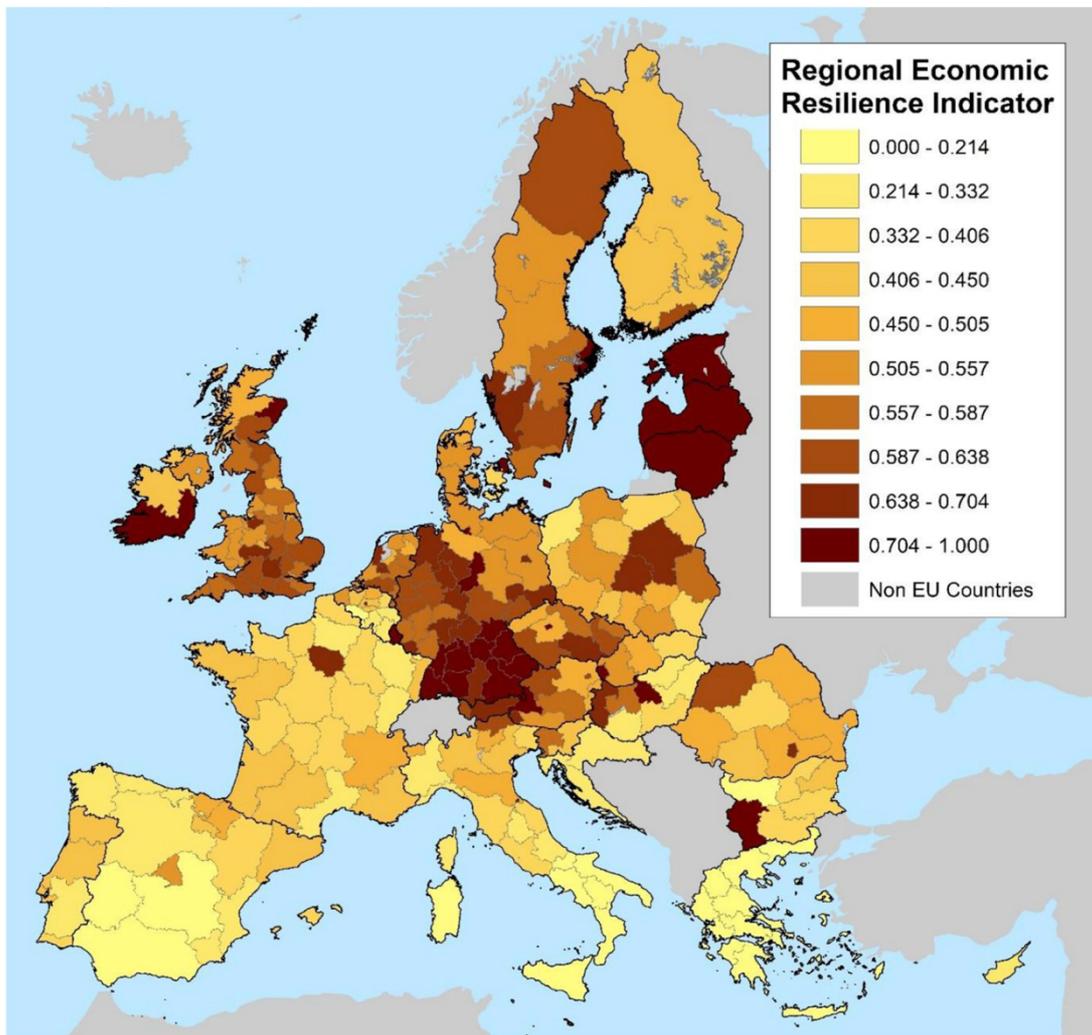
Notes: The lower the values, the less resilient the regions are; regions with higher values are more resilient.
Source: Pontarollo and Serpieri (2020, p. 7).

Another methodology focusing on the short-term is developed by Faggian et al. (2018) and categorises regions into four groups depending on the resistance and recovery capacities (high or low resistance and fast or slow recovery). The difference compared to the previous studies is that Faggian et al. (2018) focus on Italian regions and use a different approach to categorise regions.

The resistance is defined by a sensitivity index that shares a common structure with the location quotient and uses the employment level prior to the shock (2007-2008) and

during the recessionary period (2009-2010) as variables. Both variables are computed at the regional and national level (Faggian et al., 2018, p. 399). Hence, a value above one means that the given region was more resilient than the overall nation. The recovery is measured in terms of employment growth in the year after the shock, namely 2011 in the case of Italy. A region is characterised as resistant if the sensitivity index is above one and as having a fast recovery if the growth rate of employment is positive.

They find two interesting results: (1) resistance and recovery are not correlated, and (2) there is a strong heterogeneity amongst the regions. When depicting the spatial distribution on a map, there is a strong difference between the north and the south of Italy: northern regions have higher resistance and recovery than southern regions.

Figure 2.3 depicts the distribution of the economic resilience of Italian regions, the white-coloured regions being the best-case scenarios and the green-coloured ones the worst-case scenarios. It is also interesting to note that in the north of Italy, most regions had strong resistance followed either by a slow or fast recovery (namely a high or low employment growth rate) and those that did not resist well to the crisis had a strong recovery (burgundy colour). On the contrary, in the south of the country, a majority of regions had low resistance and either a fast or slow recovery.

The two methodologies by Sensier (2018) and Faggian et al. (2018), although different, share similar results in the case of Italian regions. They both focus on employment, which is a measure of well-being, have a short-term time horizon and differentiate resistance and recovery, hence taking into account the "adaptability" of the economy. However, there are also some differences due to the categorisation of the regions. While the first study by Sensier (2018) uses one variable and compares absolute levels of employment in different points in time, the methodology by Faggian et al. (2018) uses two variables (a sensitivity index and employment growth rates) to categorise the regions in relative terms. Nonetheless, the overall results are similar to both the analysis of Sensier (2018) and Pontarollo and Serpieri (2020), notably regarding the north-south disparity.

Figure 2.3: Distribution of the Italian regions into the four categories based on the sensitivity index and employment growth rate.
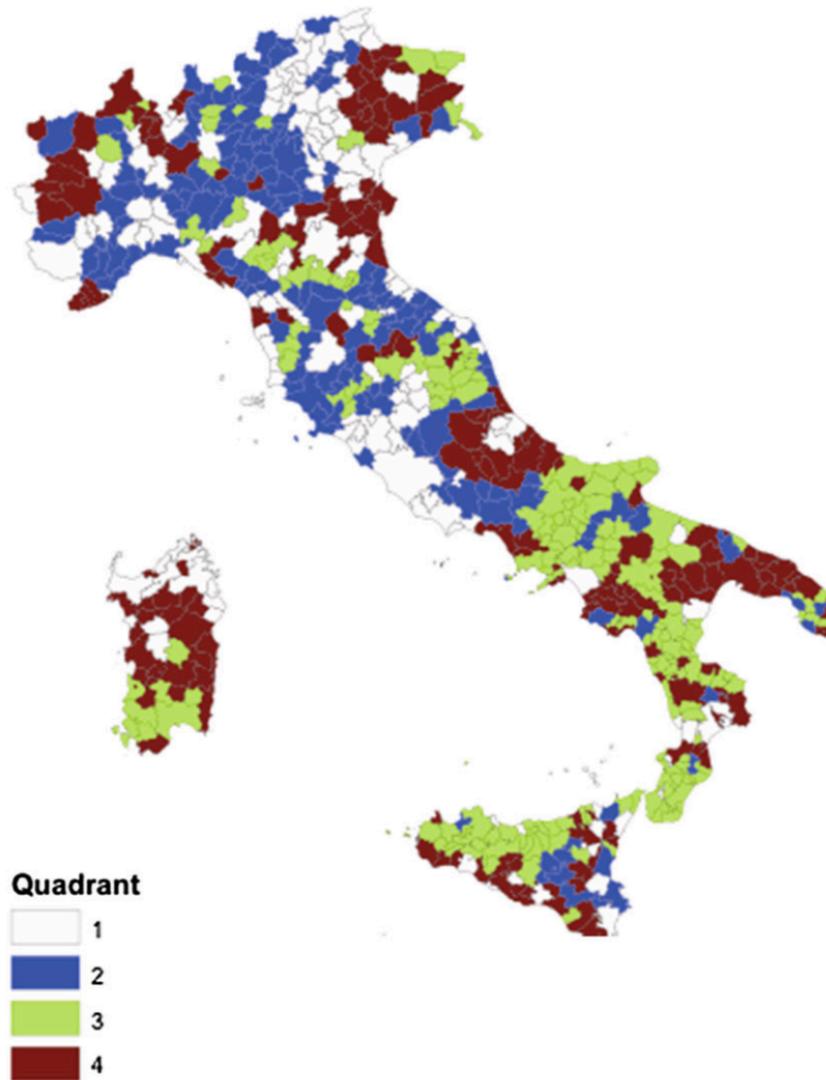
Note: Quadrant 1 (high resistance/fast recovery), quadrant 2 (high resistance/slow recovery), quadrant 3 (low resistance/slow recovery), quadrant 4 (low resistance/fast recovery).

Source: Faggian et al. (2018, p. 405).

Sensier and Devine (2020) analyse economic resilience though business cycles' turning points in terms of real output, employment and productivity of UK regions (NUTS-1) during the period 1998-2018, namely before and after the Great Recession. Similarly to the studies highlighted above, the authors differentiate the various dimensions of economic resilience which are (1) resistance, (2) duration, (3) recovery and (4) renewal. Regions are classified in a scorecard (see table 2.1). For resistance, if a region has a lower

fall in one of the variables than the national average, it is classified as more resilient and is coded 1, if not then it is coded 0. For duration, the region is coded 1 if the duration of the recession is shorter than the national recession. For recovery, regions that recovered faster or at the same time than the country are coded 1. For renewal, a region is coded 1 if the growth rate in the aftermath of the recession is greater than before (Sensier and Devine, 2020, p. 21).

The results show that the most resilient regions were the South East, the South West, and the East and West Midlands. The least resilient regions were Northern Ireland, the North East and Yorkshire (Sensier and Devine, 2020, pp. 26-27). It is also interesting to note that the results are closer to those found by Pontarollo and Serpieri (2020) than by Sensier (2018). This is most certainly due (1) to the data availability, and (2) to the level of geographical aggregation.

Table 2.1: Scorecard of economic resilience of UK regions for the period 1998-2018 (NUTS-1).

	NE	NW	YH	EM	WM	ET	LN	SE	SW	WL	SC	NI
GVA												
1	1	1	0	0	0	0	0	1	1	0	1	0
2	1	1	1	1	1	1	1	1	1	1	1	0
3	0	0	0	1	1	0	1	1	1	0	1	0
4	0	0	0	0	1	0	0	1	1	0	0	0
Jobs												
1	0	1	1	0	0	0	0	0	1	1	0	0
2	0	0	0	0	0	0	0	1	1	0	0	0
3	0	0	0	1	0	1	1	1	1	0	0	0
4	0	1	1	0	1	1	1	1	0	1	0	1
Prod												
1	0	1	0	1	0	1	0	1	1	0	1	0
2	1	1	1	1	1	1	1	1	0	1	1	0
3	1	0	0	1	1	0	0	1	0	1	1	0
4	0	0	0	1	1	0	0	0	0	0	0	1
Total	4	6	4	7	7	5	5	10	8	5	6	2
Rank	6	4	6	3	3	5	5	1	2	5	4	7

Notes: Resistance, 2: duration, 3: recovery, 4: renewal; GVA stands for gross value added; Prod stands for productivity; Full name of NUTS-1 regions can be found in the list of abbreviations.

Source: Sensier and Devine (2020, p. 26).

Han and Goetz (2015, p. 131) also introduce a measure of economic resilience which is applied to employment in US counties during the Great Recession. The authors focus on three variables: (1) the time of the shock's impact (i.e. when the recession begins), (2) the response of locations to the shock in terms of employment decline, and (3) the relationship between recession and recovery (Han and Goetz, 2015, p. 132). More

precisely, they divide economic resilience into two stages: (1) the absorption of the changes triggered by the shock (i.e. measured by the employment drop), and (2) the rebound happening during the recovery process (i.e. measured by the rate of change between the recovered and lowest levels of employment after the shock) (Han and Goetz, 2015, p. 134). Based on these measures, it can be said that the most resilient locations are those that "are able to minimize the effect of a shock while obtaining the largest possible benefit from reorganization" (Han and Goetz, 2015, p. 136). Hence, the locations with a smaller drop and greater rebound are more resilient.

Consistently with the studies presented above, the authors find strong patterns of heterogeneity between US counties (see figure 2.4). The study also shows that counties dominated by agricultural activities were more resilient, such as the Plains and Southwest regions. Counties with smaller population tend to be more resilient. The authors interpret this result by arguing that "small population implies a relatively simple economic structure" that can more easily be adapted to new economic contexts (Han and Goetz, 2015, p. 144).

Figure 2.4: Map of resilience of US counties in the Great Recession for the period 2003-2014.
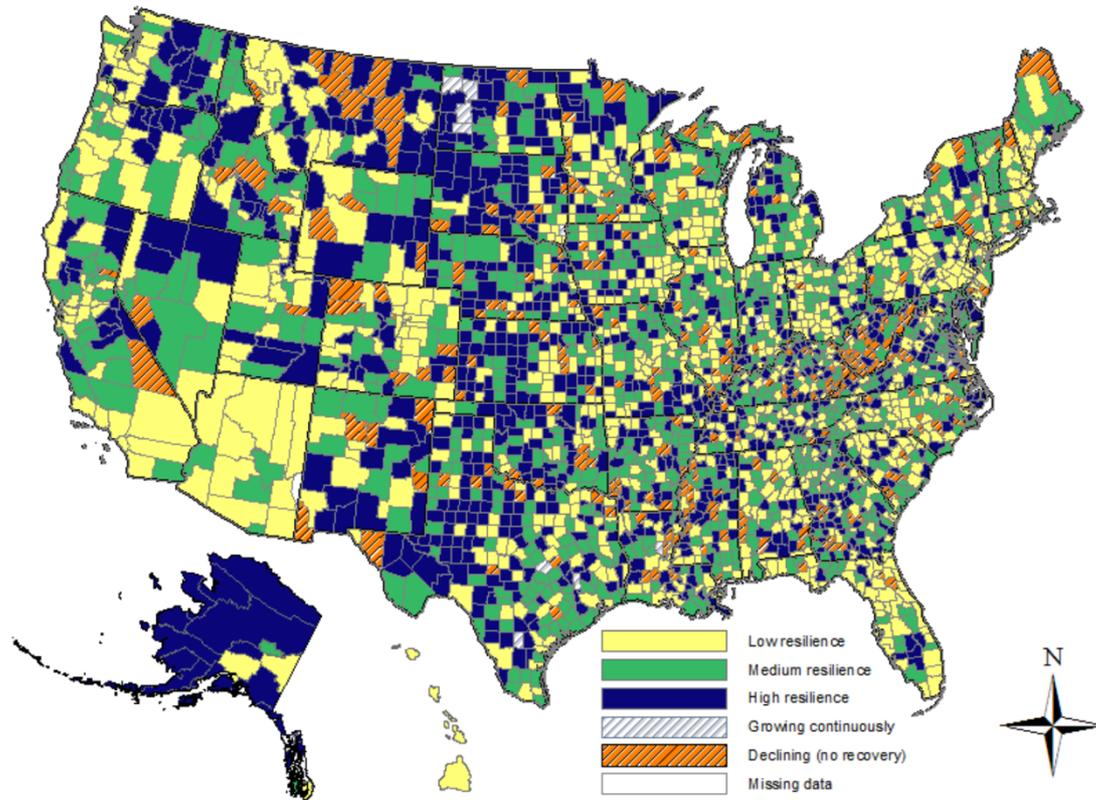
Source: Han and Goetz (2015, p. 144).

Echoing the study by Han and Goetz (2015), a more recent analysis conducted by Ringwood et al. (2018) also computes a measure of economic resilience and applies it to employment data of US counties. Similarly to the studies presented above, they refer to the Great Recession. However, in their analysis, they measure economic resilience as the difference between expected and actual employment (Ringwood et al., 2018, p. 381).

Similarly to the analysis of Han and Goetz (2015), the authors build a relative two-dimensional measure of economic resilience that includes both the depth and duration of the response to the shock (Ringwood et al., 2018, p. 382). They use data on employment for US counties from 1990 until 2015 (Ringwood et al., 2018, p. 382). The results are similar to those found by Han and Goetz (2015) and are depicted in figure 2.5.

Figure 2.5: Map of resilience of US counties in the Great Recession for the period 1990-2015.
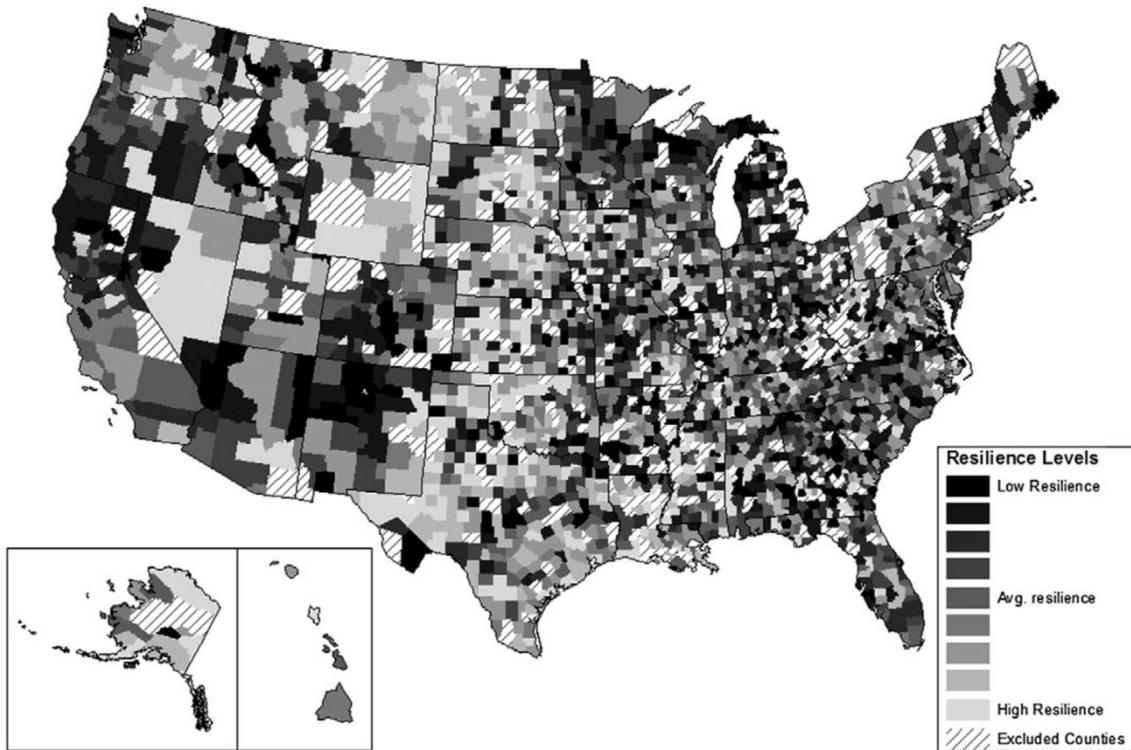
Source: Ringwood et al. (2018, p. 393).

Even though different methodologies were applied, the studies presented in this subsection all show the spatial heterogeneity of economic resilience both between and within countries. This conclusion implies that location-specific factors and mechanisms are at play and influence economic resilience. Each study has disentangled economic resilience in different phases before and after the shock which allows a classification of locations depending on the reaction of their economies in each phase. However, the studies presented above have not shed light on potential determinants of economic resilience. Hence, this step is carried out in the following section by reviewing studies focusing on the economic resilience and which aims to understand what drives the prosperity of locations in times of crisis.

2.2   Determinants of economic resilience

The analysis conducted in the previous section has shed light on the state of the current knowledge in regard to the conception of economic resilience. Two key insights came out of the above analysis. First, shocks, whether endogenous or exogenous, engender a change of the business environment. Therefore, resilient firms are those that have successfully adapted to the changes caused by a shock. Second, economic resilience varies not only between but also within countries, highlighting a localised dimension of economic resilience. Hence, the focus should be on the mechanisms that enable economic actors, in particular firms, to adapt to a new economic environment.

When reviewing the literature on the determinants of economic resilience, the majority of studies have focused on the influence of (1) industrial structures and agglomeration forces, (2) innovation, (3) territorial capital and institutions, (4) entrepreneurship, and (5) the quality of the labour market.

Two types of approach are found in the literature: (1) studies based on more qualitative data such as interviews and surveys (amongst others: Kakderi and Tasopoulou, 2018; Sagan and Masik, 2018; Wink et al., 2018; Valdaliso, 2020), and (2) studies based on more quantitative data such as employment figures (amongst others: Kahl and Hundt, 2015; Doran and Fingleton, 2016; Delgado and Porter, 2018; Bishop, 2019).

2.2.1   The influence of economic structure

The explanation of economic resilience most encountered in the literature focuses on the economic structure of locations. The importance of diversification (as opposed to specialisation), the role of networks and connectedness as well as related variety have been regarded as favouring the economic resilience of locations (Mai and Chan, 2020, pp. 882-883).

Since the role of the industrial structure and, most of all, of industrial agglomeration is strongly related to innovations and knowledge spillovers, it is difficult to disentangle some of the determinants (Porter, 2003; Delgado et al., 2014). Higher levels of innovation

may be the result of a certain industrial relatedness or of the agglomeration of similar industries favouring a competitive environment.

In a case study on the economic resilience of the German region of Baden-Württemberg, Wink et al. (2018, p. 57) find that manufacturing industries had an important role in the region's response to the Great Depression. In fact, the regional innovation system based on the collaboration between manufacturing industries (i.e. the car manufacturing industry and the machinery sector) and public and private organisations (i.a. social consensus with trade unions) helped firms to recover quickly from the shock (Wink et al., 2018, p. 41). They add that the importance of the manufacturing sector has allowed the development of intensified cross-industry and cross-firm collaboration as well as collaboration with other organisations, which led to new innovative capabilities and as a consequence, to new economic strengths. This collaboration resulted in an increase of both gross domestic product (GDP) and employment between 2010 and 2014 (Wink et al., 2018, p. 57). They add that the region has reached a certain level of related diversity since many services are linked to the car manufacturing industry (Wink et al., 2018, p. 48).

In Spain, Valdaliso (2020, p. 637) focuses on the machine-tool industry between 1960 and 2015. The findings suggest that three main factors influence the resilience of that particular manufacturing industry: (1) business size, flexibility and production specialisation, (2) absorptive and innovative capacity, and (3) geographical concentration (Valdaliso, 2020, p. 637). The author argues that firms which have experienced stronger resilience have also developed a strong productive flexibility by concentrating on niche markets and by collaborating with neighbouring firms and technology centres (Valdaliso, 2020, p. 656). The analysis highlighted the fact that firms were able to move up the technology ladder towards activities that require advanced technologies and skilled labour. Finally, the concentration at the regional level enabled firms to increase their absorptive capacity by facilitating learning and the diffusion of knowledge (Valdaliso, 2020, p. 657).

Angulo et al. (2018) also investigate the industrial structure of Spanish regions in relation to their resilience capacity. They find that regions specialised in the service sectors were more resilient in the face of a shock, as compared to other sectors such as the construction

sector (Angulo et al., 2018, p. 349). Also, they find that regions with location advantages (i.e. externalities) have experienced higher resilience (Angulo et al., 2018, p. 349). This last result is akin to the conclusions of Valdaliso (2020). Similarly, Cuadrado-Roura and Maroto (2016) find that industrial specialisation positively affects economic resilience in Spain.

In the Pomorskie region of Poland, the authors of the case study indicate that it is the diversity of export-oriented industries, ranging from ship-building to electronics and chemicals, that have helped the region resist to the crisis (Sagan and Masik, 2018, p. 30). It is interesting to note that these industries are not only export-oriented, but also require specific skills and advanced labour. On top of that, the region is specialised in the logistics industry which provides useful complementarities with exporting industries (Sagan and Masik, 2018, p. 38).

While the cases of Baden-Württemberg and Pomorskie have focused on how exporting manufacturing industries were able to first absorb and then rebound in the face of the shock, Healy (2018, p. 84) takes the example of South-West Ireland where some industries such as the construction, accommodation, food and public sectors suffered the most from the crisis. It is interesting to note that those industries have relatively low international exposure and are mostly oriented towards the domestic market. Healy (2018, p. 93) also adds that the region hosts an internationally competitive export-oriented sector that provided stability for the firms involved thanks to the transfer of practices, technologies and know-how.

Another region that did not recover by 2011 is the Greek region of Western Macedonia. In a case study, Kakderi and Tasopoulou (2018, p. 115) point out the negative role of the limited industrial diversification which is dominated by the energy sector. As a consequence, the region is characterised by low levels of innovation and reduced support for private investment (Kakderi and Tasopoulou, 2018, p. 115). There is however one sector which quickly recovered from the shock: the fur sector. According to the authors, this is the result, among other factors, of changing distributional systems and investment in innovations during the years prior to the shock (Kakderi and Tasopoulou, 2018, p. 116).

Echoing the results of Wink et al. (2018) and Valdaliso (2020), Di Caro (2014) finds that Italian regions specialised in manufacturing industries had comparatively better

resilience. In fact, the results show a positive relationship between the resilience of manufacturing industries and overall economic development. In a complementary study, Di Caro (2017) finds that economic diversity plays an important role in shaping economic resilience. Even though these results seem to be contradictory, they may explain a common phenomenon. In fact, part of the answer may be given by Cainelli et al. (2019, p. 768). Similarly to the results of Di Caro (2017), they show that industrial diversification increases economic resilience. However, they also show that technological relatedness has a positive impact on economic resilience in the short-run, but vertical relatedness has a negative effect in the long-run (Cainelli et al., 2019, p. 768). A further explanation of this phenomenon is that technological relatedness has a positive effect through "inputs market pooling", while vertical relatedness works as a propagation mechanism through input-output relations, consequently amplifying the effect of a shock (Cainelli et al., 2019, p. 768).

Brown and Greenbaum (2016) explore the relationship between industry diversity and economic resilience. More specifically, they analyse the influence of diversity and concentration on unemployment rate stability in counties in Ohio between 1977 and 2011. They find that concentration is related to lower unemployment rates during "good" times, and more diversified counties have better resilience in times of crisis (Brown and Greenbaum, 2016, p. 1347). According to the authors, this result is consistent with the fact that "specialised counties with localisation economies may experience competitive advantages while there is growth and while their industry of concentration is thriving" but are less capable of sustaining a shock (Brown and Greenbaum, 2016, p. 1362). Furthermore, the relationship between concentration and resilience also varies over time depending on the type of industry. Hence, the reaction of particular industries may evolve in time, depending on the types of shocks. The authors warn of broader claims that specific types of industry are less resilient (Brown and Greenbaum, 2016, p. 1363).

Similarly to Brown and Greenbaum (2016), Brakman et al. (2014) investigate two possible determinants of economic resilience, namely urbanisation and specialisation. The focus is on unemployment and GDP per capita in EU regions (NUTS-2) and they take the Great Recession as the shock. The authors find that both factors are important drivers of economic resilience. Regions with high urbanisation that are specialised in medium to high-tech industries were more resilient (Brakman et al., 2014, p. 1).

Regarding urbanisation, the results contradict those found by Han and Goetz (2015) that have found that rural counties in the US were more resilient. Hane-Weijman et al. (2017) find similar results in Sweden, notably that workers have a higher likelihood of returning to work when a location has a strong concentration of identical or related industries (Hane-Weijman et al., 2017, p. 768). On the contrary, a high concentration of unrelated activities slows the re-employment process. The intuition is that workers' skills and experience match the demands of related industries, which as a consequence increases the absorptive capacity of the regional labour market (Hane-Weijman et al., 2017, p. 778).

The role of specialisation has also been tackled by Pudelko and Hundt (2017) in the case of Western Germany during the Great Recession. In particular, they explore the role of agglomeration economies arising from related and unrelated specialisation. Unlike the previous studies, they separate resilience in two phases: resistance and recovery. This enables them to gain better insight into the role of specialisation. They find that it has a negative impact on resistance but a positive influence during the recovery phase (Pudelko and Hundt, 2017, p. 3). They also find that unrelated variety negatively affects economic resilience as it undermines the recovery process (Pudelko and Hundt, 2017, p. 24). In light of their results, the authors argue that policies favouring related specialisation in knowledge-intensive industries would be the most beneficial in regard to the resilience of locations (Pudelko and Hundt, 2017, p. 24).

The conclusions of Pudelko and Hundt (2017) are supported by the analysis of Kahl and Hundt (2015). They study the relationship between clusters and economic resilience using the German biotechnology industry. The findings show that "specialisation at the network and context-level" seems to be susceptible to external shocks and that diversified regional agglomerations seem to be associated with economic resilience (Kahl and Hundt, 2015, p. 371). Interestingly, they also find that the adaptive process (i.e. the capacity of firms to diversify both their portfolio of activities and their networks ties) is facilitated by geographical proximity and increases economic resilience. Therefore, geographical proximity seems to help the adaptability of the firms by facilitating collaboration between economic agents and as a consequence, plays a positive role in economic resilience. In a complementary study, Hundt et al. (2018, p. 1) investigate the interaction between firm- and cluster-level determinants of performance before and after the Great Depression (i.e. 2004-2007 and 2009-2011) using data on manufacturing and services firms in Germany.

The empirical results notably show that cluster externalities driving the performance of firms depend on the macroeconomic cycle. When the macroeconomic environment is stable, firms benefits from these externalities. However, in times of crisis, this mechanism is interrupted (Hundt et al., 2018, p. 24). This is consistent with the results of Brown and Greenbaum (2016) (see above).

Other studies have focused on the relationship between clusters and economic resilience. Behrens et al. (2020) investigate whether firms within the textile and clothing sectors in Canada were more resilient than firms outside a cluster. They study plant-level data between 2001 and 2013 but find little evidence that plants in this cluster are more resilient (Behrens et al., 2020, p. 1). While Behrens et al. (2020) did not find any strong evidence of a positive impact of clusters on resilience (i.e. in the case of the textile cluster in Canada), Wrobel (2015) finds such evidence for the German mechanical engineering sector. The point of departure is the use of the "adaptive resilience" notion. Wrobel (2015, p. 273) shows that there is a significant positive impact on employment for firms within a cluster, as opposed to firms outside of a cluster. It also appears that dimensions such as "solidarity" and "altruism" of cluster actors were of importance at the beginning of the crisis (Wrobel, 2015, p. 273). In the Pittsburgh region, Treado and Giarratani (2008, p. 63) find that an industrial cluster can be a source of economic resilience for the region. In fact, they argue that the cluster's intermediate suppliers are an important economic factor in transitioning from a traditional single industry towards a more diversified economy (Treado and Giarratani, 2008, p. 64).

Nonetheless, it seems that the works reviewed above all find some, albeit contradictory, evidence that both specialisation and diversification are important in increasing economic resilience. The study by Delgado and Porter (2018) may explain these contradictory results.

Similarly to Kahl and Hundt (2015), the focus is on the role of clusters. However, in their analysis, Delgado and Porter (2018) tackle the research question in a different way. They add five measures of cluster strength, namely the specialisation of clusters based (1) on the number of businesses, (2) on employment in upstream industries, (3) on employment in downstream industries, (4) on employment in similar industries, and (5) on patenting. This way, they are able to get around the contradictions found in the studies previously

analysed. As a result, they find that firms located in specialised industries outside of clusters suffered from the crisis, while strong cluster environments were beneficial to the firms during the crisis (Delgado and Porter, 2018, p. 5). They find that as the cluster breadth increased (in terms of the number of businesses), so did the economic resilience. In fact, it is the inter-firm and inter-industry linkages as well as knowledge links and labour pooling that reduce uncertainty in the face of a shock. In conclusion, Delgado and Porter (2018, p. 5) state that locations that are specialised in a narrow range of industries, but outside of any strong clusters, are more sensitive to economic downturns, while specialised industries that are part of a strong and broad cluster are more resilient (Delgado and Porter, 2018, p. 26).

Until this point, the analysis in this subsection has mostly focused on the effect of the industrial structure, on the debate about diversification versus specialisation as well as on agglomeration forces and clustering of co-located related industries. However, studies have also looked at the effect of innovation, territorial capital, entrepreneurship and labour market efficiency. These dimensions will be investigated in the following subsections.

2.2.2   The influence of innovation

Studies focusing on the influence innovation or creativity on economic resilience have also been published. It is important to note that the economic structure, agglomeration economies and externalities as well as the clustering of related industries also have an impact on innovation and creativity.

Following this statement, an interesting perspective is brought by Hannigan et al. (2015) who find that innovation in clusters can increase even though there is a decline in the overall industrial activity. They demonstrate this trend using 35 years of data on patents in the Detroit automobile cluster (Hannigan et al., 2015, p. 613). They find that local knowledge is sustained thanks to the increasing technological specialisation as well as the connectedness to centres of excellence (Hannigan et al., 2015, p. 613). As a consequence, while the overall industry employment is declining, it becomes more concentrated and move towards a "global centre of innovative excellence" (Hannigan et

al., 2015, p. 613). Through the role of innovation, the industry is able to reorganise its resources and sustain its competitive position by moving towards advanced activities. Further, Clark et al. (2010) analyse the relationship between the innovative capacity of firms and economic resilience by carrying out a comparative case study analysis. The results suggest that locations with many innovative small firms are more resilient than locations dominated by large firms (Clark et al., 2010, p. 131).

In the first chapter, it has been shown that knowledge is an important driver of innovation, whether it is, for example, technical knowledge or information about new opportunities and new resources. This means that the importance of related and unrelated variety as well as differentiated knowledge may be of importance for innovation and economic resilience.

Sedita et al. (2017) analyse the relationship between those dimensions and economic resilience by focusing on Italian labour data (i.e. employment growth). They find that both related variety and differentiated knowledge are important drivers of regional resilience (Sedita et al., 2017, p. 155). Moreover, they focus on the type of knowledge, namely synthetic, analytical and symbolic. Synthetic knowledge is necessary to develop new combinations of existing knowledge. It requires experience and know-how that often leads to incremental innovations. Analytical knowledge is associated with scientific knowledge that is usually critical for breakthrough innovations. Finally, symbolic knowledge relates to aesthetic attributes usually encountered in industries such as cinema, publishing, advertising and fashion, and which often result in incremental innovations (Sedita et al., 2017, p. 159). They find that the concentration of symbolic and synthetic knowledge contributes to economic resilience, while analytical knowledge-based activities do not (Sedita et al., 2017, p. 155). The surprising result regarding analytical knowledge can be explained, according to the authors, by the fact that it relies on R&D spending which tends to decrease in times of crisis (Sedita et al., 2017, p. 172). However, they also find that in this context, the related variety of the regional economic structure plays a critical role in shaping economic resilience.

Wink et al. (2018) find a similar result in the case study of Baden-Württemberg. They argue that it is the strong innovative base that helped the readjustment of the industrial structures during the crisis. In fact, 4.8% of the regional GDP was invested in R&D

activities, while the national German average in 2009 was only 2.9% (Wink et al., 2018, p. 43). In contrast, the Greek region of Western Macedonia, which had a low resilience, also had weak innovation potential due to a lack of innovative activities and research infrastructures (Kakderi and Tasopoulou, 2018, p. 117).

From a more empirical point of view, Bristow and Healy (2018c) demonstrate the importance of innovation on the long-term path to renewal and restructuring of activities. The authors argue that innovation enables firms to change both industrial and technological structures in order to adapt to changing economic conditions (Bristow and Healy, 2018c, p. 266). The intuition behind this statement is that innovative firms have developed the knowledge about the changing environment and therefore acquired the skills and techniques that enable them to move towards new markets or shift resources in order to dampen the shock (Bristow and Healy, 2018c, p. 278). They also highlight the social aspect of innovation such as collective learning processes between economic actors (i.a. departments of a firm, neighbouring firms and knowledge providers) which leads to higher levels of innovation, hence pointing out the territorial embeddedness and localised dimension of innovation (Bristow and Healy, 2018c, p. 278). In fact, the closer the economic agents, the higher the probability of acquiring new knowledge. This process of knowledge creation and transmission is in line with the commonly accepted postulate that innovation is "a continuous process of incremental problem solving rather than one of grandiose 'breakthrough'" (Bristow and Healy, 2018c, p. 279).

The results found by Bristow and Healy (2018c) are corroborated by the case study on Baden-Württemberg (Wink et al., 2018) where these linkages seemed to have played a role in fostering new collaborative projects, developing economic support between firms and leading to solutions between firms and trade unions in regard to human capital (i.a. reduced working time, development of additional skills and qualifications) (Wink et al., 2018, p. 52).

2.2.3   The influence of the regional and national context

The last result of the previous subsection leads to the following factor affecting economic resilience: territorial capital. Territorial capital relates to "the assets, being material or immaterial, public or private, which represent the development potential of places" (Fratesi and Perucca, 2018, p. 241). Fratesi and Perucca (2018, p. 261) find that territorial capital is positively related to economic resilience during the crisis in the European Union. They further investigate the role played by the different typologies of territorial capital on economic resilience and find that depending on the endowment, locations were more able to resist the initial shock or more able to quickly recover after the shock (Fratesi and Perucca, 2018, p. 261). An interesting result relates to the "innovative cross" which encompasses relational private services, collective goods and agglomeration economies and that positively influences the economic resilience of locations (Fratesi and Perucca, 2018, p. 262). This result corroborates those found above regarding innovation, networks and clusters.

Hundt and Holtermann (2020) also investigate national settings in regard to economic resilience during the resistance and recovery phases. They focus on regions (NUTS-2 level) of 22 European countries between 1990 and 2014 (Hundt and Holtermann, 2020, p. 180). The results show that the impact of the national setting is particularly important during the resistance phase (45% of the variance in regional GDP) and less during the recovery phase (22%) (Hundt and Holtermann, 2020, p. 191). Furthermore, they find that regional determinants are also affected by the national setting. This suggests that identical regional determinants may have different (or opposing) effects on economic resilience depending on the national setting. This influence is also most prominent during the resistance phase (Hundt and Holtermann, 2020, p. 198). Hence, the authors conclude that "regional patterns of resilience are additionally shaped by the inter-linkages of country-specific institutional factors and regional determinants" and consequently, economic resilience is not simply a matter of regional factors (Hundt and Holtermann, 2020, p. 201).

Similarly to Hundt and Holtermann (2020), Sondermann (2018) also focuses on national factors. Sondermann (2018) empirically investigates the relationship between economic resilience and the quality of countries' economic structure. The quality of the economic structure is measured with global indicators such as the GCI PM (Product Market

efficiency indicator of the Global Competitiveness Institute) and GCI LM (Labour Market efficiency indicator of the Global Competitiveness Institute), the Doing Business indicator (Overall World Bank Doing Business indicator), and the Economic Freedom indicator (Economic Freedom indicator of the Fraser Institute). The author finds that sound product and labour markets and the ease of doing business increase economic resilience (Sondermann, 2018, p. 97). In fact, the probability of a severe GDP decrease is 20% lower on average for countries with adaptable economic structures. This result holds for both product and labour market indicators (Sondermann, 2018, p. 112). In particular, countries with more adaptable labour markets were more resilient than countries with more rigid labour markets (Sondermann, 2018, p. 106).

The three studies presented in this subsection are consistent with the results found in the previous subsections. While subsection 2.1.3 highlighted the spatial heterogeneity of economic resilience within countries, some patterns have also been found between countries. Hence, the analyses of Hundt and Holtermann (2020), and Sondermann (2018) shed light on some determinants for these disparities. They have focused on the influence of nation-wide dimensions that affect the regional response to shocks and have found significant results. National economic policies may also influence regional determinants such as fiscal policies or the regulation of labour markets.

2.2.4   The influence of entrepreneurship

The fourth explanation of economic resilience encountered in the literature is the influence of entrepreneurship. It is important to note that entrepreneurship can constitute a facet of the more global determinants highlighted in section 2.2.1 focusing on the role of economic structure and that it may also be influenced by the flow of knowledge (see subsection 2.2.2) and the regional and national context (see section 2.2.3). Korber and McNaughton (2018) have identified six streams of analysis at the intersection of economic resilience and entrepreneurship. One of them concentrates on the role of entrepreneurship in fostering the resilience of locations. Most studies in this stream investigate the relationship between entrepreneurial activity and economic indicators (Korber and McNaughton, 2018, p. 1136). Williams and Vorley (2014, p. 257), who have

also studied the relationship between economic resilience and entrepreneurship at the regional level, argue that entrepreneurship is central in sustaining the resilience of locations by increasing the restructuring and adaptation capacities of local economies. However, entrepreneurship can only increase the resilience of a location if it is itself resilient (Huggins and Thompson, 2015, p. 326). Hence, two dimensions have to be taken into consideration: (1) the resilience capacity of entrepreneurship activities, and (2) the influence of entrepreneurship on the overall resilience of locations.

The role of MNEs in fostering the creation of new businesses as well as the role of social dimensions in shaping the resilience of entrepreneurship activities are, amongst other dimensions, part of so-called spatial context conditions, as suggested by Hundt and Sternberg (2014). Entrepreneurship not only impacts the resilience of locations, but is also influenced by the business environment. When focusing on German regions (NUTS-2 regions) before, during and after the Great Recession, Hundt and Sternberg (2014) find that space (i.e. regions) and time (i.e. before, during and after the shock) are interrelated dimensions which influence entrepreneurship (Hundt and Sternberg, 2014, p. 722). Consequently, similar attributes of entrepreneurs may result in different outcomes depending on the region and time periods, which is to say on the context conditions. More specifically, they differentiate two types of entrepreneurship: (1) opportunity-seeking, and (2) necessity-driven (Hundt and Sternberg, 2014, p. 739). They find that recessions motivate opportunity-seeking entrepreneurs, while unemployment increases necessity-driven entrepreneurs (Hundt and Sternberg, 2014, p. 739). The authors conclude that the Great Depression had a supporting effect on entrepreneurship in Germany (Hundt and Sternberg, 2014, p. 740).

Sagan and Masik (2018, p. 31) point out that the level of entrepreneurship was higher in the Pomorskie region of Poland, which had on average a higher level of resilience than other Polish and European regions. They consider entrepreneurship as a positive factor influencing economic resilience for two reasons: (1) entrepreneurship is a preferable solution to unemployment, and (2) entrepreneurship may provide services to companies who can outsource and therefore achieve a higher degree of flexibility (Sagan and Masik, 2018, p. 31). This may highlight the need for investing in incentives for the development of entrepreneurship initiatives. This result may be linked to Delgado and Porter's (2018)

finding that there is a positive relationship between economic resilience and the number of firms in a cluster.

Bishop (2019, p. 496) argues that entrepreneurs "facilitate regional adaptation to economic crises" and their ability to do so depends on the size and diversity of local knowledge. Hence, the author investigates the relationship between new firm creation in the aftermath of a shock and the diversity of the knowledge stock (i.e. unrelated knowledge diversity) since the latter is hypothesised to stimulate "new entrepreneurial opportunities" (Bishop, 2019, p. 496). An econometric model based on data at the regional level in Great Britain during the period 2004-2014 is used to test the hypothesis. The findings show that there is a positive and significant relationship between unrelated knowledge diversity and the size of the knowledge stock with economic recovery (Bishop, 2019, p. 496). This finding is consistent with the findings of Sedita et al. (2017) (see subsection 2.2.3), but contrary to the conclusions of the majority of the other studies reviewed above (amongst others: Hane-Weijman et al., 2017; Pudelko and Hundt, 2017; Delgado and Porter, 2018).

While Bishop (2019) has focused on the overall British economy, Holm and Østergaard (2015) focus on a particular sector in Denmark after the burst of the dotcom bubble: the Danish information and communication technology sector. They show that locations with a higher number of small and young information and communication technologies (ICT) companies were more resilient and tended to be more "adaptable" than others (Holm and Østergaard, 2015, p. 108). More interestingly, they find that diversity makes the sector more sensitive to changes, "which worsen the effect of the shock but speeds up the recovery" (Holm and Østergaard, 2015, p. 108). This may explain the results found by Bishop (2019) but runs counter to some studies presented above such as Kahl and Hundt (2015), Brown and Greenbaum (2016) or Pudelko and Hundt (2017).

Another interesting facet of entrepreneurship in relation to economic resilience is introduced by Ryan et al. (2020). They focus on the role of MNEs in "metamorphosing" local entrepreneurial ecosystems, or put differently, on the "processes of an entrepreneurial ecosystem that emerged from two MNE subsidiaries" (Ryan et al., 2020, p. 1). The intuition behind this proposition is that the resilience of entrepreneurial ecosystems is derived from both specialisation and heterogeneity of new firm creation in

terms of technological diversity (Ryan et al., 2020, p. 4). Large firms serve as the basis for facilitating such ecosystems and hence, increase their resilience. Their analysis and conclusions are based on the observations of MNE subsidiaries that have evolved into R&D centres in technologically related activities (results based on patent data) (Ryan et al., 2020, p. 9). They found that the majority of entrepreneurs previously worked for branches of MNEs. Furthermore, innovation unrelated to the current technology base was primarily developed by spin-offs of MNEs (Ryan et al., 2020, p. 10). Consequently, MNEs have a role in diversifying the technological base in a given location through fostering entrepreneurship.

Huggins and Thompson (2015) have not focused on the role of MNEs in fostering entrepreneurship, but have, instead, concentrated on the impact of community culture on the resilience of their entrepreneurial activity. They argue that entrepreneurship increases the resilience of locations (i.e. dampens downturn and increases recovery) and that it is positively influenced by the community culture (i.e. openness and diversity of local community culture) (Huggins and Thompson, 2015, p. 326). The intuition behind this hypothesis is that the openness and diversity of local culture leads to openness to new ideas and knowledge as well as willingness to embrace new opportunities, which eventually contributes to entrepreneurial activities and economic resilience (Huggins and Thompson, 2015, p. 326). When focusing on Great Britain during the period 2004-2011, they find that an open and diverse culture, and particularly local social values, positively influence the renewal and reorientation of local entrepreneurship (Huggins and Thompson, 2015, p. 313).

2.2.5   The influence of human capital

The fifth and last stream of literature is composed of works focusing on the role of the labour market efficiency and human capital on economic resilience. Particular variables that are encountered in this stream are the skill composition and level of human capital.

First, Diodato and Weterings (2015) concentrate on the resilience of labour markets. Following many of the works studied in this section, they distinguish between the resistance and recovery phases of resilience (Diodato and Weterings, 2015, p. 740). The

labour market comes into play during the recovery phase where workers can be reabsorbed. The speed of reabsorption depends on inter-sectoral labour mobility (i.e. skill-relatedness) and geographical position of the location (i.e. connectivity) (Diodato and Weterings, 2015, p. 740). They find that the service sector, which has higher skill-relatedness both amongst service industries and with other sectors, had a higher speed of recovery (Diodato and Weterings, 2015, p. 740). Further, they show that regions with better connectedness also have higher skill-relatedness, and consequently higher resilience (Diodato and Weterings, 2015, p. 741).

Weinstein and Patrick (2019) further investigate the dimension of skills. They analyse the relationship between skills and economic recovery. They argue that individual skills and productivity influence location productivity and, therefore, growth. Furthermore, individual skills and productivity depend on the opportunities in a given location (Weinstein and Patrick, 2019, p. 351). Based on these two arguments, the authors investigate both (1) the impact of skills on the individual's ability to deal with recession, and (2) the effect of cities' skill composition on their resilience (Weinstein and Patrick, 2019, p. 351). The authors base their analysis on Occupational Information Network data between 1990 and 2015 (Weinstein and Patrick, 2019, p. 351) and they differentiate between three types of skills: (1) cognitive skills (i.a. writing, speaking, critical thinking and problem solving), (2) motor skills (i.a. manual dexterity, dynamic strength), and (3) people skills (i.a. management personnel resources, coordination of actions, negotiation) (Weinstein and Patrick, 2019, p. 354). The study shows that economies with high "cognitive and people skill requirements" are more resilient to economic downturn while economies with motor skills are not. This relationship is even stronger for high cognitive skills, which have a stronger likelihood of employment during recessions (Weinstein and Patrick, 2019, p. 358). The authors explain this result by arguing that "interactive and higher order tasks are less likely to be outsourced or routine operations are more likely to be sent elsewhere – particularly during recessions", or put differently, that workers with cognitive or people skills are more likely to be useful during recessions. By looking deeper at the data regarding the sets of skills within the three broad categories, the authors find that persuasion, speaking and science skills are amongst the most important during recession (Weinstein and Patrick, 2019, p. 362). They conclude that "while complex problem-solving […] is just as important in a recession as not, what seems to matter even

more in a recession is the ability to communicate effectively and persuasively ideas on solutions to problems that are based on science" (Weinstein and Patrick, 2019, p. 362). Hence, the ability to communicate 'magnifies' other skills such as science or problem-solving. A final interesting result of the study is that the recovery of metropolitan areas depends on the "initial skill composition". In fact, cities with higher concentration of people skill occupations returns to pre-shock levels more quickly, hence confirming the results above regarding the sets of skills (Weinstein and Patrick, 2019, p. 348).

The majority of the studies reviewed in this section have focused on the aggregate level (regional or national) but seldom the individual level. Complementarily to the work of Weinstein and Patrick (2019), Doran and Fingleton (2016) propose an approach where the analysis is based on the individuals' response to the Great Recession. Following an econometric model based on data from the European Social Survey (ESS), they find that highly educated individuals, middle-aged individuals, unionized workers and men have a higher chance of employment in times of crisis (Doran and Fingleton, 2016, p. 651).

Glaeser et al. (2014, p. 32) confirm the results found in the previous studies when investigating regional change in the US. In fact, they show that education and skills predict the ability of cities to withstand economic downturns. Notably, they find a negative correlation between the number of educated workers and unemployment rate after the Great Depression (Glaeser et al., 2014, p. 32). However, they also argue that while there is a negative correlation between education and unemployment, this relationship may also bear the fact that workers living in educated areas may be more skilled than suggested by their education (Glaeser et al., 2014, p. 32). This relationship can explain that human capital spillovers take place. Further, they find that skilled workers are both employers and employees. Taken together with the negative correlation between unemployment and education, this result suggests that it may reflect "the ability of more skilled entrepreneurs to find opportunity in a downturn" (Glaeser et al., 2014, p. 32). This last result can be coupled with those found by Hundt and Sternberg (2014) (see subsection 2.2.4).

2.3   Synthesis: What determinants affect the economic resilience of locations?

This chapter has not only shed light on the conceptual framework and the spatial heterogeneity of the economic response to shocks but has also searched for possible determinants influencing the economic resilience of locations.

The first section of this chapter has focused on the framework surrounding the concept of economic resilience and has shown that there is a substantial number of interpretations and applications, which is mainly due to the transposition of the concept from one scientific field to another. The critical analysis performed in the first section has found answers to some of the questions and voluntarily left open other issues, in particular regarding the definitions of a shock and of economic resilience.

The first subsection has highlighted some of the definitions that were encountered in the literature following three generic definitions: engineering, ecological and adaptive resilience. Martin (2012) developed a definition based on the adaptive capacity of economies in the face of a shock. This "adaptive" resilience, as defined by Martin (2012), has been taken up and revised by most authors in order to describe the concept of economic resilience.

The first part of subsection 2.1.2 has focused on the definition of resilience in other disciplines. An observation was that it shares a common feature: a lack of an agreed definition. Walker et al. (2004) argue that each group adopts different interpretations depending on their need. Consequently, resilience can be considered as a general concept open to interpretation. In other disciplines, it has been concluded that the concept of resilience deals with the reaction of a system to changes and shocks. Based on this perspective, business cycle theories and growth theories may bring some welcome insight in analysing the concept in the economic context.

Subsection 2.1.2 has also brought forward five issues regarding the conceptualisation of economic resilience: (1) regarding the main target (i.a. firms, regional or national economies), (2) how to identify the reaction of the main target, (3) what constitutes a "shock" and how it can be identified, (4) the necessary time to consider the main target as resilient, or put differently "over what period?", and (5) the issue of self-reliance,

namely the debate around 'natural' reaction and policy implications. Some concluding thoughts on these issues were offered. First, building on Mitchell's thinking, namely that "words set traps" which narrow our perspectives, the idea was to keep the reflection as open minded as possible. Second, there seems to be an agreement on two characteristics of economic resilience that stand out from the analysis conducted in subsections 2.1.1 and 2.1.2: (1) the degree of preparedness, and (2) the capacity to recover. Hence, resilience is the ability of economies (i.e. economic actors) to cope with disturbances and changes in economic conditions.

While a more precise definition and conceptualisation has not been proposed in this study, as it is not the aim, it can be argued that the concept of resilience, approached from an economic standpoint, has to do with the adaptability of the economy, or rather, the capacity of adaptation of its underlying firms. However, an investigation of the theories of growth and business cycles may help shed some light on this issue.

Based on the conclusions of subsections 2.1.1 and 2.1.2, studies focusing on the identification of economic resilience at various spatial levels have been reviewed. This analysis made it possible to highlight the spatial heterogeneity of economic resilience both between and within countries. It shows that localised contexts engender different economic responses to shocks. In fact, whether at the European level, in the US, in Italy or in the United Kingdom, the responses of economies towards shocks have shown various spatial patterns, irrespective of the methodology applied.

Consequently, the second section of this chapter has focused on the determinants that could explain those spatial disparities, in particular location-based determinants. A thorough search of case studies and empirical analyses has offered a first step towards the potential determinants affecting the economic resilience of locations. Five streams of explanations were identified in the literature regarding potential determinants of economic resilience.

The first and most important one concentrates on the relationship between the economic structure of locations and economic resilience. Dimensions such as related variety, the diversification of agglomeration economies, the clustering of related industries or the influence of specific industries are investigated in this subsection. Most studies have highlighted the importance of related diversity as a driver of economic resilience

(amongst others: Hane-Weijman et al., 2017; Delgado and Porter, 2018; Sagan and Masik, 2018; Cainelli et al., 2019; Behrens et al., 2020). A particular aspect of related diversity is the inter-firm linkages, whether through competition (Valdaliso, 2020), through their relatedness to common complementary industries (Sagan and Masik, 2018), through technological relatedness (Cainelli et al., 2019) or through geographical proximity (Kahl and Hundt, 2015). Each of these aspects has shown a positive influence on economic resilience. Other studies have also directly studied the relationship between economic resilience and clusters (Treado and Giarratani, 2008; Delgado and Porter, 2018; Hundt et al., 2018; Behrens et al., 2020). Overall, the studies show contradictory results. Behrens et al. (2020) find no evidence of a positive impact of clusters and Hundt et al. (2018) find a positive impact of clusters in 'good' times but not in times of crisis. Further, Treado and Giarratani (2008) highlight the decisive role of suppliers within clusters. The conclusions of Delgado and Porter (2018) as well as Hane-Weijman et al. (2017) and Pudelko and Hundt (2017) may shed some light on these contradictory results. It is the specialisation of a broad set of related industries that has the greater positive influence on economic resilience. In fact, Delgado and Porter (2018) argue that it is the number of businesses, the possibility of resource pooling as well as an increased flow of knowledge that reduces the uncertainty in the face of a shock. Hane-Weijman et al. (2017) also put forward the fact that the likelihood of re-employment is increased thanks to the relatedness of skills and experience.

It is also important to note that the influence of economic structure acts as a broader explanation since it has some underlying mechanisms, which are further investigated in the following subsections. For example, agglomeration externalities and clusters increase entrepreneurship activities and innovation as well as influencing the overall quality of the microeconomic business environment as shown in the first chapter. Ergo, the determinants found in subsections 2.2.2 to 2.2.5 can be considered as underlying mechanisms of some of the determinants found in subsection 2.2.1.

The second stream of literature focuses on the influence of innovation on economic resilience. As explained above, the role of innovation may indirectly be considered as an underlying mechanism of agglomeration externalities. Several studies have investigated its role (Clark et al., 2010; Hannigan et al., 2015; Sedita et al., 2017; Wink et al., 2018; Bristow and Healy, 2018c). Overall, these studies find that innovation increases the

resilience of firms and, as a consequence, of locations. The various authors found that innovation fosters the ability to move towards niche markets and the readjustment towards a new economic situation by changing technological and production structures. Further, Clark et al. (2010) find that certain types of knowledge are associated with different kinds of innovation.

The regional and national context as an explanation of economic resilience is encountered in the third stream of literature. While this stream of literature has not attracted as many scholars as the streams focusing on economic structure, innovation or entrepreneurship, some interesting results can still be drawn. Indeed, it was shown that both national and regional dimensions affect resilience. This confirms the results found in section 2.1.3 highlighting the spatial heterogeneity of economic response both between and within countries. Dimensions such as the ease of doing business, sound labour and product markets, or the 'innovative cross' (i.e. a dimension encompassing microeconomic determinants such as agglomeration externalities and collective goods) are found to positively impact resilience. Moreover, Hundt and Holtermann (2020) find that the "national setting" determines the outcome of more localised factors.

The fourth line of research concentrate on the influence of entrepreneurship on economic resilience. Overall, the findings point towards a positive influence of entrepreneurship on economic resilience. Hundt and Sternberg (2014) find that economic downturns spark entrepreneurship (i.e. opportunity-seeking and necessity-driven entrepreneurship) as it becomes a better alternative than unemployment (Sagan and Masik, 2018). A second advantage of entrepreneurship is that it provides higher degrees of flexibility. In fact, firms can more easily outsource activities which facilitates adaptation (Holm and Østergaard, 2015; Bishop, 2019). Further, Ryan et al. (2020) as well as Huggins and Thompson (2015) have studied the relationship between determinants facilitating entrepreneurship development and economic resilience. They find that MNEs and the openness and diversity of local culture facilitate the creation of new entrepreneurship activities in times of crisis.

The fifth and last stream focuses on the quality of the human capital. It has been found that economies with more sophisticated labour supply are more resilient. Indeed, the hypothesis is that higher order tasks are less likely to be outsourced. Further,

agglomerations of industries with strong skill-relatedness are also more resilient. Weinstein and Patrick (2019) have also shown that more advanced skills are particularly important in the recovery phase (i.a. problem-solving, persuasion, science skills). Glaeser et al. (2014) argue that higher skills and education increase the ability to find opportunity in a downturn, notably for entrepreneurs.

Table 2.1 summarises the main results and determinants found in each study tackled in section 2.2. The determinants are found in the second column, while the third column summarises the main mechanisms behind each determinant.

Table 2.2 Recapitulation table of the mechanisms and determinants found in chapter 2 (classified by authors).

Authors	Main determinant(s) (Red if negative influence)	Mechanisms/Characteristics
The influence of economic structure		
Wink (2018)	Manufacturing industries	Related diversity amongst manufacturing firms increases resilience through social consensus (through labour unions) as well as collaboration (cross firms and cross countries) which result in more innovation.
Valdaliso (2020)	Business size, flexibility and production specialisation Absorptive and innovative capacity Geographical concentration	Small and medium size enterprises (SMEs) with flexible production systems focusing on niche markets. Geographical concentrations and clustering facilitate the absorptive capacity of firms and help them move towards high-tech activities with advanced technology and labour.
Cuadrado-Roura and Maroto (2016) Angulo et al. (2018)	Services Concentration/Specialisation	Specialisation in the service sectors increases resilience. Industries gaining from location advantages (i.e. externalities) have higher resilience.
Sagan and Masik (2018)	Diversity of export industries	The relatedness to complementarity industries and specific skills and jobs (more advanced) that industries need are expected to increase resilience.

Healy (2018)	Low external orientation of industries	Industries more oriented towards the domestic market are expected to be less resilient.
Kakderi and Tasopoulou (2018)	Limited industrial diversification	Industries with low investment and low innovation are expected to be less resilient.
Di Caro (2014) Di Caro (2017)	Manufacturing industries Economic diversity	Positive relationship between the resilience of manufacturing industries and industrial diversity and overall economic development.
Cainelli et al. (2019)	Industrial diversification	Technological relatedness through "inputs market pooling" increase resilience and vertical relatedness through input-output relations decrease resilience. Hence, it is the vertical diversification and technological concentration that increase resilience.
Brown and Greenbaum (2016)	Industry diversification	Concentrated industries are more performant in good times and more diversified industries are more resilient in times of crisis.
Brakman et al. (2014)	Urbanisation Specialisation	Urban areas are more resilient than smaller cities and rural areas. Further, specialisation in medium to high-tech industries increase resilience.
Hane-Weijman et al. (2017)	Specialisation of related industries	The specialisation of related industries increase the likelihood of re-employment thanks to the match for skills and experience. Hence, it increases the absorptive capacity of the labour market.

Pudelko and Hundt (2017)	Specialisation Diversification into unrelated variety Specialisation of related variety	Specialisation has a negative influence in resistance but helps the recovery. The diversification of unrelated variety has a negative influence on resilience. Conclusion: it is the specialisation of related variety that should be favoured in order to increase resilience.
Kahl and Hundt (2015)	Diversified regional agglomerations Specialisation at the network and context-level	Geographical proximity increases the capacity of firms to diversify both portfolio of activities and network ties. This diversification is found to favour resilience.
Hundt et al. (2018)	Cluster externalities depend on the macroeconomic cycle	Specialisation externalities increase the performance in good times but not in bad times.
Behrens et al. (2020)	Clustering	There is no evidence of a positive impact of clustering in the textile industry in Canada.
Wrobel (2015)	Clustering	There is a strong impact of engineering industries in Germany en resilience, notably through characteristics of cluster actors such as "solidarity" and "altruism".
Treado and Giarratani (2008)	Clustering	The large base of intermediate suppliers helps diversify the economy and increases the resilience.

Delgado and Porter (2018)	Specialisation outside clusters	The number of businesses is positively related to resilience.
	Specialisation within clusters	Industry specialisation outside of strong cluster environment reduces the resilience, while industry specialisation within strong cluster environment increases resilience.
		Inter-firm and inter-industry linkages as well as knowledge links and labour pooling reduce the uncertainty in the face of a shock, consequently increasing economic resilience.
The influence of innovation		
Hannigan et al. (2015)	Innovation increases resilience	Innovation enables declining industries to move towards niche activities and, as a consequence, be global leaders in those niche activities.
Clark et al. (2010)	Innovation increases resilience	A high number of small innovative firms increase the resilience through innovation brought by those SMEs (more than big firms).
Sedita et al. (2017)	Differentiated knowledge increases resilience	The concentration of symbolic and synthetic knowledge contribute to economic resilience.
Wink et al. (2018)	Innovation increases resilience	It is the innovative base that helped the readjustment of industrial structures through high spending in R&D.
Bristow and Healy (2018c)	Innovation increases resilience	Firms acquire knowledge about the changing environment. Then, innovation enables them to change both industrial and technological structures.

The influence of the regional and national context		
Fratesi and Perucca (2018)	Territorial capital is positively related to economic resilience	The 'innovative cross', which encompasses relational private services, collective goods and agglomeration economies, positively influences the economic resilience of locations.
Hundt and Holtermann (2020)	National setting is particularly important during the resistance phase	Regional determinants are affected by the national setting. This suggests that identical regional determinants may have different (or opposing) effects on economic resilience.
Sondermann (2018)	Quality of countries' economic structure	Sound labour and product markets as well as the ease for doing business increase economic resilience.
The influence of entrepreneurship		
Hundt and Sternberg (2014)	Space (i.e. regions) and time influence entrepreneurship Recession has a supporting effect on entrepreneurship	Recessions motivate opportunity-seeking entrepreneurs, while unemployment increases necessity-driven entrepreneurship.
Sagan and Masik (2018)	Entrepreneurship positively influences economic resilience	Entrepreneurship is a preferable solution to unemployment. Entrepreneurship provides services to companies who can outsource and therefore achieve a higher degree of flexibility.

Bishop (2019)	Entrepreneurs facilitate adaptation and consequently economic resilience	This process depends on the size and diversity of local knowledge. There is a positive and significant relation between unrelated knowledge diversity as well as the amount of knowledge with economic recovery.
Holm and Østergaard (2015)	Entrepreneurs facilitate adaptation and consequently economic resilience	Locations with more small and young ICT companies were more resilient and tended to be more 'adaptable' than others.
Ryan et al. (2020)	MNEs help the creation of entrepreneurship which further increases resilience	The hypothesis is that the diversity of entrepreneurs increases resilience.
Huggins and Thompson (2015)	Community culture increases the resilience of the entrepreneurial activity	The resilience of entrepreneurship activities is positively influenced by the community culture. The openness and diversity of local culture leads to openness to new ideas and the willingness to embrace new ideas and knowledge.
The influence of human capital		
Diodato and Weterings (2015)	Sectors with high skill relatedness have a higher speed of recovery (resilience)	Workers can be more easily reabsorbed if skill relatedness is higher between industries and sectors.
Weinstein and Patrick (2019)	Economies with high "cognitive and people skill" requirements are more resilient	Interactive and higher order tasks are less likely to be outsourced.

	Persuasion, speaking and science skills are amongst the most important during recession	The ability to communicate effectively and persuasively new or alternative ideas and the capacity to find solutions to problems that arise in times of crises are based on the most important tasks.
Doran and Fingleton (2016)	Some characteristics of labour markets are assimilated to economic resilience.	Highly educated individuals, middle-aged individuals, unionized workers and men have a higher chance of employment in times of crisis.
Glaeser et al. (2014)	Education and skills predict the ability of cities to withstand economic downturn	There is a negative correlation between the number of educated workers and unemployment. It reflects the ability of more skilled entrepreneurs to find opportunity in a downturn. Skilled workers can be both employers and employees.

Source: Personal elaboration.

Chapter 3

An investigation of growth theories

This chapter will take a closer look at the theories of economic growth. The idea of this chapter is to follow the spirit of Rabelais in his novel *Gargantua and Pantagruel* which is not simply to open a book but to be curious and to break the bone and suck the substantific marrow in order to whet our appetite and fulfil the task of this thesis (Rabelais, 2003, p. 13).

In the previous chapter, it was shown that there is a lack of consensus on (1) a proper definition for the concept of economic resilience as well as on (2) the framework surrounding the concept which leads to problems when investigating the resilience of locations. Nonetheless, the previous chapter shed light on some possible factors influencing the economic resilience of locations. This has brought some possible explanations on the factors shaping economic resilience, and notably on the role played by clusters. A further conclusion of the second chapter was to take a closer look at the theories of economic growth and business cycles in order to search for elements that can help understand the role of clusters in increasing the economic resilience of locations. Hence, the objective of this third chapter is to go over the theories of growth and to extract the "substantific marrow" in the search for elements regarding economic resilience and clusters. This investigation enables the identification of the determinants that can influence the economic resilience of locations.

The choice of the theories and models selected in this chapter is subject to discussion. One cannot simply make a laundry list of all theories and models. Since the aim of this thesis is to investigate the concept of economic resilience from a cluster perspective,

theories and models are selected in relation to (1) the microeconomic environment (as described in chapter 1), and to (2) the conclusions of chapter 2. Even though some models studied in this chapter have limited microeconomic insight (e.g. Solow), they are of importance in understanding the development of other models (e.g. the new models of endogenous growth are notably built on the critics of the Solow model). Therefore, the models studied in this thesis will be tackled in chronological order since authors are influenced, even marginally or subconsciously, by the theories and concepts that already existed. The analysis of the relationships and the underlying mechanisms between growth theories, clusters and economic resilience *per se* will be carried out in the fifth chapter (section 5.2).

This chapter will first present the stylised facts and records of economic growth in order to give the reader a better insight into the historical records. The second section focuses on growth theories. Finally, the chapter is concluded by a third section which will synthesise the key elements found in section 3.2.

According to Setterfield (2016, p. 211), economic growth can be defined as: "the process by which real income per capita rises over a protracted interval of time". The most common measure of economic growth is the increase in percentage of a variable within a certain period. And the most commonly used variable is the real income per capita (Setterfield, 2016, p. 212). The meaning behind the use of this variable is that if income per capita increases, or in other words, if there is a positive growth rate, then people will be 'more satisfied' on average.

This thesis begins with Adam Smith as he laid the groundwork for future models. Many of Smith's ideas can be found in Ricardo, Marshall or the new models of endogenous growth. The chapter then continues with the classical theories of economic growth (Ricardo, Malthus and Mill). The fiction of the stationary state as well as the importance of the division of labour in Marshall's thinking are tackled in the third subsection. The fourth subsection will focus on Schumpeter, as a source of inspiration for the new endogenous growth models, who focuses on the process of creative destruction and imperfect competition. The growth models of Harrod and Domar are dealt with in the fifth subsection and serve as a basis for the development of the Solow model of exogenous growth, which will be presented in the following subsection. Even though the latter model

has triggered a number of criticisms, it was also a source of inspiration for the development of future models that are introduced in the seventh subsection with the new models of endogenous growth. A final section will conclude this chapter and offer a synthesis of the different determinants and mechanisms documented.

3.1   Stylised facts and records of economic growth

In this section, the focus will be on the stylised facts of economic growth based on the article by Rodrik (2014) *The Past, Present, and Future of Economic Growth*. The example of England will be taken since the country has been an economic empire and is one of the first countries to have experienced the Industrial Revolution, which makes it a natural example for analysing the evolution of economic growth. England was also home to some of the fathers of economic theory such as Smith and Ricardo. The aim of this section is to present the history of economic growth and give the key facts to the reader before going through the major lines of thinking that have shaped growth theory through the last centuries.

Rodrik (2014) has highlighted six stylised facts in regard to economic growth. The first one is that economic growth has increased over time. This is illustrated in figure 1 for the case of England. It can be seen that growth evolves along an exponential path.

Figure 3.1: England's real GDP per capita for the period 1270-2016.
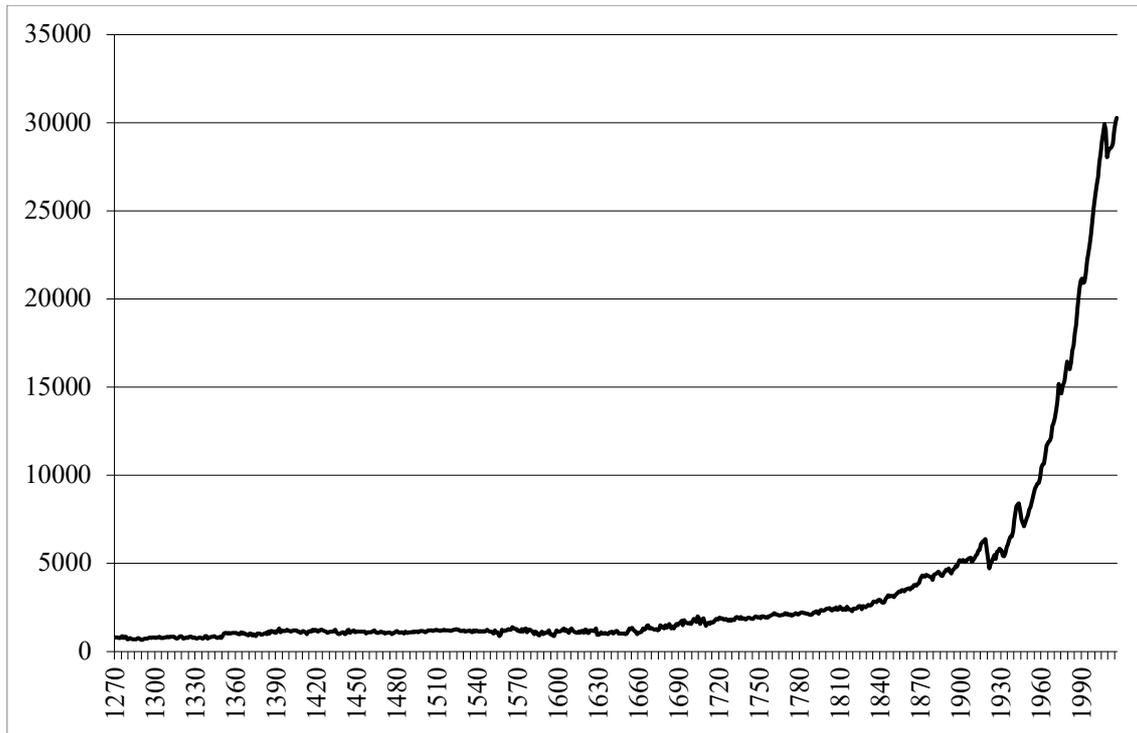
Source: Personal elaboration based on Broadberry et al. (2015).

As Rodrick (2014) mentions, it is difficult to determine with precision the take-off of the economy, which happened during the 19th century when the Industrial Revolution took place. Until the beginning of the 18th century, the economy barely increased. Setterfield (2016, p. 213) highlights the fact that since then, the economic growth has markedly varied between countries, namely between countries currently considered to be rich or poor. This divergence has become a field of analysis focusing on the following question: can poor countries catch up with rich ones? Or in other words: "whether poor countries or regions tend to converge towards rich ones?" (Barro et al., 1991, p. 107). It can be argued that poor countries may use technologies that have already been tested and applied in more advanced economies and therefore catch up with rich ones. They also point out the fact that this convergence may not only appear between rich and poor countries but also between regions of a given country (Barro et al., 1991, p. 107). This leads us to the second stylised fact of Rodrick (2014) which is that the convergence effect has not been confirmed by the historical records. In fact, Rodrick (2014, p. 21) states that "convergence has been the exception rather than the rule". This takes us to Rodrik's third stylised fact

(2014, p. 23), namely that "economic development goes hand-in-hand with productive diversification". The reasoning behind this is that poor countries are structurally different from rich ones and are not a mere replication. In fact, economic development needs to move workers to more productive industries. Piero Ghezzi, former Minister of Production of Peru, has also raised this issue during a conference on the subject of "Public-Private Collaboration for Modern Industrial Policy" at the MOC Faculty Workshop in December 2018 (Ghezzi, 2018).

When looking back at the data for England, the annualised growth rate between 1270 and 1700 is 0.17% and slightly more (0.28%) in the 18th century (Broadberry et al., 2015). However, from 1800 until 1900, the annualised growth rate stepped up to a level of 0.75% and 0.82% for the following 50 years, namely the period of the two World Wars and the Great Depression. This tallies with the first stylised fact which described the evidence that economic growth increased. As briefly mentioned above, this jump in the level of growth may be the result of the Industrial Revolution that took place in the 19th century in England. Rodrik's fourth stylised fact (2014) may explain this. Namely, "industrialization and manufactured exports have been the most reliable levers for rapid and sustained growth" (Rodrick, 2014, p. 24). When looking at absolute values, the increase in the level of GDP per capita in England roughly doubled in nearly 400 years (1270-1700), while it has been multiplied by 18 in the last 300 years (see figure 1). Rodrik (2014) also cites the examples of China, Japan and South Korea. In the case of England, from the aftermath of the Second World War until today, the economy grew at a steady annualised rate of 2.06%, which is significantly superior as the previous periods (Broadberry et al., 2015). There is, therefore, a breakthrough between the periods before and after the World Wars.

Rodrik's fifth stylised fact (2014) is that manufacturing industries exhibit unconditional convergence. Put another way, productivity growth of manufacturing industries that starts at a lower level is significantly higher. Rodrik (2014, p. 26) hypothesises that the convergence in productivity for this particular type of industry comes from the fact that "tradable" goods are produced and that the technology in this type of industry can be more easily transferred between countries. This productivity convergence at the manufacturing level does not seem to spill over to other industries and therefore does not lead to convergence at the aggregate level. This absence in convergence was highlighted

as the second stylised fact. One reason brought forward by Rodrik (2014, p. 26) is that in given countries, market and government failures hinder this process. He gives the explanation that countries which were able to move towards more advanced stages of economic development both increased productivity and employment in manufacturing industries (Rodrik, 2014, p. 27).

Rodrik's sixth and final stylised fact focuses on the role of government. Even though there is no clear correlation between government interventions and growth, he highlights the fact that Asian economies, which are characterized by higher interventionism in regard to international trade and finance, perform better than Latin American ones. Following this fact, Rodrik (2014, p. 27) concludes that: "less intervention is not necessarily good for performance". However, this last stylized fact does not meet a general agreement and is based on a rather questionable theoretical basis.

Table 3.1: Summary of Rodrik's six stylised facts.

	Fact	**Explanation**
1st	Economic growth has increased over time	Economic growth follows an exponential path.
2nd	Convergence effect between countries has not been confirmed by the historical records	The intuition that poor countries may catch up with rich ones through the use of technologies already applied in rich countries is not validated by the facts.
3rd	Economic development is related to productive diversification	Poor countries are structurally different, hence economic development needs to move workers to more productive industries.
4th	Industrialisation and manufactured exports are related to rapid and sustained growth.	Countries have experienced rapid growth as a result of industrialisation and competitive manufacturing (e.g. the Industrial Revolution in England and industrial resumption in the 1950s in Japan)
5th	Manufacturing industries exhibit unconditional convergence	Manufacturing industries produce "tradable" goods and industry-specific technologies can be easily transferred between countries.
6th	Successful economies have not been those with the least interventionism	Asian countries, characterised by higher degrees of state interventionism than Latin American countries, have higher growth rates than the latter.

Source: personal elaboration based on Rodrik (2014).

3.2 From Smith to the new models of endogenous economic growth

3.2.1 Smith: The role of the division of labour on growth

The first author to be reviewed in this chapter is Adam Smith who is considered by many as the father of economic theory. In fact, Robbins (1968, p. 9) writes "the main credit for putting economic development on the map as a subject for general analysis belongs undoubtedly to Adam Smith".

Smith's view on growth was first presented in his book *An Inquiry into the Nature and Causes of the Wealth of Nations* in 1776 and saw growth as endogenous where labour productivity is impacted by capital accumulation (Smith, 1776). Smith's focus is on the determinants that influence the growth of labour productivity such as skills and dexterity (Smith, 1993). How does capital accumulation come into play? Smith thinks that the growth of labour productivity depends upon the division of labour, which increases both revenue and stock of capital, consequently leading to an increase in labour demand and wages (Hansen, 1939, p. 2). He observes the following: "The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgement with which it is anywhere directed, or applied, seems to have been the effects of the division of labour" (Smith, 1993, p. 11). Smith (1993, p. XX) also puts forward the fact that the division of labour happens not only within, but also between firms and industries. As noted above, Smith (1993) gives three features of the division of labour: (1) an advancement in the "dexterity" of workers, (2) saving of time, and (3) invention of specific machinery. These features also make one think of the concepts of learning-by-doing which is a key aspect of the new models of endogenous economic growth. He also specified the fact that the bigger the market is, the larger the division of labour will be. To understand this position, one has to understand why the division of labour takes place.

According to Smith (1993, p. 21), the division of labour is the "gradual consequence of a certain propensity in human nature […] to truck, barter, and exchange one thing for another". Hence, the broader and wider the markets are, the higher the power of

exchanging will be. This leads to more division of labour and consequently to a higher levels of productivity.

Smith (1993, p. 18) acknowledges the fact that the development and discovery of new machinery are the result of "those who had occasion to use the machines". Based on this process, Kurz and Salvadori (2003, p. 5) note that new knowledge is continuously generated endogenously, and it becomes a public good. The accumulation of capital also strengthens this process by developing markets in terms of size and diversity, which will eventually lead towards increasing demand and therefore economic development.

As noted above, capital accumulation depends upon the division of labour. Hence, Smith also specified the reason why people accumulate capital. It comes from the "desire of bettering our condition" and "there is scarce perhaps a single instant in which any man is so perfectly and completely satisfied with his situation" (Smith, 1993, p. 203). This improvement is achieved through increasing his fortune by means of savings and accumulation. In order to do so, people have to earn a reward, a recompense for productive labour. For Smith, the demand for labour, the producer side, controls the size of the supply by "enabling workers to provide better for their children" (Smith, 1993, p. 80). Therefore, it can be said that the supply of labour, namely the workers, is determined endogenously. As a consequence, the process of accumulation determines the demand for labour.

Regarding the limits of growth, Smith has envisaged three scenarios even though there are no reasons to restrict growth in Smith's framework. The first two scenarios would be a shortage of workers or natural resources. The third scenario would be "an erosion of the motives of accumulation" (Kurz and Salvadori, 2003, p. 6).

To sum up Smith's thinking on economic growth, or of economic development towards a higher levels of prosperity, it can be said that it is driven by the accumulation of capital which is achieved through the division of labour. The division of labour is accompanied by the creation of knowledge (technical knowledge) which then becomes a public good that can be used and replicated by others, consequently fostering a competitive environment. In order to stay competitive, gain a normal profit under the hypothesis of perfect competition, the producers need to improve their goods or production processes, which is achieved by the division of labour.

3.2.2   Classical theories of economic growth

i   Ricardo: the influence of the human's desire for convenience

In 1817, David Ricardo presented his thinking on economic development in *The Principles of Political Economy and Taxation* (Ricardo, 1817b). His vision is drastically different from Adam Smith. For him, labour division does not play a role in the growth process. On the contrary, for him growth follows a "natural course of event" and the productive conditions are crucial. In fact, he states that: "profits depend on the quantity of labour […]. The effects then of accumulation will be different in different countries, and will depend chiefly on the fertility of the land" (Ricardo, 1817b, p. 76). The argument is built on the assumption that the given method of production is constant (Kurz and Salvadori, 2003, p. 8).

In order to understand Ricardo's thinking, one has to look at the relationship between wages, profits and capital accumulation. For Ricardo, there is a negative relationship between wages and profits (Ricardo, 1817b, pp. 70-71) and a positive relationship between profits and capital accumulation (Ricardo, 1817b, p. 73). Regarding wages and profits, Ricardo (1817b, p. 71) presents the following theory: profits depend on wages, wages rest on the price of necessaries, and the latter on the price of food (because of diminishing returns). In fact, the capacity of a labourer to support himself depends on food, necessaries, and conveniences, and not the quantity of money. Hence, the price of labour (wages) depends on the price of the food, necessaries, and conveniences that the labourer needs for himself and his family (Ricardo, 1817b, p. 52). For Ricardo (1817b, p. 52), alongside the "progress of society", or in other words, the increase in population, there is a tendency of wages to rise (price of labour) because food, necessaries, and conveniences become dearer and more difficult to produce. Hence, if wages rise, profits will inevitably decrease. Ricardo explains the positive relationship between profits and capital accumulation through the motivation of farmers and manufacturers to accumulate:

> For no one accumulates but with a view to make his accumulation productive, and it is only when so employed that it operates on profits. […] Their motive for accumulation will diminish with every diminution of profit, and will cease

altogether when their profits are so low as not to afford them an adequate compensation for their trouble […]. (Ricardo, 1817b, p. 73)

Ricardo (1817b, p. 73) sees the rate of profit as falling since the process leads to diminishing returns to land. In fact, if capital accumulates and labour grows but the land is given constant, the rate of production will eventually decrease, leading to a fall-off in profit (Ricardo, 1817b, p. 71). Hence, due to the positive relationship between profits and capital accumulation described above, a fall in profit will necessarily lead to a decline in the accumulation of capital. Consequently, the economy is trapped in a stationary state.

However, Ricardo thinks that technical progress (i.a. improvement in machinery, discoveries) has the ability to replace a portion of the labour force and therefore reduces the diminishing returns to land (Ricardo, 1817b, p. 52; p. 71). Yet, and unlike Smith, Ricardo understand technical progress as exogenous (Kurz and Salvadori, 2003, p. 9).

To sum up Ricardo's thinking, growth is possible through the accumulation of capital which also determines the demand for labour. He says that: "While the profits of stock are high, men will have a motive to accumulate. Whilst a man has any wished-for gratification unsupplied, he will have a demand for more commodities […]" (Ricardo, 1817b, p. 193). The only limit to growth may come from non-accumulable factors of production such as land or natural resources. The growth diminishes as soon as technical progress is not sufficient to counterbalance or neutralise the diminishing returns to land.

However, Ricardo adds a positive note to the accumulation of capital based on a reflection of Smith. On the one hand, there is a limited demand for subsistence commodities (food), which is produced by means of limited resources (land) and in turn limits "the amount of capital which can at any one time be profitably engaged in agriculture" (Ricardo, 1817b, p. 195). On the other hand, there are no boundaries to the consumption or desire for "convenience, ornaments of life, building, dress, equipage, and household furniture" and therefore almost no limit in engaging capital to procure them, except for a certain amount needed for producing food ("to maintain the workmen") (Ricardo, 1817b, p. 195).

ii   Malthus: the solution of developing new 'wants'

In his *Essay on the principles of population* in 1798 and *Principles of political economy* in 1836, Malthus views economic growth as pessimistic (Sharipov, 2015, p. 762). It is also important to note that Ricardo and Malthus focus on how growth can be sustained in the long-run. For Malthus and Ricardo, there are diminishing returns from land. Therefore, the higher the population growth is, the lower the returns would be, consequently leading to lower wages. However, there is a positive relationship between wages and population growth: "the supporting of a large family, would depend upon the rate at which the funds for the maintenance of labour and the demand for labour are increasing" (Malthus, 1986, p. 182). Therefore, high wages could trigger a "rapid increase of population" (Malthus, 1986, p. 183). Malthus' message is that the limited amount of land as a means of production is a restriction to the growth of the economy (Hansen and Prescott, 2002, p. 1207).

However, Malthus points out that a potential increase in wages would not necessarily induce an increase in population but may also result in an "improvement in the modes of subsistence, and the conveniences and comforts enjoyed" (Malthus, 1986, p. 183). This relates to Ricardo, who assumed that there is almost no limit in engaging capital to produce "the conveniences and ornaments of life". However, Malthus (1986, p. 257) also assumes a supplementary non-commodity good which is leisure time that comes from "indolence or love of ease". Henceforth, an insufficient demand would reduce the rate of profit and capital accumulation. In Malthus' words, "the powers of production, to whatever extent they may exist, are not alone sufficient to secure the creation of a proportionate degree of wealth" (Malthus, 1986, p. 288). Malthus makes an interesting remark regarding the incentives to produce wealth: it is the "wants" that produces wealth (Malthus, 1986, p. 321). In fact, one has to want to increase one's wealth in order to increase it. However, he argues that foreign commerce can spark new motives for producing through new wants or new tastes (Malthus, 1986, p. 321).

According to Fiaschi and Signorino (2003, p. 17), one of the criticisms of Malthus is that he does not explore the consequences of workers' behaviour in more depth, as it may counteract the fatal tendency of the rate of profit to fall due to the increase in population.

As a conclusion on Malthus, Fiaschi and Signorino (2003, p. 21) raise the question: "Must limits to growth be located in the productive conditions of a crucial sector, agriculture, or in the lack of an adequate level of 'effectual demand' for manufactured commodities?"

iii   Mill: The influence of the human capacity to 'understand the world'

Mill's *Principles of Political Economy* is in a similar vein to Ricardo and Malthus and provides a bridge to the marginal economists. In classical thought, growth inevitably gets trapped in a steady state caused by diminishing returns and a Malthusian increase in population. However, the difference in Mill's postulate is that the steady state may evolve due to the human capacity to understand the world (i.e. technological change) (Romer, 1989, p. 3).

The thinking behind this process of development can be illustrated by Ellis, a close collaborator of Mill, who believe that it is a "duty" to pass along a more developed civilisation, world (i.e. economy) and to advance in "happiness". To do so, people need to understand the determinants of progress (Ellis, 1846, pp. 1-4). In Mill's view, the growth process is assimilated to a "process of civilization" where an economy moves from savage states to agricultural economies and finally industrial economies (Mill, 1965, pp. 10-20). This process includes the following three aspects: (1) a stream of technological innovations, (2) a continuous increase in security of people and property, and (3) the growth of "the principles and practices of cooperation" (Mill, 1965, pp. 706-708). Regarding the first aspect, Mill mentions that:

> Our knowledge of the properties and laws of physical objects shows no sign of approaching its ultimate boundaries […]. This increasing physical knowledge is now, too, more rapidly than at any former period, converted, by practical ingenuity, into physical power. (Mill, 1965, p. 706)

This 'physical power' is the connexion with the 'phenomena of production'. Eventually, Mill (1965, p. 752) thinks that the economy will reach a stationary state in which: "a high level of development had been achieved by technical progress and accumulation and which was held at that level by restraint of population growth" (Robbins, 1968, p. 13).

Mill also gives a plausible explanation for the fluctuations in business. He sees them as a response to irrational behaviours of economic actors following a fall in the rate of profit caused by the growth process which makes them "dissatisfied with the ordinary course of safe mercantile gains" (Mill, 1965, p. 718). According to Robbins (1968, pp. 62-63), Mill also highlights the fact that the desire to consume may vary at brief intervals. He showed that a restraint or delay in consumption may lead to an abundance or an excess of commodities. Consequently, this may impact the capital employed in the production process. As long as the commodities are unsold (i.e. when there is stagnation), the capital employed remains inactive and cannot be employed in further production (Mill, 1965, pp. 274 et ss.).

What is clear from this classical growth model is that the economy unavoidably falls into a steady state due to the diminishing returns to the factors of production. Mill suggests that the steady state may evolve as a result of the human capacity to comprehend the world, which, he believed, is not part of the economic process but lies beyond it, and is therefore exogenous to the growth process (Romer, 1989, p. 3).

3.2.3 Marshall: The role of the fourth factor on the division of labour

In his *Principles of Economics*, Alfred Marshall (1920) seeks to get closer to the conditions of actual life by getting rid of the assumptions of a stationary state (Marshall, 1920, p. 306). The assumption of the constant working population is set aside, and he introduces an assumption which affirms that increasing returns to accumulation may be present, which contrasts with the classical view (Marshall, 1920, p. 306).

In Book IV of *Principles of Economics*, Marshall (1920) adds a fourth factor of production to the traditional trio of land, capital and labour: organisation. This fourth factor increases the efficiency of labour through the process of the division of labour, following Smith's insights. Interestingly, Marshall (1920) examines the role of the division of labour in relation to the use of machinery (book IV, chapter IX), the localisation of industries (book IV, chapter X), and to large-scale production (book IV, chapter XI).

Regarding the relationship between division of labour and the growth of machinery, Marshall (1920, p. 212) points out that it not only simplifies workers tasks and increases productivity but also that "[…] any manufacturing operation that can be done over and over again in the same way, is sure to be taken over sooner or later by machinery". In this sense, machinery takes over manual skills and consequently diminishes the advantage of the division of labour. However, this negative effect is counterbalanced as machinery becomes more complex and increases the "demand for judgement and general intelligence" which expands the breadth of the division of labour (Marshall, 1920, p. 214). Nonetheless, Marshall (1920, p. 215) also stresses the fact that even though labour gets more and more subdivided, the line of division becomes narrower and tasks becomes less distinct. He argues that:

> Each person should be employed constantly in a narrow range of work, but also that, when it is necessary for him to undertake different tasks, each of these tasks should be such as to call forth as much as possible of his skill and ability. (Marshall, 1920, p. 220)

This reasoning is analogous for machinery. The relationship between division of labour and development of machinery is a dynamic process that encompasses a notion of a certain continual change.

This first aspect of the division of labour calls for a second one: localisation patterns. These economies (of specialised skills and machinery) may easily be envisioned in large establishments but may also depend on the volume of production in a "neighbourhood" (Marshall, 1920, p. 220). Henceforth, Marshall (1920, p. 221) makes the distinction between internal economies (those presented above) and external economies arising between establishments, or in other words, arising due to the localisation of the industry. He stresses the importance of "the concentration of specialized industries in particular localities" in building advantages resulting from the growth of subsidiary trades, the use of "highly specialized machinery" or the creation of a local market for special skill (Marshall, 1920, p. 225). Another interesting aspect is the dynamic process behind the effect of localisation on the development of subsidiary activities, as illustrated by Marshall as follows: "[…] if one starts a new idea, it is taken up by others and combined

with suggestions; and thus it becomes the source of further new ideas" (Marshall, 1920, p. 225).

As mentioned above, localisation also positively affects the local market for special skills as it constantly provides for skill, but Marshall (1920, p. 226) also warns that having an industry too localised "makes too extensive demands for one kind of labour". However, this can be counterbalanced by having employment outside of those localised industries which can be combined with that in localised industries (Marshall, 1920, p. 226). Furthermore, if a district (or a given location) depends on one industry, it may, according to Marshall (1920, p. 227), be susceptible to depression as a consequence of shortages of raw materials or falls in demand. Similarly to the localisation of special skills, he also points out that this risk can be overruled by the localisation of several distinct and strongly developed industries that can support each other.

Marshall (1920) also investigates the division of labour in regard to large scale production, or put differently, between large and small manufacturers. He argues that the advantage of large-scale production is the economy of skills and machinery. He suggests that as machinery becomes more complex and expensive, small manufacturers cannot afford it. Maintenance, repair and depreciation may become a liability for smaller companies (Marshall, 1920, p. 235). Similarly, smaller companies may be subject to higher risk regarding experimenting with new machinery or processes. He also points out that what has been developed in regard to specialised machinery also applies to specialised skills (Marshall, 1920, p. 236).

The reason for including these external and internal increasing returns is to overrule the fatalistic conclusions of Ricardo and Malthus (Romer, 1994, p. 14). Broadly, Marshall (1920, p. 265) concludes that: "while the part which nature plays in production shows a tendency to diminishing return, the part which man plays shows a tendency to increasing return". Hence, a growth in labour and capital will improve organisation which in turn positively affects efficiency of both labour and capital. It is then a balance between human-induced increasing and nature-induced diminishing returns. In addition, it should be noted that, for Marshall (1920, p. 185), civilisation is continuously evolving (i.e. developing "new wants" or "more expensive ways of gratifying them") even though the rate of progress may be slow or regressive. In fact, he writes that:

> There seems to be no good reason for believing that we are anywhere near a stationary state in which there will be no new important wants to be satisfied; in which there will be no more room for profitably investing present effort in providing for the future, and in which the accumulation of wealth will cease to have any reward. (Marshall, 1920, pp. 185-186)

According to Kurz and Salvadori (2003, p. 19), Marshall finds that the economy grows constantly at the same rate as the exogenous growth of the population "along a steady-state growth path". Lavezzi (2003) also notes that: "Marshall advances an idea of industrial dynamics and progress". To sum up, Marshall's thinking is based on Smith and the division of labour, which acts as a source of continuous reorganisation of the economy (Lavezzi, 2003).

3.2.4 Schumpeter: the influence of market power on innovation and growth

Schumpeter was critical of explaining growth only in terms of macroeconomic components. For him, the strategic position of firms and structural changes are factors of growth, therefore having a microeconomic dimension (Erixon, 2007, p. 4).

Schumpeter regards growth as the result of innovations that he considered to be supply-side (Schumpeter, 1935a, pp. 317-318) and highlights the crucial role of entrepreneurs who execute new combinations (Schumpeter, 1935a, p. 330). In fact, the means of production can be reassembled into new combinations such as (1) the manufacturing of new products, (2) new techniques of production, (3) new market opportunities, (4) conquest of sources of new raw materials, or (5) new organisational structures such as monopolies (Schumpeter, 1935a, pp. 318-319). It is of importance to note that these new combinations do not suddenly replace old ones but rather juxtapose them. For Schumpeter (1944, p. 83), this is "the fundamental impulse that sets and keeps the capitalist engine in motion". This view is in contradiction with the classical theories since neither population, capital nor monetary systems sets the economy in motion. He also adds that this process "incessantly revolutionizes the economic structure from within, incessantly destroying

the old one, incessantly creating a new one" (Schumpeter, 1944, p. 83). This process is known as "creative destruction".

It is also interesting to note that the idea of reassembling sources of knowledge or known ideas to generate new ones is not new. As presented above, Smith also wrote on this idea in *An Inquiry into the Nature and Causes of the Wealth of Nations*. However, Schumpeter takes a more provocative position by conceiving that an entrepreneur may reassemble not only knowledge sources but also factors of production. As shown above, this reassembling of factors of production creates a "rupture of existing patterns of economic relationships" (Robbins, 1968, p. 16).

Schumpeter also distinguishes between the competition within "invariant conditions, methods of production and forms of industrial organisation" and the competition "from the new commodity, the new technology, the new source of supply, the new type of organisation", the latter being the one that counts in the sense that it "commands a decisive cost or quality advantage" (Schumpeter, 1944, p. 84). There can be a competitive situation even though only one firm is active in a field, consequently creating a monopoly. If, for example, a new method of production has been developed, the product of this method still has to compete with the old ones. Or if a new commodity is developed, the expected demand actually has to adopt the new commodity. Therefore, Schumpeter (1944, p. 102) concedes that there may be a monopoly gain in the "entrepreneurial profits" that are "the prizes offered by capitalist society to the successful innovator". In this sense, market power is an important factor influencing innovation, which is key in stimulating economic growth.

Through Schumpeter's work, the Schumpeterian theories emerged, the central idea of which is the process of economic growth based on the policies, regulations and institutions that spur innovation and the development of new technologies, consequently making the growth process endogenous (Ha and Howitt, 2007, pp. 734-735). These new Schumpeterian models of growth are articulated around the concept of creative destruction and assume constant returns to knowledge stock in R&D (Ha and Howitt, 2007, p. 734). These models predict that total-factor productivity will continue to grow as long as there are no changes in the determinants influencing R&D spending (Ha and Howitt, 2007, p. 735).

3.2.5 The emergence of Keynesian theories of growth: The models of Harrod and Domar

It can be said that while mainstream neoclassical growth theories are supply-led, which means that growth is brought about by an increase of productivity or by the level of the factors of production, Keynesian growth theories can be characterised as demand-led, namely an increase of aggregate demand will trigger economic growth (Setterfield, 2016, p. 211). Put another way, neoclassical analysis is based on Say's Law: demand will adjust to supply, while Keynesian theories reject Say's Law.

In the 1940s, the growth models of Harrod and Domar are based on Keynes's General Theory. They are the result of the work of two economists, first Roy Harrods in 1939 and then Evsey Domar in 1946 (Harrod, 1939; Domar, 1946). Both initial models are very similar and commonly believed to be equal, however, they do have some distinctions. The models are based on a single sector and the saving function is dependent on the levels of output and investment, the latter being driven by the rate of change in output (Holt, 2016, p. 361).

Harrod's model is dynamic in nature and therefore focuses on the long-term (Harrod, 1939, p. 15). To elaborate this argument, Harrod (1939, p. 15) introduces his article by asking the reader (i.e. economists): "Suppose the level of exports begins and continues to increase steadily, or suppose its rate of increase to increase, or suppose labour-saving inventions begin to be made in a steady or growing stream […]", thereby making it dynamic by definition.

Wan (1971, p. 12) writes that there are two key features of the Harrod model: (1) the fixed capital/output ratio, and (2) the adjustments that are triggered by the level of actual investment in regard to its desired level. In Harrod's work, there are three rates of growth: the warranted rate of growth, the natural rate of growth and the proper warranted rate of growth (Harrod, 1939), the warranted rate of growth being the one which "will leave all parties satisfied" (Harrod, 1939, p. 16). However, there is no inclination to think that these rates will be equal, which leads to instability (Harrod, 1939, p. 31). In this model, he accounted for the fact that the level of investment may be above or below the desired level. This specificity allows for cyclical fluctuations when the economy varies between

increasing and decreasing growth rather than staying constant (Holt, 2016, p. 361). This triggers the consequence that there could be unemployment or inflation forcing the government to intervene (Solow, 1956, p. 65).

In Harrod's model, investment by firms drives the aggregate demand and therefore output (Harrod, 1939). In the investment function, the investment by firms is positively related to increasing output. This relationship is the "accelerator effect" which accounts for the fact that firms are stimulated by the will to "ensure that their productive capacity keeps pace with economic expansion" (Setterfield, 2016, p. 222). Harrod (1939, p. 23) explains this "stimulus to expansion" by the fact that "some individuals are jogging on at a steady level, others are risking an increase of orders or output, others are willy-nilly curtailing". Hence, growth is a consequence of the action of those individuals and some may be disappointed by the situation even though the rate of growth is equal to the warranted rate of growth. If there is an expansive force taking place, then individuals will catch up (Harrod, 1939, p. 23).

A notable element of Harrod's model is the "disequilibrium analysis" resulting from the instability of the model. In fact, Harrod allowed for the inclusion of the erroneous anticipation of firms in the process, with the expressions of over-production or under-production (Harrod, 1939, p. 23). Over-production appears when individuals have produced or ordered too much and have an "unwanted volume of stocks or equipment" (Harrod, 1939, p. 24). This situation occurs when production is below the warranted level. In contrast, under-production is the result of a situation where production is above the warranted level (i.e. when producers "are running short of stocks and equipment") (Harrod, 1939, p. 24).

When turning to Domar's model of growth, one can find similarities with Harrod's work. Nonetheless, it has some unique elements, notably regarding two critiques of the Keynesian theory (Wan, 1971, p. 24): (1) the fact that investment not only affects income (the multiplier effect) but also production, and (2) the fact that employment may also be negatively impacted by the fall in income following "unemployment of capital" (e.g. obsolescence of machinery due to bad investment decisions).

For Domar (1946, p. 138), the demand side is missing in most of the models developed, since an increase in labour or labour productivity affects production but not income.

The 'accelerator effect' that is central to Harrod's model is not present in Domar's model. Instead, income is determined by investment as a mean of the multiplier (Domar, 1946, pp. 140-141). There is another difference with Harrod's model, which is the assumption behind investment. Harrod assumed that firms invest following their expectation for the future ("follow the pace"), whereas Domar's focus is technological. As a matter of fact, Domar (1946) accounts for the loss in capital value due to a "junking process". Domar (1946, p. 144) uses the term "junking process" to characterise mistakes made or the "lack of balance between the propensity to save on the one hand, and the growth of labour, discovery of natural resources, and technological progress on the other". Based on this, the central idea of the model is that if there is a junking process, then the cumulative process of investment will be weakened to "the potential social average investment productivity" (Domar, 1946, p. 140) which corresponds to the potential productive capacity and depends on technological progress (Parsons and Smelser, 2005, p. 250).

Two main conclusions can be drawn from Domar's model: (1) an equilibrium is maintained when there is no junking process, and (2) when there is a continuous junking process, then the equilibrium is destroyed (Domar, 1946, p. 146). Nonetheless, Domar (1946, pp. 146-147) mentioned elements leading to recoveries such as a reduction of the propensity to save or an increase in technical progress.

If we sum up and compare both models, they share strong similarities, such as the dynamic dimension (while Keynes's theory was considered static). They have an equilibrium path as well as a more dramatic path. However, they are also different in some ways. An important difference between both models lies in the reason for the disequilibrium. In Domar's model, it is the undermined investment (i.e. junking process) that leads to deviation from the growth path, while in Harrod's model, it is the unstable adjustment process to the desired level of investment which leads to disequilibrium.

Criticism of the models of Harrod and Domar lead to the development of neoclassical models, (i.e. Solow model) and later to the new models of endogenous growth (Wan, 1971, p. 10).

3.2.6 Solow's model of exogenous growth

Neoclassical theories of growth have been revived by the development of the Keynesian theories of growth. In fact, Solow tried to solve the problems and deficiencies that emerged from Keynesian growth theories and in particular from the models of Harrod and Domar (Solow, 1956, p. 65).

Solow (1956) first developed a model based on the criticisms made of the models of Harrod and Domar and notably on their conclusions. He argues that the "long run economic system is at best balanced on a knife-edge of equilibrium growth" where a change in parameters would result in either growing unemployment or inflation (Solow, 1956, p. 65). According to Solow, this is due to the "crucial assumption" that proportions are fixed, notably between factors of production, making it impossible to substitute labour for capital. Therefore, Solow (1956, p. 65) builds a model which abandons the assumption of fixed proportion.

In this model, growth is generated exogenously by technical progress, which can be capital-augmenting, labour-augmenting or both (Solow, 1956, p. 85). However, a problem occurs as technical progress may be considered to affect both capital and labour (Valdés, 1999, p. 17). For example, a computer enhances the capital factor; however, it also makes the employee more productive and hence it is labour augmenting. As a consequence, technical progress should be seen as labour augmenting. In fact, technical progress is assumed to be Harrod-neutral, meaning that the capital/output ratio and the marginal product of capital remain constant as technical progress takes place (Solow, 1956, p. 67). Further, it is assumed that the technological progress is produced outside of the growth process and grows at a rate that is constant and given (Solow, 1956, p. 85). Regarding the growth of the labour force, it is assumed that it grows exogenously at a given rate (Solow, 1956, p. 87).

As a consequence, the model implies that without any exogenous technical progress, the economy will grow at a steady state (i.e. reproduce the same conditions period after period) where the accumulation of capital and increase in labour are not sufficient to generate growth (Valdés, 1990, p. 29).

To conclude, Solow's aim was "to examine what might be called the tightrope view of economic growth and to see where more flexible assumptions about production would lead a simple model" (Solow, 1956, p. 91). Barro and Sala-i-Martin (2004, p. 17) note that the key aspect of the Solow model is the "neoclassical form" of the production function, which associated with the constant-saving-rate rule, spawns a straightforward general-equilibrium model. This, of course, led economists to criticise the model. Solow himself was aware of the flaws of his model. The main criticism consisted of the limited ability of modelling the stylised facts of growth (Wulwick, 1992, p. 37).

3.2.7   The new models of endogenous economic growth

A weak point of Solow's model is the limitation that diminishing returns to capital have on the growth process (Kurz and Salvadori, 2003, p. 22). In fact, the growth of an economy was sustained thanks to the inclusion of exogenous technical progress. In other words, the models did not focus on how technical progress was created and assumed that it was injected in the model. Barro and Sala-i-Martin (2004, p. 18) argue that due to the competitive assumptions of the neoclassical models, a theory on technological change is difficult to implement. They explain that the nature of knowledge, assumed as being a non-rival public good, would generate increasing returns to scale. In 1962, Arrow developed a model where knowledge was generated as a by-product of production, or known under the name of learning-by-doing (Arrow, 1962). Knowledge would therefore flow in the entire economy, instantly available to all actors, since it is considered as non-rival. This twist in the analysis explains growth as an endogenous process since knowledge, and hence technological change, is explained within the process (Holt, 2016, p. 362).

As a consequence, models of endogenous growth try to focus on factors that may cancel out the effects of diminishing returns to capital. Romer's thinking on technical progress (Romer, 1986; Romer, 1987a; Romer, 1990) is key to this current of thought. While Solow's model does not identify the roots of technical progress affecting labour, for Romer (1986, p. 1003), it is the accumulation of knowledge that sustains long-run growth. He states that: "The creation of new knowledge by one firm is assumed to have a positive

external effect on the production possibilities of other firms because knowledge cannot be perfectly patented or kept secret." (Romer, 1986, p. 1003).

Before going deeper into the endogenous growth models, we shall open a parenthesis on the characteristics of endogenous technical progress in order to have the full picture. Wan (1971, p. 215) notes that endogenous technical progress can take many forms: through (1) "inducement" in factor price, (2) "experience" in production (i.e. learning-by-doing), (3) education, or (4) research activities. Consequently, endogenous technical progress may be the result of either "unconscious recognition" (i.e. experience or inducement) or "deliberate economic decisions" (i.e. investment in education or R&D) (Wan, 1971, p. 216). He also notes that when endogenous technical progress is generated as a result of "deliberate economic decisions", one has to determine and explain the conditions for investing in such activities since it encompasses an opportunity cost.

This section will go over the so-called endogenous growth theories, beginning with the seminal works of Uzawa (1965) on human capital before moving to the contributions of (1) Arrow (1962), (2) Romer (1986; 1987a; 1987b; 1990), (3) Lucas (1988), (4) King and Rebelo (1990), and finally (5) Aghion and Howitt (1992). These authors have been studied because they take a different angle on the endogeneity of the growth process. Also, they go over each other's conclusions and hypotheses or are based on previous authors such as Smith, Marshall and Schumpeter.

i   Uzawa: Human capital as determinant of endogenous technical progress

Uzawa (1965) was one of the first economist to introduce the effect of human capital in economic growth models. For Uzawa, growth is generated endogenously through technical progress.

Building on Solow's model, Uzawa (1965) laid the foundations for Romer's (1986) and above all Lucas's (1988) thinking on economic growth. The literature refers to the Uzawa-Lucas model (Barro and Sala-i-Martin, 2004, p. 251) and will be studied later in this subsection. Uzawa's growth model takes over the assumptions of the Solow model

but includes endogenous technical progress, which is labour-augmenting (Uzawa, 1965, p. 18). In this model, growth is determined by "an advancement in the state of technological knowledge" which "is achieved only by engaging scarce resources in some positive quantities, and in analysing the pattern of the allocation of scarce resources that results in an optimum growth" (Uzawa, 1965, p. 18). An important hypothesis of the model, which will later inspire Romer is that all activities which lead to labour efficiency are catalogued as the educational sector (Uzawa, 1965, p. 19). In fact, labour is allocated in the productive sector and the educational sector, and the latter is not used as input in production (Uzawa, 1965, p. 19). Education is seen as the production of human capital. The proportion of labour employed in the educational sector also positively influences labour productivity (Uzawa, 1965, p. 19). However, the increase in labour productivity should remain lower than the increase of the education population/total population ratio. This, according to Wan (1971, p. 232), enables both the fact that education increases productivity and that education benefits every worker and not simply "educated" workers. Uzawa (1965, p. 30) finds that optimal growth is obtained when the rate of increase in labour efficiency is equal to the rate of increase in the capital-labour ratio. Barro and Sala-i-Martin (2004, p. 239) note that the inclusion of human capital in the model enables loosening of the limitation of diminishing returns to capital and makes it possible to have a long-run growth without any exogenous components. However, they also draw our attention to the fact that human capital may be strongly distinguished from knowledge in the sense that the former may be catalogued as being a rival and excludable good as it is embodied in workers who "have property rights on their own skill" with the latter being non-rival and sometimes non-excludable, as knowledge flows instantaneously and may be free of use. However, Uzawa (1965, p. 19) specifies that: "the impact of activities in the educational sector is uniformly diffused over the whole economy" (Uzawa, 1965, p. 19).

ii Arrow and Romer: The influence of experience and learning-by-doing on growth

This subsection begins with Arrow's thinking on technical progress, since the starting point for Romer is Arrow's hypothesis: "technical change in general can be ascribed to experience, that it is the very activity of production which gives rise to problems for which favourable responses are selected over time" (Arrow, 1962, p. 156). Hence, learning happens as an outcome of the attempt to solve a problem that may have occurred during the production process. This is mostly known as learning-by-doing. Learning can therefore be characterised as a capital good and a by-product (Arrow, 1962, p. 172). It should also be highlighted that technical progress, in this instance learning, is labour-augmenting (Arrow, 1962, pp. 157-158). Each new machine that is produced and used will change the way production occurs and therefore create new problems to be solved, hence developing continuity in learning, or put differently a "steady rate of growth in productivity" (Arrow, 1962, p. 157). By investing in capital stock, firms increase the stock of knowledge and therefore their productivity. It is a dynamic process where the quality of labour improves over time and positively influences productivity (Arrow, 1962, p. 172).

However, Arrow (1962, p. 172) was aware of the flaws of his model and notably the following: "society has created institutions, education and research, whose purpose is to enable learning to take place more rapidly. A fuller model would take account of these as additional variables". This will be remedied in later models that have focused on the influence of institutions and R&D activities (Romer, 1987a; Aghion and Howitt, 1992).

Wan (1971, p. 228) considers that the most interesting conclusion of Arrow's model is the welfare implications of learning since it influences the production process in providing capital inputs, integrating the newest technology and stimulating innovation.

Barro and Sala-i-Martin (2004, p. 445) argue that Romer's model is a "generalisation" of Arrow's concept of learning-by-doing. Romer first develops a model of long-run growth where knowledge is an input of production (Romer, 1986). Romer's reasoning is based on Arrow in the sense that the model takes over his assumption that the formation of knowledge is a by-product of investment and as a consequence, it eliminates the tendency

of diminishing returns to capital (Romer, 1986, p. 1019). One could also call this process "learning-by-investing". The intuition behind this is that as a firm increases its physical capital, the employees learn how to produce more efficiently. Therefore, as in Arrow's model, a key assumption is the relation between a firm's investment and stock of knowledge and that the stock of knowledge exhibits diminishing returns (Romer, 1986, p. 1003). Another assumption is the nature of knowledge, which is treated as a public good and therefore is instantly available to the whole economy (Romer, 1986, p. 1003). It means that knowledge which has been generated by one firm will influence the way another firm produces.

What can be drawn from these assumptions? In Romer's growth model, three elements stimulate a "well-specified competitive equilibrium model of growth" (Romer, 1986, pp. 1003-1004): (1) externalities, (2) increasing returns in the production of output, and (3) decreasing returns in the production of knowledge.

In 1987, Romer includes the role of specialisation in the growth process, emphasising its influence on increasing returns (Romer, 1987a, p. 56). This reminds us of Marshall's division of labour and industry localisation.

In a 1990 article, Romer introduced an application where new goods are discovered through units of labour (i.e. in R&D) rather than final products (Romer, 1990). The model is also endogenous because the cost of inventing products diminishes as society accumulates ideas (i.e. products) (Barro and Sala-i-Martin, 2004, p. 310). However, as highlighted in the introduction of this section, investing in R&D requires a decision and induces an opportunity cost. Romer (1990, p. 71) postulates that "technological change that arises from intentional investment decisions made by profit-maximizing agents" drives growth. As a consequence, he argues that a perfectly competitive market with price-taker agent cannot support such decision in investing in R&D, which can only be supported by monopolistic competition (Romer, 1990, p. 73). In fact, it seems legitimate that firms fix a higher price as a return on investment (Romer, 1990, p. 89). This postulate is akin to Schumpeter's "entrepreneurial profits" (Schumpeter, 1944, p. 102).

Romer (1990, p. 72) also considers the cost of creating fixed new "instructions" (to follow for combining raw materials), therefore implying that once created, they can be used without any more costs. He also introduces variety by stating that: "instructions for

working with raw materials are inherently different from other economic goods" (Romer, 1990, p. 72).

The latter model, whose structure is very similar to the Solow model, suggests that integration in an economy with large amounts of human capital is more important for growth than integration in an economy with a large population (Romer, 1990, p. 98).

iii   Lucas's growth model: When comparative advantage triggers structural lock-ins

Following on from Romer's work, Lucas (1988) constructed two models with the aim of following the observations of economic development. He adapted a standard neoclassical model in which he added human capital accumulation processes. An interesting point in Lucas's work is the fact that the worker has the choice between producing and accumulating human capital, which will in turn affect future productivity (Lucas, 1988, p. 17).

His first model is identical to Solow's model with the exception of the inclusion of human capital and its potential accumulation process. Lucas's view of human capital accumulation can be differentiated from Romer's view of learning-by-doing in the sense that a worker can either produce or accumulate capital but cannot do both at the same time (Lucas, 1988, p. 27). In the second model, he adopts the learning-by-doing concept. He concludes that in both models (under the assumption that they are closed, i.e. that no trade is allowed) the equilibrium growth rate leads to lower welfare (Lucas, 1988, p. 31). This is due to the fact that: "the accumulation of human capital involves a sacrifice of current utility" by either a "decrease in current consumption" in the first model or "a less desirable mix of current consumption" in the second model (Lucas, 1988, p. 31).

Lucas (1988, p. 19) pointed out the interesting fact of diminishing returns to human capital accumulation which seemed to be the dead end in Uzawa's model. In fact, human capital accumulates more slowly as time passes. As an alternative, he reformulates capital accumulation in order to eliminate the diminishing returns by postulating that no matter

the level of human capital attained, a percentage increase in human capital always requires the same effort (Lucas, 1988, p. 19).

Lucas opens the second model to trade where each country produces goods for which they have a comparative advantage (Lucas, 1988, p. 31), in other words, countries producing goods where human capital provides an advantage (Lucas, 1988, p. 33). This implies that human capital is specialised in the production of one particular good. He argues that "countries accumulate skills by doing what they are already good at doing" and consequently strengthening their comparative advantage, or reinforcing the accumulation of skill in the production of that particular good (Lucas, 1988, p. 33). Hence, it will "lock in place" a given pattern of production with a stable growth rate in each country (but different between countries) (Lucas, 1988, p. 33).

One force that can be counted on to offset this lock-in is the sophistication and modification of the demand over time. A second one may be the introduction of new goods. Both these forces will push trade into a new constellation (Lucas, 1988, p. 34).

A credit of Lucas's work is the debate on human capital. Notably, he mentions that human capital is an "unobservable magnitude or force" (Lucas, 1988, p. 35). An interesting specification of Lucas's model is the use of the average capital per worker, rather than the aggregate level (Barro and Sala-i-Martin, 2004, p. 219). The reflection behind the use of the average rather than aggregate level is that, since human capital involves dimensions such as skill, learning and spillovers, then it is the average level of human capital that affects the productivity of each individual and hence of the firms (Lucas, 1988, p. 37).

Finally, Lucas (1988, p. 36) is also concerned with the external effect of human capital and based his reflections on the work of Jacob (1969). Based on Jacob and her work on cities, Lucas' reflection is that cities have a similar effect as the external effect of human capital. He refers to cities as places with "a collection of people doing pretty much the same thing, each emphasizing his own originality and uniqueness" (Lucas, 1988, p. 38).

iv   <u>King and Rebelo: The influence of attractive taxation</u>

King and Rebelo (1990, p. 127; p. 133) follow the works of Solow, Uzuwa and Lucas. The result of King and Rebelo's model (1990) is similar to Lucas's findings. They first develop their model by focusing on individuals' decisions and aspects of individual technology accumulation and then move on to the analysis of taxation and its effect on individuals' decisions (King and Rebelo, 1990, p. 127).

They also use an endogenous growth model with two sectors and with human capital as a key component. In this model, both real capital and human capital can be accumulated. As public policy measure, they chose taxation of commodity outputs by arguing that it bears a variety of public interventions (e.g. property rights regulations) (King and Rebelo, 1990, p. 128). The goal is to analyse the role that public policy incentives have on human capital accumulation, which is the source of economic growth.

They show that attractive taxation can lead small countries with important capital mobility to higher growth rates (King and Rebelo, 1990, p. 126). They find that public policies exert an important influence on growth, particularly if the economy is open to capital trade.

Overall, King and Rebelo (1990, p. 148) came to three main conclusions. First, public policies can influence the growth of economies producing in isolation and, when an economy is open to trade (access to international capital), the incentive effects of taxation on human capital accumulation are reinforced. Second, the "effects of taxation depend importantly on aspects of the production technology for new human capital". This comes from the fact that human capital is "a composite of many different activities". Regarding that specific conclusion, King and Rebelo (1990, p. 148) argue that microeconomic measurements would help to understand the comprehension of the formation of human capital. And third, public policies have a bigger influence on endogenous growth models than classical growth models (with exogenous technical progress).

v Aghion and Howitt: The influence of imperfect competition in
   research incentives

Following on from the works of Romer (1986; 1987a; 1987b; 1990) and Lucas (1988),
Aghion and Howitt (1992) also focused on the relationship between research, imperfect
competition and economic growth. They focus particularly on industrial innovations and
the inclusion of a new dimension: the obsolescence of products (Aghion and Howitt,
1992, p. 323; Barro and Sala-i-Martin, 2004, p. 20). An important source of inspiration
was Schumpeter's work and notably the process of "creative destruction" and the role of
imperfect competition (Schumpeter, 1944). The dimension of the obsolescence of
products is similar to Domar's "junking process" which refers to the fact that new
investments may render certain assets "useless" (Domar, 1946, p. 144).

In their endogenous model, growth is generated by the inclusion of a competitive research
sector which produces vertical innovations (Aghion and Howitt, 1992, p. 323). They
argue that the motivation to invest in future research activities dampens current research
by "threatening to destroy rents created by current research" (Aghion and Howitt, 1992,
p. 323). This is a typical case of "creative destruction" where inputs are "reorganised"
into new structures which, according to Aghion and Howitt (1992), reduces the incentives
in investing in current R&D activities. In fact, by including obsolescence in the process,
by definition, new products rule out old ones. As a consequence, the creation of new
products induces both a creation of value (via the new products) and a loss of value (due
to the obsolescence of old ones) (Aghion and Howitt, 1992, p. 323).

Therefore, the level of research between two consecutive periods is negatively related
(i.e. a period is the time between two successive innovations) (Aghion and Howitt, 1992,
p. 324). More specifically, in their model, the level of research in a given period is
negatively dependent on the expected level of research in the following period. This is
the result of two effects: (1) the rent that research engenders is the anticipation of a
monopoly position in the following period and the position will last for as long as no
other innovations occur, and (2) a general equilibrium effect triggered by the wage of
"skilled labour" used in either research or manufacturing (Aghion and Howitt, 1992, p.
324). This last effect must occur in order to respect the labour market. In fact, they argue
that: "the expectation of more research next period must correspond to an expectation of

higher demand for skilled labour in research next period" (Aghion and Howitt, 1992, p. 324). This can be achieved through higher real wages and therefore reduces the monopoly rents.

Aghion and Howitt (1992, p. 349) conclude that "growth results exclusively from technological progress, which in turn results from competition among research firms that generate innovations". They specify innovation in the sense that they are new intermediate goods that enable more efficient production of end outputs (Aghion and Howitt, 1992, p. 349). However, when new innovations are introduced, existing intermediate goods will become obsolete alongside their monopoly rents. As a consequence, they find that there is only one stationary equilibrium defined by the relationship between research in two successive periods (Aghion and Howitt, 1992, p. 324).

3.3   Synthesis: What determinants drive economic growth?

The aim of this chapter was to go over the growth theories that were developed throughout the centuries in order to look for elements that join both concepts of economic resilience and clusters. Table 3.2 at the end of this section, summarises the main conclusions of each author studied in this chapter. Many determinants of economic growth have been identified, ranging from capital accumulation, trade and human capital to incentives in investing in R&D. These determinants were also compared to the potential growth equilibrium that they engender in each theory.

The chapter first presented the records of economic growth as well as the stylised facts in order to give the reader a clearer picture of the evolution of economic growth. In the second section, authors were analysed in a chronological order, beginning with Smith.

For Smith, growth is endogenous and has no limit. The theory concentrates on the determinants that influence the growth of labour productivity such as the division of labour. The division of labour is accompanied by new market and new knowledge creation. The conclusion that there is no limit to the growth process is shared by Ricardo with condition: that there is no restriction in the consumption of ornaments and luxuries.

Otherwise, in Ricardo's view, the economy gets trapped in a stationary state due to diminishing returns. Technical progress can only counterbalance those diminishing returns until a certain point.

This view is shared by most of the classical authors, and notably by Malthus and Mill. While for Malthus, it is trade that makes it possible to extricate the economy from the steady state, Mill argues that this finality can only be reached by the 'capacity to understand the world'. Overall, Ricardo, Malthus and Mill find that the economy gets trapped in a steady state in the long run. Nevertheless, they have suggested possibilities to move beyond it.

Following the classical theorists, Marshall and Schumpeter have also proposed a microeconomic-based approach to growth. In his theory, Marshall introduces a fourth factor of production: organisation. Organisation increases labour efficiency through the division of labour in relation to (1) the use of machinery, (2) the localisation of industries, and (3) large-scale production. In Marshall's growth theory, the principal aspect is the focus on productivity depending on specialisation on narrower tasks. This is akin to Smith's vision of growth and of the division of labour. In Marshall, when new ideas are developed, they are taken over by others and serve as a basis for the development of new ideas. While Marshall's focus is on specialisation and externalities, Schumpeter investigates the role of entrepreneurs on economic development. Entrepreneurs innovate by developing new combinations that grant them a temporary superior profit. Hence, innovation stimulates economic growth. In particular, Schumpeter stresses the importance of competition from new commodities or technologies.

In the first half of the 20th century, Harrod and Domar have proposed a more aggregated growth model. In Harrod's model, investment is represented by the aggregation of the investments made by each individual, with different expectations about the future, and consequently different behaviour. As a result, growth is unstable, which creates fluctuations that force governments to intervene. While Domar's approach produces the same result, the process is slightly different. It is the technology which leads to an unstable growth path by generating a loss in capital value due to the emergence of a 'junking process'. Consequently, both models lead to an unstable growth path.

Following the models of Harrod and Domar, and building on their criticisms, Solow proposes a model which is closer to the actual records of economic growth. Growth is explained by the introduction of external technical progress. Without an exogenous component (i.e. exogenous technical progress that can be both labour and capital augmenting), growth cannot be sustained. This flaw has been corrected in the so-called "new models of endogenous growth", where technical progress is inherent to the growth process. In fact, authors such as Uzawa, Arrow, Romer and Lucas argue that technical progress is labour augmenting and endogenous. For Uzawa, technical progress takes the form of workers active in an "educational sector" which influences labour productivity. In Arrow's model, the educational sector is replaced by the concept of learning-by-doing, considered as a by-product of production. Thanks to the learning-by-doing process, labour productivity increases over time and generates growth. Romer improves Arrow's understanding of endogenous technical progress by including externalities. In fact, knowledge is treated as a public good. Further, Romer argues that investment in R&D is only possible if firms can gain a monopolistic profit.

In Lucas's models, the conclusions are different from Uzawa, Arrow and Romer since the economy gets trapped in a given structural patterns. In fact, workers face an opportunity cost: they can either choose between production or human capital accumulation (i.e. which affects productivity at a later stage). Hence, growth leads to lower welfare. The solution would be to allow economies to trade. However, Lucas finds that an economy produces goods for which it has a comparative advantage. As a consequence, economies accumulate skills and knowledge in the production of goods for which they already have an advantage. In this process, the economy gets trapped in a given pattern. However, an economy would be able to move towards other structural patterns with the evolution of human needs and demand sophistication.

Finally, two different aspects are investigated through the works of King and Rebelo (1990) as well as Aghion and Howitt (1992). First, King and Rebelo (1990) argue that taxation bears a variety of public interventions which influences the accumulation of human capital. They find that attractive taxation leads small countries with significant capital mobility to higher growth rates. Aghion and Howitt (1992) focus on the incentives to innovate. They follow Schumpeter's theory as well as introducing a concept close to Domar's 'junking process', notably the fact that growth is generated by innovation and

hampered by obsolescence. They argue that the obsolescence of products hampers the incentives to invest. In fact, investments in current research are threatened by future research which makes old assets useless. As a consequence, there is only one stationary equilibrium defined by the relationship between research in two successive periods.

Table 3.2 below summarises the main conclusions of each author studied in this chapter. They appear in the same order as in this chapter. Based on the conclusions of this chapter, an analysis of the relations and the underlying mechanisms between growth theories, clusters and economic resilience will be carried out in the fifth chapter (section 5.2).

Table 3.2: Recapitulation table of the mechanisms and determinants found in chapter 3 (classified by authors).

Subsection	Author(s)	Key determinant(s), mechamisms and characteristics
Smith	Smith	Growth is endogenous and concentrates on the determinants that influence the growth of labour productivity. The division of labour occurs thanks to the exchange and barter of goods as well as the increasing sise of markets. In order to stay competitive (i.e. gain a normal profit), firms have to improve their goods and production activities which is achieved through the division of labour. **Mechanism:** The division of labour increases capital accumulation, which further increases labour productivity. Eventually, new markets are developed which triggers an increase in demand and a sustained growth process. The division of labour (i.e. dexterity, learning-by-doing) within and between firms and industries is accompanied by new knowledge creation that becomes a public good and which further increases the competitive environment. Finally, for Smith, there is no limit to growth.
Classical	Ricardo	Growth is exogenous and follows a "natural course of events" where fertility of land is crucial and is different from one country to another (i.e. initial productive capacities matters). Hence, profits depend on the quantity of labour and the quality of land. **Mechanism:** Capital accumulation increases labour but leads to diminishing returns to land. Consequently, the rate of profit is falling which further decreases capital accumulation. Consequently, the economy reaches a stationary state. Nonetheless, Ricardo allows for external technical progress which can replace portions of the labour force. It reduces the diminishing returns to land. However, if technical progress is too low, then it cannot counterbalance the diminishing returns to land and, therefore, growth diminishes.

		Yet, Ricardo argues that while there are limits to the consumption of food, there is no restriction in the consumption of ornaments and luxuries. Ergo, capital can be invested with no limit in those sectors which sustains growth through the accumulation of capital in the production of ornaments and luxuries. The focus is on growth over the long run.
Classical	Malthus	**Mechanism:** High wages are accompanied by both population growth and an increase in consumption of convenience and comfort. Similarly to Ricardo, there are no limits on engaging capital in these sectors. However, with "convenience" comes "love of ease" which negatively impacts demand and reduces profits as well as capital accumulation. Consequently, the power of production is not sufficient to sustain growth. A proposed solution is commerce which acts as a way to spark new motives for producing through new "wants". These new motives for production sustain the growth process. The focus is on growth over the long run.
Classical	Mill	The economy is trapped in a steady state due to diminishing returns to land and population growth. Nonetheless, the steady state can evolve thanks to the 'human understanding of the world' (i.e. process of civilisation). However, this component is treated as exogenous. **Mechanism:** This process of civilisation is composed of technological innovation, increase in security of people and property as well as cooperation between persons. It further increases physical knowledge which is converted into physical power (i.e. production). A stationary state is reached when a high development is achieved.

		Moreover, fluctuations in business are due to irrational behaviour of economic actors which leads to restrains of consumption. It is translated to unsold goods. As a consequence, capital is trapped and cannot be reinvested until the goods are sold.
Conclusion drawn from the classical theories: The economy gets trapped in a steady state. However, there are different ways to overcome the steady state: (1) investment in "ornaments commodities", (2) commerce (which generate the creation of new wants and new motive for production), and (3) the capacity to understand the world (i.e. exogenous technical progress).		
Marshall	Marshall	The fourth factor of production is organisation (according to Marshall). **Mechanism:** Organisation increases labour efficiency through the division of labour in relation to (1) the use of machinery, (2) the localisation of industries, and (3) large-scale production. Growth is a balance between human-induced increasing returns and nature-induced decreasing returns. The division of labour and the use of machinery: It increases labour productivity. Indeed, workers are specialised in narrower tasks but must be able to perform other tasks in relation to their skills. The division of labour and the development of machinery is a dynamic process which triggers a continual change.

		The division of labour and the localisation of industries: The specialisation of skills and machinery is more easily possible in large firms as well as in the aggregate production of a "neighbourhood". This is known as external economies. Also, the dynamic process is as follows: a new idea is taken up by others and combined with supplementary suggestions which end up being a new source for further ideas. However, if a "neighbourhood" is too specialised in one industry, there is a risk of being susceptible to depression. A solution would be the localisation of several distinct and strongly developed industries that can support each other. The division of labour and large-scale production: Economies of skill and machinery makes it easier for big firms to afford machinery that becomes more and more complex (in terms of maintenance, repair, etc.). For Marshall, there is no reason to be near a stationary state because of new wants. Also, the division of labour acts as a source of continuous reorganisation of the economy.
Schumpeter	Schumpeter	Growth is the result of innovations. **Mechanism:** Innovations are carried out by entrepreneurs who seek a monopoly gain. Entrepreneurs execute new combinations such as, *inter alia*, developing new products, new techniques of production by reassembling sources of knowledge as well as factors of production. Entrepreneurs obtain a market power which gives them an entrepreneurial profit. This profit increases the incentive for innovations which further stimulate growth. These new combinations take the place of old ones in a continuous process which keeps the capitalist process in motion. This continuous process incessantly changes the economic structure: it is called "creative destruction".

		Entrepreneurs can reassemble sources of knowledge as well as factors of production.
		For Schumpeter, it is the competition "from the new commodity, the new technology, the new source of supply, the new type of organisation" which "commands a decisive advantage", as opposed to competition within "invariant conditions" (Schumpeter, 1944, p. 84).
Keynesian	Harrod-Domar	Change in output influences investment and growth.
		Mechanism: In Harrod's model, firms' investments are stimulated by the will to keep the pace of expansion (i.e. accelerator effect which reflects an estimation made by firms about the future). The stimulus to expansion comes from the fact that some individuals are on a steady level, others are risking an increase, and others experiencing a decrease. Growth is the aggregation of those individuals which makes it unsteady.
		Hence, cyclical fluctuations are due to the level of investment being above or below the desired level. This forces governments to intervene in order to prevent unemployment or inflation.
		While investors in Harrod's model are driven by the fact that they "follow the pace", in Domar it is technologically motivated.
		Mechanism: Domar introduces the concept of 'junking process' (i.e. loss in capital value due to lack of balance between saving on the one side and growth of labour, discovery, technical progress on the other). This junking process weakens the cumulative process of investment to the level of potential productive capacity which depends on technological progress. Put differently, the junking process undermines investment, which leads to deviations from the growth path.

		If there is no junking process, then investment, income, capital and productive capacity will grow at same rate. The economy would reach an equilibrium. For Domar, recoveries are possible if there is an increase in technical progress. The focus is on growth over the long run.
Neoclassical	Solow	Growth is generated exogenously by technical progress (i.e. capital augmenting, labour augmenting or both). **Mechanism:** Without exogenous technical progress, the accumulation of capital and increase in labour are not sufficient for generating growth. Consequently, the economy grows along a steady state. The focus is on growth over the long run.
New models	Uzawa	Growth is generated through endogenous technical progress (i.e. labour augmenting). **Mechanism:** The educational sector positively influences labour productivity. Optimal growth is reached when the increase in labour efficiency is equal to the increase in the capital-labour ratio. Labour can be employed either in the productive or educational sector (i.e. source of human capital) and activities of the educational sector are uniformly diffused over the whole economy.
New models	Arrow-Romer	Arrow: Technical change is equal to experience (i.e. production engender problems that can be solve by experience). Hence, the concept of learning-by-doing is a capital good or a by-product of production. **Mechanism:** Investment in capital stock stimulates learning-by-doing which further increases the stock of knowledge. Consequently, labour improves over time which in translated in an increase in productivity and economic growth. However, Arrow does not take into account factors that may accelerate the learning-by-doing such as institutions or education.

		Romer makes a generalisation of Arrow's model where knowledge is treated as a public good which is instantly available to the economy. By doing so, Romer accounts for externalities, increasing returns of output and decreasing returns of knowledge. Also, for Romer, the cost of inventing products diminishes as society accumulates ideas (i.e. products). Also, investing in R&D is only possible in monopolistic markets because firms need a return on investment.
New models	Lucas	In Lucas's first model, workers can choose between production or human capital accumulation (which affect productivity at a later stage). Hence, they cannot do both and therefore involves a sacrifice. Consequently, human capital accumulation involves a decrease in consumption. Hence, the equilibrium growth rate leads to lower welfare. A solution is the openness to trade. **Mechanism:** The second model is open to trade for goods which have a comparative advantage (i.e. for which human capital provides an advantage). Therefore, human capital is specialised in the production of one particular good. As a consequence, countries accumulate skills in producing goods for which they have already an advantage. However, this process locks in place the location, which gets trapped in a given structural pattern. A solution would be to consider that the sophistication of demand and human needs evolve over time, which would push trade to a new constellation. Lucas was inspired by Jacob and considers that the external effect of human capital is akin to those of cities.

New models	King and Rebelo	Hypothesis: taxation bears a variety of public interventions.
		The authors look at the influence of public policy measures (i.e. through taxation of small countries) on human capital accumulation and, consequently, on economic growth.
		They show that attractive taxation can lead small countries with important capital mobility to higher growth rates.
New models	Aghion and Howitt	They study the relationship between imperfect competition and growth with a focus on industrial innovations and the obsolescence of products.
		For competitive research sectors that produce vertical innovations, the investment in current research is threatened by future research (inputs are reorganised into new structures). The rent of research is the anticipation of a monopoly position (similar to Schumpeter's theory). It is based on both Schumpeter's process of creative destruction and Domar's junking process.
		Mechanism: New investments make old assets useless. Consequently, future investment eliminates the rents created by current research, which is analogous to a case of creative destruction. Hence, inputs are reorganised into new structures which reduces incentives for R&D activities.
		Conclusions:
		▪ Competition amongst research firms generates innovation and technological progress. This process triggers economic growth.
		▪ There is one stationary equilibrium defined by the relationship between research spending in two successive periods.

Source: Personal elaboration.

Chapter 4

An investigation of business cycle theories

In this fourth chapter, a similar analysis as in the previous chapter is carried out, with a focus on business cycle theories. The study of the selected theories of business cycle helps to highlight elements that may influence economic resilience from a cluster perspective. Similarly to the previous chapter, the selection of theories is up for debate. The methodology applied is identical to that of chapter 3. Hence, theories and models are selected in relation to (1) the microeconomic environment (as described in chapter 1), and (2) the conclusions of chapter 2. The theories are presented in chronological order. The analysis of the relationships and the underlying mechanisms between business cycle theories, clusters and economic resilience will be carried out in the fifth chapter (section 5.2).

This chapter begins with the presentation of the stylised facts of economic fluctuations before moving on to the theories in a second section. Firstly, the seminary works of Burns and Mitchell are explained and will pave the way for the analysis of Pigou, who emphasises the role of expectations as the determining factor of business cycles. The effect of innovation is then brought into the picture with Schumpeter's view. Haberler's theory of the business cycle is then tackled and, more precisely, the focus will be on the influence of international trade on economic fluctuations. There is then a short explanation of real business cycle (RBC) theories as a bridge between the 'older' theories of business cycle (i.a. Mitchell, Pigou, Schumpeter and Haberler) and the 'new' explanations of business cycles. In fact, RBC theories which strongly rely on mathematical principles, and Keynesian and monetarist theories (which are not

165

considered in this chapter), have not been able to provide a convincing explanation of business cycles. As a consequence, new alternative theories have emerged based on, for example, financial considerations and industrial structures. These theories will be presented in the end of section 4.2. Finally, section 4.3 provides a synthesis similar to the ones in the previous chapters.

4.1   Stylised facts and records of business cycles

Business cycle theories aim to show (1) "where and how wave movements start" or put differently what is (are) the cause(s) of business cycles, and (2) "how the original wave movement spreads from its source over all the processes of industry, commerce, and finance" (Mitchell, 1927, p. 54).

Jones (2015, p. 3) notes the "anomalous" effect of the Great Depression on the decline of GDP per capita when looking at a broad time span, much like many recessions (see figure 4.1). However, they do not last for a long period of time and the economy finishes by rejoining the growth path it followed before the crisis. It is also important to note that the causes of these crises are diverse, for example, demand shocks, wars or geopolitical tensions, which impact the economy in different ways.

Figure 4.1: England's real GDP per capita for the period 1900-2016.
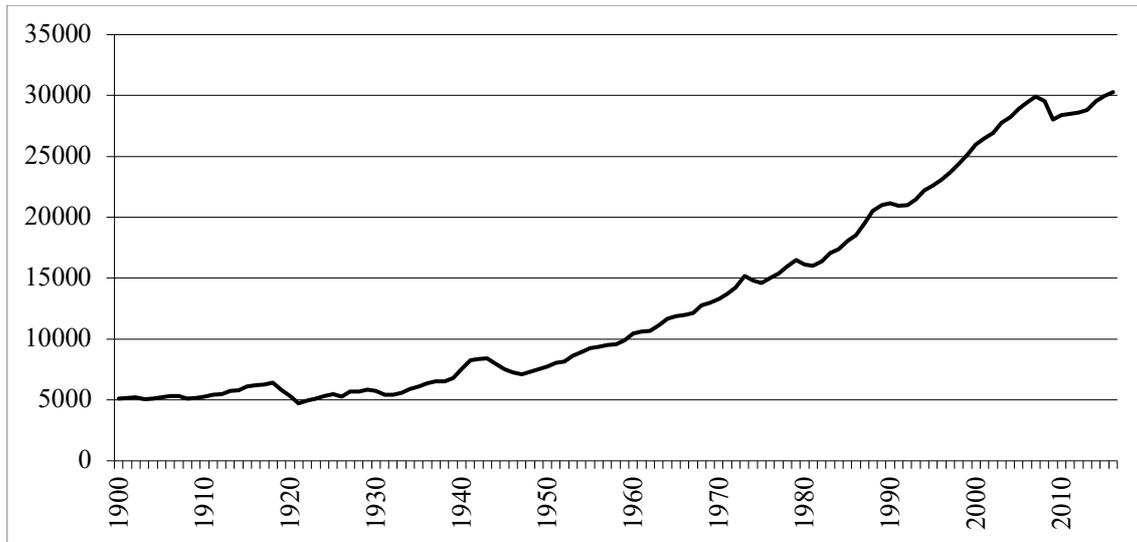
Another feature of the data on England from 1700 until 2016 can be highlighted. When depicting the annualised growth (figure 4.2), one can see that the volatility tends to slightly attenuate over time. In figure 4.2, the volatility is presented for periods of 20 years. It can be seen that the volatility seems to lower over time.

Figure 4.2: The yearly rate of growth and the 20 years average standard deviation of England's GDP per capita for the period 1270-2010.
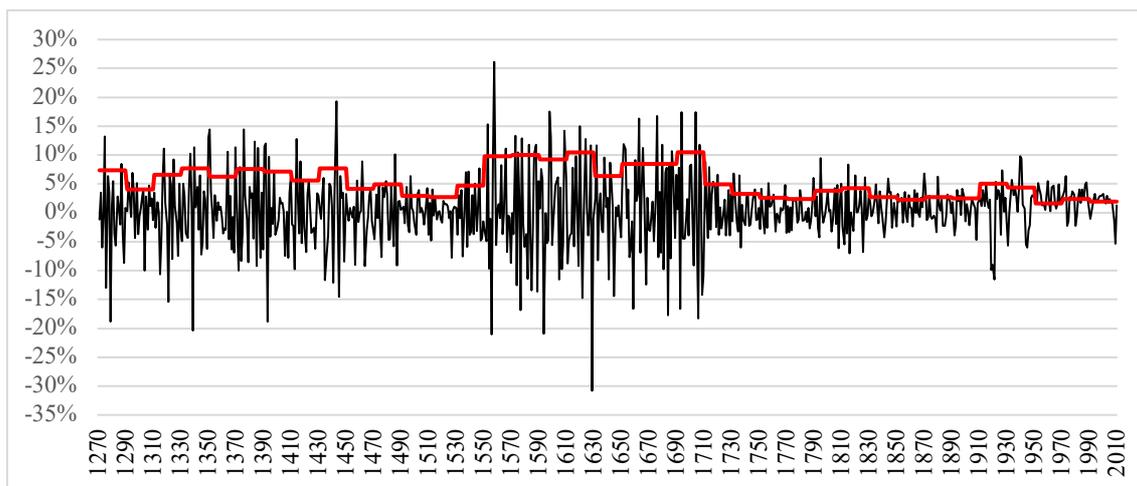
Notes: In black: yearly rate of growth; In red, 20 years average standard deviation.

When looking deeper into the volatility of the annualised growth rate, Thomas et al. (2010) give three explanations for the high fluctuations in the first half of the 18th century. Firstly, it can be explained by periods of poor harvest and the fact that agriculture accounted for 30% of GDP at that time. Secondly, England was often at war during this period, consequently increasing disruption to trade. A third reason for the volatility was the investment cycle which fluctuated depending on waves of optimism. Thomas et al. (2010) note that the period from 1830-1913 had fewer severe downturns and that the average yearly growth rate increased. During this period, investment was a main driver of growth and cycles remained frequent (waves of investment in homes and the railway system). Another important driver of the second half of the period was exports associated with gold discoveries and free trade. Thomas et al. (2010) also point out that there were no notable wars, which allowed the government to lead a stable fiscal policy. In contrast, the beginning of the 20th century was marked by higher volatility levels due to the Great Depression and the two World Wars, which affected the English economy. This period is also marked by a lower average yearly growth rate. After the Second World War, fluctuations were weaker despite the oil crises and the Great Recession in the beginning of the 21st century. According to Thomas et al. (2010), home demand was the main driver of recovery from downturns in the 1970s and 1980s.

4.2   From the preliminary works of Mitchell towards the new business cycle models

4.2.1   The pioneering works of Wesley C. Mitchell

Wesley Clair Mitchell, the first director of research of the National Bureau of Economic Research (NBER), was a pioneer in business cycle research (Rebelo, 2005, p. 219; Fogel et al., 2013, p. 37). Hodrick and Prescott (1997, p. 2) note that Mitchell's prior works have influenced economists in studying business cycles. Mitchell is mostly concerned with the question: "How do business cycles run their course?" rather than in the causes of business cycles (Mitchell, 1927, p. 470). In a book published in 1913, *Business Cycles,* Mitchell (1913, p. vii) "offers an analytic description of the complicated processes by

which seasons of business prosperity, crisis, depression, and revival come about in the modern world". In a second work published a decade later in 1927, *Business Cycles: The Problem and Its Setting*, Mitchell extends his analysis in light of new data and insights.

The book *Measuring Business Cycles* by Wesley C. Mitchell and Arthur F. Burns, published in 1946, has been at the root of future development on business cycle theory. While published after some works of the authors that will be studied in the following sections, the joint work of Burns and Mitchell will also be analysed in this section. A posthumous book, published in 1951, entitled *What Happens During Business Cycles: A Progress Report*, discusses and formulates a synthesis of the findings of his preceding works (Mitchell, 1951).

i   A first explanation of business cycles

In his 1913 book *Business Cycles*, Mitchell presents the relationship between profit, price and cost as the general cause of business fluctuations. He argues that profits are influenced by sales expectations together with the revenue to cost difference, both being impacted by the rate of employment and capacity utilisation. During the late stages of expansion, business costs rise faster than product prices, which reduces profits and sales expectations. However, before going closer to the sources of business fluctuations, Mitchell presents some principles of what he defines as the "money economy" or put differently "the fact that economic activity takes the form of making and spending money incomes" (Mitchell, 1913, p. 21).

Mitchell (1913, pp. 22-26) presents four principles that describes the economic enterprise and that are of importance in explaining business cycles: (1) the "uneven development of business organisation", (2) the "interdependence of business enterprises", (3) the "pecuniary versus industrial factors in business prosperity", and (4) the "factors affecting pecuniary profits".

Firstly, the "uneven development of business organisation" refers to the important differences between enterprises that leads to uneven reactions to prosperity and depression. Mitchell argues that it is "the most elaborate business enterprises" that show

more variation, such as commerce, industry or finance (Mitchell, 1913, pp. 22-23). In his 1927 book, Mitchell (1927, p. 88) stresses that larger enterprises are more affected by depressions than medium-sized enterprises and small enterprises. Secondly, enterprises are so "bound to each other by industrial, commercial, and financial ties that none can prosper and none can suffer without affecting others" (Mitchell, 1913, p. 23). Mitchell illustrates his case by mentioning the relationship between creditors and debtors, between competitors and also between the ownership of enterprises of different kind or in different places (Mitchell, 1913, pp. 23-24). This second point brings us to the third one, the "pecuniary versus industrial factors in business prosperity", where the focus should be on the "difficulties of business" rather than the "difficulties of industry" because it enables investigation of the relationship between enterprises as described in the second point above (Mitchell, 1913, p. 25). The fourth and final principle considers the factors that affect profits, such as the prices of goods and margins (Mitchell, 1913, p. 26).

Mitchell (1913, p. 449) describes the "rhythm of business activity" in four phases: (1) the "revival" or "cumulation of prosperity", (2) the "full prosperity" which in turn progressively creates (3) a "crisis" that ends in (4) a "depression". And then the cycle starts over. He mentions that the recurring sequence of each four phases brings about novelties and therefore differences to previous cycles as in a "process of cumulative change" (Mitchell, 1913, p. 449). He insists that "a theory of business cycles must therefore be a descriptive analysis of the cumulative changes by which one set of business conditions transforms itself into another set" (Mitchell, 1913, p. 449). This descriptive analysis must look for the recurring sequences in each of the four phases to highlight uniformities which in turn "must be used in attempting to interpret the known phenomena of business cycles" (Mitchell, 1913, p. 450). Put differently, it is an exercise where a thorough analysis of the different phases of each cycle may contribute to a general understanding of the mechanisms of business cycles.

Mitchell (1913, p. 451) begins his analysis of the features and characteristics behind business cycles with the phase "cumulation of prosperity" – namely when the economic activity revives after a depression – and ends the analysis with the "depression" phase. However, stresses that the key component is not the phase with which the analysis begins but the relationship between the phases and the conditions that a phase brings to the following one (Mitchell, 1913, p. 571). Therefore, if the analysis begins with the

"cumulation of prosperity" phase, it has to take into account the "legacy from depression".

This "legacy from depression" is, amongst other things, a low level of price, of the cost of doing business and of profits (Mitchell, 1913, p. 571). However, these features enable a revival of the economy by increasing the demand for wares (because of low prices) or by increasing the margin (due to low costs) (Mitchell, 1913, pp. 452-453). This will create an increase in the volume of trade and, as described above, the interdependence of business activity spreads the revival amongst other business fields. This process is therefore 'cumulative' in the sense that enterprises buy more materials and supplies from other enterprises, the other enterprises buys from others, and so on. Consequently, prices increase and spread with the increase in demand.

However, these changes in the level of prices are uneven between commodities and are notably caused by differences in the organisation of the various commodities and labour markets or by "technical circumstances affecting the relative demand and supply of these commodities" (Mitchell, 1913, p. 571). This process not only enhances production, profits and prosperity but, as mentioned, also creates disparities and stresses that erode the good functioning of the business system. Mitchell (1913, p. 573) highlights two types of stresses: the first type concerns the increase in the cost of doing business such as the increase in unitary costs past a certain level of production, the decline in labour efficiency due to the employment of 'undesirables' (i.e. undesirable labour units) or the expiration of old contracts based on lower prices, while the second type of stresses refers to "the accumulating tension of the investment and money markets" where the supply of funds falls short of the growing demand.

At this stage, where the prospect of profits lowers and funds get scarcer, some firms may have difficulties honouring their "maturing obligations" while others are focusing their interests in maintaining solvency instead of "pushing their sales". As a consequence, there is a financial readjustment combined with a decrease in new orders (Mitchell, 1913, p. 576).

The depression phase depends on the extent of the contraction of new orders, since demand is cumulative as showed above, which in turn discourages new investments (Mitchell, 1913, p. 578). A side effect is the increase in unemployment due to the reduced

volume of production which, in turn, also decreases demand and consequently new orders. The decrease of new orders is accompanied by a fall in expected profits and, therefore, spreads "discouragement among businessmen" (Mitchell, 1913, p. 578).

However, these readjustments of price and volume of production may counterbalance the forthcoming depression since the cost of doing business diminishes and the productivity of employment rises (after the dismissal of "undesirable" labour). Hence, the production may increase again and being cumulative, it spreads to other fields of the economy, thereby starting the cycle again (Mitchell, 1913, pp. 578-579). It can be concluded that the breadth of the depression depends on the readjustment processes, the enterprises' interrelation and market organisation. Besides, Mitchell (1913, p. 581) observes that: "cycles differ widely in duration, in intensity, in the relative prominence of their various phenomena, and in the sequence of their phases".

As causes of these differences, Mitchell mentions that the stresses which impact the economic activity may be random and exogenous and impact not only a single enterprise but the whole industry, locality or nation (Burns and Mitchell, 1946, p. 466). These random factors can take the form of earthquakes, epidemics, political decisions, government policies, technological improvements or the opening of trade routes which impact the economy (Mitchell, 1913, p. 582). He also stresses the difficulty of assessing the effects and intensity of propagation that each of these various sources of stress may have on the economic system since there are also endogenous components that may hamper the propagation (i.a. closer organisation, wider knowledge or firm policies) (Mitchell, 1913, p. 582) or react to changes (i.a. monopoly control, degree of industrial integration, organisation of labour) (Mitchell, 1913, p. 583). Hence, some 'disturbances' may last longer than others depending on the economic agents affected and the rapidity of their response, which may widely differ. Burns and Mitchell (1946, p. 467) also stress the possibility that "unfavourable" factors or stresses may reduce or overpower an expansion and "favourable" factors may accelerate business revival (Burns and Mitchell, 1946, p. 467).

As a conclusion of this first analysis, it can be said that each new cycle is unique and grows out of the preceding cycle, which is therefore a process of cumulative change. In his 1927 book, in the light of new data, Mitchell (1927, p. 354) confirms that: "every

business cycle is a unique historical episode, differing in significant ways from all its predecessors, and never to be repeated in the future". Hence, there is a diversity of amplitude and timing, and statistics do not show evidence of 'the' business cycle (Mitchell, 1927, p. 454). However, this postulate raises two questions: "Does economic life actually proceed in recurrent fluctuations having similar characteristics? If so, by what processes are continuous and repetitive movements of this character brought about?" (Mitchell, 1951, p. viii). Consequently, there is a need to differentiate what is "usual" or "typical" from what is "unusual" or "exceptional" (Mitchell, 1927, p. 469).

This task is carried out in Burns and Mitchell's 1946 book by decomposing arrays of time series and adopting a micro-analysis with "floods of data on the turbulent details of economic reality" (Shaw, 1947, p. 283). They use averages to highlight recurring cyclical movements of individual activities and average deviations to measure the variability of business cycles around their central tendencies (Burns and Mitchell, 1946, p. 480). Put differently, this methodology brings out characteristic, or average features of business cycles (Epstein, 1999, p. 535). They also keep "strict neutrality" regarding earlier theories or attempts to explain business cycles (Shaw, 1947, p. 285). Based on the large amount of time series presented in their book, Burns and Mitchell (1946) believe that the relative importance of each economic process changes from one cycle to another (Shaw, 1947, p. 298).

Based on the previous works enumerated in this section and on new data, Mitchell describes, in a posthumous book published in 1951, the process of each phase of the business cycle, beginning with the expansion phase.

In the beginning of the expansion, various series aries such as production, employment, money income, commodity prices, imports, domestic trade and security transactions, and there is a decrease in bond yields (i.e. long-term interest rates) and bankruptcies. As the expansion continues, long-term interest rates rise and, at the end of the expansion phase, trading and stock prices decrease while the deficit of some defaulting enterprises increases. In parallel, construction contracts and bank deposit turnovers decrease (Mitchell, 1951, pp. xvii-xviii).

The following phase is the contraction of the economy, which is not the exact opposite of the expansion phase. In fact, Mitchell (1951, p. xix) notes that "troughs are more

dispersed and skewed towards leads than are the arrays at peaks" and that expansions last longer and is more "vigorous" than contractions. At the beginning of the contraction phase, long-term interest rates and "business failures" continue to increase while production, employment commodity prices, incomes and business profits decrease (Mitchell, 1951, p. xviii). However, reaching a certain point, bankruptcies decline, meaning that the economy has got rid of defaulting enterprises. In the following stage of the contraction, share trading and prices as well as enterprise creation, securities issues, and construction contracts increase (Mitchell, 1951, p. xviii). This leads towards the expansion phase.

While the above 'story' describes a 'usual' business cycle, it has often been suggested that each cycle incorporates unique features, which is confirmed by the statistics presented in the book without completely excluding the fact that some processes may also be recurrent. It is also interesting to note that the phases of "prosperity" and "depression", which have been used in Mitchell's first and second book have been replaced by "expansion" and "contraction".

ii   Towards a first agreed definition

Parallel to the explanation of economic fluctuations, Mitchell also proposed a definition of the concept of business cycles. Following what has been developed in the first part of this subsection, it can be said that business cycles are a succession of fluctuations that are not necessarily regular (i.e. they have no periodicity) but "far from haphazard" (Mitchell, 1927, pp. 466-467). Mitchell (1927, p. 468) also notes that the term "business" refers to the activities of commerce and "cycles" to fluctuations.

In order to delineate the framework of analysis, the definition of business cycles should not only incorporate certain conditions but also excludes economic situations such as (1) the modification of the economic processes between the dates of "crises", (2) fluctuations affecting only a negligible portion of the economy, (3) yearly (i.a. seasonal) fluctuations, and (4) "long waves" referring to the long-term growth of the economy (Mitchell, 1927, p. 468).

Burns and Mitchell (1946, p. 5) also argue that the question of the economic equilibrium, namely the fact that the economy "returns toward a normal state", should be set aside since the observation of such equilibrium is not possible. Indeed, it can be debated that since each cycle depends on the preceding one and each state evolves into another one, the economy is never in equilibrium.

Based on the abovementioned reflections, Burns and Mitchell (1946, p. 3) propose a definition of business cycles:

> Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

Many later studies and theories of business cycles have built on this definition, which is frequently used as a point of departure (Epstein, 1999, p. 525).

The definition has important implications: (1) business cycles happen in economic activity with business enterprises driven by profit and include notions of "individual initiatives" and competition; (2) an expansion phase is followed by a contraction which in turn is supplanted by a revival that triggers the expansion of the following cycle; (3) consequently they "run a continuous round" in the sense that each phase succeeds the preceding one; (4) "no intervals are admitted" between each phase or cycle; (5) they range between one and twelve years (based on earlier attempts at identifying business cycles); and (6) they are not divisible into smaller cycles (i.e. they are not evolving smoothly towards the turning point but may be "interrupted movements in the opposite direction") (Burns and Mitchell, 1946, pp. 5-7).

iii Synthesis of Mitchell's findings

In their collection of works presented and analysed above, Burns and Mitchell have demonstrated, through a large amount of time series describing the various economic processes, that even though business cycles differ from each other and they show various patterns, business cycles also tend to reproduce recurring processes of economic activity (Burns and Mitchell, 1946, pp. 488-491). In fact, the analysis in Burns and Mitchell's various works has not shown sufficient support for the idea that all business cycles are similar. This view was already presented in Mitchell's first book on the fluctuation of the money economy.

They show that each cycle, respectively each phase of the cycle, depends on the preceding one, hence being unique, and that they may be influenced by exogenous random factors (e.g. wars, political decisions, technological improvements and trade agreements). Therefore, business cycles are an intricate accumulation of various economic processes depending on the complexities of the preceding cycle or phase impacted by random external factors (Epstein, 1999, p. 549). These exogenous random factors may positively or negatively impact the course of an expansion or contraction. Besides, these external factors may affect economic processes differently, depending on elements such as the "uneven development of business organisation" or the "interdependence of business enterprises", and therefore have different impacts on the course of business fluctuations (Mitchell, 1913, pp. 22-26).

Finally, it can be said that there is no theory capable of explaining and therefore of measuring "the" business cycle and that such a theory should rather be constructed on the "characteristics of average behaviour" of business cycles. However, this warning has not been followed by many macroeconomists who have, instead, accepted the Koopmans/Marschak interpretation which overlooks the diversities and complexities of business cycles (Epstein, 1999, p. 540).

4.2.2 Neoclassical school: Early theories of endogenous business cycles

In the 1920s, several theories of self-sustaining cycles (i.e. relying on internal dynamics) emerged, notably building on the seminary work of Mitchell. In this section, three different endogenous theories are addressed as they provide distinctive explanations: (1) Arthur C. Pigou argues that expectations are the primary cause of business fluctuations, (2) Joseph A. Schumpeter argues that it is the introduction of innovations that creates variations in aggregate production, and (3) Gottfried Haberler analyses the impact of trade and openness in business cycles. All three economists provide a different explanation of the sources and mechanisms of business fluctuations. Nonetheless, they do not conflict with each other but rather accommodate one another.

i   Pigou: The influence of expectations on business cycles

In 1927, Arthur C. Pigou published *Industrial Fluctuation* in which he develops a theory where the primary cause of fluctuations is the variations in profit expectations. For Pigou (1927, p. 35) expectations are derived from real causes such as harvest and innovations, from psychological causes such as "changes in attitude of mind" (i.e. no constant judgement towards a "constant basis of fact") or from autonomous monetary causes.[2] Similarly to the works of Mitchell, Pigou does not concentrate on developing a rigorous econometric model but rather on developing a theory based on a comprehensive analysis of the facts. Pigou leaves aside long-term movements and seasonal fluctuations and, instead, focuses on "cyclical" fluctuations that are "extending over short spans of years" (Pigou, 1927, p. 4). This section will concentrate on the analysis and conclusions of *Industrial Fluctuations* and hence follow the same logic: the focus will first be put on the causes of fluctuations and then some remedies proposed by Pigou will briefly be described.

As mentioned in the introduction to this section, Pigou considers it to be the businessmen's expectations of profit that explain the causes of business fluctuations. The

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[2] In this thesis, the monetary implications are set aside as they are not part of the MOC framework presented in the first chapter.

starting point in Pigou's analysis is the hypothesis that fluctuations can only be caused by variations in the demand for labour since, with the exception of population change, the supply of labour does not fluctuate (Pigou, 1927, pp. 19-20). Hence, Pigou defines the causes of industrial fluctuations as "deviations in the movement of the demand schedule away from its general line of trend" (Pigou, 1927, p. 22). Put differently, the factors influencing these variations in the demand schedule of labour are the causes of industrial fluctuations. It is therefore necessary to understand how demand schedule may vary in time.

Pigou (1927, p. 26) argues that the demand for labour depends on (1) the yield resulting from the use of quantities of labour (2) discounted for the period between the payment for the labour and the result of the use of labour (i.e. "the emergence of its fruit"). Consequently, he identifies two possibilities affecting the variation in demand schedule for labour: (1) changes in yield expectations, and (2) changes in the rate of discounting. According to Pigou, the records show that it is the change of yield which primarily impacts the demand for labour and not variations of the discounting rate (Pigou, 1927, pp. 33-34).

As mentioned above, Pigou has divided the causes influencing the expectations of yield (i.e. profits resulting from industrial spending) into three categories: (1) real causes, (2) psychological causes, and (3) autonomous monetary causes (Pigou, 1927, p. 35). However, these causes are not compatible with self-repeating movements such as those found in a stationary economy. In fact, if businessmen are rational, they would then realise the consequences of each repeating cause (whether real or psychological) and would therefore not repeatedly make the same mistakes (Pigou, 1927, p. 36). In fact, if everything were to happen again and again, rational businessmen would have perfect foresight. Hence, only a situation with an "inconsistency in facts" would allow for errors in forecasting and create variations in expectations (Pigou, 1927, p. 74). Hence, these errors in forecasting may be present in a non-stationary economy. To illustrate this point, Pigou (1927, p. 36) takes the example of given situations of prosperity which may make businessmen over-optimistic about the future. In turn, this expectation, shared by a group of businessmen, and its resulting economic consequences impact other groups of businessmen. In turn, this triggers a real cause that has new repercussions on future

expectations. Therefore, a real cause may trigger a psychological cause that has real repercussion on the economy, and so on.

Pigou lists five categories of initiating real causes: (1) harvests, (2) technical inventions and improvements that translate into new products or a comparative advantage, (3) discovery and exploitation of new resources (e.g. mineral deposits), (4) "industrial disputes" (e.g. strikes), and (5) changes in consumers' taste and desires (e.g. for new commodities) (Pigou, 1927, p. 40). Regarding the second of these causes, Pigou (1927, p. 47) specifies that the invention needs to generate a wave movement, therefore excluding the "steady stream of invention" and minor industry-specific inventions.

It has been explained that the variations in expectations of profits are the result of errors in forecasting due to initiating causes. Pigou adds that the range of errors in forecasts depends upon factors such as (1) the businessmen in control of an industry and their relative influence, (2) the availability and transparency of information, (3) the division of industry in units "acting independently of one another", (4) the time needed to produce a given commodity, and (5) the demand in an "untried market" (i.e. the demand in sophisticated or new markets) (Pigou, 1927, pp. 74-83). If these errors are independent of one another, then they may neutralise one another. However, Pigou (1927, p. 84) states that the range of error may be increased when there is "a tendency towards common action among them".

Therefore, in order to understand industrial fluctuations, one must account for the (1) initiating causes, (2) the resulting errors in forecasts, and (3) their range which depends on the "interdependence of forecasts" or the similarity of the businessmen's reaction to these errors (Pigou, 1927, p. 89).

Until this point, only the causes and the mechanisms behind industrial fluctuations have been tackled. The comparative importance of each initiating cause and the effect of forecasting errors on the amplitude of these fluctuations has not been analysed yet (Pigou, 1927, p. 207). Pigou argues that the causes are interdependent and consequently the effect of one particular cause depends on its relation to other causes at play (Pigou, 1927, p. 208). He also stresses the importance of the errors in forecasts by arguing that if they were excluded, industrial fluctuations would be "substantially" reduced "perhaps to the extent of one-half" (Pigou, 1927, p. 220).

Pigou (1927, pp. 225-226) also discusses the fact that if a "remedy" (i.e. for industrial fluctuations) against one principal cause is introduced, it will have a bigger effect than if that particular remedy is introduced together with other remedies. He identifies two kind of remedies: (1) those that eliminate one or more initial causes of fluctuations, and (2) those that act directly on the fluctuation (Pigou, 1927, p. 248). For this second category of remedies, Pigou put forwards policies that create "new demand in bad times" and also that transfer demand "to bad times from good times" (Pigou, 1927, p. 314).

As a synthesis, it can be said that in Pigou's view, industrial fluctuations are the result of the persistence of forecasting errors, due to the initiating causes, that react upon one another in a multiplier effect, and through the psychological reaction of businessmen, that lead the economic system to "fail to get into equilibrium" (Collard, 1983, p. 412).

ii   Schumpeter: Instability created by the introduction of innovations

In the previous chapter, Schumpeter's view on economic development has been presented and analysed. It has been shown that economic growth was triggered by the role of entrepreneurs who reassemble new combinations of means of production (i.e. innovations) through the process of creative destruction. This section will be complementary in the sense that it will not focus on growth but rather on the fluctuations that accompany the growth process. In fact, innovations not only trigger growth but also create fluctuations.

This section will focus on three works of Schumpeter: (1) a first article published in 1927 *The Explanation of the Business Cycle* which notably discusses Pigou's *Industrial Fluctuations*, (2) a second article published in 1935 *The Analysis of Economic Change*, and (3) a double volume book published in 1939 *Business Cycles*. In these works, Schumpeter aims to analyse what makes the economy transition from one state of equilibrium to a new one (the equilibrium is temporary in Schumpeter's analysis) (Croitoru, 2017, p. 70).

In *The Explanation of the Business Cycle*, Schumpeter (1927, pp. 289-298) makes seven propositions about business cycles based on a discussion of Pigou's *Industrial*

Fluctuations: (1) static conditions are incompatible with cycles, (2) "continuous growth" is compatible with static conditions (e.g. continuous marginal increase in population and capital which lift the equilibrium), (3) innovations are the "fundamental initial impulse" of cycles which may from time to time be influenced by exogenous disturbances, (4) a "normal depression" is a reaction of the economic system to a boom and brings the economic system to a new equilibrium, (5) a boom consists of the "carrying out of innovation" (new combinations of means of production as a result of continuous marginal variations are not considered as innovations), (6) innovations are not continuous but happen "by leap" (if they were continuous, innovations would be "absorbed" in the growth process without creating any fluctuations), and (7) the innovation and success of some entrepreneurs lures others who will build on these innovations, hence creating an economic boom (once a step has been made, others may more easily replicate it). In this article, Schumpeter (1927, p. 306) also analyses the role of banks in financing entrepreneurs and, consequently, impacting the momentum of both prosperity and depression.

Following these seven propositions, Schumpeter differentiates, in a second article on business cycles *The Analysis of Economic Change*, factors affecting industrial change and classifies them in three categories: (1) "outside factors" such as wars, natural disasters or changes in commercial policies which are regarded as exogenous to the economic system, (2) "growth factors" such as population, capital accumulation or steady technical progress which occurs continuously, and (3) innovations which shape the long-term trend of the economy in cycles (Schumpeter, 1935b, pp. 2-4).

It has been shown in the previous chapter that innovations are the driving force of growth. In fact, economic growth is not the sole result of the influence of the abovementioned 'growth factors' but is also the result of the introduction of innovations. It follows that growth is not a smooth and continual process but is rather the result of upward jumps (Geiger, 2014, p. 50).

Figure 4.3 represents this relation between long-term trends and cyclical movements of economic development. Each jump is followed by a downswing which is the "normal depression" that brings the economy to its new equilibrium (as described above in proposition 4).

Figure 4.3: Relation between growth and cyclical movements in Schumpeter's view.
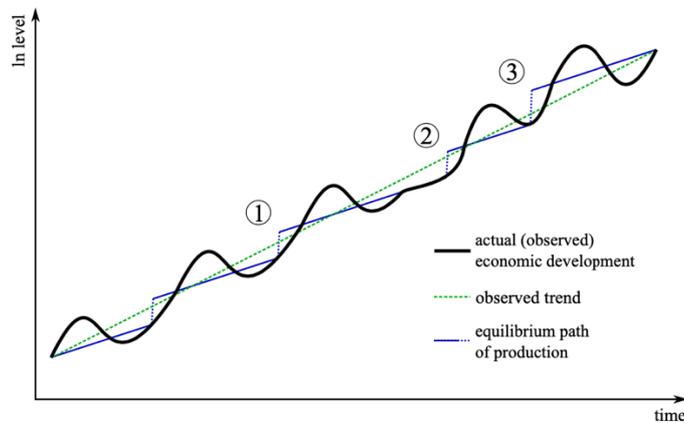
Figure 2. Graphical interpretation of Schumpeter's theoretical understanding of trend, cyclical elements, and resulting fluctuations forming a business cycle and economic development.

Source: Geiger (2014, p. 47).

The innovative process takes the form of a reorganisation of means of production and all elements of the system have to adapt to this transformation. Hence, a disequilibrium is temporarily created, and during this period of time, incertitude raises and entrepreneurs wait until an equilibrium is established before introducing a new innovation (Schumpeter, 1939, p. 135). It is also important to keep in mind that one entrepreneur alone will not create a disequilibrium. It is the accumulation of entrepreneurs who follow the initiating entrepreneur and create a "momentum" that eventually leads to the upswing and disequilibrium of the economy (Schumpeter, 1939, p. 134). This scenario is described by Schumpeter (1939, p. 149) with a cycle constituted of four phases: (1) prosperity, (2) abnormal liquidation or recession,[3] (3) depression,[4] and (4) recovery or revival.

Firstly, the "momentum" is accompanied by the secondary waves that are the result of two behaviours: (1) "old" firms react to this new situation, and (2) these "old" firms speculate on this situation (Schumpeter, 1939, p. 145).

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[3] A recession is commonly referred to as "a period of decline in economic activity" in terms of GDP of at least two consecutive quarters (IMF, 2020).

[4] A depression is considered as an "extremely severe recession in which the decline in GDP exceeds 10 percent" (IMF, 2020).

Schumpeter (1939, p. 145) notes:

> A new factory in a village, for example, means better business for the local grocers, who will accordingly place bigger orders with wholesalers, who in turn will do the same with manufacturers, and these will expand production or try to do so, and so on.

New loans are contracted and "reckless" or unsuccessful enterprises enter the market. Schumpeter argues that this process generally "outruns" the new equilibrium (Schumpeter, 1939, p. 149).

Secondly, this speculative phenomenon will eventually come to an end in the second phase, as soon as an "impairment" appears and readjusts the economic system (Schumpeter, 1939, p. 148). Also, this process of speculation is accompanied by an increase in prices and costs. In this spiral of rising costs, "old" firms, that were not able to adjust may not be able to compete against "new" firms, leading to their failure. This "abnormal liquidation" is characterised by a "downward revision of values and a shrinkage of operations that reduce them […] below their equilibrium amounts" (Schumpeter, 1939, p. 149). The system then enters in the depression phase which is not considered as a "necessary" part of the cycle (unlike recession and revival). In fact, an economy may develop a recession without entering depression if no external factors (i.a. panic or mood of the business community) influence the business situation (Schumpeter, 1939, p. 150).

The depression or recession will eventually come to an end and start its "way back" to the new equilibrium through the inclusion of new innovations, knowing that there are no external stimuli needed to revive entrepreneurial activity (Schumpeter, 1939, p. 151). However, Schumpeter argues that this "natural" restoration is not sufficient in certain depressions and that governments should take action to alter the course of the cycle (Schumpeter, 1939, p. 155). This phase is called the recovery or revival (Schumpeter, 1939, p. 149). However, the economy will not find itself at the same new equilibrium as the one it was heading for before the 'abnormal liquidation' phase. In fact, the abnormal liquidation and depression phase (which may take several years) may 'liquidate' firms that do not have adequate financial support.

Nonetheless, Schumpeter (1939, p. 132) notes that the economy will still "show a net surplus" and, consequently, the underlying growth trend will continue its course at a higher level that has been set by the combination of the new innovation and its subsequent depression or recession. Hence, this new equilibrium represents:

> The response by the system to the results of entrepreneurial activity – adaptation to the new things created, including the elimination of what is incapable of adaptation, resorption of the results of innovation into the system, reorganisation of economic life so as to make it conform to the data as altered by enterprise, remodelling of the system of values, liquidation of indebtedness. (Schumpeter, 1939, p. 137)

iii   Haberler: The influence of international trade on business cycles

In 1937, Gottfried Haberler published *Prosperity and Depression* as part of a resolution of the Assembly of the League of Nations in order to coordinate the work on the understanding of economic depressions (Haberler, 1937, p. v). Haberler not only analyses existing theories in the first part of the book, but he also proposes a general synthesis in the second part based on those existing theories. He argues that those theories, which sometimes contradict one another, can be reconciled (Haberler, 1937, p. 2). In this thesis, one aspect of Haberler's book will be analysed, namely the chapter *International Aspects of Business Cycles*. In fact, throughout his career, Haberler not only focused on business cycles, but also on monetary theory and international trade (i.a. the introduction of the opportunity cost as a trade-off that each economy faces and that can be represented by the production possibility frontier). It is the relationship between business cycles and international trade that is of interest for this study.

In the chapters preceding his enquiry on the international aspects of business cycles, Haberler notably shows that the cycle can be divided into four phases: (1), upswing (2) downswing, (3) upper turning point, and (4) lower turning point (Haberler, 1937, pp. 268-269). In this analysis, the focus is on the international aspects of business as it will bring new insights to the analysis.

Haberler begins his analysis with a closed economy and introduces disintegrating factors one by one (Haberler, 1937, p. 407). Three disintegrating factors (which are the result of the uneven distribution of resources) are added in the following order: (1) transportation costs (i.e. imperfect mobility of goods and services), (2) localisation of investment, credit and banking (i.e. imperfect mobility of capital), and (3) national currency autonomy (Haberler, 1937, pp. 407-408). While Haberler (1937, p. 408) argues that the latter is the most important factor, in the context of this research, only the effects of the first two disintegrating factors will be analysed as they operate not only between countries with distinct political borders or currency unions, but also, and most importantly, within those borders or unions.

Transportation costs include both the cost of goods' transportation and the "trouble" (i.e. cost) in moving the consumer to the goods or services (Haberler, 1937, p. 408). Haberler describes a scenario where there is a "fortuitous" expenditure in a certain location. Under the hypothesis of transportation costs, there is a tendency to less specialisation and division of labour. Hence, the primary income increase that the beneficiary of this "fortuitous" expenditure receives will be "living near to the group which increased their expenditure" as a result of transportation costs (Haberler, 1937, p. 409). The beneficiary of the second income increase will locate near the beneficiary of the primary increase, and so forth. Nonetheless, the uneven distribution of resources keeps a certain degree of specialisation and therefore, a certain amount of the primary income may be spent on imports. Hence, the secondary income increase may be lessened and "transferred" to beneficiaries in other locations (Haberler, 1937, p. 409). Consequently, Haberler (1937, pp. 409-410) states that the more specialised the locations are, the less chance there is for localised expansion or contraction.

Regarding the phase of the cyclical movement, it can be said that the duration of an expansion or a contraction increases the chances of spilling over to other locations. This is not the result of specialisation but of the cycle mechanism. For example, as an expansion goes on, unemployment decreases and enterprises are used at full capacity. Hence, wages and prices increase which, in turn, create a switch in demand from local to foreign products as they become cheaper in comparison (Haberler, 1937, p. 411). This shift in demand will depend on the transportation costs, or put differently, on the interrelation between two locations.

Haberler (1937, p. 412) also analyses the effect of innovation under the hypothesis of transportation costs. In this case, there is an opposition between firms that have implemented the innovation and those that have not. In the case of a 'spaceless' economy, the effect will be similar to the analysis made by Schumpeter, namely the fall of 'old' firms. However, if those 'old' firms are localised in areas secluded (to a certain degree) by transportation costs, then they may be less impacted by the innovations.

It is also important to note that tariff barriers act in the same way as transportation costs, with the difference that they can be removed by political decisions (Haberler, 1937, p. 413).

The second disintegrating factor is the imperfect mobility of capital or, in other words, the localisation of capital (i.e. loanable funds). In fact, Haberler (1937, p. 417) notes that most economic agents invest at home even though interest rates may be higher abroad. It is important to note that: "the imposition (removal) of restrictions on capital movements will tend to reduce (raise) the rate of interest in the capital-exporting country, and to raise (reduce) it in the capital-importing country" (Haberler, 1937, p. 418).

Haberler puts forward the principle that the localisation of capital dampens both local booms and depressions (Haberler, 1937, p. 419). In the case of a boom and no international capital markets, interest rates will increase more in comparison while in the case of a depression, the rate of interest will stay at a low level as funds cannot leave the location in search of higher interest rates, hence increasing chances of recovery. However, this principle is not a rule of thumb. In fact, in the scenario of a boom (e.g. as a consequence of an increase of foreign demand), there is an inflow of money which will increase the possibilities of investible funds and demand which, in turn, keeps the rate of interest at a lower level than if capital exports would have been possible. However, the principles and scenarios presented above are only applicable when different locations are in different stages of the business cycle (Haberler, 1937, pp. 419-420). If we now turn to the case of general booms or depressions (i.e. affecting all locations at the same time) and if capital movements are not hindered, then investment will be made in more promising locations and hence, less promising locations may suffer from limited capital inflow. Consequently, with imperfect mobility of capital, these less promising locations may still enjoy investment that would not be made in a general capital market.

Regarding the effect of such mechanisms on the spread of cyclical movements to locations, Haberler (1937, p. 421) argues that the mechanisms are ambiguous. On the one hand, localisation of capital tends to spread both booms and depressions from location to location. In fact, if a country is a promising investment hub, a boom would develop in this country accompanied by a rise in interest rates: funds would flow in from foreign countries. This increase in funds has repercussions on imports and the foreign countries would experience an increase in exports to the "promising" location. On the other hand, it was presented in the above analysis that localisation of capital tended to dampen booms and depressions. If we take the scenario described above, this rule would limit the imports of the 'promising' location and consequently limit the 'stimulus' to the foreign locations. In fact, the transfer of funds to the 'promising' location by analogy diminishes the funds available for investment in the foreign countries. However, Haberler (1937, p. 421) argues that this effect is less important than the former, hence hindering the spread of the boom (or depression). This also depends on the internationalisation of the capital market, the latter being notably influenced by government policies and the confidence of economic agents (Haberler, 1937, p. 424).

As a concluding note, it can be said that while transportation costs tend to "disturb the uniformity of the cyclical movement" and increase the chances of localised booms and depressions, no general statement can be offered regarding the effect of imperfect capital mobility on business cycles (i.e. no synchronisation or deviation of the cycles between locations) (Haberler, 1937, p. 425). Haberler also warns the reader that the analysis presented in his chapter 12 is a presentation of a method of intuitive analysis rather than "definite results" of concrete cases (Haberler, 1937, p. 450).

4.2.3   Real Business Cycle theory

In the aftermath of the Great Depression, business cycle theories switched from microeconomic to monetary and psychological foundations (King and Rebelo, 1999, p. 929). However, those macroeconomic models behaved poorly, and the revival of business cycle analysis appeared in the late 70s and 80s with the works of Lucas (1976) and the rise of the real business cycle (RBC) theories led by Kydland and Prescott (1982) as well

as Long and Plosser (1983). The main idea of RBC theories is that fluctuations are triggered by real factors such as technology shocks or change in total factor productivity (Vecchi, 1999, p. 160). These shocks are propagated in the economic system through consumption, investment, labour input or anticipation, and consequently, generate cycles (Kydland, 1995, p. xiii).

This revival is based on the Lucas critique which state that an econometric model needs parameters that are invariant to policy intervention (Lucas, 1976; Kehoe et al., 2018, p. 3). As a result, new theories were based on microeconomic foundations with a general equilibrium analysis.

Consequently, RBC theories followed the path of Kydland and Prescott (1982) who introduce three ideas (Rebelo, 2005, p. 217): (1) the use of general equilibrium models (such as neoclassical growth models) in order to study business cycles, (2) the unification of business cycles and growth theories in the sense that business cycle models should be consistent with the stylised facts of long-run growth, and (3) the calibration of models in order to generate artificial economies that mimic real economies and that allow for comparison (Kydland and Prescott, 1982). In their analysis, they also add two important hypotheses: (1) the time needed for building new capital goods lasts over multiple periods, hence "each stage of production requires a period and utilizes resources", and (2) the inclusion of exogenous stochastic shocks to technology (i.e. shocks affecting productivity) (Kydland and Prescott, 1982, p. 1345).

The second important article in the beginning of the RBC literature is *Real Business Cycles* by Long and Plosser (1983), published a year after the preliminary work by Kydland and Prescott. In their article, Long and Plosser (1983) argue that technology shocks are sector-specific and only temporary and that fluctuations arise progressively as sectors are linked by input-output relations. They argue that their model:

> Transforms and amplifies serially uncorrelated and cross-sectionally independent shocks to production in each sector into output series that exhibit positive serial correlation (persistence) and a significant amount of positive cross-sectional correlation (comovement) [*sic*]. (Long and Plosser, 1983, p. 67)

If a given sector gets hit by a shock to productivity, it will spread to other sectors, hence showing patterns of cross-sectional correlation.

However, RBC theories have not only been controversial as they raised some problems but have also contributed little to the understanding of business cycles (amongst others: Glasner, 1997, p. 559; Vecchi, 1999, p. 168; Rebelo, 2005, p. 222; Romer, 2016). Amongst the problems presented by the critics are (1) the role of technology shocks in triggering recessions (i.e. recessions are assimilated to technological regress), (2) the exogenous aspects of technology shocks, and (3) the employment of calibration (i.e. the definition of the parameters' value needed for calibration) and simulation of the testing procedures (i.e. the closeness of the artificial to the real economy). In fact, the first two problems highlighted above do not concur with an understanding of both economic theory and stylised facts. Nonetheless, Hansen and Prescott (1993, pp. 282-283) give some examples of technological shocks that may have provoked the 1990-1991 recession in the US such as business regulations (i.a. government-imposed constraints on pollution) and political or institutional change.

To stress these problems, Romer (2016, p. 7) makes an analogy between RBC theories and string theory in physics in the sense that they "illustrate a general failure mode of a scientific field that relies on mathematical theory" where "facts can end up being subordinated to the theoretical preferences" (Romer, 2016, p. 1; p. 7).

However, there is an important bridge in the literature between the monetary and Keynesian theories of business cycle that flourished in the aftermath of the Great Depression (those theories are not considered in this chapter), and the new models of business cycle, which are studied in the following section. In fact, early theories of business cycle were endogenous in nature, meaning that the cycles were a consequence of the economic system, or put differently that a boom generated the subsequent recession, in turn generating the following recovery and boom in a non-ending fashion. On the other hand, in modern business cycle theories (including RBC theories) economic fluctuations are the result of exogenous shocks or disturbances that continually strike the economy (Chatterjee, 2000, p. 1). While the first view implies that the economy is never in a stable equilibrium, the second view presupposes that only regular external shocks are necessary to disturb the economy. However, it is important to note that earlier theories, mostly based on observations, do not reject the fact that exogenous elements have the potential to disturb the economy, hence influencing each stage of the cycle (e.g. worsening a recession or damping a boom). Nonetheless, it is interesting to note that some

of these 'real' shocks are considered as endogenous in the early theories and as exogenous in modern theories.

Another flaw of RBC theories is the aggregation problem which assumes homogeneity amongst economic actors and economic structures. Kiyotaki (2011, p. 206) argues that the inclusion of heterogeneity is needed to understand how the productivity of individual firms is impacted. Various intensity in human capital, investment in tangible and intangible capital or the inclusion of endogenous technical progress (as in the endogenous growth theories) are a necessity in order to grasp the sources and propagation mechanisms of business cycles (Kiyotaki, 2011, pp. 206-207).

4.2.4   Alternative and new explanations of business cycles

In this section, various studies and articles are analysed which will help enrich the comprehensive picture of the mechanisms behind business fluctuations. The focus of this thesis being clusters, particular attention will be given to models analysing the role of investment accessibility, economic structures and specialisation on business cycles. Their synchronisation, notably between countries or regions, is also tackled.

i   Financial considerations impacting the mechanisms of business cycles

Financial considerations and notably credit crunches play an important role in business cycles according to Eckstein and Sinai (1986) and Aghion et al. (1999). Both investigate the role played by a shortage of credit and the role played by financial considerations alongside the cycle.

In their work *The Mechanisms of the Business Cycle in the Postwar Era*, Eckstein and Sinai (1986) not only estimate econometrically possible mechanisms driving business cycles but they also present and analyse eight post-war cycles in order to derive the various phases and mechanisms that compose them.

In observing these eight cycles, they identify five types of causes: (1) booms (i.e. when aggregate demand raises more than the balanced growth path), (2) negative demand shocks (i.e. decline in aggregate demand), (3) supply shocks (i.e. disruptions to production such as limitation of "key" materials), (4) price shocks (i.a. ending of price controls), and (5) credit crunches (i.a. decrease in the availability of credit and funds, increase in interest rates) (Eckstein and Sinai, 1986, pp. 40-41). They conclude from these observations that there is no single and universal economic causes that creates business cycles (Eckstein and Sinai, 1986, p. 47). Nonetheless, they observe that each recession analysed was preceded by a credit crunch.

Based on these observations, they identify that a cycle, in general, is composed of five stages: (1) recovery/expansion, (2) boom, (3) pre-crunch period/credit crunch, (4) recession/decline, and (5) reliquefication (Eckstein and Sinai, 1986, p. 48). Nonetheless, they also make room for exceptions in the sense that each cycle is not composed of every phase but may omit one or more phases and that each phase may also overlap another (Eckstein and Sinai, 1986, p. 48).

The recovery phase starts at the lower turning point and finishes when production has returned to the previous peak level. Then the expansion continues until the upper turning point is reached. They also argue that no "special" theory is needed to explain expansion (Eckstein and Sinai, 1986, p. 48), hence, it can be concluded that one has to turn to the growth theories for an explanation of expansion. A boom is considered as the period when industries are growing with "unsustainable rapid growth", which is temporary, and production is "near its ceiling of potential output" (Eckstein and Sinai, 1986, p. 50).

The pre-crunch period/credit crunch stage is considered as a standard stage of the cycle (see comment above on the recurrence of credit crunches). Credit demand which outreaches the ability to finance, and inflation, both increase demand for credit. Eventually, the supply of credit can no longer keep pace with demand, hence increasing interest rates (Eckstein and Sinai, 1986, p. 51; p. 53). At this point, called the pre-crunch period, expectation of businesses lowers for the future alongside the increasing cost of financing. As a result, businesses cease to hire, reduce inventories and stop investment in plant and equipment (Eckstein and Sinai, 1986, p. 53). At this point, the crunch period is reached, which is also graphically recognisable as the upper turning point.

The following phase is the contraction/recession and lasts from the upper turning point until the end of the absolute decline in output (Eckstein and Sinai, 1986, p. 53). During this phase, businesses adapt to the changing availability of capital triggered by the pre-crunch/crunch phase (e.g. inventory adjustment, reduced spending commitments). The authors indicate that the lower turning point is reached when "business spending commitments have moved closer to the new, lower equilibrium and stock adjustment processes set up for a reversal" (Eckstein and Sinai, 1986, p. 54). Further, they mention that policies, whether monetary or fiscal, may accelerate or delay the lower turning point.

Finally, the fifth and last phase, reliquefication, happens towards the end of the recession and the beginning of the recovery phase and is characterised by a financial restructuring of businesses (Eckstein and Sinai, 1986, p. 54). During this stage, businesses take measures to improve cashflows and strengthen balance sheets which paves the way for the following revival/recovery phase. The authors also argue that the reliquefication phase, similarly to the credit crunch phase, is systematic in every business cycle (Eckstein and Sinai, 1986, p. 60).

Furthermore, the financial factor is a fundamental component of the business cycle (Eckstein and Sinai, 1986, p. 59). In fact, it was mentioned in the preceding analysis that two of the five phases are systematic: the credit crunch and reliquefication phases, both having a financial aspect. Hence, the authors propose an underlying cycle to business cycles, namely the "flow of funds cycle" which can be divided into four phases: (1) accumulation, (2) development of financial instability or the pre-crunch period, (3) crunch, and (4) reliquefication (Eckstein and Sinai, 1986, p. 61).

During the accumulation stage, there is an accumulation of physical and financial assets that takes place alongside the expansion phase of the business cycle. At this time in the flow of funds cycle, financial constraints are low and funds are available (Eckstein and Sinai, 1986, p. 61). This process will eventually set the stage for a boom, then leading to the crunch.

The pre-crunch period (second stage) corresponds to the beginning of the third stage of the business cycle. As explained, during this period the supply of funds cannot keep up with rising demand, hence creating a "squeeze on liquidity" and external financing sources can only be acquired at a high cost (Eckstein and Sinai, 1986, p. 61). Eventually,

debt and interest increase for businesses and worsen balance sheets. The pre-crunch period evolves into the crunch phase which is the culminating point of the pre-crunch period. It can be likened to a credit crisis where the expansion of the economy faces a lack of available liquidity (Eckstein and Sinai, 1986, pp. 61-62). The authors observe that this crunch period was often triggered by (1) the consequences of an over expanding economy (i.e. a boom), (2) a shortage of funds (due to reasons such as a decrease in savings, deposits or cash flows), and (3) restrictive monetary policies (Eckstein and Sinai, 1986, p. 62). Hence, the crunch is characterised by (1) a boom (outlined by raising demands for loans and decline in savings which engender "tight liquidity situations" for financial institutions), (2) inflation (households and businesses cannot follow raising prices, hence reducing savings and cash flows and increasing the cost of doing business that consequently leads to higher demand for loans), (3) tight money and disintermediation (accompanied by a raise of interest rates and a decrease in asset price which increase the cost of loans and decrease savings and cash flow even more), and (4) financial instability (worsening of balance sheets and increase in risky investments that turn into an "undesired liability structure") (Eckstein and Sinai, 1986, pp. 62-65).

Finally, during the reliquefication phase of the flow of funds cycle, business spending is lowered alongside liabilities. Simultaneously, monetary policies provide funds to stimulate the economy and interest rates stay at a low level (Eckstein and Sinai, 1986, p. 65). Hence, the cost of doing business is also reduced and "rebuilding balance sheets" takes place (Eckstein and Sinai, 1986, p. 65).

The authors then econometrically test the mechanism of business cycles. They find that impulse mechanisms are crucial in triggering fluctuations (e.g. oil shocks, change in monetary policies and credit crunches) (Eckstein and Sinai, 1986, p. 94). Aggregate demand, consumption spending and housing construction are also an important part of the cyclicality. They conclude that the business cycle mechanism through which a shock is transmitted to and through the economy remains intact whether the economy is struck by an external or an endogenous shock (Eckstein and Sinai, 1986, p. 96). They also identify the following aspect: it is changes in real durable consumption that had the most severe impact on business cycles (more than housing or business fixed investment, for example) (Eckstein and Sinai, 1986, pp. 96-97).

In a second article published in 1999, Aghion et al. (1999; p. 1359) show that unequal access to investment possibilities creates business fluctuations. They argue that all savers are not investors for the following three reasons: (1) an investor requires certain skills, ideas and connections that a saver may not have, (2) many investments require a minimum amount of capital, and (3) distance may hinder the ability to invest (e.g. close cooperation may be required between investors of different industries or of different firms in the same industry) (Aghion et al., 1999, p. 1360).

They find that an important degree of separation between savers and investors is accompanied by fluctuations around steady-state growth paths (Aghion et al., 1999, p. 1361). The explanation of the cycle is as follows. During periods of slow growth, savings are high and debt capacities of investors are limited, hence producing low interest rates. Consequently, the combination of low interest rates and low debt burden allows investors to gain higher profits that will serve to increase both reserves and dept capacities. This situation allows investors to increase their investments until the level of investment eventually catches up and surpasses savings leading to an increase in interest rates. Finally, debt burden increases and profits decrease leading to a contraction of investment and consequently, to a situation of slow growth (Aghion et al., 1999, p. 1361). And so the circle starts again.

What have we learned from this mechanism in relation to their hypothesis? They show that when constraints on credits are important and the proportion of investors is low relative to savers, then a boom will come to an end as the debt capacity of investors will "exhaust" and the economy will fall into a recession (Aghion et al., 1999, p. 1362).

This degree of separation between savers and investors also has an impact on the reaction of the economy towards productivity shocks. If the degree of separation is low (i.e. a situation comparable to a boom as opposition to a low growth period), then the productivity shock is immediately 'used' by the economy. By opposition, the economy will react slowly to the productivity shock when separation is high (Aghion et al., 1999, p. 1362).

Overall, the authors conclude that markets with less developed financial markets and higher separation between savers and investors tend to have more fluctuating economies (Aghion et al., 1999, p. 1363). This analysis calls for policy issues in order to improve

access to both credit direct investment opportunities such as, for example, the improvement of infrastructure or human capital (Aghion et al., 1999, p. 1387).

ii   The opportunity cost of introducing new innovations

In an article published in 1998, Aghion and Saint-Paul (1998) develop a model of productivity growth with the inclusion of demand fluctuation. The aim is to understand the "incentives for firms to implement new technologies" at different stages of the business cycle (Aghion and Saint-Paul, 1998, p. 323). These incentives improve firms' productivity through factors including reorganisation and spending in R&D.

They confront the model in the face of two different hypotheses: (1) "productivity is costly in terms of current production" which refers to the fact that the implementation of new technologies may affect current production, and (2) the "cost of productivity improvements is independent of current production", namely the implementation of new technologies does not affect current production (Aghion and Saint-Paul, 1998, p. 322).

The intuition behind this analysis is that reallocation of labour (or resources) happens during downturns as the opportunity cost is lower, namely the implementation of new technologies happens during recessions (Aghion and Saint-Paul, 1998, p. 323). It can also be argued that the accumulation of human capital has a lower opportunity cost during a recession (Aghion and Saint-Paul, 1998, p. 323).

They find that the first hypothesis is countercyclical, that is when the cost of increasing productivity is lower during a recession. Hence, a recession may positively affect the long-term growth of the economy (Aghion and Saint-Paul, 1998, p. 336). They argue that in recessions the cost is lower than the expected return. In contrast, the second hypothesis results in a procyclical trend. The cost of implementing innovations does not fall during a recession while expected returns do (Aghion and Saint-Paul, 1998, p. 323). In fact, return to productivity decreases during a recession, but the cost of reorganisation does not change. The authors also conclude that the first case corresponds to the results found throughout the literature (Aghion and Saint-Paul, 1998, p. 322).

The authors also draw attention to the fact that expectations and expected returns are lower during recessions than periods of expansion, and consequently, that an increase in the number of recessions does not positively affect the long-run growth of the economy. And therefore, that "business cycle has no first-order effect on long-run growth" (Aghion and Saint-Paul, 1998, p. 336). It is important to note that the analysis only accounts for demand shocks and leaves supply shocks aside, the latter having a positive effect on productivity.

iii   The influence of industrial structure on business cycles

A final array of studies that are addressed in this chapter focuses on the relationship between industrial structure, business cycles and their synchronisation. The effect of trade and industrial specialisation has been analysed in the articles presented in this section both at the national and regional level.

The first angle tackled is the role of malinvestments, in so-called "progressive" firms and industries, on the course of the business cycles. This particularity of the economic composition has been proposed by Åkerman and Dahmén, who based their reasoning on Schumpeter's theory of business cycles (Erixon, 2011, p. 106). They argue that malinvestments (i.e. faulty investments) in "progressive" firms and industries (i.e. firms and industries in a transformation process which increase their production on the long run) contribute to structural imbalances and to the downturn of the cycle (Erixon, 2011, p. 106).

Åkerman and Dahmén's theory is best explained through the description of the cycles' mechanism. The cycle starts with the recovery phase where the revival is set by firms that are financially sound, cost effective and who switched to the use of modern technologies (Erixon, 2011, p. 112). "Progressive" firms experience rapid expansion during this stage of the cycle, which leads to a structural change in the economy. They introduce the notion of "development blocks" that can be defined as "a complementary relation or a positive externality between industries, firms, and plants where innovations or investments are concerned" (Erixon, 2011, p. 112). For example, there are innovations which are not profitable without the development of complementary innovations that will stimulate new

technologies and products. Hence, the introduction of innovation will call for investments in complementary firms or industries. Consequently, the constitution of "development blocks" is a characteristic of the revival and expansion phase.

The rapid increase of "progressive" firms and industries during the expansion phase creates "structural tensions" as investments in these firms or industries "are not matched" by investment in firms and industries of that same "development block" (Erixon, 2011, p. 113). As a consequence, the performance of these "progressive" firms and industries is lower than expected, hence leading to faulty investments. They argue that it is the incompetence and low experience of new firms in progressive industries that leads to such investments. It follows that overconfident economic agents are forced to reconsider their expectations downward.

These malinvestments will end up in a constraint of credits and available funds, which also affects other firms and industries that fail to fund their activities (Erixon, 2011, p. 113). Malinvestments can in some cases generate a general credit constraint affecting the whole economy and altering the course of the cycle from expansion to recession.

The recession is characterised by a decrease in investments as a consequence of the credit constraint, the "dismantling" of malinvestments, and a reduction in profit expectations (Erixon, 2011, p. 114). Hence, during the recession, there is a "consolidation" of the economic structure with a stop to creation of new firms, the exit of faulty businesses, and mergers and acquisitions of other businesses. From this perspective, recessions may have a beneficial twist. However, one has to keep in mind that they also cause collateral damage in the sense that credit constraints also impact other businesses, which were lagging behind after a slow recovery and which may eventually lead to bankruptcies (Erixon, 2011, p. 115).

Erixon (2011, p. 115) argues that the lower turning point of the cycle in the Åkerman-Dahmén theory is the weak spot. As a recession goes on, it becomes more 'differentiated' amongst the firms and industries with a bigger dispersion in prices, costs and profits. As mentioned in the beginning of the description of the cycles' mechanism, recovery is led by those firms and industries that are cost effective, financially healthy, and at the cutting edge of technology. Towards the end of the recession, the elimination of firms has liberated capital that can be reinvested in those firms and industries and hence reduced

the structural "tensions" that were created during the expansion phase (Erixon, 2011, p. 116). "Development blocks" are rebuilt with new investments as well as mergers and acquisitions made by these "sound" firms that also bring new opportunities for collaboration.

The inclusion of malinvestments as well as "development blocks" is an extension to Schumpeter's understanding of business cycles, notably between the expansion and recession phases.

The last three studies analysed in this section focus on the effect of trade and industry specialisation of the synchronicity of business cycles at the national level (de Haan et al., 2008; Inklaar et al., 2008) and at the regional level (Belke and Heine, 2006). The aim is to understand if countries (and regions) with intense trade ties and structural similarities have similar business cycles.

Inklaar et al. (2008) study the trade intensity of 21 OECD countries and find that trade intensity positively affects business cycle synchronisation (i.e. countries with strong trade ties experience similar business cycles) but that at the same time other underlying factors, such as specialisation, also influence business cycle synchronisation (Inklaar et al., 2008, p. 648). In fact, trade intensity leads to economic specialisation and inter-industry international trade. Consequently, they argue that trade intensity has two effects in the face of an industry-specific shock: (1) on the one hand specialisation leads to less synchronisation between business cycles, and (2) on the other hand intra-industry relations lead to more synchronisation (Inklaar et al., 2008, p. 648). And overall, economy wide shocks striking one particular country will also affect surrounding countries that have strong trade ties with the country that was originally hit.

In a similar way, de Haan et al. (2008) also analyse the synchronicity of business cycles in regard to trade and specialisation with similar results. The authors also add in their analysis that economies with similar structure and production patterns will have a similar reaction to both industry-specific and economy-wide shocks and hence show similar business cycles.

Finally, Belke and Heine (2006) study the synchronicity of EU regional employment cycles (i.e correlation of business cycles) through the lens of specialisation. The

advantage of studying regions instead of countries is that it releases the hypothesis that countries are homogenous, at least for important countries.

The authors link the synchronisation of business cycles (measured by regional employment) with a range of specialisation indicators. They find that business synchronisation has declined between EU regions due to differences in their economic structure, hence confirming the argument put forward by de Haan et al. (2008) (see above) (Belke and Heine, 2006, p. 91). However, this result raises the question of why synchronisation has increased between countries but declined between regions of one country. They suggest that countries have similar industrial structures that represent the average of their heterogenous regions. Hence, there are no strong differences of industrial structures at the national level as it can be found at the regional level.

4.3   Synthesis: What   determinants   trigger   business fluctuations?

This last section proposes a synthesis of the causes and mechanisms of business cycles documented in this chapter. Similarly to chapter 3, the aim was to go over business cycle theories in order to look for clues that can join both concepts of economic resilience and clusters. Many factors influencing business cycles have been identified, ranging from the uneven development of business organisations, psychological causes and faulty investments to the implementation of innovations.

The records of business cycles were presented first, as well as the stylised fact, in order to give the reader a clearer picture of cycles' patterns. In the second section, authors were analysed in chronological order, beginning with the leading works of Burns and Mitchell. They paved the way for thinking on business cycles, notably by proposing a definition:

> Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but

not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own. (Burns and Mitchell, 1946, p. 3)

They identified four main factors that explain business cycles and that have a microeconomic foundation: (1) the uneven development of business organisations, (2) the interdependence of business enterprises, (3) the pecuniary versus industrial factors in business prosperity, and (4) the factors affecting pecuniary profits. Nonetheless, there is also the possibility of external factors hitting the economy. The first factor mentions that the more "elaborate" organisations are more sensitive to economic fluctuations. Second, the interrelations between firms and industries implies that they are dependent on the economic health of their counterparts. The third factor suggests that the focus should be on firms rather than industries or larger aggregated levels in order to understand their level of development and interdependence (i.e. the first and second factors proposed above).

These factors trigger two stresses which generate cycles: (1) an increase in the cost of doing business, and (2) an accumulating tension of the investment and money markets. Further, four stages of the cycle are identified: (1) revival, (2) full prosperity, (3) crisis, and (4) depression. However, more important than the division in various phases is the interrelation between the different moments of the cycle as well as their respective mechanisms. Further, each cycle is regarded as an accumulative process where, for example, the cumulation of prosperity depends on the legacy of the previous depression. Mitchell also concludes that the breadth of the depression depends on the readjustment processes, the enterprises' interrelations as well as market organisation, hence on various elements that influence the four factors described above.

An important conclusion of the analysis is that each cycle is unique and that an explanation should focus on microeconomic characteristics of average behaviour that take into account the diversities and complexities of business cycles.

In the first half of the 20th century, other explanations of business cycles have been proposed in parallel to Mitchell's seminary works. This chapter has focused on three authors that try to explain business cycles through different causes. For Pigou, real and psychological causes are the primary factors influencing fluctuations. For Schumpeter, it

is the introduction of innovations that creates business cycles. Finally, Haberler analyses the impact of openness to trade on fluctuations.

For Pigou, real causes (i.a. harvest, technological change, discoveries and consumer desire) create errors in forecasts, which are the roots of psychological causes. This creates further real causes that spawn more forecast errors. Pigou specifies what factors can influence errors in forecasts: (1) the businessmen in control of an industry, (2) the division of industries, (3) the time needed to produce a given commodity, and (4) the demand in an "untried market". The interrelationship between these factors also influences errors. Additionally, Pigou proposes two types of solutions to dampen fluctuations: (1) those that eliminate one or more initial factors causing fluctuations, and (2) those that act directly on the fluctuation (i.a. create new demand in bad times and transfer demand from good times to bad times).

In Schumpeter's view, it is not real or psychological causes but rather the implementation of innovations that creates fluctuations, and in particular breakthrough innovations, as opposed to the continuous stream of innovations that can result from experience or learning-by-doing. He understands fluctuations as a means to move from one state of equilibrium to another. Schumpeter argues that entrepreneurs will copy or build on innovation implemented by their peers, which creates a boom and, as a result, a temporary disequilibrium. This process both consolidates the economy by eliminating firms that cannot adapt to the new conditions and frees up means of production that can be reallocated to firms that have successfully adapted. Moreover, Schumpeter identifies four phases of a cycle: (1) prosperity, (2) abnormal liquidation or recession, (3) depression, and (4) recovery or revival. It is important to note that depressions are not a necessary phase of the cycle. In fact, an economy may move towards the revival without entering a depression. Overall, Schumpeter thinks that fluctuations are part of the growth process of economies.

Haberler stresses the role of international trade, in particular the influence of transportation costs and the localisation of capital. Under the hypothesis of transportation costs, Haberler argues that there will be less specialisation. Hence, an increase in income will be spent in the location. However, once the location has reached full employment, prices increase and demand shifts towards foreign products. The shift of demand depends

on the embeddedness between locations. Hence, the more embedded locations are, the less chance there is of having localised expansion or contraction. Regarding capital mobility, Haberler's conclusions are more ambiguous. In fact, localisation of capital tends to dampen both local booms and depressions. However, if there is an increase in foreign demand, then it can spark booms. Further, in the case of perfect mobility, a general boom or depression will favour more promising locations. Hence, if capital mobility is hindered, less promising locations are favoured. Finally, Haberler divides the cycle into four phases: (1), upswing (2) downswing, (3) upper turning point, and (4) lower turning point. Conclusively, transportation costs tend to "disturb the uniformity of the cyclical movement" and increase the chances of localised booms and depressions. No general statements can be drawn regarding the effect of imperfect capital, according to Haberler (1937, p. 425).

While RBC theories may contain the largest literature in the field of business cycle analysis, they bring only little to the debate in the context of this thesis. In fact, some hypotheses and argumentations are controversial in economic thinking. First of all, in RBC theories, it is the economic thinking that has to adapt to mathematical theory, rather than the latter being a tool to model economic mechanisms. Further, the aggregation assumes homogeneity of all economic actors and structures, which contradicts previous business cycle theories. Finally, RBC theories allow for negative technological shocks, which has been strongly disputed and criticised in the economic literature. However, and similarly to the neoclassical models of growth, they fill a gap in the literature between the Keynesian theories, that focus on macroeconomic and monetary aspects, and the new models. New business cycle theories focus on microeconomic characteristics such as investment possibilities, innovation or specialisation.

First, Eckstein and Sinai (1986) as well as Aghion et al. (1999) argue that credit crunches play an important role in economic fluctuations. Eckstein and Sinai (1986) analyse both business cycles and, in parallel, the flow of funds cycles. They find that five types of shocks can create fluctuations: (1) booms (i.e. positive demand shocks), (2) negative demand shocks, (3) supply shocks, (4) price shocks, and (5) credit crunches. They also find that each recession is preceded by a credit crunch. The business cycle can be separated in five phases: (1) recovery/expansion, (2) boom (i.e. unsustainable rapid growth), (3) a pre-crunch period/credit crunch (i.e. the supply of credit can no longer keep

pace with the demand, which increases the interest rates), (4) recession/decline (i.e. a period necessary to adapt to the changing availability of capital), and (5) reliquefication (i.e. improve cashflows and strengthen balance sheets). However, they point out that a cycle is not necessarily composed of each of these phases as one or more may be omitted. They do not give any explanations for the expansion phase since it can be explained by the growth theories. Since financial considerations are inherent to business cycles, the authors propose a flow of funds cycle, which is composed of four phases: (1) accumulation (i.e. there is an accumulation of physical and financial assets since financial constraints are low and funds are available), (2) developing financial instability (i.e. the so-called pre-crunch period), (3) crunch, and (4) reliquefication. Interestingly, the authors show that the crunch period (which also corresponds to the third phase of the business cycle) is characterised by a shortage of available funds.

Second, Aghion et al. (1999) focus on the access to investment possibilities and argue that unequal access creates fluctuations. In fact, an important degree of separation between savers and investors increases fluctuations. The degree of separation depends on the following three reasons: (1) an investor requires certain skills, ideas and connections that a saver may not have, (2) many investments require a minimum amount of capital, and (3) distance may hinder the ability to invest. Overall, the authors conclude that product markets with less developed financial markets and higher separation between savers and investors tend to have more fluctuating economies.

Third, Aghion and Saint-Paul (1998, p. 323) investigate the "incentives for firms to implement new technologies" at different stages of the business cycle. They argue that reallocation of labour (or resources) happens during downturns since the opportunity cost is lower. Or put differently, reorganisation happens during recessions. They find two cases: (1) the cost for increasing productivity is lower in a recession, hence a recession positively affects long-term growth of the economy, and (2) the cost of implementing innovations does not fall during a recession, while expected returns do (i.e. return to productivity decreases during a recession, however the cost of reorganisation does not change). By screening the literature, the authors also find that the first case corresponds to the results found throughout the literature.

Fourth, Erixon (2011), Inklaar et al. (2008), de Haan et al. (2008) as well as Belke and Heine (2006) focus on the relationship between fluctuations and economic structure. Erixon (2011) investigates Åkerman and Dahmén's theory, which analyses the influence of malinvestments (i.e. faulty investments) as well as the role of "progressive" firms and industries in contributing to structural imbalances. Progressive firms experience rapid expansion which creates "structural tensions" since their performance is lower than expected. This leads to malinvestments. A recession is then assimilated to a "consolidation" of the economic structure, where "development blocks" (i.e. positive externality between industries or firms) are rebuilt and consolidated. In Åkerman and Dahmén's theory, the concept of "development blocks" is an important component as some innovations are not profitable without investment in complementary activities or industries.

Inklaar et al. (2008) study the trade intensity of 21 OECD countries and find that trade intensity as well as specialisation positively affects business cycle synchronisation. They argue that trade intensity has two effects in the face of an industry-specific shock: (1) on the one hand strong specialisation leads to less synchronisation between business cycles, and (2) on the other hand strong intra-industry relations lead to more synchronisation. De Haan et al. (2008) also analyse the synchronicity of business cycles in regard to trade and specialisation and find similar results to Inklaar et al. (2008), namely that economies with similar structure and production patterns will have a similar reaction to both industry-specific and economy-wide shocks. Likewise, Belke and Heine (2006) investigate the synchronicity of cycles through the lens of specialisation, but the focus is on regions rather than countries. They find that business synchronisation has declined between EU regions due to increasing differences in their economic structure. A common result emerges out of those three studies, namely that similar industrial structures increase the synchronisation of business cycles and show similar reactions to shocks.

Table 4.2 summarises the main conclusions of each author studied in this chapter and highlights the phases, the factors influencing fluctuations and the mechanisms of cycles. They appear in the same chronological order. Based on the conclusions of this chapter, an analysis of the relations and the underlying mechanisms between business cycle theories, clusters and economic resilience will be carried out in the fifth chapter (section 5.3).

Table 4.1: Recapitulation table of the mechanisms and determinants found in chapter 4 (classified by authors).

Subsection	Author(s)	Key determinant(s), mechamisms and characteristics
Mitchell	Burns and Mitchell	Profit expectations are influenced by sales expectations and cost margins. By the end of expansion, costs are higher than prices. Hence, profit expectations diminish. **Mechanism:** ▪ Four factors explaining business cycles: (1) the uneven development of business organisations, (2) the interdependence of business enterprises, (3) the pecuniary versus industrial factors in business prosperity, and (4) the factors affecting pecuniary profits. Nonetheless, there is also the possibility of external factors hitting the economy. ▪ These factors generate two types of stress: (1) an increase in the cost of doing business, and (2) an accumulating tension of the investment and money markets. Finally, the breadth of the depression depends on the readjustment processes, the enterprises' interrelation and market organisation. Four stages of the cycle are identified: (1) revival, (2) full prosperity, (3) crisis, and (4) depression. Note: Each cycle is different because they are considered as an accumulation process (i.e. the preceding cycle influences the new one).

		A first definition of business cycles is proposed: "Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own (Burns and Mitchell, 1946, p. 3)."
Neoclassical school	Pigou	Fluctuations reflect the variations in profit expectations. **Mechanism:** Real and psychological causes influence yield expectations (i.e. profits resulting from industrial spending). A change of yield primarily impacts the demand for labour. Eventually, it is the variations in the demand schedule of labour that cause industrial fluctuations. Real causes create an error in forecast, which further changes the expectations. These variations in expectations are at the root of psychological causes. These psychological causes lead to further real causes that create new errors in forecast, and so on. Real causes can be, *inter alia*, harvest, technological change, consumer desires. Errors in forecast depend upon: (1) the businessmen in control of an industry, (2) the division of industries, (3) the time needed to produce a given commodity, and (4) the demand in an "untried market". The errors in forecast and their range depend on the 'interdependence of forecasts' or on the similarity of the businessmen's reaction to these errors.

		There are two kind of remedies to fluctuations: (1) those that eliminate one or more initial factors causing fluctuations, and (2) those that act directly on fluctuations (i.a. create new demand in bad times and transfer demand to bad times from good times). Pigou focuses on cyclical fluctuations that are extending over short spans of years.
Neoclassical school	Schumpeter	Innovations create fluctuations. Schumpeter tries to answer the following question: what makes the economy transition from a state of equilibrium to a new one? **Mechanism:** Innovations are the 'fundamental initial impulse' of cycles, in particular innovations that are not continuous but that happen "by leap". The success of some entrepreneurs lures others who will build on these innovations. This creates a boom (i.e. a carrying out of innovation) which leads to a disequilibrium. A readjustment of the economic system happens with a downward revision of values and a shrinkage of operations. This leads to a recession until a new equilibrium is reached. This sets the base for a new revival. The new equilibrium represents "the response by the system to the results of entrepreneurial activity – adaptation to the new things created, including the elimination of what is incapable of adaptation" (Schumpeter, 1939, p. 137). A cycle is composed of four phases: (1) prosperity, (2) abnormal liquidation or recession, (3) depression, and (4) recovery or revival. However, Schumpeter does not exclude that cycles can also be influenced by exogenous disturbances. Schumpeter also stresses the role of banks in financing entrepreneurs. Banks have a role in both expansion and depression.

Neoclassical school	Haberler	Haberler stresses the role of international trade in creating fluctuations.
		He introduces two disintegrating factors (1) transportation costs, and (2) localisation of investment, credit and banking into a closed economy.
		Regarding transportation costs:
		▪ **Mechanism:** Under the hypothesis of transportation costs, there is a tendency to less specialisation and division of labour. There is a primary increase in income followed by a secondary increase in income near the beneficiary of the primary income increase. The process continues with the tertiary income increase, and so on. However, specialisation is still present because tertiary income increase is lower than the second, which is also lower than the primary.
		▪ Conclusion: The more specialised the locations are, the less chance there is for a localised expansion or contraction.
		▪ Regarding innovations: if 'old' industries are localised in secluded areas (to a certain degree) by transportation costs, then they may be less impacted by innovations.
		Regarding the localisation of capital:
		▪ Haberler puts forward the principle that the localisation of capital dampens both local booms and depression.
		▪ Further, in the case of general booms or depressions with imperfect mobility of capital, the less promising locations may still enjoy such investment that would not be made in a general capital market.
		Overall, the mechanisms are ambiguous.

		Booms would develop and are accompanied by a rise in interest rates. As a consequence, funds would flow in from foreign locations. This increase in funds has further repercussion on imports. The localisation of capital tends to dampen booms and depression. This rule would limit the imports of the 'promising' location and consequently limit the 'stimulus' to the foreign locations.
		Haberler divides a cycle into four phases: (1) upswing, (2) downswing, (3) upper turning point, and (4) lower turning point.
		Conclusion:
		Transportation costs tend to "disturb the uniformity of the cyclical movement" and increase the chances of localised booms and depressions (Haberler, 1937, p. 425). On the other hand, no general statement can be drawn regarding the effect of imperfect capital.
RBC theories		In the RBC theories, fluctuations are triggered by real factors such as technology shocks or change in total factor productivity. They are propagated in the economic system through consumption, investment, labour input or anticipation. Hence, these shocks generate cycles.
		Three new ideas are presented: (1) the use of general equilibrium models, (2) the unification of business cycle and growth theories, and (3) the calibration of models in order to generate artificial economies that mimic real economies.
		Nonetheless, RBC theories are controversial:
		- It is considered as a failure mode of a scientific field that relies on mathematical theory. - There is an aggregation problem which assumes homogeneity amongst economic actors and economic structures.

Alternative and new theories	Financial considerations	**Eckstein and Sinai (1986)**
		Five types of shocks are identified: (1) booms, (2) negative demand shocks, (3) supply shocks, (4) price shocks, and (5) credit crunches.
		The business cycle is composed of five stages: (1) recovery/expansion, (2) boom (i.e. an unsustainable rapid growth), (3) a pre-crunch period/credit crunch (i.e. the supply of credit can no longer keep pace with the demand which increases the interest rates), (4) recession/decline (i.e. a period necessary to adapt to the changing availability of capital), and (5) reliquefication (i.e. improve cashflows and strengthen balance sheets).
		The flow of funds cycles is composed of four phases: (1) accumulation (i.e. there is an accumulation of physical and financial assets since financial constraints are low and funds are available), (2) developing financial instability (i.e. the so-called pre-crunch period), (3) crunch, and (4) reliquefication.
		Aghion et al. (1999)
		It is the unequal access to investment possibilities that creates business fluctuations.
		All savers are not investors for the following three reasons: (1) an investor requires certain skills, ideas and connections that a saver may not have, (2) many investments require a minimum amount of capital, and (3) distance may hinder the ability to invest.
		Mechanism: Slow growth periods are accompanied by low interest rates. Further, low interest rates and low debt burden allow investors to gain higher profits. Investments eventually catch up and surpass savings leading to an increase in the interest rate which increase the debt burden. In this situation, profit decreases.

		When the degree of separation between investors and savers is low, then productivity shocks are immediately 'used' by the economy. Hence, higher separation between savers and investors tend to create more fluctuating economies.
Alternative and new theories	Opportunity costs of innovation	**Aghion and Saint-Paul (1998)** The focus is on the "incentives for firms to implement new technologies" at different stages of the business cycles (Aghion and Saint-Paul, 1998, p. 323). They argue that labour (or resources) reallocation happens during downturns as the opportunity cost is lower. Hence, reorganisation happens during recessions. They assume two opposing situations: (1) "productivity is costly in terms of current production", and (2) "the cost of productivity improvements is independent of current production" (Aghion and Saint-Paul, 1998, p. 322). They find that: (1) the cost for increasing productivity is lower in a recession, hence a recession positively affects long-term growth of the economy in the first case, and (2) the cost of implementing innovations does not fall during a recession, while expected returns do (i.e. return to productivity decreases during a recession, however the cost of reorganisation does not change). The authors also conclude that the first case corresponds to the results found throughout the literature.

Alternative and new theories	Industrial structure	**Erixon (2011)** Åkerman and Dahmén's theory analyses the influence of malinvestments (i.e. faulty investments) and how "progressive" firms and industries contribute to structural imbalances and to the downturn of the cycle. **Mechanism:** "Progressive" firms experience rapid expansion which leads to a structural change of the economy (constitution of "development blocks"). It creates "structural tensions" and the performance of these "progressive" firms and industries is lower than expected. As a consequence, it leads to malinvestment. Malinvestments will end up in a constraint of credits that alters the course of the cycle from expansion to recession. The recession is assimilated to a "consolidation" of the economic structure. The end of the recession is characterised by elimination of firms. Hence, new capital is available and can be invested in more "solid" firms and industries. This reduces the structural "tensions". The "development blocks" are rebuilt and consolidated which, eventually, triggers a revival. **Inklaar et al. (2008)** They study the trade intensity of 21 OECD countries. Trade intensity positively affects business cycle synchronisation but underlying factors, such as specialisation, also influence business cycle synchronisation. **Mechanism:** Trade intensity has two effects in the face of an industry-specific shock: (1) strong specialisation leads to less synchronisation between business cycles, and (2) strong intra-industry relations leads to more synchronisation.

		de Haan et al. (2008) The authors analyse the synchronicity of business cycles in regard to trade and specialisation and find similar results to Inklaar et al. (2008). Economies with similar structures and production patterns will have a similar reaction to both industry-specific and economy-wide shocks. **Belke and Heine (2006)** The authors analyse the synchronicity of EU regional employment cycles through the lens of specialisation. A particularity is that cycles are studied at the regional level. They find that business synchronisation has declined between EU regions due to increasing differences in their economic structure.

Source: Personal elaboration.

Chapter 5

Determinants influencing the economic resilience of locations: A cluster approach

Chapter 1 described how clusters increase the prosperity of locations, notably by using the microeconomics of competitiveness (MOC) framework. In fact, the drivers of the prosperity of locations are divided into three levels: (1) endowments, (2) macroeconomic competitiveness, (3) and microeconomic competitiveness (see figure 5.1).

Figure 5.1: Drivers of the prosperity of locations.
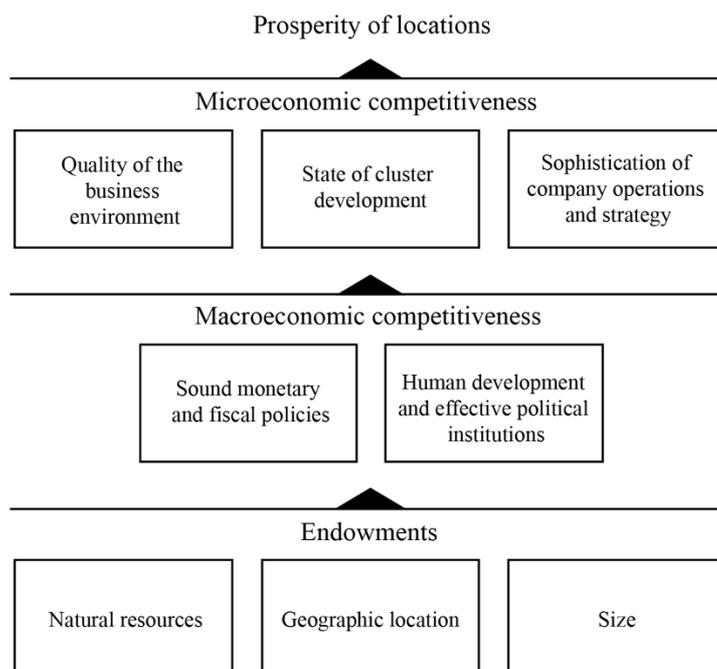
Source: Personal elaboration based on ISC (2020) and Ketels (2016, p. 14).

The concept of clusters, as defined by Porter (2008, pp. 213-214), falls within the third level, alongside the quality of the business environment and the sophistication of company operations and strategy. While the first and second levels set the conditions for prosperity, the latter depends on firms' productivity, which is created at the third level, namely at the microeconomic competitiveness level.

The quality of the business environment can be analysed using the diamond model (see figure 5.2). The model represents the 'four broad attributes' (i.e. determinants) of a location which affect the international success of its firms: (1) factor conditions, (2) demand conditions, (3) related and supporting industries, and (4) firm strategy, structure and rivalry. Chapter 1 also described how each of these determinants interact with one another in a self-reinforcing process. Clusters are a particular expression of the diamond. In fact, chapter 1 presented how clusters enhance it. In turn, the development of the four determinants as well as their interactions influence the sophistication of clusters.

Figure 5.2: The diamond model representing the determinants of national advantage.
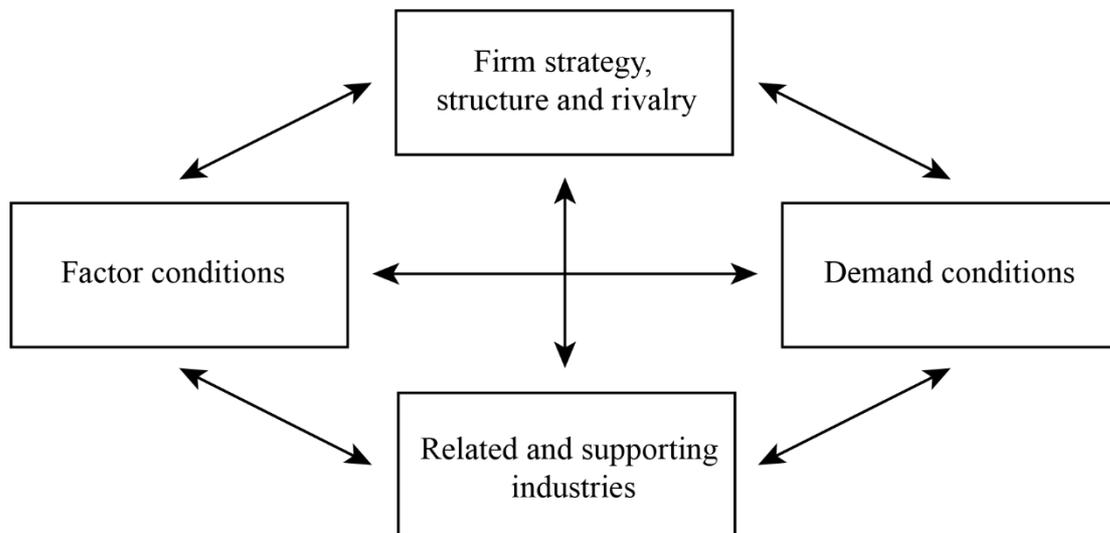
Source: Personal elaboration based on Porter (1990, p. 72).

The first chapter also reviewed studies that have analysed the influence of clusters, and their underlying mechanisms, on the prosperity of locations. Overall, the findings show that clusters increase the prosperity of locations and that several underlying mechanisms

play an important role in the process (i.a. intra- and inter-firm linkages, knowledge flows, relatedness amongst firms). Yet, these studies have not analysed the influence of clusters in the face of an economic downturn. As a consequence, the thesis investigates this influence by looking at studies focusing on economic resilience (chapter 2), and by investigating the growth theories (chapter 3) and business cycle theories (chapter 4). The aim of this chapter 5 is to bring together the determinants found in chapters 1 to 4 in order to understand if and how clusters can influence economic resilience, and as a consequence, broaden our understanding of the prosperity of locations.

Since the investigation focuses on the influence of clusters, it will follow the framework presented in the first chapter. In fact, the economic literature has used that framework to analyse the influence of clusters on prosperity, independently of the business cycle. In this thesis, the aim is also to analyse the influence of clusters, with a particular focus on their influence during economic downturns. The contribution of the MOC framework is twofold: (1) it may help answer some of the issues raised in the second chapter regarding the definition and conceptualisation of economic resilience, and (2) it may help find the determinants influencing economic resilience, notably through the influence of clusters.

This chapter is structured as follows. The first section focuses on the insights that the analyses conducted in chapters 1, 3 and 4 may bring to the issues raised regarding the definition and conceptualisation of economic resilience. The second section brings together the determinants found in chapter 1 with those found in chapter 2. The same analysis is conducted in the third section with a focus on growth theories, and in the fourth section with the determinants identified in the business cycle theories. Finally, the fifth section will propose a general synthesis and draws the limitations as well as the outlines for further empirical analyses.

5.1   Resolving issues on the conceptualisation of economic resilience

Chapter 2 was divided in two main sections: the first one focusing on the issues surrounding both the definition and the conceptual framework of economic resilience, and the second one aimed at identifying the determinants found in the economic resilience literature.

The conclusions drawn in subsection 2.1.2 showed that there is no consensus on a proper definition of economic resilience, resulting in a lack of framework. The investigation conducted in section 2.1 also highlighted some potential clues regarding the conceptualisation of economic resilience. Nonetheless, the analysis carried out in the first chapter, as well as in chapters 3 and 4, may bring some insights on these issues.

It has been concluded that economic resilience is an underlying capacity of economic actors to cope with disturbances and changes in economic conditions. Indeed, most studies reviewed insisted on the capacity of successful firms to cope with changes, notably by building on the definition of "adaptive" resilience proposed by Martin (2012). Adaptive resilience puts forward the capacity of an economy to "reconfigure, that is adapt, its structure (firms, industries, technologies and institutions) so as to maintain an acceptable growth path in output, employment and wealth over time" (Martin, 2012, p. 10). Others have built on different but closely related definitions of resilience. Overall, all studies acknowledged the fact that resilient economies are able to adapt to changing economic conditions. Hence, it was argued that the resilience of economic actors is continuously built up rather than acquired "on the spot".

In the first chapter, it was presented how a competitive advantage was sustained and how industries were able to broaden their sources of advantage. It was shown that the progress of sustaining and upgrading a competitive advantage is slow and that firms need to reorganise their resources. In fact, firms can sustain their competitive advantage depending on three conditions: (1) the source of the advantage (2) the number of distinct sources, and (3) the constant improvement and upgrading. A turning point was the intersection of various clusters that enables firms to build on, *inter alia*, different skills and technologies. This shows that, according to the MOC framework, the process of

sustaining and upgrading a competitive advantage is not acquired "on the spot" but is rather continuously built up.

Therefore, the definition of "adaptive" resilience proposed by Martin (2012), as well as its derived definitions, describe a process close to the MOC framework. In both situations, the central elements are the capacity to evolve, to cope with a changing environment and to continuously seek growth.

Many authors have not only proposed a definition of economic resilience, but also suggested breaking the concept down into phases, ranging from two to four distinct ones. As an example, Duval and Fogel (2008, p. 3) divide the resilience process into two phases: (1) the dampening of the shock, and (2) the speed of return. Other examples are Foster (2007, p. 14), who proposes four phases: (1) anticipate, (2) prepare for, (3) respond to, and (4) recover from. Similarly, Martin (2012, p. 11) also suggests four phases (1) resistance, (2) recovery, (3) re-orientation and (4) renewal. While the terms are different, the storylines are close. Overall, what comes out of these separations is that there are two characteristics of resilience: (1) the degree of preparedness, and (2) the capacity to recover. The degree of preparedness refers to the anticipation and the capacity to resist and dampen the shock, whereas the capacity to recover deals with the re-orientation, renewal or the speed of return. As a consequence, the determinants affecting the first characteristic may be different to those influencing the second characteristic.

This view can be reunited with the MOC framework, which explains how firms can both sustain and develop new advantages. It this case, sustaining can be assimilated to the degree of preparedness and developing new advantages to the capacity to recover. However, the business cycle theories may also shed some light on the matter. Some business cycle theories investigated in chapter 4 divide cycles into four distinct phases, notably the seminal works of Mitchell (1913, 1927, 1951): (1) revival, (2) full prosperity, (3) crisis, and (4) depression. For Schumpeter (1927; 1935b; 1939), business cycles are also divided into four phases: (1) prosperity, (2) abnormal liquidation or recession, (3) depression, and (4) recovery or revival. The two phases of economic resilience identified above relate to revival and crisis in Mitchell's work and to recovery/revival and prosperity in Schumpeter view. In chapter 4, it has been noted that a crisis or depression does not necessarily end up in a depression phase. Eckstein and Sinai (1986) argue that the

recession/decline phase is a period necessary to adapt to changing conditions, which is then followed by a phase of reliquefication in order to improve cashflows and, finally, a revival phase. These three phases are close to the two phases of economic resilience highlighted above.

There was also an issue of target, namely of what is impacted by a shock. An answer has already been given in chapter 2. In the MOC framework, it has been demonstrated that it is firms that drive the prosperity of locations. Furthermore, in many growth theories, it is firms or businesses that create economic growth (amongst others: Smith, Marshall, Schumpeter and Harrod). This observation can also be made with the business cycle theories where firms are the primary target (amongst others: Mitchell, Schumpeter, Haberler and Aghion). Transposed to the economic resilience framework, it can be said that resilient economies are those whose firms have been resilient.

The identification of the reaction is also of importance. This relates to both the measures as well as the identification of the shock itself. To what are firms resilient and through what indicators can it be identified? In the MOC framework, competitive firms are those that reach higher levels of productivity. In many studies, such as Delgado et al. (2010), Delgado et al. (2014) or Resbeut and Gugler (2016), performance is measured through employment growth or new business creation. Further, Slaper et al. (2018) use measures such as gross domestic product, productivity per employee or income. In the economic resilience literature, variation in employment has been the most common measure (amongst others: Faggian et al., 2018; Sensier, 2018). The identification of the shock is a more difficult task. In his seminary works on business cycles, Mitchell (1913, p. 582) argues that the shocks or stresses affecting economies and their propagation are difficult to assess since they may be endogenous elements that can hamper the propagation. Further, the number of economic agents and the rapidity and intensity of their reaction also influence the outcome favourably or unfavourably (Mitchell, 1913, p. 583; Burns and Mitchell, 1946, p. 467). Burns and Mitchell (1946, p. 480) use average deviations to measure the variability of business cycles. They also show that the contraction is characterised by a decrease in employment and income. For Pigou (1927, p. 22), fluctuations are deviations of a particular measure (of demand schedule in his theory) away from its line of trend. The IMF considers a recession to be "a period of decline in economic activity" in terms of GDP of at least two consecutive quarters (IMF, 2020).

However, a recession would imply that the economy was not prepared or has not recovered. Of importance when studying economic resilience is that the shock is wide enough to spot differences in reaction between various economies and to understand why some economies are doing better than others.

A further issue is the time span, or put differently, resilience over what period? This issue focuses on the debate around short- versus long-term analysis. In the MOC framework, it was shown that sustaining and developing competitive advantages is a slow process, hence it focuses on a longer horizon. On the other hand, Sensier (2018, p. 12) argues that the short-term encompasses a social dimension. While the growth theories take a long-term perspective, the business cycle theories investigated in chapter 4 provide significant insight into this issue. Some authors such as Burns and Mitchell (1946) as well as Sensier (2018) show that some indicators react more tardily in comparison to others (e.g. employment and output). As a consequence, the choice of indicator may influence the timespan used to analyse economic resilience. Moreover, it was argued in this section that economic resilience encompasses two distinct characteristics (i.e. the degree of preparedness and the capacity to recover) and as a consequence, each characteristic may require a different timespan. For example, the degree of preparedness can be analysed in the short-term as it regards the resistance and capacity to recover over the longer term as it encompasses dimensions such as re-orientation and transformation. Overall, this issue still remains open as no objective answer can be given based on the elements brought by the previous chapters.

As a conclusion it can be said that the definition of economic resilience most encountered in the literature is the "adaptive" definition of resilience, which also fits within the MOC framework. Further, resilience can be characterised as a combination of both the degree of preparedness and the capacity to recover from a shock. It can be measured by indicators of economic activity such as employment, GDP per capita or productivity. Finally, the period of analysis depends on the indicator used to measure resilience and on the two characteristics of economic resilience.

5.2   Insights from the economic resilience literature

In this first section, the determinants found in chapter 2 are compared to the theoretical framework and empirical results found in chapter 1. In chapter 2, five distinctive influences have been identified in the literature in order to explain economic resilience: (1) economic structure, (2) innovation, (3) regional and national context, (4) entrepreneurship, and (5) the quality of human capital. In this section, the underlying mechanisms of these influences are compared to those found in the first chapter regarding the MOC framework. In particular, those influences are compared to both the theoretical aspects presented in section 1.1 and the determinants empirically identified in section 1.2.

5.2.1   How economic structure influences economic resilience

Industrial structures and agglomeration forces have been the core of the literature explaining economic resilience. Some authors have highlighted that locations with a specialisation in manufacturing industries were more resilient (Brakman et al., 2014; Di Caro, 2014; Wink, 2018; Valdaliso, 2020), while others have stressed that services industries increase the resilience of locations (Angulo et al, 2018). However, there is a common determinant that explains the heterogenous results of these four studies: the locational linkages between firms. In fact, Brakman et al. (2014) show that urban areas are more resilient than rural areas and that specialisation in high-tech industries increases resilience. The literature on urban agglomeration shows that it increases the performance of firms (amongst others: Glaeser et al., 1992; Glaeser and Kerr, 2009; Glaeser 2019). Di Caro (2014) explains this positive influence through the related diversity amongst firms; Wink (2018) highlights both the social consensus and collaboration between firms as well as the related diversity; Valdaliso (2020) that geographical concentration and clustering enhance absorptive capacity and finally; Angulo et al. (2018) present geographical concentration, which increases externalities amongst firms.

It is interesting to note that this common determinant, namely the interrelation amongst firms, whether through externalities, collaborations, related diversity or absorptive capacity, was highlighted as an important factor of clusters. In fact, Porter (2000; 2008)

argues that prosperity depends, notably, on the quality of the business environment whose determinants are influenced by both domestic rivalry and geographical concentration. Furthermore, relatedness and intra- and inter-firm linkages were identified as strong mechanisms of clusters (amongst others: Alberti and Pizzurno, 2015, 2017; Alcácer and Delgado, 2016; Turkina and van Assche, 2018).

Further, authors have focused on the role of economic diversity on resilience (Kahl and Hundt, 2015; Brown and Greenbaum, 2016; Di Caro, 2017; Kakderi and Tasopoulou, 2018; Sagan and Masik, 2018; Cainelli et al., 2019). These studies show that industrial diversification increases the economic resilience of locations. In particular, Brown and Greenbaum (2016) show that concentrated industries are more performant in good times, but diversified industries are more resilient in times of crisis. This would imply that the mechanisms for growth are different than those for resilience. Hence, clusters increase growth in good times, but would make locations less resilient in bad times. Further, Kakderi and Tasopoulou (2018) argue that limited industrial diversification has a negative impact on resilience as it is assimilated, in the case of Greece, to low innovation and investment. However, it can be argued, in light of the MOC framework, that innovation does not depend on industrial diversification *per se*, but rather on competition that brings incentives to innovate and invest. Healy (2018) finds that industries with low external orientation (i.e. industries oriented towards the local market) are less resilient. This finding is corroborated by Sagan and Masik (2018) who show that it is the diversification of exporting industries, namely of industries that compete internationally, that is of importance for resilience. These industries have incentives to innovate as well as invest in specific skills and advanced jobs.

This dimension was also raised in chapter 1 regarding firms' strategy and clusters' development. Indeed, Porter argues that the ability to compete internationally increases the quality of the business environment at home and helps sustain and develop competitive advantages. Alcácer and Delgado (2016), and Turkina and Van Assche (2018) have shown that both internal and external agglomerations are important factors influencing the internationalisation of firms. For example, as firms move towards knowledge-intensive activities, they seek to establish horizontal linkages outside of a cluster which leads to internationalisation. This engenders new external agglomeration economies and new knowledge acquisition that fosters their competitive position at home.

This argument is confirmed in the economic resilience literature by Cainelli et al. (2019), who find that technological relatedness increases resilience, while vertical relatedness has the opposite effect. Finally, Kahl and Hundt (2015) emphasise the role of diversified regional agglomeration which increases the capacity of firms to diversify the portfolios of activities and networks. Diversified agglomeration could refer to related diversification since the authors focus on networks in their explanation. Hence, an increase in related diversity could increase resilience.

This dimension of related diversity has been broadly investigated and offers an opposite explanation of economic resilience than economic diversification (Hane-Weijman et al., 2017; Pudelko and Hundt, 2017). This dimension of related diversity is also seen as an important mechanism in studies that have focused on the influence of clusters on resilience (Treato and Giarratani, 2008; Wrobel, 2015; Delgado and Porter, 2018; Hundt et al., 2018; Behrens et al., 2020). With the exception of Behrens et al. (2020) and Hundt et al. (2018), the other studies find a positive influence of clusters on resilience, notably through the dimension of related diversity. Hane-Weijman et al. (2017) find that the specialisation of related industries increases the likelihood of re-employment and the absorptive capacity of the labour market. In the first chapter, it has been explained how clusters increase investment in factor conditions, which can take the form, for example, of a large pool of specialised workers. Hundt et al. (2018) find that cluster externalities depend on the macroeconomic cycle. Namely, that cluster externalities help in good times, but not in bad times. This conclusion is akin to the result of Brown and Greenbaum (2016).

In the previous section, it was concluded that economic resilience depends on two characteristics: the degree of preparedness and the capacity to recover. It can therefore be that specialisation or cluster externalities are more effective for the capacity to recover (i.e. growth) than the degree of preparedness (i.e. resistance). However, it can also be due to an error in cluster identification. In fact, Pudelko and Hundt (2017) find that industrial specialisation worsens resilience, but that specialisation of related industries increases resilience. The specialisation of related industries can be assimilated to clusters, encompassing not just one industry but also actors such as suppliers and firms at various stages of the value chain. This statement is confirmed by the results of Treado and Giarratani (2008) who find that it is the large base of intermediate suppliers within a

cluster that increases the resilience in the Pittsburgh area. In the first chapter, it has been shown that the strong competition between suppliers increases the sophistication of the produced intermediary goods and enables fulfilment of the more advanced requirements of buyer firms.

Further, Wrobel (2015) as well as Delgado and Porter (2018) find that clusters have a positive influence on resilience. Wrobel (2015) highlights the role of the increased "solidarity" and "altruism" between firms in Germany. Delgado and Porter (2018) find that industrial specialisation outside of clusters negatively influences resilience, but that industrial specialisation within clusters increases resilience. They also find that the number of businesses increases resilience. In fact, the first chapter has shown that clusters increase the creation of businesses and that, in turn, they diversify the cluster into new related activities that increase the breadth and depth of the cluster. As a consequence, it expands the sources and sophistication of competitive advantages as well as prevents lethargic behaviour of cluster participants.

Moreover, Delgado and Porter (2018) highlight the underlying role of inter-firm and inter-industry linkages in influencing resilience. They argue that these mechanisms reduce uncertainty in the face of a shock, similar to the explanation given by Wrobel (2015). This can also be explained by the fact that geographic concentration of various economic actors within clusters increases the dissemination and flow of information, as explained in the first chapter (Alberti and Pizzurno, 2015; 2017). Hence, actors can more easily be informed about, *inter alia*, opportunities, risks, the application of innovations or the state of technology development.

What comes out of this first analysis is that more than the types of industry, it is the linkages amongst firms and industries within a location that is of importance for economic resilience. In particular, the specialisation of related diversity and clusters are found to be important determinants of resilience. Following the investigation conducted in the first chapter, it can be said that these environments are characterised by strong competition, incentives to innovate and easier access to information. Hence, these environments foster capacities to adapt to constantly changing economic conditions which prevent firms to acquire a passive and lethargic behaviour. As a consequence, it can be said that these

environments help both characteristics of economic resilience, that is the degree of preparedness and the capacity to recover.

5.2.2   How innovation influences economic resilience

The second influence identified in the economic resilience literature is innovation. Innovation can be a by-product of specialisation of related industries and clusters. In fact, the first chapter has shown that clusters are characterised by higher innovation levels and patent growth (Porter, 2000 and 2008; Delgado et al., 2014). However, innovation can also take place outside of clusters. Overall, the five studies analysed in chapter 2 find a positive influence on innovation of economic resilience.

First, Hannigan et al. (2015) explain this positive influence by the fact that innovation enables firms in declining industries to move towards niche activities and hence, to be global leaders in these markets. Further, Clark et al. (2010) stress the role of SMEs in increasing resilience and find that the influence on resilience of a large number of innovative SMEs in a location is higher than the influence of a few dominant large firms. These two results are consistent with the theoretical examination and empirical evidence provided in the first chapter. Indeed, the MOC framework insists on the importance of domestic rivalry in raising the development and sophistication of the diamond's four broad attributes, notably in creating incentives to invest in specialised factors of production and in innovating. Further, domestic rivalry also increases incentives for firms to innovate in order to improve their productivity and differentiate themselves from their competitors. In the first chapter, Alberti and Pizzurno (2015; 2017) have also stressed the importance of start-ups that facilitate knowledge leaks, which are then disseminated.

Sedita et al. (2017) investigate the influence of innovation through the role of specific types of knowledge. Interestingly, they find that both synthetic (i.e. necessary to develop new combinations of existing knowledge) and symbolic knowledge (i.e. relates to aesthetic attributes encountered in cinema, advertising and fashion) are of importance for economic resilience, while analytical knowledge (i.e. scientific knowledge critical for breakthrough innovations) is not. The somewhat counterintuitive result regarding

analytical knowledge may be explained by the results of Wink et al. (2018) as well as Bristow and Healy (2018c) who argue that the innovative base helps the adjustment of productive and technological structures. Bristow and Healy (2018c) suggest that this adjustment is dependent on the knowledge that firms can gather about the changing environment. In fact, it is not about breakthrough innovation, but rather about adjusting to new economic conditions. Hence, it is the more incremental innovations that are of importance, consequently highlighting the importance of synthetic knowledge. In the first chapter, the role of information and knowledge flows have been commented on and regarded as an important underlying mechanism of clusters and agglomeration externalities. In particular, the more concentrated knowledge flows are, the higher the probability of acquiring that knowledge is.

5.2.3 How the regional and national context influence economic resilience

The influence of the regional and national context was found to influence economic resilience (Fratesi and Perucca, 2018; Sondermann, 2018; Hundt and Holtermann, 2020). Indeed, Fratesi and Perucca (2018) find that territorial capital (i.e. the innovative cross which encompasses private services, collective goods and agglomeration economies) is positively related to economic resilience. This is not surprising considering the results found above regarding innovation as well as agglomeration externalities and clusters. More interesting are the results of Hundt and Holtermann (2020). They find that the national setting is more important during the resistance phase than during recovery. In particular, their results suggest that similar regional determinants have different effects on resilience depending on the national setting. The authors conclude that resilience is not only about regional factors but also about country-specific institutional factors. Finally, Sondermann (2018) shows that sound labour and product markets not only make it easier to do business but also increase the resilience. Overall, the results of this stream of literature remind us of the macroeconomic competitiveness level of the MOC framework. In fact, the macroeconomic level sets the conditions for prosperity. It allows

for the creation of prosperity, which is then achieved at the microeconomic competitiveness level.

5.2.4   How entrepreneurship influences economic resilience

Fourth, the role of entrepreneurship as a factor influencing resilience is also tackled in the literature (Hundt and Sternberg, 2014; Holm and Østergaard, 2015; Huggins and Thompson, 2015; Sagan and Masik, 2018; Bishop, 2019; Ryan et al., 2020). Overall, the results show that entrepreneurship increases the resilience of locations. Hundt and Sternberg (2014), and Sagan and Masik (2018) find that recessions motivate opportunity-seeking entrepreneurs, while unemployment increases necessity-driven entrepreneurship. In fact, entrepreneurship is a preferable solution to unemployment (Sagan and Masik, 2018). Furthermore, they find that entrepreneurship provides services to companies who can more easily outsource and, as a consequence, achieve a higher degree of flexibility (Holm and Østergaard, 2015; Sagan and Masik, 2018). This has also been found by Bishop (2019) who argues that entrepreneurs facilitate adaptation. However, entrepreneurship is influenced by the available knowledge. Bishop (2019) finds that the quantity and diversity of knowledge increase the creation of entrepreneurship and, *in fine*, of economic recovery. Hence, it can be said that entrepreneurship increases both the degree of preparedness, by providing services to firms, and the recovery through market entrance. The access to knowledge has also been highlighted above and in the first chapter as an important underlying mechanism of clusters. It was also shown that external agglomerations are of importance for smaller firms and start-ups. Consequently, entrepreneurs play a positive influence on resilience. In this regard, clusters facilitate both new business creation and access to information which suggests that clusters increase the resilience of locations.

Finally, Ryan et al. (2020) focus on the role of MNEs in facilitating entrepreneurship, while Huggins and Thompson (2015) find that community culture increases the resilience of entrepreneurial activity and, eventually, of economic resilience. Alberti and Pizzurno (2015; 2017) find that start-ups are willing to collaborate with established firms in order to acquire knowledge necessary for their development. In return, they leak knowledge to

the established firms. Furthermore, the openness and diversity of the community culture lead to openness of new ideas and the willingness to embrace them. These processes are enhanced in clusters where the likelihood of such relationships is higher. In fact, the geographical proximity between firms within clusters was also seen as increasing the motivation to compete and therefore, the motivation to take on new ideas, to innovate and to distinguish themselves. Based on these observations, it can also be concluded that clusters increase resilience.

5.2.5   How human capital influences economic resilience

Fifth, a last stream of literature explains economic resilience through the quality of the labour market (Glaeser et al., 2014; Diodato and Weterings, 2015; Doran and Fingleton, 2016; Weinstein and Patrick, 2019). Overall, these studies find that more advanced human capital is associated with a higher level of resilience. Diodato and Weterings (2015) find that sectors with high skill-relatedness had higher recovery since workers can more easily be reabsorbed. This finding is akin to the finding of Hane-Weijman et al. (2017) – that the specialisation of related industries increases the likelihood of re-employment. Since clusters are composed of supporting and related industries, the relatedness between firms is also higher. This result was also found in the first chapter, where Neffke et al. (2017) show that labour flow mainly takes place within related industries. In fact, firms seek industry-specific knowledge more than skills.

Further, Weinstein and Patrick (2019) find that economies with high cognitive and people skill requirements are more resilient. This is due to the fact that interactive and problem-solving tasks are less likely to be outsourced and are of importance in firms' transformation process to adapt to changing conditions. In fact, the authors argue that people skills such as persuasion and the ability to communicate on solutions and new ideas are key in times of crisis. This result is akin to the those found by Sedita et al. (2017) where symbolic and synthetic knowledge were key in contributing to economic resilience. The cluster theory does not investigate types of knowledge or skills in detail. Nonetheless, these two types of knowledge increase the sophistication of tasks in the value-chain. Hence, it can be deduced that clusters encompass cognitive and people skills.

Finally, Doran and Fingleton (2016), and Glaeser et al. (2014) find that resilient economies and cities are those with more highly educated people. Glaeser et al. (2014) find a negative correlation between the number of educated workers and unemployment. They argue that more educated workers can become skilled entrepreneurs who have a stronger ability to find opportunities in downturns, hence increasing the recovery phase. Above, it was argued that clusters increase both the accessibility of knowledge (i.a. about opportunities, new technologies and the current industrial situation) and the sophistication of skills, tasks and workforce.

In light of the combination of the five streams of literature and the MOC framework developed in chapter 1, it can be concluded that clusters increase the resilience of locations, hence contributing further to the prosperity of locations. However, since economic resilience is composed of two principal characteristics (i.e. the degree of preparedness and the capacity to recover), clusters may have a stronger influence on one of the characteristics. In fact, clusters may have a bigger influence on the degree of preparedness or on the capacity to recover. Some underlying mechanisms seem to primarily influence the degree of preparedness while others increase the capacity to recover. To further investigate these two influences, a closer look into the growth and business cycle theories is offered.

5.3   Insights from the growth theories

Intuitively, growth relates to the processes which increase real income per capita over time. Put differently, it is the processes that increase the prosperity of locations (Setterfield, 2016, p. 212). Regarding the process of economic resilience, growth can be tied to the recovery phase, where economies move towards higher levels of prosperity.

Using data on England's GDP per capita from 1270 to 2016, it was shown that since the industrial revolution during the 19th century, GDP per capita has increased exponentially (figure 3.1). Rodrik's six stylised facts were presented: (1) economic growth has increased over time, (2) the convergence effect between countries has not been confirmed by the historical records, (3) economic development is related to productive

diversification, (4) industrialisation and manufactured exports are related to rapid and sustained growth, (5) manufacturing industries exhibit unconditional convergence, and (6) successful economies have not been those with the least interventionism (Rodrik, 2014).

Overall, these stylised facts are close to the theoretical development and empirical results of the MOC framework, and in particular of clusters. First, it has been proved that clusters increase productivity growth as well as the prosperity of locations. Second, the framework does not investigate the convergence effects between economies. However, it does suggest that building a competitive advantage is a slow process. Also, while clusters can be present in every economy, the more advanced and sophisticated clusters are found in more developed economies. Consequently, economies that lack sound macroeconomic conditions will not be able to create prosperity. Hence, they will lose ground against more competitive economies that can build their prosperity on strong clusters. This would give an explaination on the lack of convergence between developing and developed economies. Third, the most sophisticated clusters are those that have diversified their sources of competitive advantage. Fourth, the more competitive and sophisticated industries and clusters are those that have internationalised, whether through intra-firm linkages or the prospection of new markets. Porter puts forward the role of traded industries as opposed to local ones in driving the prosperity of locations thanks to higher wages or higher rates of innovation which then influence local wages (Porter, 2003, p. 549). Traded industries "sell products and services across regions and often to other countries" (Porter, 2003, p. 559). Fifth, the MOC framework does not tackle the subject of convergence, as highlighted above for the second stylised fact, or of convergence of productivity between manufacturing industries. However, Delgado et al. (2014) show that convergence forces take place at the region-industry level, while agglomeration forces are encountered at the cluster-level. Namely, they show that the "growth rate of an industry within a region may be declining in the level of economic activity of that industry" (Delgado et al., 2014, p. 1785). However, convergence forces at the industry level are counter-balanced by agglomeration forces arising at the cluster level. Finally, the sixth stylised fact regarding interventionism is not tackled by the MOC framework, yet the framework stresses the role of government in influencing the development of the four "broad attributes" of the diamond.

In chapter 3, the theories were discussed in chronological order. With the exception of Solow's model of growth, all theories were selected based on the determinants found in chapter 1 regarding clusters.

5.3.1 Smith, Marshall and Schumpeter: the dimensions of division of labour, innovation and entrepreneurship

In Smith's theory (Smith, 1776), growth depends on the increase in labour productivity, which depends on the division of labour. The division of labour is possible thanks to the trade of goods and increased market size. Furthermore, firms have to constantly improve in order to stay competitive. This process is accompanied by new knowledge creation that becomes a public good.

These elements were also found in the MOC framework, where prosperity depends on firms' productivity and their capacity to increase productivity through innovation. The division of labour in Smith's theory is the counterpart of specialisation in the MOC framework. The more specialised and sophisticated the industries are, the deeper the division of labour is. In section 5.2, specialisation was regarded as having a mitigating effect on resilience. In fact, it was shown that it is the specialisation of industries within clusters as opposed to specialisation of industries outside of clusters that increases resilience. Further, educated workers and advanced skills and tasks were also found to contribute to resilience. This dimension is encountered in clusters as well as in Smith's growth theory. In fact, the division of labour is associated with differentiated tasks. In Smith's theory, the increase in productivity triggers the development of new markets as well as an increase in size. In terms of the competitive strategy of firms, the size of markets as well as the size of clusters is key for their location choice and for achieving agglomeration of scale in specialised inputs. Further, it reduces the risks for suppliers as they face many buyers.

A last dimension is knowledge, which is created thanks to the division of labour in Smith's theory. Knowledge creation is considered as a by-product of the division of labour that becomes a public good and strengthens the competitive environment. This

process is also encountered in the cluster theory, notably by facilitating innovation and new firm creation. In fact, the concentration of knowledge within clusters reinforces the probability of dissemination amongst the cluster participants. This has notably been shown by Alberti and Pizzurno (2015; 2017) when focusing on a particular cluster in Italy. Hence, cluster participants are aware of opportunities, technological development, new specialised inputs or market conditions. In the previous section, this mechanism has been found to increase resilience.

Building on Smith, Marshall (1920) and Schumpeter (1935a; 1944) have also proposed a microeconomic-based approach to growth. As highlighted in the first chapter, the concept of clusters is strongly based on the works of Marshall and Schumpeter, in particular by building on the concepts of the division of labour, external economies and entrepreneurship. In Marshall's growth theory (1920), the principal common aspect is the focus on productivity, and more precisely, the specialisation on narrower tasks. This is akin to Smith's vision of growth and of the influence of the division of labour. Nonetheless, Marshall introduces a fourth factor of production: organisation. Organisation increases labour efficiency through the division of labour in relation to (1) the use of machinery, (2) the localisation of industries, and (3) large-scale production.

First, the division of labour and the use of machinery increase labour productivity through specialisation on narrower tasks. This is similar to clusters where productivity depends, *inter alia*, on access to specialised inputs. Both in Marshall's theory and in the MOC framework, this process is dynamic as it encompasses a continual change. This continual change is the result of innovation.

Second, the division of labour and the localisation of industries induce external economies, a dimension that was discussed in the first chapter. Marshall (1920) argues that the specialisation of skills and machinery is easier in the aggregate production of "neighbourhoods". These neighbourhoods are another way of naming clusters, primarily building on the co-location of related actors. Interestingly, Marshall (1920) also warns that overly specialised locations are susceptible to depression and suggests that the localisation of several distinct and developed industries dampens the risk. In essence, this is one of the conclusions from the analysis conducted in the previous section regarding the role of clusters on economic resilience. In fact, it was concluded that specialisation in

narrower tasks leads to more vulnerability, but that innovation leads to increased resilience. In a similar vein, Marshall (1920) argues that the division of labour acts as a source of continuous reorganisation of the economy. Hence, firms that compete in this changing environment would also be more resilient in the face of shocks since they implement strategies to compete in constantly changing environments. This dynamic environment prevents firms from developing lethargic behaviour.

Third, the division of labour and large-scale production enable economies of skills and machinery. In the MOC framework, the internationalisation of firms has been seen as an important step towards sustaining and developing competitive advantages. The internationalisation of firms not only allows them to benefit from foreign advantages but also to open up to larger markets. It enables them to take advantage of economies of scale. Consequently, they increase their productivity and reduce any risks linked to their home location. However, the analysis conducted in the second chapter has shown that smaller firms have higher resilience than bigger firms. It was argued that smaller firms have more flexible production systems and that they can readjust more rapidly to changing economic conditions (Clark et al., 2010; Holm and Østergaard, 2015; Valdaliso, 2020).

While Marshall has focused on specialisation and externalities, Schumpeter (1935a; 1944) investigates the role of entrepreneurs on economic development. Entrepreneurs innovate by developing new combinations (i.a. new products and new techniques of production) that grant them an entrepreneurial profit (i.e. a temporary monopoly gain). Hence, innovation stimulates economic growth. Innovation and new business creation (i.a. through entrepreneurship) are key determinants in the development of clusters. In fact, innovation increases productivity growth and new business formation diversifies clusters into new related industries which further expand the sources of competitive advantage, *in fine*.

In Marshall's theory, the dynamic process that is of importance for firms' adaptive capacity is induced by the division of labour. This dynamic process is also encountered in Schumpeter. In Schumpeter, rather than the division of labour, it is the combinations (i.e. innovation) that take the place of old ones in a continuous process. It incessantly changes the economic structure (i.e. the process of "creative destruction"). While the origins seem different, they have the same root – a change in the way of producing and

competing. This gives rise to new ideas that are then taken up by others and combined with supplementary knowledge. The previous section presented this particular capacity of resilient economies.

These dimensions of division of labour, innovation and entrepreneurship were found to positively increase economic resilience, independently from a cluster effect. More precisely, innovation and entrepreneurship were found to increase both the degree of preparedness and the recovery characteristics. The developments of Smith, Marshall and Schumpeter confirm some mechanisms of clusters in terms of growth and resilience.

5.3.2   Ricardo, Malthus and Mill: overcoming the steady state

The classical theories of economic development were also studied. Ricardo (1817b), Malthus (1986) and Mill (1965) explain growth as an exogenous process where the economy gets trapped in a steady state due to decreasing returns from land and decreasing returns to population. In fact, if exogenous technical progress is too low, it cannot counterbalance the diminishing returns. The MOC framework insists on the capacity of firms to innovate, which is to say to implement new technology or new ways of doing things. This raises productivity and economic growth. The difference is that technological development is considered endogenous in the MOC framework. However, Ricardo (1817b), Malthus (1986) and Mill (1965) also allow for the inclusion of factors that overcome this steady state. Ricardo (1817b) suggests that there is no limit for the consumption of ornaments and luxuries, while for Malthus (1986), trade makes it possible to extricate the economy from the steady state, and Mill (1965) argues that it is the 'capacity to understand the world'. These elements can also be found in the cluster literature, however under another appellation: namely the sophistication of demand and factor conditions (i.e two determinants of the diamond). The first chapter explained how clusters improve the four determinants of the diamond and increase their sophistication. Hence, clusters increase the capacity to move away from the steady state. Regarding economic resilience, it can be said that locations with strong cluster environment are more able to recover after a shock if the sophistication of factor and demand condition is high. This will increase the growth rate in the aftermath of a shock.

5.3.3   Harrod and Domar: factors leading to instability

In the first half of the 20th century, Harrod (1939) and Domar (1947) have proposed a more aggregated growth model. In Harrod's model, growth comes from the investment made by firms which want to keep the pace with economic expansion. However, each individual firm may have different expectations about the future (or erroneous anticipations), which leads to differences in their will to keep the pace. This leads to an unstable growth path. In clusters, it can be argued that there are less 'erroneous anticipations' since firms are better informed thanks to more concentrated knowledge flows, as previously explained. Further, the relatedness amongst cluster participant is higher whether in terms of technology, factors of production, opportunity costs. As a consequence, the level of investment will be closer to the desired level, thereby reducing cyclical fluctuations and reaching higher growth rates.

Domar's approach is slightly different. It is the technology, and not firms' expectations as in Harrod's model, which leads to unstable growth. There is a loss in capital value due to a 'junking process' (i.e. an imbalance between savings and technical progress or a misdirection in investment) which weakens the cumulative process of investment. However, this 'junking process' can be counterbalanced by the reduction in the propensity to save or an increase in technical progress. Firms within clusters are competing in a dynamic environment that is characterised by higher levels of innovation and employment growth. However, these types of environment also require higher levels of investment. Furthermore, cluster participants are better informed, which leads to less misdirection in investment. Hence, it can be argued that in clusters, this process is less likelyto lead to an unstable growth path.

5.3.4   Solow: the need for technical progress

Following Harrod and Domar, and building on their criticisms, growth is explained by the introduction of external technical progress according to Solow (1956). Without an exogenous component (i.e. exogenous technical progress that can be both labour and capital augmenting), growth cannot be sustained. While Solow's model comes closer to

the actual patterns of growth, it bears only little explanatory power, since growth is explained by the residuals, namely by external technical progress. While it frees up from the crucial assumptions in the models of Harrod and Domar such as fixed proportions between factors of production (which restrain the substitution of labour for capital), it adds another restraining assumption, namely the fact that the capital per output ratio and the marginal product of capital remain constant as technical progress increases. It is therefore difficult to draw any conclusions in regard to clusters and economic resilience. At best, it highlights the need for technical progress in order to sustain the growth process, which is also postulated in the cluster theory.

5.3.5 New models of endogenous growth: the influence of human capital and the incentives to invest

In the so-called "new models of endogenous growth", technical progress is inherent to the growth process. Uzawa (1965), Arrow (1962), Romer (1986; 1987a; 1987b; 1990) and Lucas (1988) argue that technical progress is labour augmenting.

Uzawa (1965) introduces an "educational sector" which influences labour productivity. Interestingly in regard to the cluster theory, activities of the educational sector are diffused to the economy and become a public good, highlighting the externalities taking place within clusters. The educational sector can be compared, in the cluster theory, to R&D departments, research institutes or centres of excellence. In section 5.2, it was concluded that skilled and educated people are associated with economic resilience. This can be explained by Uzawa's approach where more educated workers are associated with both higher levels of productivity and knowledge dissemination.

In Arrow's model (1962), the educational sector is replaced by the concept of learning-by-doing, which is considered as a by-product of production. Hence, labour productivity increases over time and generates growth. Higher levels of investment in capital are also positively associated with learning-by-doing, which increase the stock of knowledge. In clusters, competition spurs firms to invest in order to sustain and develop their advantage.

This is accompanied by a comparatively higher stock of knowledge which, as previously explained, increases growth and economic resilience.

Romer (1986; 1987a; 1987b; 1990) improves Arrow's understanding of endogenous technical progress by including externalities such as the influence of institutions and education. In particular, knowledge is treated as a public good. This notion is also encountered in the cluster theory, where the dissemination of knowledge is easier. In fact, it has been shown that the geographical concentration, informal and formal networks as well as intra- and inter-firm linkages facilitate knowledge flows (amongst others: Alberti and Pizzurno, 2015 and 2017; Neffke et al., 2017; Alcácer and Delgado, 2016).

Further, Romer (1990) argues that investment in R&D is only possible if firms can gain a monopolistic profit. This notion is close to Schumpeter's theory whereby entrepreneurs gain a superior profit with the implementation of innovations. In the MOC framework, the monopolistic (or entrepreneurial) profit is replaced by the concept of competitive advantage, when in essence, they represent the same incentive.

Lucas (1988) introduces an opportunity cost for workers who can choose between production or human capital accumulation (which affects productivity). This equilibrium growth rate leads to lower welfare that can, nonetheless, be counterbalanced by openness to trade. Porter (2003) finds that it is traded clusters that raise the level of income and experience higher growth rates. In the economic resilience literature, Sagan and Masik (2018) and Healy (2018) also find that export oriented industries are more resilient. Also Valdaliso (2020) and Hannigan et al. (2015) find that firms competing in niche markets are also more resilient. However, Lucas argues that economies get trapped in the production of goods for which they have an advantage since they accumulate skills in the production of that particular set of goods. The solution, according to Lucas, would be to consider that the sophistication of demand and human needs evolve and push trade into new constellations. This is akin to the solutions proposed by the classical theorists, such as Ricardo, Malthus and Mill, to move away from the steady state. In the MOC framework, clusters are able to expand thanks to the internationalisation of firms within the cluster, and evolving sophistication of the demand and factor conditions. Regarding economic resilience, it has been shown that the specialisation in a narrow range of industries is negatively associated with resilience. If an economy gets trapped in a given

structure and cannot evolve, it may also be less resilient in the face of changing economic conditions. The sophistication of demand and human needs may therefore help these economies to reorient towards new activities. It has been suggested in the first chapter that clusters increase the development and sophistication of each of the determinants of the diamond, including demand conditions.

King and Rebelo (1990) analyse the impact of taxation on human capital accumulation and, consequently, on economic growth. They show that attractive taxation leads small countries to higher growth rates. More than the microeconomic competitiveness level, this dimension relates to the macroeconomic competitiveness level, which the MOC framework considers to be the conditions for the creation of prosperity. Sophisticated and developed clusters are based on a sound macroeconomic competitiveness level. In chapter 2, the analysis of Hundt and Holtermann (2020) on the importance of the national context has been presented. The authors found that this dimension was important both during the resistance and recovery phases. Nonetheless, the influence was higher during the resistance phase. This is confirmed by both the MOC framework and King and Rebelo growth model.

Finally, Aghion and Howitt (1992) focus on another key aspects of clusters, namely incentives to innovate. They argue that growth is generated by industrial innovation and hampered by the future obsolescence of outcomes, which reduces the incentives to invest. The strong competition in clusters pushes firms to invest and innovate. In light of these two conclusions, it can be argued that there is an opportunity cost, a trade-off, between investing in an activity that will eventually become obsolete and losing a competitive advantage to competitors. When the cost of losing a competitive advantage outweighs the cost of obsolescence, the firm is encouraged to invest and innovate. This opportunity cost is also present in times of crisis when a firm has to change its production process or reorient towards new activities in order to adapt to the changing economic conditions. Consequently, it can be said that if the cost of continuing a declining activity in times of crisis (i.e. losing a competitive advantage) outweighs the cost of innovating, then the firm is encouraged to invest, innovate or reorient its activities.

5.4 Insights from business cycle theories

Business cycle theories aim to investigate the causes of fluctuations and how they spread from their source. Similarly to the measure of growth, business cycles are primarily measured by fluctuations in GDP per capita. When looking at the evolution of GDP per capita in England over two centuries (1900-2016), periods of crisis such as the Great Depression, the Second World War or the Great Recession can be considered as "anomalous" (Jones, 2015, p. 3). In fact, the analysis of the yearly rates of growth show that these crises do not last long and that economies re-join their growth path. The volatility of the growth rate also tends to diminish over time.

In chapter 4, the theories were discussed in chronological order. With the exception of the RBC theories, the others were selected based on the determinants found in chapter 1 regarding clusters.

5.4.1 Burns and Mitchell: three causes of stress

The seminary works of Mitchell (1913; 1927; 1951) and Burns and Mitchell (1946) were investigated first. They have provided the first definition of business cycles which, among other things, details the different phases of a cycle: expansion, recession, contraction and revival which lead to the next expansion. They argue that cycles show amplitudes 'of their own' and the duration varies between one to twelve years. Hence, each cycle is unique and depends on the preceding one. This is of importance regarding economic resilience. In fact, it was argued that resilience depends on firms' reaction to a change in economic conditions. In light of the suggestion that each cycle is unique, it can be said that the firm's reaction depends on its activities and performance during the previous cycle. Hence, firms' resilience, and by aggregation locations' resilience, depends not only on their resistance during the previous recession or downturn but also on their performance during the previous revival and expansion. Since firms within clusters show higher performance in 'good' times (amongst others: Delgado et al., 2010; Delgado et al., 2014; Resbeut and Gugler, 2016), it can be argued that they would be better off at the beginning of the incoming cycle.

Further, they argue that fluctuations arise from varying profit expectations that depend on sales and cost margin. Then, four principles explain business cycles, three of which are interesting from a cluster point of view. The first principle is the uneven development of business organisations where the more "elaborate" ones show more sensitivity to economic fluctuations (i.e. the terms advanced or specialised are used in the cluster theory). Second, the interdependence of business enterprises, the interrelation between firms and industries, is a key dimension of clusters. Mitchell (1913) argues that actors are dependent on the economic health of their counterparts and since these interdependences are higher in clusters, fluctuations may spread more rapidly. Also, Delgado et al. (2014) have found that cluster performance is positively related to the business environment in neighbouring locations. Hence, locations that have resilient neighbours may also have a higher likelihood of being resilient. Third, the pecuniary versus industrial factors in business prosperity are critical and similar to the cluster theory. It suggests that the focus should be on firms, rather than industries or larger aggregated levels, in order to understand their level of development and interdependence (i.e. the first and second principles above). The focus on the cluster level, rather than the industrial level, makes it possible to take these principles into account.

These factors also generate two types of stresses: an increase in the cost of doing business and an accumulating tension of the investment and money markets. Firms within clusters are characterised by higher levels of productivity and clusters offer lower barriers to entry. Consequently, if the cost of doing business temporarily rises, they have a comparatively higher likelihood of sustaining their activities.

Following these three principles, it can be said that clusters increase fluctuations of economic activities. However, Mitchell (1913) also points out that endogenous factors such as closer organisation and wider knowledge of firm policies may hamper the propagation. These three factors are encountered in clusters. As a consequence, the influence of clusters on the propagation of business cycles is ambiguous and depends on the relative importance of the principles and factors described above.

5.4.2   Pigou: the influence of homogeneity

Pigou (1927) explains business fluctuations through the influence of real causes that impact the demand for labour. Real causes such as harvest, technological change or consumer desire create errors in forecasts that are then the roots of psychological causes. Clusters are notably driven by technological change and the sophistication of demand conditions. However, they are also characterised by geographical proximity and concentrated knowledge flow. As a result, clusters may trigger real causes that are not necessarily translated into psychological causes since errors in forecasts may be lower.

Pigou (1927) finds four factors that influence errors in forecasts, two of which are of interest regarding the concept of cluster: the division of industries and demand in an 'untried market'. Two characteristics of clusters are the specialisation of firms and industries (i.e. similar to the division of industries) and sophisticated demands (i.e. similar to "untried markets"). This means that clusters would increase errors in forecast. The range of the fluctuations depends on the similarity of the reactions to these errors.

While the terms are different, these factors are similar to those proposed by Mitchell. They refer to both the heterogeneity and the dynamism of the economic structure. This implies that the reaction of firms will be heterogenous as firms have different production functions, face various market players and have distinctive expectations about the future. While clusters are composed of highly specialised firms, suppliers, service providers or institutions, they can still be considered as relatively homogenous. In fact, following the definition of clusters given by Porter (2008, pp. 213-214), it is said that firms not only compete but also cooperate. Furthermore, it was shown that there is strong relatedness within clusters, which can increase the homogeneity. In fact, cluster participants share common needs, depend on similar consumer desires, finance specific activities and benefit from agglomeration externalities. Hence, there is a certain homogeneity in terms of needs, risks and expectations that translates into a more uniform reaction and reduced fluctuations.

5.4.3   Schumpeter: lessons of changing economic conditions

Schumpeter (1927; 1935b; 1939) has not only studied the growth process of economies but also their fluctuations. However, the source of growth and business cycles is identical: the implementation of innovations by entrepreneurs. Schumpeter sees business cycles as transition phases from one state of equilibrium towards a new one. Innovations that change the constellation of an economy, as opposed to incremental innovations, are of particular importance in creating fluctuations. This creates a boom that leads to a temporary disequilibrium which is followed by a recession that serves to correct the imbalances triggered by the innovation.

Clusters are not necessarily characterised by path-changing innovations but rather by incremental innovations in terms of, *inter alia*, production processes, new inputs or intermediary products. Schumpeter's statement regarding the new equilibrium is interesting in regard to economic resilience. The new equilibrium represents "the response by the system to the results of entrepreneurial activity – adaptation to the new things created, including the elimination of what is incapable of adaptation" (Schumpeter, 1939, p. 137). This strongly relates to the observations made in the second chapter. In fact, many studies investigating economic resilience, whether focusing on economic structure, innovation, entrepreneurship or quality of human capital, have highlighted this capacity to adapt to changing conditions. The non-resilient economies were found to be those incapable of adapting. As a consequence, business environments favouring the adaptability of firms increase economic resilience.

Clusters are characterised by environments where competition forces firms to innovate. This creates a dynamic environment with continuously changing economic conditions. Hence, firms that are used to incorporating this dynamic dimension into their competitive strategies have a higher likelihood of being resilient.

5.4.4   Haberler: general and localised booms/contractions

Haberler (1937) stresses the role of international trade, in particular the influence of transportation costs and the localisation of capital. Trade is of particular importance for clusters, and notably the so-called traded clusters. The first chapter has also stressed the importance of the internationalisation process of firms.

First, under the hypothesis of transportation costs, Haberler (1937) argues that there will be less specialisation and division of labour. Hence, each increase in income will benefit the actors close to the primary source. This has also an influence on innovation. In fact, 'old' industries that are secluded by transportation costs are less impacted by innovation. Therefore, they are active in more stable environments. This situation results in a higher chance of experiencing a localised expansion or contraction. For example, if an exogenous shock hits a secluded location, then the contraction will spread amongst the businesses. This is an important insight in regard to the cluster theory. An important step in the sophistication of clusters is their international development, namely their capacity both to compete and to create ties internationally. In doing so, they would be more resilient in the face of location or industry specific shocks by relying on foreign-based advantages and foreign markets.

Regarding capital mobility, Haberler's (1937) conclusions are more ambiguous. On the one hand, it was shown that localisation of capital tends to dampen both local booms and depressions. On the other hand, in the case of perfect mobility, a general boom or depression will favour more promising locations. Hence, if capital mobility is hindered, a general boom or depression will favour less promising locations, and more promising locations are disadvantaged since the stimulus to export is limited. The conclusions are ambiguous regarding clusters. Firms in clusters tend to be more "promising" (i.a. higher levels of innovation, higher growth rates of employment and business creation) and would therefore be favoured by capital mobility in the case of general booms. Haberler (1937) argues that the liberalisation not only depends on government policies but also on the confidence of economic agents to invest in foreign locations. By pursuing an international strategy, firms within cluster are able to attract foreign capital and benefit from general booms.

However, this process also works for generalised recessions. Following the intuition described above, clusters would be more affected. This has also been raised by Mitchell (1913) who finds that more 'elaborate' firms are more sensitive to economic fluctuations. Therefore, while clusters benefit comparatively more from generalised booms, they are comparatively more handicapped by generalised recessions.

5.4.5   Insights from Real Business Cycle theory

The RBC theories were considered as having low added value in the investigation conducted in this thesis. In fact, some hypotheses and arguments are controversial in economic thinking (Romer, 2016) and are at odds with the MOC framework. They notably build on negative technological shocks and negative productivity shocks, on generalised business cycles and uniformed economies. Hence, the assumptions of both negative technological/productivity shocks and homogeneity of economic actors runs against the MOC framework.

However, these theories fill a gap in the literature and explain the development of the new models. Hence, new business cycle theories are investigated, with a focus on microeconomic characteristics such as investment possibilities, innovation or specialisation.

5.4.6   Alternative and new theories: investment considerations, innovation and specialisation

First, Eckstein and Sinai (1986) as well as Aghion et al. (1999) argue that credit crunches play an important role in fluctuations. Eckstein and Sinai (1986) analyse both business cycles and, in parallel, the flow of funds cycles. They find that five types of shock can create fluctuations, namely positive and negative demand shocks, supply shocks, price shock or credit crunches. Since firms within clusters are competing against fierce rivals, they are spurred on to constantly innovate and differentiate themselves. This means that

they are able to meet consumers' new wants by moving early. Hence, they are able to benefit from positive demand shocks.

Further, it has been argued that firms within clusters are able to reorient and adapt to changing conditions. Hence, negative demand shocks can be dampened if the breadth and depth of clusters is sufficiently large, or put differently, if clusters rely on multiple sources of competitive advantage. Clusters also reduce the risks of supply shocks. In fact, they are composed of a large base of suppliers or firms competing in the base-industry and rely on differentiated and sophisticated intermediary goods. The bargaining power of each actor (i.e. firms, workers, suppliers) is also lower, hence reducing the risk of a shortage of inputs. Since clusters are characterised by higher levels of productivity and lower costs of doing business, price shocks may be comparatively less severe. Credit crunches are more delicate for clusters. In fact, they heavily rely on innovation and new business creation in order to sustain and develop their competitive advantage. These depend on the capacity to finance R&D activities or innovation (new combinations of factors of production). At the firm level, the internationalisation process also depends on the availability of funds. Consequently, a credit crunch may impact the sustaining and development of competitive advantages in clusters.

Second, Aghion et al. (1999) focus on the access to investment possibilities and argue that unequal access creates fluctuations (i.e. an important degree of separation between savers and investors increase fluctuations). The degree of separation depends on three reasons, two of them relating to clusters. First, an investor requires certain skills, ideas and connections that a saver may not have. In clusters, knowledge flow is more concentrated. Hence, cluster participants, as well as financial institutions, are better informed about, *inter alia*, opportunities, risks and the state of technical development. Second, distance may hinder the ability to invest. In clusters, firms and actors are geographically concentrated and therefore, that distance is reduced. The separation between savers and investors may be lower in clusters. For Aghion et al. (1999) lower separation between savers and investors is found to dampen fluctuations. Consequently, it can be said that clusters dampen fluctuations.

Third, Aghion and Saint-Paul (1998) investigate the "incentives for firms to implement new technologies" at different stages of the business cycle. They argue that reallocation

of labour (or resources) happens during downturns since the opportunity cost is lower. Hence, reorganisation happens during recessions. The incentives to innovate in clusters are comparatively high, therefore, understanding how incentives vary in different stages of the business cycle is of importance for the resilience capacity of clusters. By screening the literature, the authors also find that the cost of increasing productivity is lower in a recession, hence that recessions positively affect the long-term growth of the economy.

For clusters, this means that the cost of reorienting and adjusting in the face of a shock is lower than in expansions and particularly important since innovations are comparatively high. This cost of opportunity was also encountered in the growth model of Aghion and Howitt (1992) presented in the preceding section. It was concluded that if the cost of continuing a declining activity in times of crisis (i.e. losing a competitive advantage) outweighs the cost of innovating, then the firm is encouraged to invest, innovate or reorient its activities.

Fourth, Erixon (2011), Inklaar et al. (2008), de Haan et al. (2008) as well as Belke and Heine (2006) focus on the relationship between fluctuations and economic structure. First, Erixon (2011) investigates Åkerman and Dahmén's theory, which analyses the influence of malinvestments (i.e. faulty investments) in so-called progressive firms. The study by Delgado et al. (2010) find that the survival rate of new firms is higher in clusters. Hence, the likelihood of faulty investments can be considered to be lower in clusters. Åkerman and Dahmén's theory further postulates that recessions are assimilated to a "consolidation" of the economic structure, where "development blocks" (i.e. positive externalities between industries and firms) are rebuilt and consolidated. In fact, Åkerman and Dahmén's theory assumes that some innovations are not profitable without investment in complementary activities or industries. Put in the cluster context, it can be said that clusters reduce fluctuations as they can be considered as "development blocks", which therefore reduce the risk of malinvestments in some "progressive" firms.

Inklaar et al. (2008) study the trade intensity of 21 OECD countries and find that trade intensity and specialisation positively affect business cycle synchronisation. Further, de Haan et al. (2008) find similar results, namely that economies with similar structures and production patterns will have similar reactions to both industry-specific and economy-wide shocks. This result is also confirmed by Belke and Heine (2006) who investigate the

synchronicity of cycles through the lens of specialisation at the regional level. They find that business synchronisation has declined between EU regions due to increasing differences in their economic structure.

These studies show that similar industrial structures increase the synchronisation of business cycles and homogenous reactions to shocks. On the one hand, clusters tend to differentiate industrial structures between locations, hence decreasing synchronicity. On the other hand, they increase trade or inter-industry linkages between these locations, thereby increasing synchronicity. Overall, the influence of clusters depends on the relative importance of these two counteracting effects. Following Mitchell's thinking, it was concluded that specialisation increases the sensitivity, and inter-firm linkages increase the synchronicity of fluctuations. However, in was also shown that these fluctuations depend on endogenous factors (such as closer organisation, wider knowledge of firm policies) that may hamper the propagation. In Pigou's theory, it is the reaction of economic actors that determines that amplitude of the fluctuations. It was concluded that since cluster participants share common needs and face similar risks, they could be considered as relatively homogenous and, as a consequence, have more uniform reactions.

5.5   Discussion of the results and final comments

The aim of this fifth chapter was to contrast the determinants found in the first chapter with those in chapters 2 to 4. This analysis has given an understanding of how clusters can influence economic resilience and, therefore, increase the prosperity of locations in times of crisis.

5.5.1   Discussion of the results

Some issues regarding the framework surrounding the concept of economic resilience were answered in section 5.1. Based on the MOC framework as well as the analyses

conducted in chapters 3 and 4, some ideas have been proposed regarding the definition and the conceptualisation of economic resilience.

The definition of economic resilience most commonly encountered in the literature is the "adaptive" definition of resilience, which is to say that resilient economies composed of resilient firms are able to is adapt their structure in order to "maintain an acceptable growth path in output, employment and wealth over time" (Martin, 2012, p. 10). Further, it was concluded that resilience can be characterised by a combination of both the degree of preparedness and the capacity to recover from a shock. For Eckstein and Sinai (1986), the recession/decline phase is a period necessary to adapt to changing conditions. The more prepared the firms are (i.e. firms that have strong adaptive capabilities), the lower the recession/decline is. The capacity to recover would then refer to the revival and prosperity phases, which can be explained by the growth theories.

For Pigou (1927), fluctuations are the results of variations in the demand for labour. Hence, indicators of economic activity based on employment such as employment levels, GDP per capita or productivity can be good measures of economic resilience. Finally, the period of analysis depends on the indicator used to measure resilience and on the two characteristics of economic resilience. In fact, each measure has different sensibilities to changing conditions. In order to analyse resilient economies, a generalised shock that affects a range of locations needs to be identified.

The MOC framework shows how firms can sustain and upgrade their competitive advantages, notably by innovating. If we follow Schumpeter's thinking, innovation can be considered as the reorganisation of the means of production that take the place of old ones. Schumpeter argues that the shift towards a new equilibrium is the adaptation to the new things created. Hence, firms that are incapable of adaptation are eliminated. This thesis shows that it is at the microeconomic level that such adaptive capacities are built. In particular, clusters offer an environment where firms can achieve higher levels of innovation.

In particular, if we sum up and compare the results found in this chapter, three key aspects of clusters are found to increase the adaptation capabilities of firms, and consequently, economic resilience: (1) the internationalisation process, (2) the relatedness amongst cluster participants, and (3) the flow of knowledge (i.e. information accessibility).

i.   Internationalisation process

A key aspect of the development and sophistication of clusters is their international orientation, namely their capacity to compete and to create ties internationally. The internationalisation of firms increases foreign demand (higher awareness) and enables firms to build on the advantages of host locations (diversification of the sources of competitive advantages). In Haberler's theory, it has been shown that capital mobility and lower transaction costs reduce the likelihood of localised recessions and increase the flow of funds towards more 'promising locations'. Further, internationalisation increases the size of markets, which triggers more division of labour and increases growth (Smith, 1776; Marshall, 1920). In turn, the division of labour implies differentiated skills and tasks that is accompanied by knowledge creation as well as entrepreneurship. Bigger markets also diversify outcomes for firms and enable them to benefit from economies of scale. This relationship has notably been found by Krugman (1991) and Delgado et al. (2014).

For Lucas, trade pushes the economy towards a new constellation which reduces the risk of lock-in. This observation is corroborated by Porter (2003), Sagan and Masik (2018), Slaper et al. (2018) and Healy (2018) who demonstrate that trade increases both the performance and the resilience of firms. While internationalisation can lead towards bigger markets, it also creates niche markets where specialised firms can become global leaders by innovating and re-orienting (Hannigan et al., 2015; Valdaliso, 2020). Ricardo, Malthus and Mill argue that the sophistication of demand (i.e. new wants) and trade are a solution in order to move away from the steady state. This can notably be achieved through the internationalisation process of firms.

Further, firms that develop international ties increase vertical and technological relatedness. Firms with international strategies, built on the advantages of host locations, have a better ability to sustain and develop new competitive advantages (Dunning, 1980 and 1998; Rugman, 2009; Alcácer and Delgado, 2016). *In fine*, this process increases the flexibility at home. Turkina and van Assche (2018) have shown that the acquisition of foreign knowledge leads to related diversity that increases innovation. This way, firms are able to move towards higher-order advantages and diversify their sources of advantages. Cainelli et al. (2019) find that technological relatedness increase resilience,

while Neffke et al. (2011), Petralia et al. (2017) and Hidalgo et al. (2018) find that it increases the chance of entering an industry or region. It shows how patterns of related diversification takes place. In chapter 2, related diversification has been found increase economic resilience (amongst others: Hane-Weijman et al., 2017; Pudelko and Hundt, 2017; Delgado and Porter, 2018).

ii.   The relatedness amongst cluster participants

The relatedness amongst cluster participants is also found to favour economic resilience. Relatedness has an effect on, *inter alia*, entrepreneurship, innovation, knowledge flows or the sophistication of factor conditions.

Porter (2008, p. 229) postulates that clusters affect competition "by stimulating new business formation that support innovation and expand the cluster". Neffke et al. (2011) have shown that technological relatedness increases firms' entry (i.e. entrepreneurship), which leads to the diversification of the cluster. In the second chapter, related diversity has been found to increase economic resilience, through the increased number of firms, suppliers and others related actors in clusters. Hence, entrepreneurship leads to a related diversification of clusters. This has three important repercussions on resilience.

First, the availability of 'pools' of advanced and specialised inputs lowers entry barriers and makes it easier for firms to reassemble factors of production (Schumpeter, 1944; Neffke et al., 2011). Hence, the cost of doing business is lower, which further decreases the opportunity cost of investing, in particular for R&D activities. A larger base of suppliers makes innovation less risky for firms since they can outsource the development and production of necessary inputs (amongst others: Treado and Giarratani, 2008; Sagan and Masik, 2018). Hence, firms are more flexible and have more incentives to adapt and change (Aghion and Howitt, 1992; Aghion and Saint-Paul, 1998). Further, the strong relatedness within clusters increases the chance that a group of firms can finance local institutions or specialised inputs and infrastructures. It also reduces the risk of investing and increases the equal access to investment (i.e. both the minimum amount and the distance between investors are lower). Aghion et al. (1999) find that this possibility reduces the risk of fluctuations and Wink (2018) find that collaboration and consensus

between cluster actors increase resilience. Also, while showing strong specialisation patterns with differentiated firms and inputs, clusters are also seen as homogenous in the sense that cluster participants cooperate, share common needs, build on related technologies and face similar risks, amongst other things. This homogeneity reduces the likelihood of dissimilar expectations and consequently dampens fluctuations (Mitchell, 1913, 1927, 1951; Pigou, 1927; Harrod, 1939; Burns and Mitchell, 1946; Domar, 1947). Overall, it can be said that the cluster environment reduces the opportunity cost for innovating.

Second, the availability of 'pools' of advanced and specialised inputs leads to an increase in the sophistication of human capital and skills. It was shown that high quality human capital and skills were found to increase the quality of the business environment and that it is also associated with increased resilience (Glaeser et al., 2014; Diodato and Weterings, 2015; Doran and Fingleton, 2016; Weinstein and Patrick, 2019). Further, new endogenous growth theories such as Uzawa (1965) Arrow (1962) or Romer (1986; 1987a; 1990) have highlighted the role of human capital in increasing economic growth. Further, Hane-Weijman et al. (2017) have found that 'pools' of specialised workers also increase the likelihood of re-employment. It brings more homogeneous labour markets. And Neffke et al. (2017) find that most labour flows take place within related industries, notably thanks to industry-specific experience or knowledge. This relates to the learning-by-doing dimension that is at the core of Arrow (1962) and Romer (1986; 1987a; 1987b; 1990) growth models.

Third, discontinuities (i.e. unrelatedness) can neutralise competitive advantages and reduce economic resilience when, for example, technological discontinuities or the emergence of divergent global needs that are not perceived by local competitors arise. As a consequence, cluster advantages are 'neutralised' as factors of production, technological base, suppliers, *inter alia*, become inadequate. In fact, Neffke et al. (2011) show that more 'peripheral' industries tend to exit a location; Petralia et al. (2017) find that firms' capacity to accumulate and develop new technologies depends on prior capabilities (similar to Arrow-Romer learning-by-doing); Erixon (2011) shows that it can lead to faulty investments in 'progressive' firms (which eventually leads to a recession that is considered as a readjustment process); and Mitchell (1912) and Harrod (1939) argue that the unevenness or divergent expectations lead to fluctuations, respectively

unstable growth paths. Further, Porter (1990, p. 166) advances that in such situations, the diamond "no longer support and stimulate investment and innovation to match the industry's evolving structure". This is akin to Domar's junking process that also leads to unstable growth.

iii. Flow of knowledge

Clusters increase the flow and concentration of knowledge, which eventually lead to a better access to information for cluster participants. Information increases innovation and reduces uncertainty.

In the first chapter, it was stated that clusters increase the chance of knowledge spillovers. Hence, there is a higher chance of acquiring knowledge that is not available to firms outside of clusters. Hidalgo et al. (2018) argue that the cost of moving knowledge has increased relative to the cost of moving goods. Hence, concentrated knowledge flows are important, which can be achieved in clusters. Alberti and Pizzurno (2015) show that technological knowledge networks have a higher density that is more important for innovation. This relates to the types of knowledge highlighted by Weinstein and Patrick (2019), who find that problem solving are important for resilience. Further, Alberti and Pizzurno (2017) find that start-ups (i.e. entrepreneurs) increase knowledge leaks and dissemination. This can be tied to Smith (1776) and Romer (1986) that treat knowledge as a public good that is instantly available to the public. Since clusters increase the formation and survival of new businesses, it can be concluded that clusters also increase knowledge flows and dissemination.

Further, information reduces uncertainty. In fact, following Åkerman and Dahmén's theory, better access to knowledge reduces the risk of "faulty investments" since actors are better informed (Erixon, 2011). The accessibility of knowledge in clusters also diminishes the distance between savers and investors, which eventually leads to less fluctuations (Aghion et al., 1999). Furthermore, anticipations of cluster participants are similar since more actors have access to the same knowledge. For Harrod (1939), Mitchell (1912) and Pigou (1927), this homogeneity leads to a more stable growth path. Finally, Murray et al. (2016, p. 212) have found that easier access to knowledge (as experienced

in clusters) increases "early and late stage innovation". Hence, it enables firms within clusters to move early and adapt more quickly to changing economic conditions.

Overall, these three key aspects of clusters increase the incentives to innovate, enable firms to diversify their sources of economic advantage, and help firms move towards related activities. Underlying determinants such as geographical concentration, entrepreneurship, the division of labour or the sophistication of factor and demand conditions are found to favour these key aspects and, consequently, increase economic resilience.

5.5.2   Final comments

The analysis conducted in this thesis has tried to understand if and how clusters can influence the economic resilience of locations. It suggests that clusters positively influence the economic resilience of location and further contribute to the prosperity of locations. This constitutes a hypothesis for subsequent empirical analysis. In fact, while the influence of clusters on the prosperity of locations during 'good' times is well established in the literature, the influence during periods of economic downturns has not been extensively investigated.

Clusters exert their influence by providing firms with a competitive and dynamic environment that forces them to adopt strategies in order to cope with continuously changing business conditions. Hence, the preparedness of these firms is higher when a shock changes the economic conditions. Developing 'related diversity' prevents clusters from "inward focus, inertia, inflexibility, and accommodation among rivals" (Porter, 1990, p. 151). Underlying determinants of clusters such as entrepreneurship, innovation, and the sophistication of factor and demand conditions are found to favour resilience.

Nonetheless, there are certain constellations in which clusters would not contribute to the economic resilience of locations. These situations take place when the three key aspects described above are not sufficiently developed. In fact, a low international orientation, unrelated cluster participants and characteritics that would reduce the flow of knowledge result in a lower degree of preparedness and capacity to recover. As showed by Delgado

and Porter (2018), it is advanced clusters, whose depth and breadth are the more developed, that positively influence economic resilience.

However, the analysis conducted in this thesis also suffers from limitations. A first limitation refers to the conceptual character of the analysis. The conclusions are based on the intersection of different fields of economic literature (i.a. economic geography, growth theories, business cycle theories) encompassing both conceptual and empirical works. However, no empirical investigation is proposed to test the conclusions drawn from the analysis. A second limitation is bias in the selection of theories, in particular in growth and business cycle theories. A choice was made to focus on theories that share similarities with the MOC framework, and in particular with the concept of clusters. The growth and business cycle theories go beyond the limited selection of theories studied in this thesis. As a consequence, other dimensions affecting the growth process or fluctuations, such as monetary policies, inflation or budgetary and fiscal policies are not tackled. They may have provided information on other dimensions of the economic resilience of locations. A third limitation is the sole focus on the influence of clusters on economic resilience. In fact, the hypothesis is that clusters positively influence economic resilience. However, they may be other factors such as the macroeconomic factors mentioned above that also influence the resilience of locations. In fact, a particular policy intervention may have different effects on given locations depending on their microeconomic conditions. A fourth limitation is the fact that most studies analysed in the second chapter use the impact of the Great Recession as a starting point, and do not differentiate between the types of shocks such as supply or demand shocks.

Based on the findings as well as on the limitations listed above, some new lines of research for future analysis of the relation between clusters and economic resilience can be outlined. First, building on the theoretical foundations provided by this thesis, empirical studies on the influence of clusters would confirm the theoretical results and hypotheses. Similarly to the empirical studies reviewed in section 1.2, empirical studies focusing on the overall impact of clusters on the one hand and on key determinants of clusters on the other hand would be welcome. Moreover, the issues highlighted in subsection 2.1.2 and the corresponding clarifications suggested in section 5.1 should be taken into consideration when building the empirical models. For studies focusing on the overall influence of clusters, a database building on cluster mapping covering different

countries should be favoured. The studies by Delgado et al. (2014) as well as Delgado and Porter (2018) provide an interesting basis for the development of empirical models that could account for the influence of clusters on prosperity. A complementary analysis would be to understand the role of clusters on the degree of preparedness and on the recovery of firms. Which phases are especially impacted by clusters? Which underlying determinants of clusters play a role on each phase? For example, does entrepreneurship have more effect on the degree of preparedness or on the capacity to recover? Another dimension to investigate is the type of shocks. In fact, depending on the type of shock, the influence of clusters could be different. A final line of research would focus on the relationship between the influence of clusters and macroeconomic policies. In fact, macroeconomic policies may have distinct effects depending on the microeconomic structure. However, a more thorough conceptual investigation of this particular relationship is needed.

Conclusion

The concept of economic resilience has gained popularity in the aftermath of the Great Recession. Many scholars and economic institutions such as the IMF and the WEF have jumped on the bandwagon. However, chapter 2 documented how a proper framework for the analysis of the concept is lacking. By building on the microeconomics of competitiveness framework, this thesis has taken a closer look at the determinants of economic resilience, in particular, the influence of clusters in increasing the economic resilience of locations. Studies have shown the heterogeneity pattern and the locational dimension of economic resilience and, therefore, argued that the determinants of economic resilience may lie at the microeconomic level.

Competitiveness has been extensively studied in past centuries in order to understand what drives prosperity and well-being. Prosperity depends on firms' activities and capacity to raise their productivity level. In turn, locations provide a business environment for firms to increase productivity. Moreover, studies have shown that clusters increase the prosperity of locations by providing firms with a competitive environment (Porter, 2003; Delgado et al., 2010; Delgado et al., 2014; Resbeut and Gugler, 2016). Consequently, the research question of this thesis was "do clusters increase the economic resilience of locations"?

Based on an extensive literature review covering the holistic microeconomics of competitiveness framework, studies on economic resilience as well as growth and business cycle theories, it was found that clusters increase the economic resilience of locations. Clusters provide firms with an environment that enables them to quickly adapt to changing economic conditions. Through drivers such as entrepreneurship, higher incentives to innovate, concentrated knowledge flows, sophisticated factors and demand

conditions, firms have both a higher degree of preparedness and a better capacity to recover. Consequently, clusters further contribute to the prosperity of locations by mitigating the risks of economic downturn associated with shocks.

The investigation proposed in this thesis falls within the line of work on economic development and follows in the steps of many economists including Smith, Ricardo, Marshall and Porter in trying to understand how economies can reach higher levels of well-being and be more prosperous. By focusing on a specific aspect of this process, namely the ability to be resilient in the face of a shock, this thesis broadens our understanding of the mechanisms of economic development. However, the thesis does not provide a holistic comprehension of economic resilience, but rather presents one particular facet. In fact, it does not claim to explain economic resilience. That is why the title of the thesis mentions 'On economic resilience' rather than 'Economic resilience' since there are, most certainly, complementary explanations of economic resilience.

Yet, by looking at economic resilience through the lens of clusters, it goes beyond the mere explanation of single determinants, as clusters encompasses multiple determinants. In fact, they provide a unique path in understanding economic resilience. This perspective offers a new agenda for firms' strategies and government interventions. Following Porter (2008, p. 215), clusters provide a "forum of dialogue" for firms, economic and political actors in thinking about prosperity, but also, as this thesis shows, about economic resilience.

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