



Master's thesis
May 2007
Department of Economics
Lund University

International diversification from a Swedish perspective during the implementation of EMU.

Authors:
Bogren, Rikard
Olby, Peter

Supervisor:
Asgharian, Hossein

Abstract

In this thesis the change in effect of international diversification during the implementation of EMU is investigated, by taking a Swedish perspective. This is done by studying correlation and Sharpe ratio development. The countries included in this study comprise of both EMU countries and a disperse group of other world markets. It can be concluded that a Swedish investor has had a positive diversification effect within the EMU countries, although an increase in correlation and a slight decrease in average diversification effect during the investigated period. The opposite, a slight average increase in diversification effect, is observed for the non-EMU countries.

Key words: International diversification, correlation, Sharpe ratio, Mean-Variance.

Content

1. Introduction	1
1.1 Background	1
1.2 Problem discussion.....	2
1.3 Purpose	2
1.4 Delimitations	2
1.5 Earlier research.....	3
1.6 Outline	4
2. Theoretical background	5
2.1 International Diversification	5
2.1.2 Risk and costs of International Diversification	6
2.1.3 Reduced effect in volatile times	6
2.1.4 Home Bias	7
2.2 Correlation.....	8
2.2.1 Test for homogeneity among two correlation coefficients.....	9
2.3 Mean-Variance theorem and the efficient frontier	9
2.4 Sharpe ratio	13
3. The foundations EU and EMU	15
3.1 European Union.....	15
3.2 European monetary union	15
3.3 The implementations of EMU, a three step process.....	16
3.4 Sweden and EMU.....	17
4. Data and Method	19
4.1 Data and time periods.....	19
4.2 Correlation.....	19
4.3 Efficient frontier	20
4.4 Sharpe.....	21
5. Result and analysis	23
5.1 Descriptive statistics.....	23
5.2 The Efficient frontier.....	24
5.3 Correlation.....	26
5.3.1 Rolling correlation.....	26
5.4 Sharpe ratio	30
6. Conclusion.....	33
Conclusion.....	33
Extending research	34
Sources	35
Published sources	35
Electronic sources	37
Appendix	38

List of tables, figures and diagrams

Figure 1: Correlation between two assets	8
Figure 1: Portfolio Frontier and the minimum variance portfolio	10
Figure 2: Zero beta portfolio	11
Figure 3: Capital market line	12
Figure 4: Market portfolio	14
Table 1: Descriptive statistics	23
Diagram 4: Efficient frontier of the EMU portfolio.	24
Diagram 5: Efficient frontier of the EMU portfolio with negative excess return.	25
Diagram 6: Efficient frontier of the World portfolio.	25
Diagram 1: Rolling correlation between Sweden and Italy, Sweden and Germany. Sweden and France	27
Diagram 2: Rolling correlation between France and Germany	28
Diagram 3: Rolling correlation between US and Japan	29
Table 2: Increase in Sharpe ratio moving from domestic to EMU portfolio.	31
Table 3: Increase in Sharpe ratio moving from domestic to World portfolio.	32

1. Introduction

In this introduction chapter, the background of international diversification will be presented to give an overall picture of the subject. This is followed by the problem discussion leading to the purpose of this thesis. After this the delimitations of the thesis are presented followed by earlier research and at last the outline of the thesis.

1.1 Background

International diversification is a method to reduce risk in a portfolio by investing in non-domestic assets (Grubel 1968). The intuition behind international diversification is that assets from different countries are thought to have lower correlation than assets from the same country, hence investing in non-domestic assets with low correlation yields lower risk and thereby creating a diversified portfolio (Levy and Sarnat 1970).

One prerequisite for international diversification is capital mobility. During the past 20 years, deregulations in capital markets around the world have made it easier to invest in foreign markets and thereby increasing capital mobility (Iwaisako 2002). One prominent example of deregulation is the European Monetary Union (EMU), which aims towards a common currency, central bank, and monetary policy between European countries. EMU has been implemented in three steps:

- *1990, 1 July. First step in EMU, free capital mobility.*
- *1994, 1 January. Second step in EMU, economic convergence.*
- *1999, 1 January, Third and final step in EMU, common financial and monetary policies.*

Deregulations and increased capital mobility has affected international diversification both positive and negative. The ability to freely access foreign markets will in a positive way increase the possibility to utilize the risk reduction coming from international diversification. The negative effect comes from that markets become more integrated and that the correlation between them increases, thus reducing the diversification effect.

1.2 Problem discussion

As globalization and deregulations of financial markets, due to for example EMU, makes it easier to invest in international markets, it may also increase the correlation between these markets since they become more integrated. The adoption of one and the same currency in the EMU market may also increase the correlation within EMU and lower the effect of international diversification. Not only correlations within the EMU markets but also correlations with other world markets might be affected. The objective of this thesis is to investigate how the effect of international diversification has evolved from a Swedish perspective during the implementation of EMU.

1.3 Purpose

The purpose of this thesis is to investigate, by taking a Swedish perspective, how the effect of international diversification has changed during the implementation of EMU. This will be done by studying correlation and Sharpe ratio development, to see how the gain from diversifying internationally has change during this time period.

1.4 Delimitations

The countries used in this thesis in addition to Sweden, are those which implemented the final step in EMU in January 1999, and a representative group of countries from the world market. The countries that implemented the final step in EMU in January 1999 are: Belgium, Finland, France, Ireland, Italy, Netherlands, Portugal, Spain, Germany, Luxemburg and Austria. Greece and Slovenia, which commenced with the final step in EMU in 2001 and 2007 respectively, will be excluded due to their later involvement in EMU. To be able to compare the effect of diversification within EMU, a World portfolio will be constructed, including US, Japan, Canada, Australia, New Zealand, Hong Kong and Norway. These countries represents a disperse selection of world markets where a Swedish investor is able to diversify. The time period for the MSCI equity indices used in this thesis is 1988 to 2006.

The methods used in this thesis are correlation and portfolio creation according to the mean-variance criterion which results in Sharpe ratios for comparison. Other ways to investigate benefits from diversification used in earlier studies are cointegration, correlation forecasting and CAPM. However these methods are not used in this thesis.

1.5 Earlier research

International diversification has been the subject of a large amount of studies for many years. The methods used in these studies are varying depending on the structure of the study, but measures such as correlation, Sharpe ratio, and cointegration are many times used. The fundamental principle of portfolio theory, and thereby international diversification, has its foundations in Markowitz article "Portfolio selection" from 1952, where it is concluded that portfolio diversification earns higher returns given a certain risk. Later studies such as Grubel (1968) and Levy and Sarnat (1970) have laid the theoretical foundation for international diversification.

Grubel (1968) investigated the effect of international diversification for a US investor during the period 1959 to 1966. He found that by investing in foreign equity markets, a US investor would have gained a better risk adjusted return than by only investing in the US. Furthermore, Levy and Sarnat (1970) investigated the correlation between markets during the time period 1951 to 1967. They found that international diversification where effective during this time period since the correlation between the investigated countries where less than one.

During recent years studies have been made, developing and investigating the effect of international diversification. One example of an investigating study is Goetzmann, Li, Rouwenhorst (2002), where the correlation structure between major world equity markets during the last 150 years where investigated. This study concluded that the correlation structure between equity markets has changed during the years and can not be seen as constant. Studies investigating the effect of the introduction of the Euro have also been made. In Kempa and Nelles (2001) the effect of international diversification before and after EMU where examined. They conclude that the effect of international diversification is positive throughout the process of EMU.

1.6 Outline

This thesis will be structured in the following way: In chapter 2, the theoretical background behind international diversification, correlation, portfolio theory, and Sharpe ratio will be presented. In chapter 3, the foundations of EMU are presented to get an understanding of how EMU has affected international diversification. In chapter 4, the data and the methods used in this thesis will be presented. In chapter 5, the results will be presented with a following discussion. In chapter 6, conclusions will be drawn from the results.

2. Theoretical background

In this part economic theories used in this thesis are presented. First international diversification is explained, this will be followed by the theory behind portfolio creation. Then the theories behind Sharpe-ratio and correlation will be explained.

2.1 International Diversification

A general explanation of diversification is not to put all eggs in one basket, meaning that by spreading the wealth between different assets the risk is reduced. The work of Markowitz and Marschak (1938), Markowitz (1952) and Tobin (1958) gives content to this rule by using the first two moments of the probability function, mean and variance. Using diversification, the risk reduction in a portfolio is not decreased proportionally, the marginal gain of adding one extra asset to reduce risk in the portfolio is decreasing, Solnik (1974). This means that adding an extra asset to a portfolio of 100 assets do not reduce the risk as much as when adding an extra asset to a portfolio consisting of 10 assets. Important to remember is that the entire risk can never be completely reduced since the market risk is not possible to diversify.

International diversification can be described as an extension to the diversification effect investigated by Markowitz and Marschak (1938), Markowitz (1952) and Tobin (1958). Instead of only using domestic assets to reduce volatility in a portfolio, international diversification reduces the volatility in a portfolio by adding non-domestic assets to the domestic portfolio.

Investing in low correlated assets reduces the volatility in the portfolio leading to a better risk-adjusted portfolio return (Brandhorst 2002). Another reason for using international diversification, than portfolio risk reduction, is the possibility of higher returns due to better performing markets in other countries. Low returns in domestic markets make investors look for new investments in other countries (Brandhorst 2002). Finding countries with high returns, in comparison with the domestic market, might give both an increased return and a positive diversification effect. Bartram and Dufey (2001) discuss three benefits of international diversification; participating in the growth of other countries, hedging possibilities and diversification effects, and the possibility of abnormal returns due to market segmentation.

Reduced economic barriers because of economic unions like EMU, NAFTA (North American free trade agreement) and ECOWAS (Economic Community of West African States) together with decreased information costs as well as travel and transportation costs has resulted in more integrated markets (Bartram and Dufey 2001). Global firms like IKEA and General Electric have extended their operations around the world resulting in increased globalization in the world markets. These factors has made it easier to transfer capital between country borders (Iwaisako 2002), increasing the investment possibilities.

2.1.1 Risk and costs of International Diversification

As mentioned in the section above, international diversification is primarily used to reduce the risk in a portfolio. With international diversification certain risks and costs may also increase, according to Bartram and Dufey (2001). Investments in countries with different currencies increase the exchange rate risk. Different taxation systems and interest rates may increase both costs and risks. Transaction costs are difficult not to be affected by, and the higher the transaction cost the higher the cost of international diversification. Transaction costs are often viewed as the biggest and most important cost of international diversification. These risks and costs have to be evaluated when deciding in which countries to invest, hence they have to be compared with the benefit gain from international diversification. Because of these risks and costs Bartram and Dufey (2001) show that it is more sensible to invest in international mutual funds that preferably are linked to a world capital market index instead of private investing by foreign brokers.

2.1.2 Reduced effect in volatile times

An interesting reflection coming from the study made by Solnik, Boucelle and Le Fur (1996) is that international correlations fluctuates widely over time, high market volatility results in high correlation. The correlation fluctuations seem natural since the market is cyclical. The more surprising and problematic result is that when markets are volatile, the effect of international diversification is reduced due to increasing correlations. This is the most apparent shortfall and thereby most criticized aspect of international diversification, since this indicates that the benefits of international diversification are reduced when it is needed the most.

2.1.3 Home Bias

A precondition for international diversification is that investors are willing to invest in foreign markets. According to French and Poterba (1991), US and Japanese investors are reluctant to hold more than a fraction of their wealth in foreign assets, despite the benefits of international diversification. This problem is called home bias, investors are reluctant to invest in foreign assets despite the benefits. French and Poterba (1991) show that home bias can be justified if the investors have optimistic expectations about the domestic market and pessimistic expectations about the foreign market. They show that investors are more afraid of unwanted risk in foreign markets, since they are not familiar with these markets leading to home investment bias. In Hasan and Simaan article “A rational explanation for home bias” (2000), they show that the attractiveness of diversifying can be outweighed by the cost of estimation risk (it is difficult to estimate mean returns in foreign countries). They show that if the investor’s domestic market is large and diversified, the gains from international diversification might be outweighed by the negative impact of the estimations error, leading to home bias. Investors in countries with less diversified markets gain more from international diversification since they have fewer possibilities in the domestic market. These investors are less averse of the estimation risk, leading to less home bias in less diversified markets.

Haselmann and Herwartz (2005) investigate the effect of the Euro on the investment behaviour of a German investor. They show that German investors has decreased their national investments and increased the investments in EMU countries and in the US, hence reducing home bias. Higher investments in EMU countries come from reduced exchange rate risk due to the Euro. Increased investments in the US are due to the higher integration between EMU countries which increases the correlation, leading to a more effective portfolio risk reduction in the US market. They conclude that EMU decreased the investment home bias for a German investor, due to decreased exchange rate risk.

The cause of home bias is hard to derive, some researchers show that it is caused by institutional constraints and some show that it is caused by investor preferences. No matter the cause of home bias, it still affects international diversification. A home biased investor are not interested in international diversification.

2.2 Correlation

Correlation describes how two random variables follow each other or the linear relationship between them, but it does not describe the causality between the two variables. Correlation or the correlation coefficient between two variables is stated as a value between 1 and -1, where a negative correlation means that the two variables move in opposite directions and when the coefficient is positive the variables move together. A correlation of 1 means the two variables follows each other perfectly, if one variable goes up the other variable goes up as well, this can be viewed on the left hand side of figure 1. On the right hand side of figure 1 a perfect negative correlation, correlation coefficient equal to -1, can be viewed.

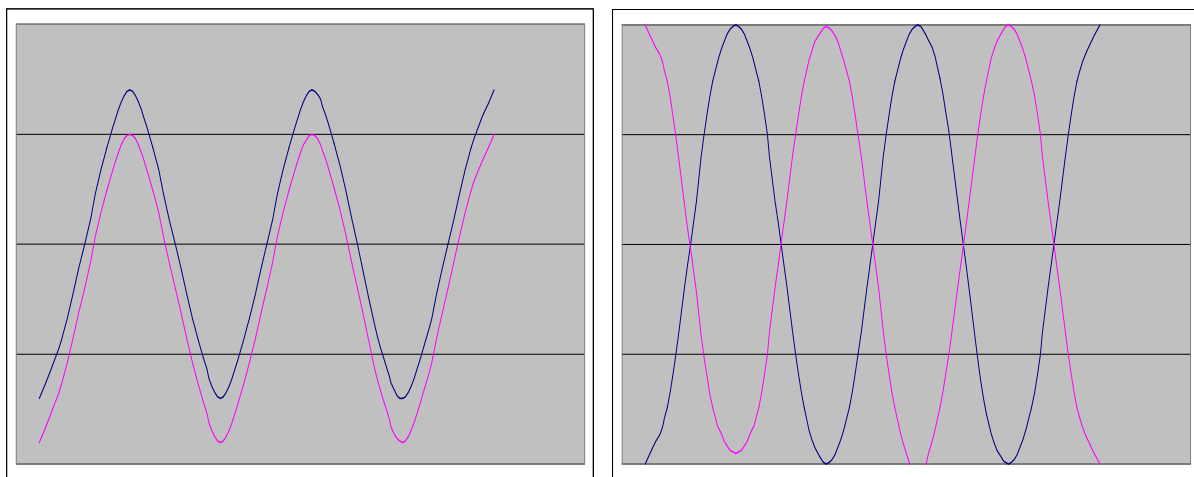


Figure 1: Correlation between two assets

The mathematical notation for calculating the correlation coefficient is stated in formula 1.

$$\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y} = \frac{E((X - \mu_X)(Y - \mu_Y))}{\sigma_X \sigma_Y} \quad (1)$$

Correlation is an important measure when investors are searching for investments that will reduce the volatility in the portfolio, since a low correlation between assets in a portfolio will give a reduced volatility.

A method used to examine the market correlation over time is rolling correlation. The correlation between two variables is calculated for a certain time window, this window is gradually moved forward in time iterating the entire time series. This way of using a time window for the correlation gives a view of the development of the correlation. One study

using rolling correlation is Goetzmann, Li, Rouwenhorst (2002) where they use a backward window to investigate how the correlation has developed between return series for different markets.

2.2.1 Test for homogeneity among two correlation coefficients

To test if two correlation coefficients can be considered the same, the test of homogenous correlations is used. This test is conducted by using the z-transformation of two correlation coefficients to conduct a hypothesis test, where the test statistic is calculated as in formula 2.

$$t_s = \frac{z_1 - z_2}{\sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}} \quad (2)$$

Where z_i is the z-transformed correlation coefficient and n is the number of observations.

The test has the following hypothesis:

$$H_0 = \rho_1 = \rho_2$$

$$H_1 = \rho_1 \neq \rho_2$$

A rejection of H_0 indicates that there is no homogeneity among two correlation coefficients.¹

2.3 Mean-Variance theorem and the efficient frontier

In the article “Portfolio Selection” from 1952, Harry Markowitz laid the foundation to modern portfolio theory. In this article and later work Markowitz develops the idea behind ranking portfolios and the effect of diversification.

By the use of the two first movements of a probability distribution, the mean and the variance, a frontier of portfolios can be created. This frontier consists of portfolios with the lowest variance for each given expected return. In accordance with a risk avert investor, the investor will always chose the asset with the lowest variance for any given return. Thereby a risk avert investor will always hold a portfolio on the frontier. Portfolios can thereby be ranked using this framework, called Mean-Variance criterion. Since only the first two movements, mean and variance, has to be known to rank according to the Mean-Variance criterion it makes a

¹ For further information see Sokal and Rohlf, Biometry, 1981, Biometry, San Francisco, Freeman, page 520.

very useful tool. The reasoning behind this is because in practice, knowledge about all movements in the probability distribution is often not known. There are two additional assumptions made when using the Mean-Variance framework, the utility function of the investor is assumed to be quadratic and the assets distribution is normally distributed. Quadratic utility implies that expected utility depends on the expected return and variance of the asset.

The characteristic of the portfolio frontier is a parabola where the variance is a function of the expected return.

$$\sigma^2 = f(E[r_p]) \quad (3)$$

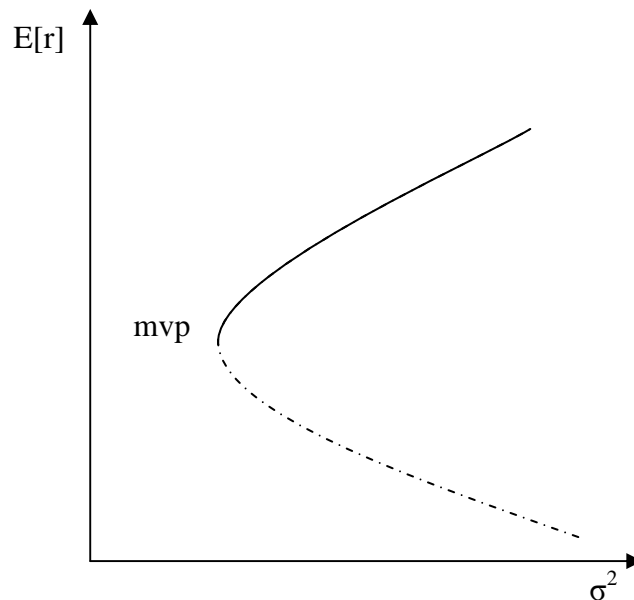


Figure 1: Portfolio Frontier and the minimum variance portfolio

Figure 1 shows the portfolio frontier, where the solid curve illustrates the efficient portfolios and the dashed curve shows the inefficient portfolios. The portfolios on the dashed curve are portfolios, in a set of portfolios, with the same variance, but these portfolios are dominated by the portfolios on the solid curve in terms of expected return. Due to this, risk avert investors will hold an efficient portfolio where the expected return is greater than for the equivalent inefficient portfolio given a specific variance. The convex characteristic of the frontier makes it possible to find one unique solution to a maximization of expected return to variance. The solution to this problem is the minimum variance portfolio. This portfolio has the lowest variance of all portfolios along the frontier. In figure 1 the minimum variance portfolio is

2. Theoretical background

symbolized with mvp . The mvp portfolio divides the frontier into the efficient and the inefficient halves of the portfolio. In addition to have the lowest variance the covariance between the mvp -portfolio and any other frontier portfolio is equal to the variance of the mvp -portfolio:

$$\text{cov}(r_{mvp}, r_p) = \sigma_{mvp}^2 \quad (4)$$

Other important properties of frontier portfolios are that a convex combination of two efficient portfolios yields a new efficient portfolio, and that for every frontier portfolio (except mvp) there exists another frontier portfolio with zero covariance with that portfolio. This portfolio is called the zero-covariance portfolio. The graphical illustration of the zero-covariance portfolio can be viewed in figure 2 where the horizontal line, that intersects with extension of the line between p and mvp on the y -axis, crosses the frontier, marked $zc(p)$.

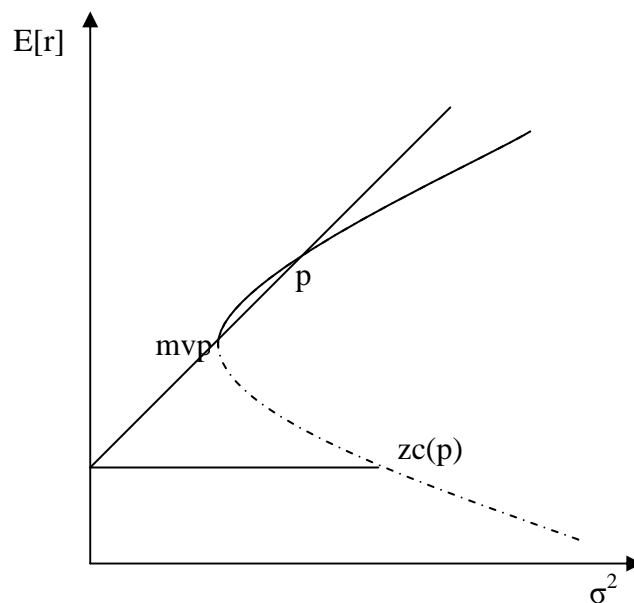


Figure 2: Zero beta portfolio

If a risk free asset is introduced the option of portfolios that a risk avert investor will hold will change to a combination between risky efficient portfolios and the risk free asset with the return of r_f . This creates the Capital Market Line (CML) illustrated in figure 3. Note that this is depicted in the mean-standard deviation space.

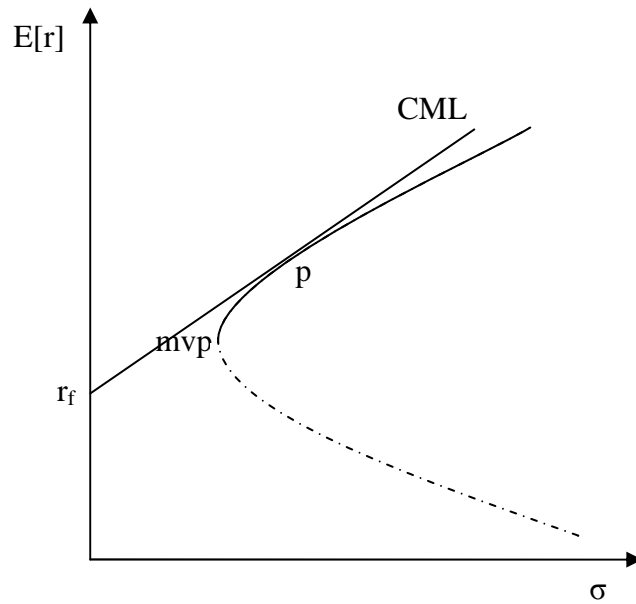


Figure 3: Capital market line

Invertors will hold portfolios along the CML and thus creating the new frontier. In the scenario in figure 3 the risk free rate is below the.mvp portfolio, but there are three possible scenarios.

$r_f < E[r_{mvp}]$ Where the risk free rate is below the expected return of the.mvp.

$r_f = E[r_{mvp}]$ Where the risk free rate is equal to the expected return of the.mvp.

$r_f > E[r_{mvp}]$ Where the risk free rate is above the expected return of the.mvp.

In the case where the risk free rate is equal to the expected return of the.mvp, according the mean variance criteria, the investor will only hold the risk free asset as it's variance is smaller. In the case where the risk free asset is above the expected return of the.mvp the CML will be downward sloping and tangent the inefficient part of the parabola or hyperbola in the case where the mean-standard deviation space is used.

By the use of the portfolio frontier and the capital market line the ranking of portfolios can be made. The conclusion of what kind of portfolio a risk avers investor will hold can also be derived.

2.4 Sharpe ratio

The Sharpe ratio, Sharpe (1966), is a measure of the excess return in relationship to the standard deviation of a portfolio. The standardization of the measure, by dividing the excess return by the standard deviation, makes it possible to compare Sharpe ratios from different portfolios. When doing these comparisons it is crucial to know that the Sharpe ratio only takes the first two moments of the probability distribution into account, hence comparisons building on other moments are not valid. The mathematical expression for the Sharpe ratio is presented in formula 5.

$$S r_p = \frac{E[r_p] - r_f}{\sigma_p} \quad (5)$$

The Sharpe ratio will yield a value indicating how well the investor is compensated for the amount of risk taken. A higher value indicates a higher compensation compared to a lower value.

The Sharpe ratio can be interpreted as a measure of how efficient an asset or portfolio is in the Mean Variance framework. By maximizing the Sharpe ratio in the Mean Variance framework the market portfolio, or the portfolio with the highest Sharpe ratio, is derived. The Sharpe ratio is equal to the slope of the Capital Market Line, CML, in the space standard deviation-expected return. This is presented in figure 4. The portfolio with the highest Sharpe ratio will be the tangency portfolio of the efficient frontier that intersects with the risk free rate on the y-axis, called the market portfolio.

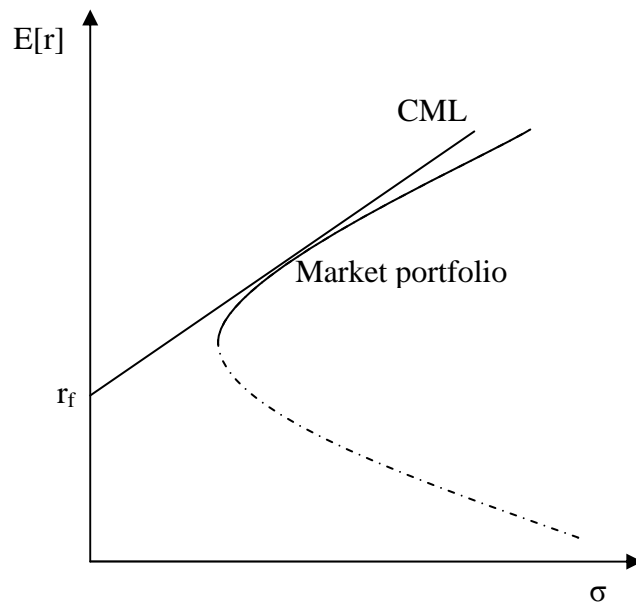


Figure 4: Market portfolio

The CML consists of linear combinations of the risk free asset and the market portfolio. CML springs from the work of James Tobin, where he, in his article “Liquidity Preferences as Behavior Towards Risk” from 1958 develops the separation theorem. He argues that the portfolio construction and the risk preferences of an investor can be separated in two steps. The first step is a mathematical construction of an efficient set that do not take risk preference into account. The second step is to combine the efficient portfolio with the risk free asset given the amount of risk tolerance.

In accordance with the Mean-Variance framework, the Sharpe ratio assumes the return to be normally distributed and the investor to be risk averse. One additional assumption is that the investor only holds one risky portfolio and one risk free asset.

The Sharpe ratio can be used to quantify diversification gains by studying the change in the Sharpe ratio when adding foreign assets to a mean-variance efficient frontier consisting of domestic assets (Cao, 2005). Adding foreign assets will change the structure of the frontier, hence resulting in a new market portfolio. The difference between the Sharpe ratio of the domestic market portfolio and the Sharpe ratio of the foreign market portfolio will show the diversification effect. Using the Sharpe ratios as a measure of the international diversification effect is used in studies by Rowland and Tesar (2004), Kalra, Stoichev and Sundaram (2004), and Sällström (1999).

3. The foundations EU and EMU

In this part the history and workings of EMU will be explained. First an historical primer on EU and EMU will be made. After this the implementations and the consequences of EMU will be shown, giving a better understanding of the effects for a Swedish investor. At last the Swedish involvement in EMU will be explained.²

3.1 European Union

The foundation of EU derives from the European Coal and Steel Community (ECSC) signed by Belgium, Luxemburg, Netherlands, Italy, France and Germany in 1952. ECSC where established to increase the cooperation between the included countries to prevent a new European world-war by open up the trade of steal and coal. The general idea with ECSC was that cooperating countries depended on each other, and this dependence would prevent them from engage in hostile activities. The idea of increasing the integration between countries developed during the years and new treaties where signed. Out of ECSC came EC (European community) and in 1992 the European Union was established when 12 countries signed the Maastricht Treaty (The Maastricht Treaty where then implemented in 1993). EU is built on three pillars, European community, Common Foreign and Security Policy, and Police and Judicial Co-operation in Criminal matters. EU was established to build an inner market between EU-members with free mobility for commodities, services, capital and persons. The last two countries included in EU are Bulgaria and Romania who joined in January 2007. In 2007 EU consists of 27 member countries.

3.2 European monetary union

The purpose of EMU (European monetary union) is, together with the inner market, increase employment and growth in the member countries. EMU where implemented in three steps where the countries involved in the third and final step adopts a common currency (Euro), common economic policy and a common central bank.. In 2007 there are 13 members of the final step in EMU; Belgium, Finland, France, Ireland, Italy, Netherlands, Portugal, Spain, Germany, Luxemburg, Austria, Greece, and Slovenia. All countries included in EU are also

² <http://www.eu-upplysningen.se/>

<http://www.sweden.gov.se/>

<http://www.eu-upplysningen.se/>

These sources are used for the entire chapter.

participating in EMU, but not all EU-members are involved in the final step.

3.3 The implementations of EMU, a three step process

EMU has been implemented in three steps beginning with the first step 1 of July 1990. At this date, laws that counteracted with free capital movements between EU-member states were revised or abolished increasing the possibility of investing in EU-member states. The economical politics in each member state were coordinated and members were encouraged to discuss their economic politics with each other. The national central banks in the EU region increased their cooperation during this first step.

The second step in the implementation of the EMU started in January 1994 when the Maastricht Treaty was implemented. This step involved the start of the European Monetary Institute (EMI), which together with the national central banks started to develop a common monetary policy, and overlooked the Euro exchange rate system. In 1998 the EMI was replaced by the European Central Bank (ECB). During the second step, each member state had to make their national central banks more independent, hence the national central banks should not take instructions from the national government or from any EU institution. The scrutiny of the national economic politics was strengthened to ensure a healthy financial status of each member state. In 1997 the Stability and Growth Pact was implemented to ensure stability in the national fiscal policy. This pact set the guidelines for the national annual budget deficit not to exceed 3% of the national BNP, and the country national debt was not allowed to exceed 60% of national BNP. In 1998 the head chiefs of all member states in EU decided that 11 countries did fulfill the requirements for membership in the European Monetary Union. To be a member of EMU each country had to fulfill the convergence criteria presented below:

- *Inflation in a member state is not allowed to be higher than 1.5% of the inflation in the three member states with the lowest inflation.*
- *The national debt is not allowed to exceed 60% of national BNP and the budget deficit is not allowed to exceed 3% of national BNP.*
- *The long-term interest rates are not allowed to be more than 2% higher than corresponding interest rates in the three countries with the lowest inflation.*

- *The exchange rate of the national currency should have been stable for two years, without devaluations or other serious problems, before entrance in the monetary union.*

The third step in the implementation of EMU started in January 1999. The final step meant that EU became a monetary union with a common currency, a common central bank (ECB) and a common monetary policy (NOTE: each EMU member state has their own fiscal policy). The Euro where not immediately used as a mean of payment, first the 11 EMU member states currencies where locked to the Euro with a fixed exchange rate for three years. The Euro notes where implemented in 1 January 2002, the national note where liquidated during a 2 month process.

Sweden, Denmark and Great Britain are the only countries of the original 15 EU members that are not included in the third and final step of EMU. Though Sweden in a public vote 2003 decided not to take part of the final step, the convergence criteria can include Sweden in the final step when the exchange rate becomes stable, without Sweden applying for an entrance. Denmark and Great Britain can not join the monetary union without an application due to special arrangements. Greece and Slovenia joined the final step later then the original EMU member states, Greece joined in 2001 and Slovenia in 2007. The 11 countries (Slovenia has already joined the third step) that has joined the EU in the 21st century are expected to join the final step in a 10 year horizon, of course depending on the possibility of these countries to fulfil the convergence criteria.

3.4 Sweden and EMU

Sweden joined EU in 1995 together with Finland and Austria. In 2007 Sweden is only participating in the first two steps in EMU, implicating free capital mobility and economic convergence. In 1997 the Swedish government decided not to participate in the final step since the Swedish Krona where not stable in comparison with the other EU-currencies. A stable currency is one of the convergence criteria for entrance in the final step, and as long as this criterion is not fulfilled Sweden can not move on to the final step. In a public vote in 2003, the Swedish public agreed with the decision of the government not to join the final step.

EU and EMU has opened up the borders of Europe and due to the four so called freedoms; free movement of persons, commodities, services and capital. These four freedoms have improved the possibilities for a Swedish investor to invest in other EMU countries. Other positive effects that arise from EMU might be reduced transaction costs and increased information possibilities. The increased integration between EMU members might lead to higher correlation, reducing the effect of international diversification inside the EMU region (Haselman and Herwartz, 2005). This might increase the willingness to invest in other markets like the US, where the correlation might be lower. Kempa and Nelles (2001) investigated how exchange rate risk affected international diversification within the EMU area. They found that the gains from international diversification were more substantial when including exchange rate risk. They also found that the elimination of foreign exchange rate risk lower the cost of equity in the national stock market.

For a Swedish investor, EMU can be viewed both positive and negative, the investment possibilities has increased, information and transaction costs has decreased, a more converged market might also reduce home biasness. On the negative side higher integration between EMU markets increases the correlation among them.

4. Data and Method

In this part the methods will be explained and how they were applied. First the data and time period will be explained, followed by an explanation of how the correlation and the rolling correlation were calculated. Next the portfolio creation will be explained, followed by how the Sharpe ratio was calculated.

4.1 Data and time periods

In this thesis Morgan Stanley Capital International equity indices (MSCI) are used for each country, covering the period from 1988 to 2006 which spans the three step implementation of EMU. All indices are denoted monthly which gives 228 observations for each country. The indices are all denoted in US dollars. These indices are transformed into excess return indices by subtracting the risk free rate, represented by a Swedish government bond. These excess returns are used in all calculations. All data is collected using the Eco-Win data base.

4.2 Correlation

Correlation describes the linear relationship between two variables. Correlation or the correlation coefficient between two variables is stated in a value range between 1 and -1. To study the correlation between the different excess return indices, both a rolling correlation and correlation for each year and selected time periods are calculated.

The yearly correlations between each of the countries are calculated, resulting in 171 correlation coefficients for each year. The correlation coefficient between each pair of countries for two successive years is tested using the test for homogenous correlation with a significance level of 95%. The test is used for all years and for all correlation coefficients. The test is used to investigate if the correlation coefficient has been the constant between two countries over a period of time. This test for homogenous correlations is also done for two larger time periods, before and after the adoption of the Euro.

In the rolling correlation calculation a time window of 36 observations is used. The window is gradually moved forward by one observation for each calculation. This results in a series of correlations spanning from 1991 to 2006 between each country.

4.3 Efficient frontier

Efficient frontiers are created by use of the excess returns for Sweden and the EMU portfolio countries for each year of the study, 1988 to 2006. Frontiers including Sweden and the World portfolio countries are also generated.

To create these frontier the following maximization problem is used, Best and Grauer (1990).

$$\max_{\{w\}} \left\{ tw' \mu - \frac{1}{2} w' V w \quad | w' \mathbf{1} = 1, w_i \geq 0 \right\} \quad (6)$$

Where w is a vector of weights, μ is a vector of returns from the different assets, V is the variance-covariance matrix from the assets, and t is a measure of risk tolerance. A smaller value of t implies higher risk aversion and a value of 0 implies no risk tolerance at all. In addition, a short selling restriction is also invoked, implying that a weight for an asset can not take on a negative value, $w_i \geq 0$. Formula 6 can also be viewed as the risk tolerance times the expected return of the portfolio minus half of the variance of the portfolio.

The variance-covariance in formula 7 is calculated by multiplying a matrix of standard deviations with a correlation matrix and then by the matrix of standard deviations again.

$$V = \begin{bmatrix} \sigma_1 & \circ & 0 \\ \circ & \circ & \circ \\ 0 & \circ & \sigma_N \end{bmatrix} \begin{bmatrix} 1 & \circ & \rho_{1N} \\ \circ & \circ & \circ \\ \rho_{N1} & \circ & 1 \end{bmatrix} \begin{bmatrix} \sigma_1 & \circ & 0 \\ \circ & \circ & \circ \\ 0 & \circ & \sigma_N \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \circ & \sigma_{1N} \\ \circ & \circ & \circ \\ \sigma_{N1} & \circ & \sigma_{NN} \end{bmatrix} \quad (7)$$

The diagonal of the variance-covariance matrix consists of the variances of the assets in the portfolio. As shown in formula 9 the variance of the portfolio can be calculated by multiplying the weight matrix with the variance-covariance matrix and then again multiplying with the weights.

$$\mu_p = w' \mu \quad \text{Expected return of the portfolio} \quad (8)$$

$$\sigma_p^2 = w' V w \quad \text{Variance of the portfolio} \quad (9)$$

The frontier is generated by varying the risk tolerance³. Only the positive values of t will be examined since this will yield the efficient frontier.

For each year, a set of calculations are made, varying the risk tolerance from 0 and upward using the excess return series for that year. Since no short selling is allowed there will be a point when increasing the risk tolerance will have no effect on the portfolio composition. This is when all weights are zero in all assets except for the most risky which is equal to one. The mean and variance of the portfolio, with respect to the weights received from the maximization for each instance of risk tolerance, yields the efficient frontier. The shift in the front is analyzed, but it is important from a diversification point of view to remember that not only changes in correlation will affect the frontier but also the mean and variance of the time period.

To conduct the actual calculation and maximizations, OpenOffice.org 2.2 Calc and Microsoft Excel 2003 are used. These are both spreadsheet applications with similar functionality.

4.4 Sharpe

The Sharpe ratio, Sharpe (1966), measures the risk adjusted return on an investment. The Sharpe ratio is in this thesis used to investigate the international diversification effect. This is done by examining the gain in Sharpe ratio in moving from a domestic portfolio to an international diversified portfolio over a specific time period. Changes in Sharpe ratios can be compared for different time periods to investigate if the gains from international diversification have changed over time. The reasoning behind using the change in Sharpe ratio when moving from a domestic to an international portfolio when investigating how the effect of international diversification has changed is due to the way the Sharpe ratio is constructed. The Sharpe ratio is calculated using the mean and standard deviation, hence a period of high returns will yield a higher Sharpe ratio compared with a period with lower returns but the same standard deviation. The same goes for the standard deviation but in the opposite direction. Thus a comparison between Sharpe ratio might lead to biased results.

³ For further information see Best and Grauer, 1990, The Efficient set Mathematic When Mean-Variance Problems are subject to Linear Constraints, Journal of Economics and Business, 42, page 107.

The portfolio used for the Sharpe ratio calculation is the market portfolio, the portfolio with the maximum Sharpe ratio. This portfolio is constructed by solving the following maximization problem:

$$\max \left\{ \frac{w'[\mu_p - r_f]}{\sqrt{w'Vw}} \mid w'I = 1, w_i \geq 0 \right\} \quad (10)$$

Where w is the weight vector, V is the variance-covariance matrix, μ_p is the expected return vector, and r_f is the risk free rate.

The change in Sharpe ratio for a given time period, $\Delta S r_t$, is calculated as a percentage change of the domestic, $S r_{dt}$, to the international Sharpe ratio, $S r_{it}$ by the following formula:

$$\Delta S r_t = \frac{S r_{it} - S r_{dt}}{S r_{dt}} \quad (11)$$

Under certain circumstances a negative Sharpe ratios will be generated. This is due to a higher risk free rate than the return of the asset or portfolio, this leads to a negative value in the nominator. There is no consensus of how to interpret a negative Sharpe ratio, since a rational investor never invests in such an asset. In this thesis however ex post variables are used enabling this problem. Since the improvement in Sharpe ratio moving from a domestic to an international portfolio is investigated, a movement from a negative value to a less negative value is interpreted as an improvement.

5. Result and analysis

In this part the results and analysis are presented. First the descriptive statistics are presented, after this the movement of the frontier is described. This is followed by the results from the correlation and the Sharpe ratio analysis.

5.1 Descriptive statistics

Table 1 displays the descriptive statistics for each of the excess return series used in this thesis during the time period 1988 to 2006 presented in percentage form.

Table 1: Descriptive statistics

	Mean	Std dev	Min	Max
Sweden	0,7120	7,2239	-25,4775	20,3081
EMU				
Belgium	0,5763	5,0707	-20,8979	21,7181
Finland	0,4955	9,3262	-38,5461	28,3939
France	0,4930	5,4890	-17,2109	18,3473
Ireland	0,4305	5,6505	-20,4711	16,1316
Italy	0,2153	6,5324	-22,3161	18,8501
Netherlands	0,5264	4,8543	-19,9448	12,0635
Portugal	0,0049	6,3512	-21,8534	24,0837
Spain	0,4863	6,1710	-24,6901	19,0739
Germany	0,3760	6,3133	-28,2481	20,9823
Luxembourg	0,4763	5,4702	-29,3177	16,3262
Austria	0,4507	6,4575	-27,5433	21,6739
World				
US	-0,4250	6,5328	-22,6969	20,5695
Japan	0,3326	4,4271	-11,2680	13,1398
Australia	1,0143	5,2468	-16,1378	16,0775
Hong Kong	1,1062	7,5394	-34,0580	28,6885
New Zealand	0,6037	6,5114	-22,3580	24,4156
Canada	0,9170	5,0056	-24,5467	13,5637
Norway	1,0850	6,7312	-32,4908	15,5839

Table 1 shows that the average excess returns for the EMU portfolio countries range between 0,0049 % (Portugal) and 0,5763% (Belgium), and that the average excess returns for the World portfolio countries range between -0,43 % (US) and 1,11 % (Hong Kong). An interesting note is that Sweden shows higher average excess return than all EMU portfolio countries, and is only outperformed by Australia, Hong Kong, Canada and Norway. Comparing the EMU portfolio countries with the World portfolio countries, average standard deviation show that the EMU countries have higher standard deviation than the world countries on average. Finland, Sweden and Hong Kong show the highest standard deviation, where Finland also shows the highest maximum and the lowest minimum excess return.

5.2 The Efficient frontier

The efficient frontier for each year has been calculated for both the EMU and the World portfolio. When analyzing the change or shift in the frontier it is important to remember that not only correlation affects the frontier but also the mean and variance of the excess returns. This part of the analysis is therefore used to get a clearer view of the investment possibilities during the period.

We can see a clear difference between the early and the later frontiers of the EMU portfolio during the examined time period. The frontier has moved up and to the left, indicating an increase in excess return and a decrease in standard deviation. In addition to a movement up and to the left, a slight decrease in the range between maximum and minimum for both variance and mean is observed over time.

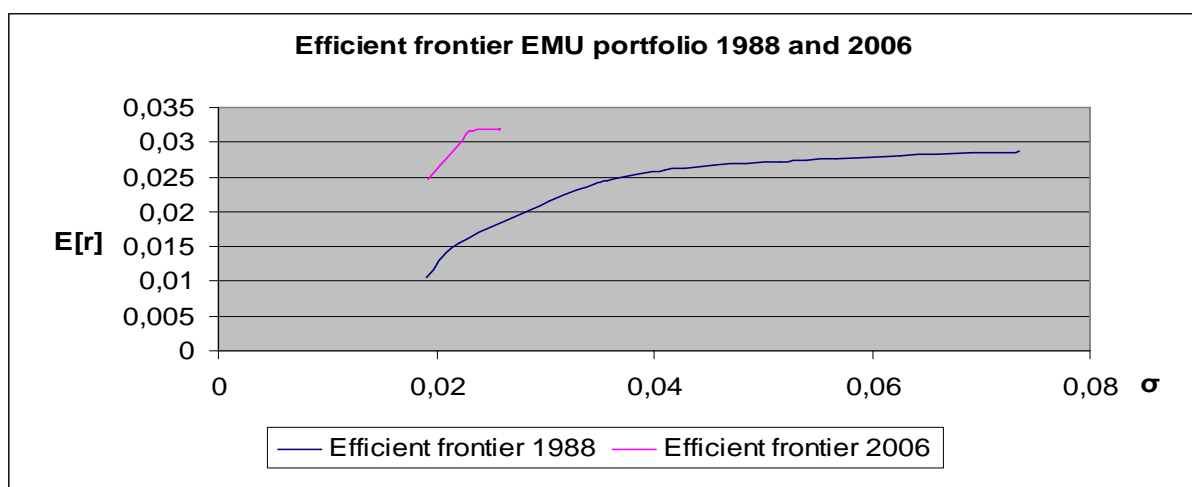


Diagram 4: Efficient frontier of the EMU portfolio.

5. Result and analysis

The movement in the frontier presented in diagram 4 is typical for the entire examined time period, where a gradual change can be seen, with the two frontiers in diagram 4 representing the two extremes or end observations. There are exceptions to this frontier movement, illustrated in diagram 5, where a negative excess return due to bad market performance can be seen on the lower part of the frontier.

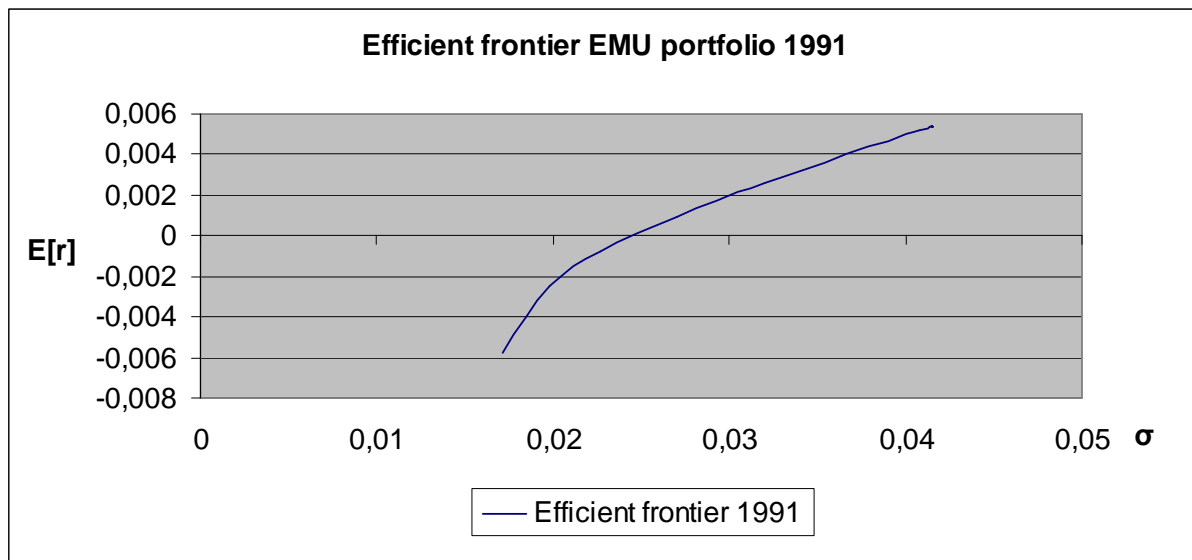


Diagram 5: Efficient frontier of the EMU portfolio with negative excess return.

The World portfolio frontier shows smaller movements than the EMU portfolio frontier. As can be viewed in diagram 6, only a slight increase in excess return with respect to the variance is shown during the time period 1988 to 2006.

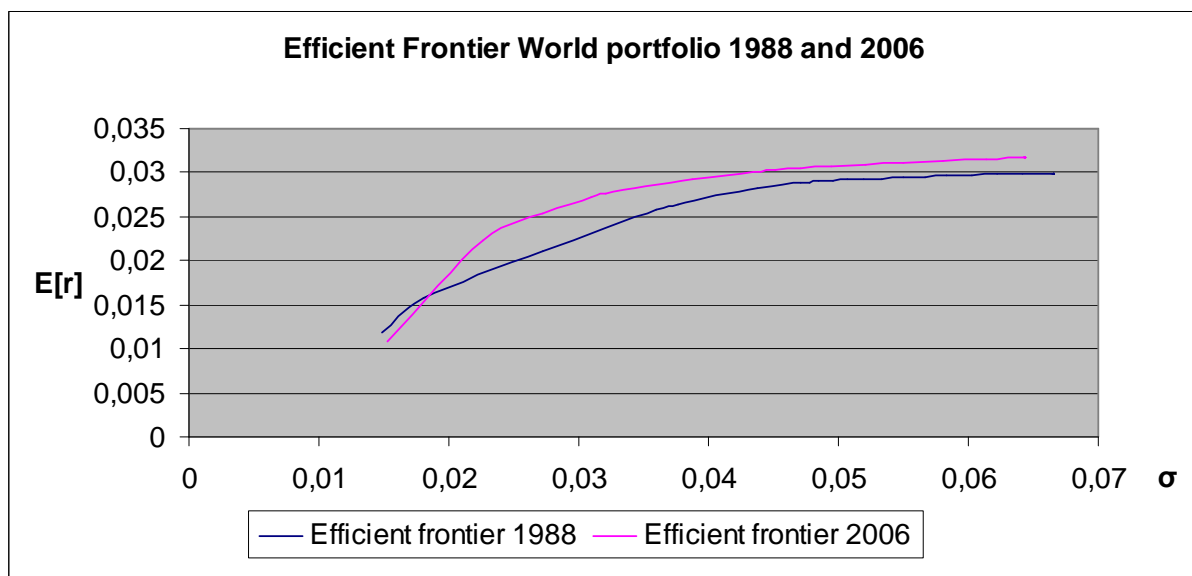


Diagram 6: Efficient frontier of the World portfolio.

There are similar exceptions as with the EMU portfolio, where the lower part of the frontier exhibits negative excess return. The set of possible investments in the World portfolio has been rather stable over the time period in comparison with the EMU portfolio where the maximum and the minimum mean and variance decreased over time.

5.3 Correlation

The correlation will be examined in three ways. A test if the correlation coefficient is constant over time for each excess return series, consisting of 171 tests each year. Correlation between all series for two sub periods, the first and second half of the period divided by the introduction of the Euro, is also examined. Finally, rolling correlation is calculated between each pair of excess return series.

By using the test of homogenous correlations each year, H_0 could not be rejected in 9.52 % of the tests, implying a homogenous correlation coefficient between two years. This means that 90.48 % of the correlations coefficients are concluded to change each year with a significance level of 95%. The change in correlations is in line Goetzmann, Li, Rouwenhorst (2002), they show that the correlation between markets shifts considerably through time. Since there is change in correlation between the series, this will affect diversification.

By examining the correlation matrix in appendix 1 it can be concluded, using the test for homogenous correlations, that only 4.1% of the correlation coefficients have remained constant over the two time periods. The time periods are chosen to highlight the final step in the implementation of EMU. We can observe a general increase in correlation but not only among the EMU portfolio countries but also among the countries comprising the World portfolio. The average increase in correlation between the EMU portfolio countries are 0.135 and 0.139 for the World portfolio. We can not conclude that the increase in correlation only derives from the implementations of EMU, especially since the correlation between the World portfolio countries show almost the same increase.

5.3.1 Rolling correlation

A rolling correlation is constructed between all excess return series, resulting in 171 correlation series. The results are presented in three diagrams, these represent the general development of the correlation during this time period.

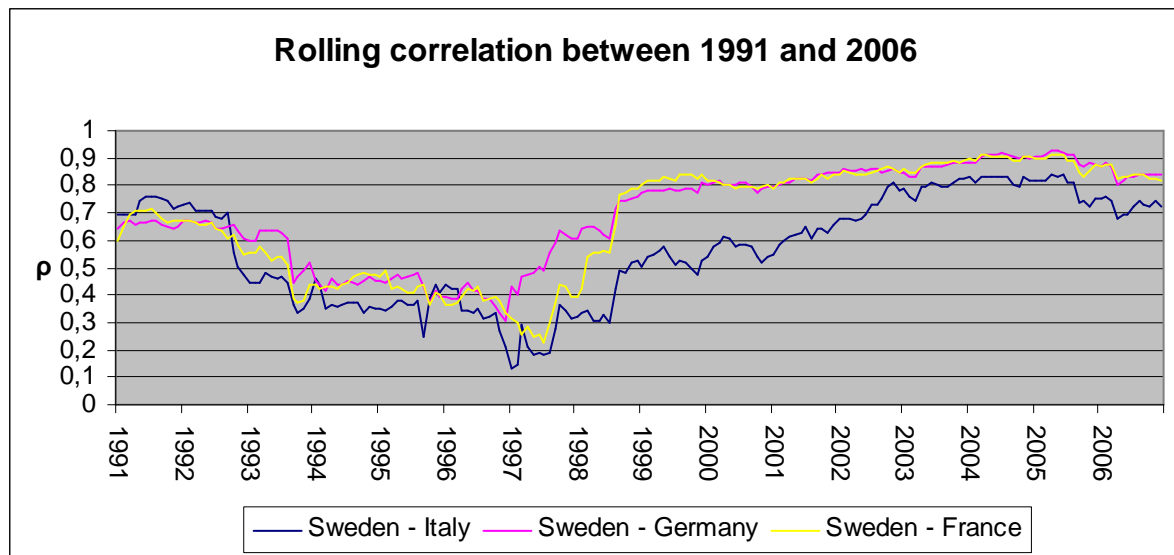


Diagram 1: Rolling correlation between Sweden and Italy, Sweden and Germany. Sweden and France

Diagram 2 shows the rolling correlation between Sweden and Italy, Sweden and Germany, Sweden and France. The correlation is high in 1991 and in the end of 2006, with a decrease during the period of 1993 to 1997. The trend in these rolling correlations can be observed in all of the correlations between Sweden and the EMU portfolio countries, although not as striking as shown in diagram 2. There are two exceptions, in the case of Finland and Spain, where the correlation is more stable over time, ranging from 0.6 to 0.8, showing only small fluctuations and no apparent dips or increases. The cause of the decrease in diagram 1 is hard to tie to a certain event, but the increase during the years of 1997 and 1998 might be due to the two major crises that affected the world markets during this period, the Asia crisis in 1997 and the crisis in Russia in 1998. This reasoning is supported by Solnik, Boucrelle and Le Fur (1996) where they show that correlation increases during turbulent periods. Another possible explanation for the increase is that Sweden joined the EU and EMU in 1995. The effects of integration due to EU and EMU could probably have had an increasing effect on the correlations between the member states.

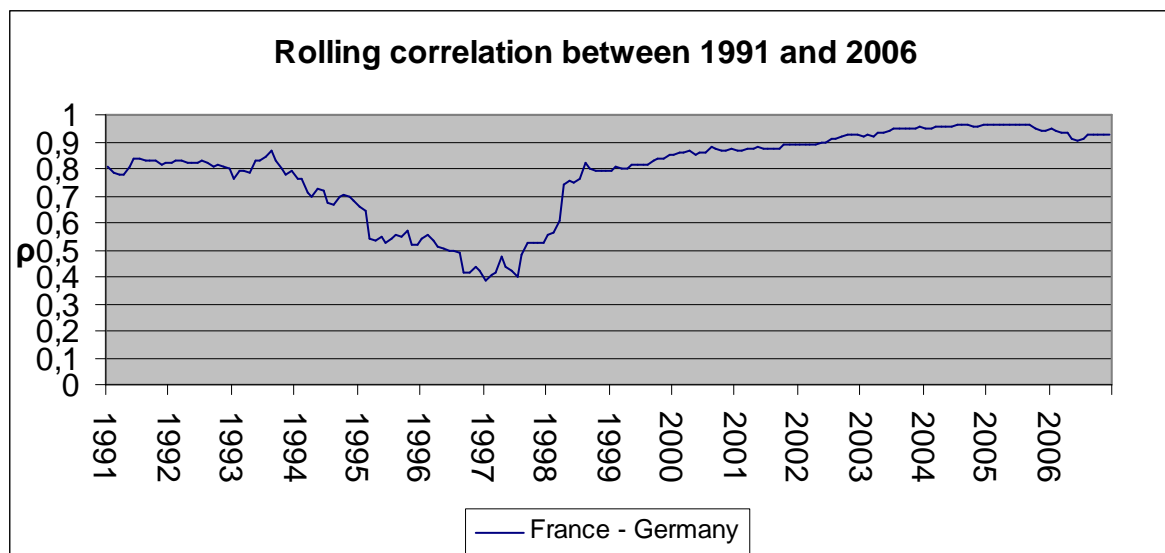


Diagram 2: Rolling correlation between France and Germany

Diagram 2 shows the development of the correlation between France and Germany from 1991 to the end of 2006. The correlation is high and stable up until 1994 where a decrease occurs until 1997 when the correlation increases reaching 0.9 in 2006. Diagram 2 illustrates similar trends as the correlation in diagram 1. This trend is also observed between other members of the EMU but with lower correlation than this extreme. The effect of the adoption of the Euro in 1999 can according to us be observed in this correlation development since the correlation start increasing in 1998 and increases to almost 1 in 2004 and 2005. One of the implications of this high correlation, that Germany and France exhibits, is that they are never used in the same optimal Sharpe portfolio. Another explanation for this increase might be the crises described in the section above.

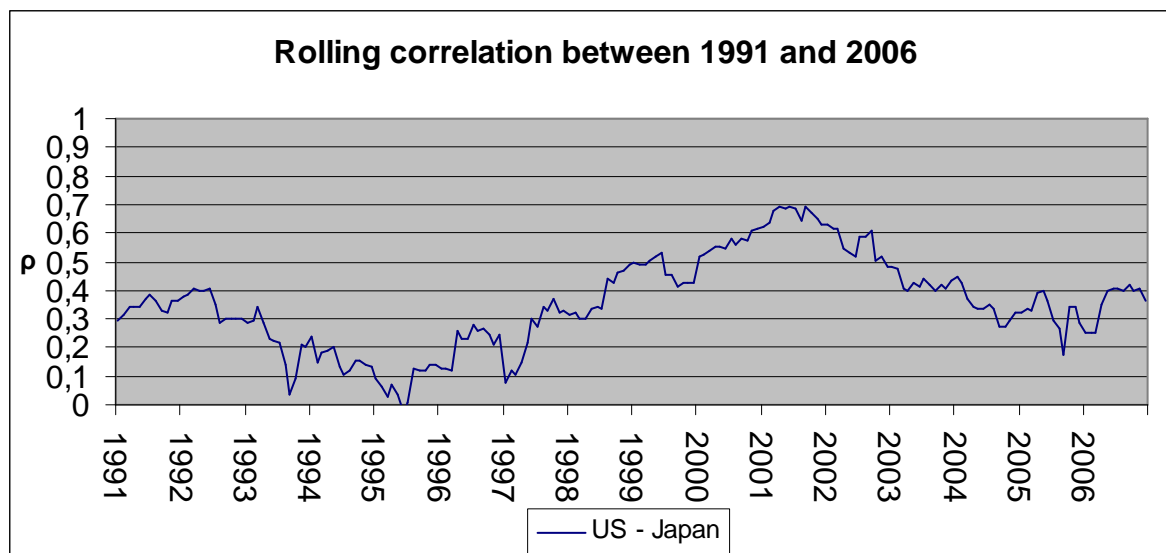


Diagram 3: Rolling correlation between US and Japan

Diagram 3 shows the development of the correlation between US and Japan from 1991 to the end of 2006. This result is typical for rolling correlations involving Japan, where all countries but Australia, New Zealand, and Hong Kong show this low correlation pattern and modest fluctuations with Japan. Some of this might be explained by the result from Söhnke, Bartram and Dufey (2001), where they state that countries that are geographically close tend to show higher correlation, but the crisis in Asia during 1997 is a more reasonable explanation.

A general conclusion from all rolling correlations is that a trend can be seen in almost all correlations between EMU portfolio countries, where fairly high correlation in the beginning of the period is followed by a short dip and a steep increase. The World portfolio countries do not show the same clear cut trends as the EMU portfolio countries, rather more modest magnitude and volatility in correlation. The correlation development between the EMU portfolio countries and the World portfolio countries are, apart from US, Canada, and Norway, showing low correlation in relation to the correlation seen between the EMU portfolio countries. The correlation between US, Canada, Norway and the EMU portfolio countries shows a more similar, but not at all as clear, pattern as between the EMU portfolio countries.

5.4 Sharpe ratio

By measuring the change in Sharpe ratio of the market portfolio, moving from a Swedish domestic portfolio to an internationally diversified portfolio, the effectiveness of international diversification is examined. The result from this shows that international diversification has proven to yield a better result than only investing in the domestic portfolio. This however is expected since adding assets to a portfolio can only increase the maximum Sharpe ratio. More interesting is how the gain from investing internationally has changed over the time period. This is done by examining the percentage increase in the Sharpe ratio moving from a Swedish market portfolio to the EMU and World market portfolio.

We find that during the period 1988 to 2006 the gain from investing in the EMU portfolio, in contrast of only investing in the domestic portfolio, has been volatile. Increase in Sharpe ratio is ranging from 0% to 692% with an average increase of 173%. This can be viewed in table 2. Three extreme observations occur where the increase is over 300%. This is a result of very low Sharpe ratios in Sweden during that specific time period. If these extreme observations are excluded the average increase is approximately 100%. The development of the gain in Sharpe ratio from diversifying in the EMU portfolio shows no trend, there is however a slight decrease over time of the average percentage increases if the first and the second half of the sample are compared. The result is the same both with and without the extreme observations. The gains of diversifying in the EMU portfolio are high throughout the implementation of EMU with exception of 1999 where the increase is close to zero because the Swedish market performed as good as the EMU portfolio.

Table 2: Increase in Sharpe ratio moving from domestic to EMU portfolio.

Year	Increase in Sharpe ratio	Percent increase in Sharpe ratio
1988	0,1735	32%
1989	0,3225	119%
1990	0,2631	87%
1991	0,0864	202%
1992	0,1284	40%
1993	1,0650	403%
1994	0,2076	171%
1995	0,2589	76%
1996	0,8062	145%
1997	0,5397	522%
1998	0,7172	692%
1999	0,0004	0%
2000	0,2013	75%
2001	0,1595	69%
2002	0,4869	156%
2003	0,5179	77%
2004	0,6609	113%
2005	0,4704	273%
2006	0,7411	112%

The increase in Sharpe ratio from diversifying in the World portfolio shows similar results as for the EMU portfolio, with an increase ranging from 49% to 673% and an average increase of 149% excluding observations above 300%. A comparison between the earlier and the later half shows however a slightly higher increase during the later period in opposite of the EMU portfolio.

Table 3: Increase in Sharpe ratio moving from domestic to World portfolio.

Year	Increase in Sharpe ratio	Percent increase in Sharpe ratio
1988	0,330	61%
1989	0,314	116%
1990	0,602	200%
1991	0,292	584%
1992	0,673	207%
1993	0,686	260%
1994	0,244	201%
1995	1,149	338%
1996	0,597	108%
1997	0,451	435%
1998	0,200	193%
1999	0,769	99%
2000	0,262	98%
2001	0,346	151%
2002	0,682	219%
2003	1,150	436%
2004	0,568	97%
2005	1,160	673%
2006	0,323	49%

As a measure of how the diversification effect has developed during the implementation of EMU, the increase in Sharpe ratio shows no significant trend tendencies over this time period, however the gain in Sharpe ratio has been quite volatile for both the EMU and the World portfolio. None of the portfolios shows a clear dominance over the other in increase of Sharpe ratios. This suggests that, during the period 1988 to 2006, the effect of international diversification for a Swedish investor among the EMU portfolio countries and the World portfolio countries has not been drastically affected by the convergence of financial regulations, markets, and currencies within EMU.

6. Conclusion

This part includes the final conclusion drawn from the results. This is followed by suggestions about future extended studies.

6.1 Conclusion

The purpose of this thesis was to investigate, by taking a Swedish perspective, how the effect of international diversification changed during the implementation of EMU. This was examined by studying correlation between excess return indices and the change in Sharpe ratio when moving from a domestic market portfolio to an international market portfolio. The implementation of EMU might have led to changes in correlation between both member countries and the rest of the world.

By examining the correlation between both the EMU portfolio countries and the World portfolio countries we can conclude that correlations are not constant over time. We can see different patterns of correlation movements between the EMU portfolio countries and the World portfolio countries. EMU portfolio countries seem to exhibit higher correlations among them selves compared to the World portfolio countries. One such example is the correlation between France and Germany where the correlation almost reached unity during 2004. Although we can not be completely sure that EMU has been responsible for the average increase in correlation among the EMU member countries, we can see a clear increase in correlation running up to the third and final step of EMU. This kind of behaviour is not observed for the World market countries. Thereby it supports our theory that EMU has increased the correlation among its members.

The effect of investing internationally instead of domestically has been measured with the change in Sharpe ratio. We can observe very volatile changes in the gain from international diversification, ranging from 0% to over 600%. This volatile behaviour is observed for both the EMU and the World portfolio. When calculating the gain from the diversification the portfolio with the maximum Sharpe ratio is used. It can be noted that the EMU market portfolios often consist of only two or three assets where Austria and Luxembourg are most frequent, which results in frontiers with smaller range. In contrast to this the World market portfolios are often constructed using all but one or all but two of the seven available assets, the frequency of usage are more disperse and non of the assets are used more than the others.

We can observe a slight decrease in average gain during the second half of the examined time period for the EMU portfolio, suggesting that the diversification effect for a Swedish investor has decreased in the EMU markets. The opposite can be observed for the World portfolio, indicating an average increase of the diversification effect.

Combining the results in this thesis, we conclude that a Swedish investor has had a positive diversification effect within the EMU countries, although we can observe an increase in correlation and a slight decrease in average diversification effect during this period. The opposite can be concluded for the World portfolio. We can not conclude that the increase in correlation between EMU countries can be derived from the implementation of EMU, but we consider it very likely.

6.2 Extending research

An interesting alternative not examined in this thesis is the possibility for industry diversification. Instead of diversifying between countries an investor diversifies between industries. A study handling this is Eiling, Gerard and de Roon (2005) where they investigate the importance of country and industry factors as determinants of international equity returns. Forecasting the gains from diversifying within the EMU countries could also be done in further research by creating models that incorporates correlation. The scope of international diversification is wide and changes in world economies during recent years make the possibilities of extensions to this thesis immensely large.

Sources

Published sources

Bartram, Söhnke., Dufey, Gunter., (2001) “International portfolio investment: Theory, Evidence and institutional framework”, *Financial Markets, Institutions & Instruments*, 10, 2001.

Best, Michael J., Grauer, Robert R., (1990), “The Efficient set Mathematic When Mean-Variance Problems are subject to Linear Constraints”, *Journal of Economics and Business*, 42, 1990, pp 107.

Cao, Jie., (2005), “International Diversification through iShares And Their Rivals”

Eiling, Esther., Gerard, Bruno., Roon, Frans de., (2005) “International diversification in the Euro zone: The increasing riskiness of industry portfolios”

French, Kenneth., Poterba, James., (1991) “Investor Diversification and International Equity Markets”, *The American Economic review*, 81, 1991, pp 222-226.

Goetzmann, William., Li, Lingfeld., Rouwenhorst, Geert., (2002), “Long-Term Global Market Correlations”, *Yale ICF Working Paper No. 00-60*.

Grubel, Herbert G., (1968), “Internationally Diversified Portfolios: Welfare Gains and Capital Flows”, *American Economic Review*, 58, 1968, pp 1299-1314.

Hasan, Iftekhara., Simaan, Yusif., (2000) “A rational explanation for home country bias”, *Journal of international Money and finance*, 19, 2000, pp 331-361.

Haselmann, Rainer., Herwartz, Helmut., (2005) “The Introduction of the Euro and its Effects on Investment Decisions”.

Iwaisako, Tokuo., (2002), “Does international diversification really diversify risks?”, *Journal of the Japanese and International Economies*, 16, 2002, pp 109–134.

Kalra, Rajiv., Stoichev, Miroslav., Sundaram, Srinivasan., (2004) “Diminishing gains from international diversification”, *Financial series Review*, 13, 2004, pp 199-213.

Kempa, Bernd., Nelles, Michael., (2001) “International correlations and excess returns in European stock markets: does EMU matter?” *Applied Financial Economics*, 11, 2001, pp 69-73

Levy, Haim., Sarnat, Marshall., (1970), “International Diversification of Investment Portfolios”, *The America economic review*. 60, 1970, pp 668-675.

Makover, H., Marschak, J., (1938), “Assets, prices and monetary theory”, *Economica*, 5, 1938, pp 261-288.

Markowitz, Harry., (1952), “Portfolio Selection”, *Journal of Finance*, 20, 1952, pp. 77-91.

Rowland, Patrick. F., Tesar, Linda. L., (2004), “Multinationals and the gains from international diversification”, *Review of Economic Dynamics*, 7, 2004, pp 789-826.

Sharpe, William. F., (1966), “Mutual Fund Performance”, *Journal of Business*, 39, 1966, pp 119-38.

Sokal, Robert L., Rohlf, James F., (1981), *Biometry: the principles and practice of statistics in biological research*, Freeman, San Francisco, pp 520

Solnik, Bruno., (1974), “Why Not Diversify Internationally Rather Than Domestically?”, *Financial Analysts Journal*. 51, 1995

Solnik, Bruno., Boucelle, Cyril., Le Fur, Yann., (1996), “International Market Correlation and Volatility”, *Financial Analysts Journal*, 52, 1996, pp. 17–34.

Sällström, Torbjörn., (1999), “International Diversification Benefits A mean variance spanning test”.

Tobin, James., (1958) “Liquidity Preference as Behavior Towards Risk”., *The review of economic studies*, 25, 1958, pp 65-86.

Electronic sources

Brandhorst, Eric., (2002). "International Diversification", *State Street Global Advisors*, www.ssga.com/library/resh/ericbrandhortsinternationaldiversification71502/page.html, 2007-05-12.

<http://ec.europa.eu/> 2007-04-16

<http://www.eu-upplysningen.se/> 2007-04-18

<http://www.sweden.gov.se/> 2007-04-16

Appendix

Appendix 1: Correlation matrix 1988-1998 and 1999-2006

	Sweden	Belgium	Finland	France	Ireland	Italy	Netherlands	Portugal	Spain	Germany	Luxembourg	Austria	US	Japan	Australia	Hong Kong	New Zealand	Canada	Norway
Sweden		0,44	0,60	0,51	0,58	0,48	0,63	0,51	0,71	0,56	0,40	0,38	0,50	0,50	0,48	0,36	0,52	0,46	0,59
Belgium	0,52		0,33	0,71	0,53	0,43	0,70	0,42	0,52	0,69	0,28	0,37	0,49	0,42	0,23	0,25	0,15	0,38	0,43
Finland	0,66	0,24		0,32	0,50	0,45	0,48	0,34	0,53	0,42	0,31	0,37	0,43	0,35	0,42	0,34	0,41	0,45	0,52
France	0,86	0,75	0,63		0,48	0,47	0,72	0,42	0,59	0,76	0,21	0,49	0,50	0,39	0,36	0,33	0,24	0,42	0,47
Ireland	0,56	0,64	0,33	0,64		0,39	0,64	0,52	0,60	0,53	0,36	0,43	0,52	0,50	0,39	0,33	0,36	0,44	0,52
Italy	0,72	0,67	0,48	0,83	0,54		0,46	0,40	0,56	0,53	0,26	0,39	0,34	0,36	0,22	0,20	0,27	0,40	0,39
Netherlands	0,74	0,81	0,47	0,89	0,70	0,79		0,57	0,61	0,76	0,24	0,55	0,59	0,48	0,44	0,40	0,44	0,57	0,57
Portugal	0,65	0,63	0,41	0,71	0,53	0,69	0,64		0,63	0,42	0,31	0,47	0,33	0,36	0,25	0,30	0,45	0,31	0,40
Spain	0,76	0,67	0,43	0,83	0,68	0,76	0,78	0,72		0,56	0,34	0,43	0,53	0,52	0,46	0,40	0,50	0,48	0,54
Germany	0,86	0,73	0,54	0,93	0,70	0,80	0,87	0,68	0,83		0,25	0,67	0,44	0,33	0,33	0,31	0,26	0,41	0,47
Luxembourg	0,65	0,37	0,42	0,62	0,40	0,55	0,59	0,41	0,61	0,67		0,24	0,25	0,13	0,32	0,23	0,25	0,29	0,32
Austria	0,36	0,68	0,08	0,50	0,55	0,52	0,59	0,40	0,51	0,52	0,34		0,21	0,23	0,26	0,30	0,30	0,32	0,47
US	0,77	0,55	0,61	0,78	0,62	0,56	0,74	0,45	0,70	0,79	0,59	0,38		0,31	0,43	0,46	0,32	0,73	0,46
Japan	0,41	0,24	0,36	0,41	0,39	0,33	0,43	0,23	0,34	0,36	0,44	0,36	0,49		0,34	0,30	0,35	0,32	0,32
Australia	0,64	0,51	0,45	0,64	0,60	0,55	0,63	0,43	0,62	0,63	0,53	0,50	0,64	0,55		0,43	0,66	0,54	0,44
Hong Kong	0,60	0,42	0,39	0,56	0,46	0,48	0,57	0,32	0,55	0,58	0,63	0,45	0,61	0,46	0,60		0,34	0,56	0,35
New Zealand	0,45	0,44	0,32	0,47	0,48	0,41	0,48	0,31	0,45	0,47	0,42	0,57	0,47	0,37	0,72	0,50		0,44	0,44
Canada	0,72	0,45	0,56	0,73	0,45	0,59	0,62	0,47	0,61	0,68	0,63	0,41	0,78	0,57	0,72	0,62	0,50		0,53
Norway	0,65	0,69	0,44	0,78	0,61	0,66	0,74	0,56	0,64	0,74	0,54	0,57	0,65	0,47	0,71	0,54	0,48	0,68	

The values above the diagonal are correlations for the time period 1988 to 1998 and the values below the diagonal are correlations for the time period 1999 to 2006.