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Abstract

The introduction of the euro as the official currency of the European monetary union on January 1, 1999 demonstrated the results of a long legal and political process to establish a European Union (EU) currency. This paper explores whether the relationship between European, United Kingdom, and United States equity markets have been altered by the introduction of the euro and specifically, whether this development has isolated the United Kingdom equity markets from those of Europe. Using monthly observations from 1994 – 2003 on equity index data for the Netherlands, Austria, Belgium, Denmark, France, Germany, Italy, Spain, United Kingdom, and the United States we find that there has been an increase in the correlation coefficient of major European countries and the United States and the United Kingdom. Moreover, the volatility of the major equity markets has also increased over the last five-year period, while three of the five smaller markets have declined.

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I. INTRODUCTION

Much has been written about the introduction of the euro and the impact that the unified European currency would have on the capital markets in Europe. The original impetus for the one currency concept was first proposed by Robert Mundell in the 1960's, and he coined the term "europa" to describe a single currency for Europe. The first significant structured movement towards a unified currency began with the signing of the Maastricht Treaty in 1991. The adopting countries negotiated amongst themselves for eight years establishing and meeting guidelines on inflation, interest rates, and government deficits. The euro officially fixed the currencies of eleven European countries on January 1, 1999.[1] The official implementation of the euro allows for the opportunity to investigate how proposed changes in international law impacts regional economic activity. Some have anticipated that the implementation of the euro would achieve a convergence of the member countries' economies and capital markets, and consequently lead to the isolation of the United Kingdom.

This paper contributes to the academic literature by exploring this convergence by estimating the correlation coefficient and volatility of the equity markets of the member nations before and after the introduction of the euro. These results are then contrasted with the United Kingdom and the United States for the same time periods. Mundell (2003) discusses the benefits of the European Monetary Union (EMU) for the member countries. He argues that it has resulted in a better monetary policy for the countries involved, a reduction in transaction costs, a unified capital market, and global recognition of a dominant currency to rival the dollar and the yen. Others have argued that the single currency will also remove the need to hedge currency risk within the EMU.

The empirical results in this paper provide interesting observations about the international equity markets, the impact of the euro, and the general interrelationships between exchange rates and equity markets. The results suggest that the United Kingdom and the United States have not become more isolated since the introduction of the euro. In addition, there has been a general increase in volatility of the major European equity markets and a decline in volatility of the smaller equity markets of Europe. The paper proceeds as follows. Section II is a review of the academic literature followed by Section III, which discusses the data collection process. Section IV discusses the

[1] Germany, France, Italy, Netherlands, Spain, Ireland, Belgium, Luxembourg, Austria, Portugal, and Finland were the original 11 adopting members, with the U.K., Denmark, and Sweden choosing not to adopt. Denmark is included in the study to provide additional data on the smaller equity markets of the EU.

empirical results followed by the conclusion and discussion of future research issues.

II. REVIEW OF THE LITERATURE

Previous literature has explored the issue of convergence, although not directly related to equity markets and the introduction of the euro. Eun and Resnick (1984) were one of the first authors to perform an in depth study on the correlation structure of international equity markets. The authors test twelve different models to determine which should be used to estimate the international correlation matrix. Barrios, Brulhart, Elliott, and Sensier (2003) analyzed correlations of eleven U.K. regions and six euro area countries over the 1966 to 1997 time period. The authors found that there was a divergence of the relationship between the U.K. regions and the euro area countries. Duarte (2003) addresses the issue of inflation divergence of the eleven countries before and after the introduction of the euro. The author finds that in the aggregate there has been an increase in the inflation differentials in these countries since the introduction of the euro. In addition, the author also found an increase in the dispersion of these differentials. The author raises the issue of the suitability of a one currency economy in an area were the countries are so heterogeneous. Freimann (1998) notes that there has been a substantial increase in the co-movement of European equity markets over the past twenty years. The author goes on to state that the implementation of the European Monetary Union should continue to move these markets in a similar fashion because of the similarity in interest rates and inflation rates.

Vaziri (2003) measures the correlation coefficients between seven Euro-Asian equity markets and the S&P 500 to determine if risk reduction would be possible by investing in these emerging markets. The author concludes that there is a risk-return tradeoff present with higher equity returns that also subject the investor to greater exchange rate fluctuations. Marmer (2003) has found that there has been a significant increase in the correlation coefficient of Canada and other international equity markets. The correlation coefficient has increased from .34 in 1990 to .70 in 2002. Marmer (2003) contends that part of the increase in correlation can be attributed to the overall international bear market that has existed recently. Bunyaratavej and Hahn (2003) use a convergence modeling approach to assess whether the Southeast Asian area would be a good candidate for a single currency similar to the euro. The authors conclude that the Southeast Asian area may not be very well suited for a single currency because of the diverse level of economic development in the region.

Lizieri, McAllister, and Ward (2003) investigate whether there has been a convergence of the European real estate equity markets after the European monetary integration. The authors use 1997 as the date for monetary integration because they argue by then there was a noticeable reduction in the inflation and long-term interest rate differentials of the EU countries. Lizieri, McAllister, and Ward (2003) find that there has been a much greater integration

in the equity markets than the real estate markets due to the unique characteristics of the latter. Ang and Bekaert (2002) observe that correlation coefficient of international equity markets tend to increase during volatile bear markets. The authors investigate whether the benefits of international diversification are as significant as anticipated if there is a convergence of correlations. Ang and Bekaert (2002) do find benefits of international diversification regardless of the market activity. Rouwenhourst (1999) argues that there has been low correlation coefficient between certain international equity markets because of country effects caused by specific shocks to certain countries. The author goes on to note that as of 1999 there was no evidence that there has been a convergence of equity markets in the EMU.

III. DATA COLLECTION

This paper examines the volatility and correlation of total returns of equity markets of member countries of the EMU with the United Kingdom and the United States before and after the introduction of the euro. Using financial data obtained from StockVal, Yahoo!Finance, and the CRSP databases, we obtained equity index data for the Netherlands, Austria, Belgium, Denmark, France, Germany, Italy, Spain, United Kingdom, and the United States. The data set was incomplete for the other indices of countries that are members of the EMU. The specific indexes are provided in Table 1. Taking the natural logs of the indices, we constructed rates of return for the various indexes from January 1994 to December 2003.[2] The equity data set consists of 60 monthly observations before and 60 after the introduction of the euro. The data for the Spanish equity market used the first Friday of each month as opposed to the first trading day due to limits on the availability of the data. The Spanish market also has four fewer observations in the pre-euro era. The data for the pound sterling, dollar, and euro were obtained from StockVal and x-rates.com.

IV. EMPIRICAL ANALYSIS

Table 1 provides the indices that were constructed along with the market capitalization values of each country's equity markets expressed in dollars. It is readily apparent from the table that there is a significant difference in the capitalization values for the countries. The United States equity markets dwarfs the other major exchanges. The U.K., France, and Germany, are also considerably larger than the other equity markets. The table also outlines the indices that were used as proxies for the various countries. Table II provides the monthly mean and standard deviations for the indexes before and after the implementation of the euro in January, 1999. To test the validity of the data set, the natural logs from the United States index was correlated with total return data from the CRSP database. A correlation coefficient of .99 was generated.

[2] Specifically, we constructed the data set by estimating the natural log of the monthly index divided by the previous month.

The mean returns for the major indices were considerably higher during the 1994 – 1998 time periods. All of the indexes in the study experienced positive returns with Spain, Germany and the United States having the highest arithmetic annual returns of 22.80%, 19.12% and 19.07% respectively. This reflects the strong equity returns that were being experienced globally during the mid and late 1990's. The five major indices of the U.S., U.K., Germany, France, and Italy experienced negative returns during the 1999-2003 time period.[3] The results do illustrate that the equity markets have started to rebound with significant positive returns for the past twelve months for all of the indices. Four of the five major indexes have also shown an increase in the standard deviation of returns after the introduction of the euro. Italy was the only major country that did not experience an increase in the volatility of its returns. Correspondingly, three of the five smaller indices in the study experienced a decline in their standard deviation after the introduction of the euro.

Table III and Table IV report the correlation coefficients of the equity markets during the 1994-1998 and 1999-2003 time period respectively. The results suggest that there has been an overall increase in the correlation coefficients of the major equity markets. In particular, the United Kingdom has experienced an increase in correlation with every other equity market with the exception of Austria and Spain. These results are consistent with previous literature that has found a general convergence of equity markets due to globalization. The correlation coefficient of the U.K. with the other four major equity markets increased from .65 in the 1994-1998 period to .80 in the 1999-2003 time period. Surprisingly, we found that there was a divergence with smaller equity markets such as Austria's. The results suggest that the introduction of the euro has not led to a divergence of capital markets between the United Kingdom, United States and the major capital markets of the euro area. Part of this increase in correlation can also be attributed to the fact, as noted by Ang and Bekaert (2002), that there is a tendency to have an increase in correlation during volatile bear markets.

The discussion of the European equity markets would not be complete without a discussion about relative exchange rates. Previous research has discussed the home bias effect; that is the propensity of investors to invest in their own domestic markets. This phenomenon has the advantage of mitigating an investor's exchange rate exposure, but also limits the benefits of diversification and exposure to potentially higher yielding equity markets. There has been an overall appreciation of the pound sterling and the euro to the dollar with present exchange rates at a ten year high for the euro and the pound sterling. The dollar is presently trading at $1.84 per pound sterling and $1.24 per euro. It is also interesting to note that the pound sterling has appreciated in relation to the euro over the past few years. Finally, although not reported in the paper, there has been an overall decrease in the volatility of the euro / pound

[3] The returns for the Netherlands, Spain, and Belgium were also negative over the 1999-1993 time period with Austria and Denmark actually experiencing positive returns over the entire time period.

sterling exchange rate over the past four years. [4] Additional research is necessary to assess whether there has been a structural change in the relationship between exchanges rates and international equity markets after the introduction of the euro.

V. CONCLUSION

This paper has explored the relationship between the U.K., U.S., and European equity markets to determine if there has been a divergence or convergence after the introduction of the euro on January 1, 1999. The major equity markets of Europe have experienced an increase in correlation with the U.K. and U.S. equity markets after the introduction of the euro. The empirical results also suggest that there has been an overall increase in the volatility of the major equity markets in the study. There is no evidence that suggests that the U.K. has become more isolated since the introduction of the euro. The smaller equity markets of Austria and Denmark have actually outperformed the major indexes in the post euro era. In addition, there has not been the same level of increase in the correlation coefficient of the smaller equity markets. Three of the five smaller equity markets in the study has also experienced a decline in volatility after the introduction of the euro. The results suggest that the relationship between the U.K. and the major equity markets of Europe is stronger than that between the larger and smaller equity markets of the euro area.

The results also show that there has been an overall appreciation of the pound sterling and euro in relation to the dollar over the past ten years. The pound sterling has also appreciated in relation to the euro over the past few years. Additional research needs to be conducted on the interrelationship of the currency fluctuations and their impact on the performance of equity markets. In addition, as the international equity markets start to recover, it will be necessary to determine whether the tendency towards higher correlation coefficients with the major equity markets will continue in the future.

[4] The euro/pound sterling exchange rate was constructed prior to January 1999 by multiplying the fixed conversion rate by the individual currency values during the 1994 – 1998 time period.

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Table 1. Countries, Equity Indices, Market Capitalization, and Composition

Country	Index	Market Capitalization	Composition
U.S.	S & P 500	$15,104,037,000	500 companies
U.K.	FTSE 100	$ 2,576,992,000	103 companies
FRANCE	CAC 40	$ 1,446,634,000	41 companies
GERMANY	XETRA DAX PF	$ 1,270,243,000	30 companies
ITALY	MIBTEL	$ 768,364,000	267 companies
NETHER	AEX	$ 640,456,000	25 companies
SPAIN	MADRID GENERAL	$ 504,219,000	106 companies
BELGIUM	BELGIAN 20	$ 182,481,000	20 companies
DENMARK	TOP 20	$ 107,666,000	20 companies
AUSTRIA	INDEX VIENNA	$ 29,935,000	20 companies

Table 2. Mean Monthly Returns and Standard Deviations 1994-2003

Country	Return 1994-1998	Standard Deviation	Return 1999-2003	Standard Deviation	Return 2003
U.S.	.016	.039	-.002	.049	.019
U.K.	.011	.038	-.005	.046	.008
FRANCE	.011	.059	-.003	.064	.013
GERMANY	.016	.058	-.004	.086	.026
ITALY	.018	.073	-.002	.061	.012
NETHER	.007	.115	-.007	.071	.007
SPAIN	.019	.074	-.005	.063	.015
BELGIUM	.014	.044	-.006	.054	.013
DENMARK	.013	.049	.003	.059	.021
AUSTRIA	.002	.06	.008	.046	.031

Table 3. Correlation Matrix 1994-1998

	US	UK	FRA	GER	ITA	NET	SPA	BEL	DEN	AUS
U.S.	1									
U.K.	.667	1								
FRA	.558	.728	1							
GER	.606	.696	.762	1						
ITA	.429	.518	.682	.626	1					
NET	.228	.371	.265	.365	.311	1				
SPA	.480	.581	.602	.480	.538	.283	1			
BEL	.601	.655	.796	.770	.640	.494	.529	1		
DEN	.478	.612	.685	.695	.653	.371	.5556	.689	1	
AUS	.534	.71	.648	.763	.525	.455	.505	.717	.704	1

Table 4. Correlation Matrix 1999-2003

	US	UK	FRA	GER	ITA	NET	SP	BEL	DEN	AUS
U.S.	1									
U.K.	.857	1								
FRA	.835	.829	1							
GER	.819	.804	.947	1						
ITA	.639	.709	.846	.820	1					
NET	.789	.840	.931	.926	.813	1				
SPA	.588	.566	.658	.658	.580	.619	1			
BEL	.628	.715	.710	.707	.552	.798	.390	1		
DEN	.740	.660	.748	.755	.585	.729	.583	.589	1	
AUS	.484	.543	.424	.500	.359	.526	.404	.594	.366	1