

## **Is beta still alive?**

### **Conclusive evidence from the Swiss stock market**

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**Abstract:**

Recent evidence by Fama and French (1992,1996) and others shows that betas and returns are not related empirically. They interpret this as evidence against the validity of the capital asset pricing model and they conclude that the beta is not a good measure of risk. This paper claims that usual tests do not leave much opportunity for beta to appear as a useful variable capable of explaining returns, because tests are often performed in periods where the average realised market excess return is not significantly different from zero. In order to assess the usefulness of beta, an alternative approach that dissociates results obtained in periods where the realised market excess is positive from those where it is negative is proposed. These new tests are then applied to a representative sample of the Swiss stock market over the period 1983-1991. The different results unambiguously support the fact that beta is a good measure of risk, because beta is strongly related to the cross section of realised returns. These results also confirm that there are no arbitrage opportunities on this market.

*Keywords:* capital asset pricing model, risk, stock market.

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### **1. INTRODUCTION**

As the capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965) and Black (1972) is one of the central models of financial economics, it has been extensively tested. The major focus of the tests has been to check whether returns are statistically related to betas. Empirical evidence in favour of the model is weak. At the beginning of the seventies, the results supported the validity of the model, or at least of one of its close alternatives, the zero-beta CAPM. Unfortunately for the model, different anomalies were discovered in the eighties. These anomalies are mainly variables, such as market value or financial ratios, which appear to be statistically related to returns but have no theoretical justification in the CAPM framework. This has led to the rejection of the model. Moreover, recent evidence by Fama and French (1992,1996), Jegadeesh (1992) and others has shown that betas are not statistically related to returns, which has made these authors conclude that beta is dead, i.e. that it is totally unsuitable for describing the cross sectional difference in returns and that it is an inappropriate measure of risk<sup>1</sup>.

Although different test procedures were suggested to test the model<sup>2</sup>, most of the empirical evidence is based on studies using the Fama-MacBeth (1973) procedure. My paper claims that the tests reported so far in this literature do not leave much opportunity for beta to appear as a useful variable to explain returns and this is due to two closely related reasons. The first reason is that the model is expressed in terms of expected returns, but that tests can only be performed on realised returns. The second

reason is that the realised market excess return does not behave as expected, i.e. it is too volatile and is often negative. With these observations in mind, this paper suggests an alternative approach to assess the reliability of beta as a measure of risk. It can be argued that the estimated relationship between betas and realised returns should exhibit behaviour similar to the realised market excess return. In particular, when the realised market excess return is positive, the relationship between betas and realised returns should be positive and similarly, when the realised market excess return is negative, the relationship between betas and realised returns should be negative. Pettengill, Sundaram and Mathur (1995) have recently suggested a similar approach for the US stock market. My work extends their approach and applies it to the Swiss stock market. The results show that beta is a good measure of risk, strongly related to returns in both situations. In other words, beta is still alive and remains a useful tool for portfolio management.

The paper is organised as follows: section 2 first presents the problems associated with the existing methodology and then describes the alternative approach for assessing the usefulness of the betas. Section 3 presents the Swiss stock market, the data and the empirical results of the tests and finally section 4 concludes the paper.

## **2. ARE BETAS RELEVANT? AN ALTERNATIVE APPROACH**

The traditional Fama-MacBeth (FM) methodology involves performing the following cross sectional regressions:

$$R_{pt} - R_{ft} = \mathbf{g}_{0t} + \mathbf{g}_{1t} \hat{\mathbf{b}}_{pt-1} + \mathbf{e}_t \quad (1)$$

With  $p = 1, \dots, N$  and  $t = 1, \dots, T$  and where  $R_{pt}$  is the realised return of portfolio  $p$  at time  $t$ ,  $R_{ft}$  is the risk-free rate at time  $t$ ,  $\hat{\mathbf{b}}_{pt-1}$  is the beta for portfolio  $p$  estimated for a prior

period  $t-1$ , and  $\mathbf{e}_{pt}$  is the normally, independently and identically distributed residual from the regression. At each period  $t$ , the same cross sectional regression is performed, giving  $T$  estimates for  $\hat{\mathbf{g}}_{0t}$  and  $\hat{\mathbf{g}}_{1t}$ . T-statistics are computed on the averages of these time-series to test the hypotheses implied by the standard CAPM. The usual test is that  $\bar{\hat{\mathbf{g}}}_{1t}$  should be positive and significantly different from zero. This comes from the fact that, in the CAPM framework, this coefficient should be equal to the expected market excess return,  $E(R_m) - R_f$ , which should be positive since investors are risk-averse. This should be obtained, if tests were performed on a cross section of expected portfolio returns  $E(R_p)$ . In reality, only realised returns are available for testing. Elton and Gruber (1995) have shown that if the market model and the CAPM hold period by period, then the following relationship must be observed on realised returns:

$$R_{pt} - R_{ft} = \mathbf{b}_p (R_{mt} - R_{ft}) + \mathbf{e}_{pt} \quad (2)$$

Equation (2) shows that the coefficient of the regression of realised portfolio excess returns on betas should be equal to the realised market excess return. If these regressions are repeated for several periods as in the FM methodology, then the average  $\hat{\mathbf{g}}_{1t}$  coefficient should be equal to the average realised market excess return for the considered period. If the latter is positive and significantly different from zero, then a suitable test of the CAPM implications is exactly the one proposed in the original FM procedure. The question is then, how does the realised market excess return behave? Table 1 shows the results for the Swiss stock market, where the market index is the Swiss Bank Corporation General Index and the risk-free rate is the one-month Euroswiss Franc rate.

[Insert table 1 about here]

Table 1 shows that the realised market excess return is not significantly different from zero on the Swiss stock market for the period 1975-1996. This happens independently of the frequency used for measuring returns and independently of the chosen period. This is also true for the period considered in the tests: from January 1983 until April 1991 the market excess return is 0.36% with a t-statistic of 0.72. This situation is not specific to the Swiss stock market but also appears in the US market, especially for sample periods beginning after the mid-sixties. An example is the period 1963-1990 (the period studied by Fama-French (1992)), where the monthly realised market excess return (CRSP value-weighted index minus the 3 month T-Bill rate) is 0.34% with an insignificant t-statistic of 1.35. In the light of equation (2), this means that even if the betas were accurate and the estimated coefficients would, on average, match the market excess return exactly, there should not always be a positive relationship between betas and returns. This lack of relationship is found in most studies, except that it is interpreted as evidence against the empirical validity of the CAPM and against the usefulness of betas. In summary, the results obtained with the FM methodology should be interpreted cautiously if the average realised market excess return is not significantly different from zero in the sample period. Affleck-Graves and Bradfield (1993) also consider this problem. They simulate different scenarios for the behaviour of market excess return and find that the FM procedure is clearly lacking power when the market excess return is close to zero. In other words, they find that these tests too often lead to the wrong conclusion that there is no relationship between betas and returns while such a relationship really exists.

How may this problem be solved? Different solutions exist. One solution is to choose a time period where the average realised excess market return is known to be positive and

significantly different from zero. This is what Fama and MacBeth (1973) involuntarily did when they performed their tests of the two-factor model in their original paper. They chose the period 1935-1968, where the average market excess return was 1.30% per month with a t-statistic of 4.28. The obtained  $\bar{\hat{g}}_{1t}$  was positive and significantly different from zero and so the authors concluded that the validity of the model was confirmed by the data. Unfortunately, it is not always possible to choose such a period due to the lack of available data. In the Swiss case for instance, a period where the average realised market excess return was positive and significantly different from zero could not be found. Another solution would be to check whether the difference between the estimated coefficient  $\hat{g}_{1t}$  and the realised market excess return is not, on average, significantly different from zero. This kind of test has the disadvantage that it does not indicate clearly if the risk-return relationship exists. For instance, one result of such a test could be that the constraint implied by the CAPM is satisfied but that paradoxically, there is no relationship, on average, between betas and returns.

A third solution is proposed, which gives a clear picture of the usefulness of beta. This approach explicitly takes account of the fact that tests are performed on realised returns. What should the relationship between betas and realised returns be? Since beta is a risk measure, an asset with a high beta is supposed to present a greater risk. Risk is symmetric, that is to say it measures the amplitude of the possible outcomes for an asset (realised return), but the latter can be favourable (large return) or unfavourable (low return). This definition implies that high-risk assets, according to beta, should have a larger return than low-risk assets in situations when the realised state of the nature is favourable. Similarly, high-risk assets, according to beta, should have a smaller return than low-risk assets when the realised state of the nature is unfavourable. How can the

outcome of the states of nature be identified? In the light of equation (2), it is reasonable to assume that it can be recognised by the sign of the realised market excess return. A favourable outcome can be identified by a positive realised market excess return and an unfavourable outcome occurs when the realised market excess return is negative. This means that when the realised market excess return is positive, assets with higher betas should have a larger return than those with lower betas and similarly when the realised market excess return is negative, assets with higher betas should have a smaller return than those with lower betas. If this is observed in the data, it can be considered that beta fulfils its role as a measure of risk. In order to empirically assess the usefulness of betas, the series of coefficients  $\hat{g}_{it}$  is first estimated with the FM regressions and then tests are performed to check whether the coefficients obtained when  $(R_{mt} - R_{ft})$  is positive are on average positive and also if the coefficients obtained when  $(R_{mt} - R_{ft})$  is negative are on average negative. If this is the case, then beta can be regarded as a reliable tool for measuring risk. If it is not the case, then beta can really be considered as dead.

A similar approach is proposed and tested on the US market by Chan and Lakonishok (1993) and by Pettengill, Sundaram and Mathur (1995). They find encouraging results for beta, with coefficients significantly different from zero and having the expected signs. Grundy and Malkiel (1996) also take a similar approach and find comparable results. The main differences are that they approximate the outcome of the state of nature by the raw market returns and that they only analyse what happened in bear markets. Their results show that a negative significant relationship is observed between betas and returns, confirming that beta is a useful measure of downside risk. Of course, such tests only try to establish whether beta is a useful measure of risk and are neither tests of the mean-variance efficiency of the market portfolio nor of the CAPM. This is



due to the fact that tests are performed with realised, rather than expected returns and also because of the well-known Roll (1977) critique.

Before applying this alternative procedure to the Swiss data, in the light of the preceding discussion, some interesting perspectives on the interpretation of the lack of relationship between beta and return in literature may be given. Papers usually claim that a positive relationship between betas and returns is an essential condition when considering the CAPM and betas as valid, without paying attention to the behaviour of the realised market excess return during the test period. The problem here, which has already been pointed out by Black (1993), is that if a positive relationship is found in periods where the average realised market excess return is not significantly different from zero, it means that there are arbitrage opportunities in the market (i.e. an investor who holds a portfolio long in high beta stocks and short in low beta securities, is guaranteed a positive return, whatever the conditions of the market). If such results were obtained, beta then becomes more a technical indicator than a measure of risk and the market can be considered as inefficient. Fortunately for the model and for the market efficiency in general, those studies do not find such a positive relationship and therefore indicate that there are no such arbitrage opportunities. The problem with these studies is that they give the wrong interpretation to their results, concluding that the lack of relationship between beta and return is evidence against the model and the usefulness of betas.

All the studies cited above are performed on the US stock market over relatively long periods of time. It is now interesting to see whether the same results hold for smaller

and less liquid markets, and over much shorter periods of time. The next section describes the data and the empirical results obtained for the Swiss stock market.

### **3. EMPIRICAL EVIDENCE FROM THE SWISS STOCK MARKET**

#### **3.1 The Swiss stock market and the data**

As the sample covers the period 1973-1991, only the main features of the market during this period are reviewed. Several structural changes have affected the market since 1991 but are not mentioned here.

In an international comparison, the Swiss stock market is ranked in seventh position when looking at total market value at the end of 1990. This market is very concentrated: the stocks of the ten largest firms account for more than 70% of its market value. The market is fragmented, the shares being simultaneously quoted on several exchanges. Another feature of the Swiss stock market is that firms are allowed to issue shares with different rights associated with them (e.g. voting rights or holding rights). Finally, this market can be considered as illiquid, especially for the large part of the market constituted by middle- or small-sized firms.

The database includes information on 358 stocks of Swiss companies quoted at the Zurich stock exchange from January 1973 to April 1991<sup>3</sup>. For each stock the following data has been collected: monthly closing prices and market values, as well as dividends. Simple monthly returns including dividends are computed. The major drawback of this database is that it suffers from survivorship bias. Only the stocks existing between January 1991 and April 1991 are included in the sample. All the assets, which

disappeared before that period, are not available. However, this problem does not seem to be important because two ratios measuring whether the database is representative with respect to market under consideration show that it covers more than 90% of the market for every year considered in the sample. The first one is the ratio of total market value of the stocks included in the database to the total market value of the Swiss market. The second ratio is the total number of stocks included in the database to the total number of stocks available on the Swiss market. The risk-free rate used in the tests is the one-month rate on the Euroswiss Franc. The market portfolio is not an existing index, it is a value-weighted index of the stocks considered in the sample and it includes dividends. Nevertheless, it exhibits a similar behaviour to existing indexes<sup>4</sup>.

### **3.2. Empirical results**

Only a few studies address the question of the empirical existence of the risk-return relationship as described by the CAPM on the Swiss stock market. Only the works of Modigliani, Pogue, Scholes and Solnik (1973), Vock and Zimmermann (1984) and Cornioley (1990) are known. Except for the first study, which considers a limited subsample of the market over a short period of time, the results are not very encouraging for the model, as they do not find any statistical relationship between returns and betas.

According to the original FM methodology, individual stocks are grouped into portfolios to estimate equation (1). This is done to avoid the error-in-the-variable problem due to the estimation error on betas. Individual stocks are ranked in relation to their betas estimated over a five-year period. According to this ranking, stocks are attributed to 20 portfolios for which equally weighted returns are computed. Over the

subsequent five-year period, the betas of the portfolios are estimated. Finally, these betas are used as the independent variable in the FM regression for the next 12 months. This procedure requires ten years of data before the test can be performed. Therefore, the test period considered begins in January 1983 and ends in April 1991. Each year, portfolios are rebalanced with the same procedure. Equation (1) is estimated for each of the 100 months of the test period. The results are the following:  $\bar{\hat{g}}_{1t}$  is equal to 0.92% and its associated t-statistic is an insignificant 1.36. One would conclude from those figures that betas are unrelated to returns and that they do not measure risk accurately. Other variables were added to equation (1) with a  $\hat{g}_{2t}$  coefficient to check whether they display a relationship with the cross section of returns and therefore if there are anomalies on the Swiss stock market. These are specific (or residual) risk and the logarithm of market value of the firm. The estimates show that, on average, these variables do not display a significant relationship with returns. In order to check whether the results are not due to the specific grouping criterion, tests are repeated by grouping stocks into portfolios according to their market value. The results are very similar to those obtained when stocks are grouped according to their betas, i.e.  $\bar{\hat{g}}_{1t}$  is equal to 0.18% with a t-statistic of 0.19, and confirm that, on average and over the whole period, there is no significant relationship between returns and betas. With these portfolios, check are also made to see if there is a relationship between returns and specific risk or the logarithm of market value by adding them to equation (1). Again, there is no significant relationship between these variables and returns. This last point is interesting as it shows that, during the period considered, there is no so called small-firm effect on the Swiss stock market. At this stage, the usual interpretation of all these results would be that beta is a poor measure of risk on the Swiss stock market and that

the market portfolio is inefficient. These results confirm those obtained on other markets during similar periods.

Turning now to the alternative approach proposed in section 2, that is to say, testing the usefulness of beta conditionally on the sign of the realised market excess return. The average realised excess return of the market portfolio over the period January 1983-April 1991 is 0.71% with a standard error of 0.51%, which yields an insignificant t-statistic of 1.38. During that period, 60 months have positive market excess returns with an average of 3.66% and 40 months have negative market excess returns with an average of -3.72%. These results imply that, in aggregate, even if the estimated coefficients  $\hat{g}_{1t}$  were giving exactly the value of the realised excess market return, their average should not be positive and significantly different from zero. The previous results are those which are to be expected from the behaviour of the realised market excess return and they also confirm that there are no arbitrage opportunities on the Swiss stock market.

The next step is to analyse the coefficients conditionally on the sign of the realised market excess return. Table 2 provides the average coefficients obtained with the FM regressions.

[Insert Table 2 about here]

These results show clearly that when periods of positive and negative realised market excess return are dissociated, the relationship between betas and realised returns is highly significant and with the expected sign. Moreover, the average coefficient of  $\hat{g}_{0t}$  is, as expected, not significantly different from zero. These results give support to the use of beta as a risk measure. They indicate high-risk stocks have larger returns than

low-risk stocks when the realised market excess return is positive and similarly those high-risk stocks have smaller returns than low-risk stocks, when the realised market excess return is negative. Beta appears to be a useful tool in measuring risk ex-ante because it is estimated on an interval prior to the test period. It also means that beta are stable through time. Another point to notice here is that the average value of the coefficients are also close to the average value of the realised market excess return in both situations. To check whether the results are specific to the considered time interval, the test is repeated by subdividing the period into two equal subperiods. The results are also presented in table 2. In the first subperiod, the average market excess return is 3.59% when it is positive and -2.62% when it is negative. In the second subperiod, the average market excess return is 3.75% when it is positive and -4.63% when it is negative. The results of table 2 confirm those obtained for the whole period. Coefficients for betas are again significantly different from zero and have the expected sign. They are not as close as before to the average realised value of the realised market excess returns, but this is probably due to the fact that there are fewer observations than over the whole period. These results strongly support the fact that beta is an accurate measure of risk.

In order to check the robustness of the results, other coefficients have also been considered. FM regressions are repeated for stocks grouped in portfolios according to their market value. As can be seen from table 2, the same type of results is obtained, i.e. significant  $\bar{g}_{1t}$  with expected sign and insignificant  $\bar{g}_{0t}$ . The analysis is repeated when the specific risk or market value is included in the cross sectional regressions with stocks grouped according to their beta.

[Insert Table 3 about here]

Table 3 shows that these variables are not statistically related to returns. On the other hand, betas still display a strong relationship with returns and bear the expected sign. Beta appears to be the unique measure of risk contrary to other findings. The results show that beta is not dead but alive and well. Another important implication of these results is that there are no arbitrage opportunities on the Swiss stock market. These results also indicate that previous conclusions which dismiss beta in periods where the average realised market excess return is not significantly different from zero, are unfounded. When such situations occur, a fair test for assessing the accuracy of beta as a measure of risk should dissociate periods when the realised market excess return is positive from those when it is negative.

#### **4. CONCLUSIONS**

This paper proposes an alternative approach to assess the usefulness of betas and applies it to a representative sample of the Swiss stock market. This approach is based on a more pragmatic analysis of the implications of using realised, rather than expected returns and on the fact that the realised market excess return is volatile and often negative. This approach involves dissociating the coefficients obtained in the FM regressions according to the sign of the realised market excess return, because high-risk assets should have higher returns than other assets when the realised market excess return is positive. Similarly, high-risk assets according to beta should have lower returns than other assets when the realised market excess return is negative. The results of my study unambiguously support the fact that beta is a good measure of risk as it is strongly related to returns and also because these relationships have the expected sign. Moreover, other variables such as size or specific risk are not related to returns. Finally, these results show that there are no arbitrage opportunities on the Swiss stock market. It is

important to realise here that these results cannot be interpreted as evidence in favour of the empirical validity of the CAPM mainly because expected returns are not used in the tests. These results should be more modestly interpreted as evidence that, one of the products of this model, beta as a measure of risk, is a reliable tool for portfolio management (e.g. for market-timing strategies) and that it is alive and well.

The results obtained here are interesting for another reason. They confirm those obtained in the few similar studies performed on the US stock market. The data used in these studies covered much longer periods and involved more stocks. Moreover, the US markets are more liquid than the Swiss stock market. The important point here is that the same results are obtained, even in different structural conditions. An interesting avenue of research would be to check if similar evidence is obtained for other European markets.

A final remark is that these results also have implications for tests of other asset pricing models, showing that researchers should first examine the behaviour of the realised returns on the factors they consider, before concluding that the associated risk measures are inappropriate.

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**TABLE 1: Statistics for  $(R_{mt}-R_{ft})$** 

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Period	Frequency	$\overline{R_{mt} - R_{ft}}$	$\mathbf{s}(\overline{R_{mt} - R_{ft}})$	t-stat.	Nb. observ.
01.75-12.96	monthly	0.43%	0.26%	1.65	264
01.75-12.85	monthly	0.63%	0.33%	1.89	132
01.86-12.96	monthly	0.24%	0.41%	0.59	132
02.75-12.96	bimonthly	0.84%	0.53%	1.59	131
06.75-12.96	half-yearly	2.73%	1.82%	1.50	43
1975-1996	yearly	5.71%	4.46%	1.28	21

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**TABLE 2: Results of FM regressions (in percent)**


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Period	$(R_{mt} - R_{ft}) > 0$		$(R_{mt} - R_{ft}) < 0$	
	$\hat{\beta}_{0t}$	$\hat{\beta}_{1t}$	$\hat{\beta}_{0t}$	$\hat{\beta}_{1t}$
-----				
Stocks grouped according to beta				
01.83-04.91	-0.42	3.79	-0.06	-3.40
	(-0.64)	(5.15)	(-0.06)	(-3.68)
01.83-02.87	0.98	2.37	0.86	-2.84
	(1.30)	(2.77)	(0.72)	(-2.39)
03.87-04.91	-2.02	5.42	-0.80	-3.85
	(-1.95)	(4.58)	(-0.61)	(-2.77)
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Stocks grouped according to size				
01.83-04.91	0.01	3.71	1.98	-5.11
	(0.01)	(3.33)	(1.17)	(-3.88)

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t-statistics are in parentheses

**TABLE 3: Results of FM regressions with additional variables (in percent)**

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Period	$(R_{mt} - R_{ft}) > 0$			$(R_{mt} - R_{ft}) < 0$		
	$\hat{\beta}_{0t}$	$\hat{\beta}_{1t}$	$\hat{\beta}_{2t}$	$\hat{\beta}_{0t}$	$\hat{\beta}_{1t}$	$\hat{\beta}_{2t}$
Logarithm of firm size						
01.83-04.91	-0.04 (0.33)	4.05 (5.45)	-0.24 (-0.23)	0.33 (1.39)	-2.23 (-1.97)	1.33 (0.99)
Specific risk						
01.83-04.91	-14.83 (0.96)	3.99 (5.43)	0.10 (0.50)	19.51 (1.16)	-3.46 (-3.79)	-1.06 (-0.97)

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t-statistics are in parentheses

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<sup>1</sup>For a comprehensive review of the empirical validity of the CAPM, see Frankfurter (1995) or Jagannathan and McGrattan (1995).

<sup>2</sup>For instance, the procedures proposed by Black *et al.* (1972) and by Gibbons *et al.* (1989).

<sup>3</sup>Data was collected from Datastream International available at the CEDIF, University of Lausanne. Price and dividends are adjusted for different capital structure changes.

<sup>4</sup>For instance, the correlation of its returns with those of the SBC General Index is 0.99.