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Journal of International Money and Finance 26 (2007) 305−327
Journal of International Money and Finance
www.elsevier.com/locate/jimf

The impact of EMU on the equity cost of capital

Gikas A. Hardouvelis [a,b], Dimitrios Malliaropulos [a,c], Richard Priestley [d,*]

[a] *Department of Banking and Financial Management of the University of Piraeus, Greece*
[b] *Eurobank EFG Economic Research*
[c] *National Bank of Greece, Greece*
[d] *Department of Financial Economics, Norwegian School of Management, Nydalsveien 37, N-0442 Oslo, Norway*

Abstract

This paper shows that during the 1990s the process of gradual economic and monetary integration, which eventually led to EMU, also resulted in a reduction in the equity cost of capital. A similar reduction was not present in the three EU countries which chose not to enter the Eurozone. There was also a strong convergence in the cost of equity across the different countries within a given industrial sector, but little convergence across the different sectors of a given EMU country. An implication for portfolio management is that country effects are becoming less important and sectoral effects are becoming more important.

JEL classification: G12; G15; G11

Keywords: Asset allocation; Convergence; Cost of equity; EMU; Industrial Sectors; Integration

1. Introduction

The paper studies the impact of Economic and Monetary Union (EMU) on the equity cost of capital using a set of stock price data on European Union (EU) industrial sectors. The creation of the Eurozone was preceded by a gradual regulatory harmonization among European stock

* Corresponding author. Tel.: +47 464 105 15; fax: +47 464 108 01.
E-mail addresses: hardouvelis@ath.forthnet.gr (G.A. Hardouvelis), dmaliar@nbg.gr (D. Malliaropulos), richard.priestley@bi.no (R. Priestley).

doi:10.1016/j.jimonfin.2006.12.002

markets and the abolition of various ownership restrictions on non-residents. In addition, the intense efforts to satisfy the Maastricht criteria for EMU-entry led to convergence in nominal interest rates and inflation rates and to better-balanced fiscal budgets among EMU countries. Finally, the launch of the single currency eliminated intra-European currency risk and nullified legal barriers on the foreign currency composition of institutional investors like pension funds and life insurance companies, leading to higher risk sharing among European investors.[1]

The convergence of European economies towards EMU and the adoption of the euro as the common currency in the Eurozone provides the setup for a natural experiment in order to measure how the gradual economic and monetary integration among EMU countries affected the equity cost of capital. One expects that economic and monetary integration should have led to higher integration of European stock markets during the 1990s, higher risk sharing among European investors, and, as a result, a lower equity cost of capital for European companies.

Our analysis concentrates on the behavior of industrial sectors across the different EMU countries. We explore the effects of integration across the different sectors and the different countries. While previous studies have examined the effect of EMU on the integration of European stock markets at the aggregate country level,[2] there is no reason to presume that all sectors in a given country would benefit from higher stock market integration just because the country does. For example, non-tradable or semi-tradable sectors like Resources and Utilities are likely to be affected differently than industries, which are already internationalized, such as Information Technology (IT), Consumer Goods or Financials. If EMU were important, we ought to observe a different impact on different sectors.

By examining sectoral data, we are also able to assess whether EMU led to a convergence in the cost of equity within a given sector across EU countries, or across the different sectors within a given country. This issue has important investment implications with respect to whether optimal asset allocation should take place across countries or across sectors.

It is interesting to note that three EU countries, Denmark, Sweden and the UK, chose at the present stage not to enter the Eurozone. These three countries, therefore, provide a benchmark against which we can compare the results we find for the EMU countries. If the adoption of the single currency had true causal implications on the cost of capital, then those effects ought to be present primarily among the Eurozone countries and not the three countries that stayed outside the Eurozone.

We use a conditional asset pricing model with a time-varying degree of stock market integration, which captures the evolving importance of EU-wide market risk relative to country-specific risk. Black (1974), Stehle (1977), Stulz (1981), Errunza and Losq (1985), Merton (1987) and Cooper and Kaplanis (2000), among others, propose asset pricing models of partially integrated markets. Using the framework of partial integration, we allow integration to change over time as a function of a set of instrumental variables that are chosen to capture the evolving convergence of European countries towards EMU. Our empirical model is based on a version of a time-varying integration model first suggested by Bekaert and Harvey (1995,

[1] Throughout the paper we use the terms "EMU" and "Eurozone" interchangeably to mean the set of countries which adopted the euro as their common currency. However, in the legal language of the European Union the two terms differ. Eurozone is the set of countries that have adopted the euro, but technically, EMU also includes the remaining EU countries outside the Eurozone (Denmark, Sweden, United Kingdom). These countries are legally presumed not to have entered the last stage of the EMU process.

[2] See, e.g., Hardouvelis et al. (2006).

1997) to measure integration of emerging stock markets and, subsequently, used by Hardouvelis et al. (2006) to measure the integration of EU stock markets.

The empirical results suggest that the process towards EMU has reduced the cost of equity capital in nearly all sectors of the economy and in all countries we study, except perhaps Germany. We find that the average saving in the cost of equity for countries that signed up to the single currency is larger than for countries that did not sign up. It follows that EMU had causal beneficial implications for the cost of raising equity capital by firms.

We also find that as integration increases and returns become increasingly determined by pan-European risk factors, there is a convergence in the cost of equity within a given sector across the different countries. This finding is important, given the growth in cross-border mergers and acquisitions, as well as in portfolio investments. On the other hand, convergence in the equity cost of capital across different sectors within a given country is much less pronounced. The cost of capital in the different sectors continues to reflect differences in global sector betas. These two results have potentially far-reaching implications for portfolio management. Differences between sectors seem to remain, while differences between countries seem to be disappearing.

The rest of the paper is organized as follows: Section 2 describes in more detail the channels through which economic and monetary integration in Europe can affect the cost of equity and provides some statistics on cross-border equity flows related to EMU. Section 3 presents the empirical model. Section 4 describes the data. Section 5 presents the results, while Section 6 provides some robustness tests. Section 7 concludes.

2. European stock market integration and the equity cost of capital

We can identify four possible channels through which EMU could affect the level of European stock market integration, and, as a result, the cost of capital. First, the integration of European stock markets increased due to the gradual direct abolition of barriers to intra-EU investments (Licht, 1998), as well as the indirect abolition of barriers that originated from the launch of the common currency itself. The common currency nullified various legal restrictions within the EU on the foreign currency composition of assets held by institutional investors like pension funds and life insurance companies, whose portfolios were subject to currency matching rules between liabilities and assets.[3] The abolition of these restrictions led to a broadening of investment opportunities across EMU countries, implying increased integration of European stock markets even before the launch of the euro.

The second channel is monetary policy coordination among EMU member countries which has led to so-called "nominal convergence," that is, a gradual convergence of inflation rates and long-term interest rates towards German levels and, hence, to a more homogenous valuation of equities across EMU countries. The third channel is a common monetary policy together with a similar long-run fiscal policy, which, according to the Maastricht criteria and the Stability and Growth Pact, aims at keeping each government's budget approximately in balance, may have led to a "real convergence" of European economies. That is, an increased synchronization in business cycles and higher cross-country correlations in expected real corporate earnings. Finally, the introduction of the single currency eliminated intra-EMU currency risk and, to the extent that currency risk was priced, it reduced the overall exchange rate exposure of

[3] See Danthine et al. (2000) for a description of existing regulations in individual EU countries before the launch of the euro.

EMU country stocks. This last factor, coupled with nominal and real convergence outlined above, should have also contributed to a more homogeneous valuation of equities in EMU countries even before January 1999, the date when euro was launched, as the volatility of intra-EMU exchange rates declined as the date of the euro inauguration was approaching.

In general, the impact of EMU on the pricing of stocks should have been felt even before the introduction of the common currency, since European economic and monetary integration was effectively a gradual process rather than a one-off event. After all, the launch of the euro did not come as a surprise, but was to some extent anticipated, at least since February 1992, when the Maastricht Treaty was signed. For example, the expectation of the future elimination of currency-related barriers on asset allocation ought to have affected required returns and the cost of equity capital prior to 1999. This effect should be stronger the higher the probability of the euro occurring and the closer the time span until the launch of the euro. It follows that a model of partial stock market integration that purports to explain the European experience of the 1990s ought to incorporate features associated with the likelihood and the time of EMU occurring.

Before describing the model, it is an eye-opening exercise to examine some statistics on the behavior of investors during the decade of the 1990s. Indeed, from the figures on the cross-border equity flows and portfolio holdings of EU investors, it is apparent that there was increased risk sharing in EMU countries during the 1990s. By mid-1998, cross-border equity flows in the EU had nearly tripled relative to the early 1990s and had reached a level of around $120–140 billion. Estimates of the total rebalancing of equity portfolios from domestic to pan-European portfolios are in the region of $1.5 trillion (more than one-third of market capitalization, Euromoney, August 1998). Two client surveys shortly before the launch of the euro[4] found that over one-quarter of fund managers had already implemented some change in their equity portfolios, over 50% were already well ahead in their preparations for EMU, and three-quarters indicated that they would be reconsidering their asset allocation as a direct result of EMU. Danthine et al. (2000) report increased holdings of foreign assets by domestic residents within the EU.

More formal evidence of the impact of EMU on portfolio holdings is reported in Table 1, which shows foreign equity holdings of pension funds and life insurance companies as a percentage of total equity holdings. The data are from Intersec Research. Foreign equity holdings of pension funds in EMU countries increased from 29% of total equity holdings in 1992 to more than 50% in 1999. In sharp contrast, over the same period, foreign equity holdings of pension funds in non-EMU countries remained unchanged at around 20%. Note that the foreign equity holdings of both pension funds and life insurance companies in the UK and Sweden, two EU members which are not members of the Eurozone, did not follow the same patterns as those of EMU members. In Sweden, the share of foreign equity actually fell.

The portfolio reallocation towards foreign equity in the EMU countries is even stronger for life insurance companies. Life insurance companies in EMU countries increased their foreign equity holdings from 11% of total equity holdings in 1992 to 30% in 1999. In contrast, foreign equity holdings of life insurance companies in non-EMU countries increased only slightly from 24% in 1992 to 27% in 1999. These statistics suggest that risk sharing increased among EMU investors a lot more than investors from countries outside the Eurozone.

[4] Dresdner Kleinwort Benson (March/April 1998) and Goldman Sachs and Watson Wyatt (March 1998).

Table 1
Foreign equity holdings as a percent of total equity holdings

	Pension funds		Life insurance companies	
	1992	1999	1992	1999
EMU countries				
Austria	–	38.9	6.5	25.0
Belgium	50.0	80.8	7.1	58.8
France	14.3	37.3	7.9	19.4
Germany	18.3	31.7	5.2	34.7
Ireland	56.5	69.2	0.0	48.5
Italy	0.0	10.9	33.0	12.8
Netherlands	56.3	76.0	23.3	31.3
Spain	6.3	59.4	3.3	9.0
Average EMU	28.8	50.5	10.8	29.9
Non-EMU countries				
Australia	26.2	25.5	30.1	21.6
Canada	29.1	24.1	38.4	39.3
Japan	22.9	35.4	10.0	26.7
Sweden	12.5	11.1	37.0	36.0
UK	28.1	32.4	17.5	29.0
US	7.8	15.9	2.9	3.2
Average non-EMU	19.4	20.9	24.0	26.9

The data source is Intersec Research Corp. Both private and public pension funds are included.

3. The empirical model

We consider a European country whose equity market consists of n sectors. In order to abstract from the effect of risk-free interest rate convergence on the cost of equity, we assume that investors have unlimited access to a single risk-free asset across the EU, through which they can finance equity purchases. However, due to the existence of barriers to international investment, investors are restricted from holding the EU market portfolio. As a result, the home equity market is partially integrated into the EU market. We therefore model the expected excess return on a domestic sector as a weighted average of the premium for its covariance with the EU market excess return (market risk) and the premium for its covariance with the local market excess return (local risk).[5] For country i, the vector of expected excess returns of the n sectors can be written as

$$\mathbf{r}_{i,t} = \phi_{i,t-1}\left(\boldsymbol{\beta}_i^{\mathrm{EU}} r_t^{\mathrm{EU}}\right) + \left(1-\phi_{i,t-1}\right)\left(\boldsymbol{\beta}_i^{\mathrm{L}} r_t^{\mathrm{L}}\right) + \mathbf{e}_{i,t}, \tag{1}$$

where $\mathbf{r}_{i,t} = (r_{i1,t},\ldots,r_{in,t})'$ is the $n \times 1$ vector of sector excess returns in country i (expressed in a common currency) over a common EU risk-free rate, $\boldsymbol{\beta}_i^{\mathrm{EU}}$ is an $n \times 1$ vector of sector betas with respect to the EU market excess return over the EU risk-free rate, denoted by r_t^{EU}, $\boldsymbol{\beta}_i^{\mathrm{L}}$ is an $n \times 1$ vector of sector betas with respect to the country i market excess return over the EU

[5] The model assumes that the global market portfolio is a market value-weighted average of the single currency members. Of course this rules out influences on returns from the rest of the world. Hardouvelis et al. (2006) find that this measure of integration is invariant to world market influences.

risk-free rate, denoted by r_t^{L}, $\phi_{i,t-1}$ is the degree of integration of country i into the EU market, conditional on information up to time $t-1$ and $\mathbf{e}_{i,t}$ is a vector of sector residuals.

Eq. (1) can be viewed as an approximation of expected returns in partially integrated markets, in which both global and local risk factors are priced and the degree of integration is evolving over time. This empirical model of partial integration was first developed in a regime switching context by Bekaert and Harvey (1995) to examine equity risk premia in emerging markets. Hardouvelis et al. (2006) use a version of Eq. (1), which also allows for time-varying prices and quantities of risk in order to measure the evolution of integration of EU stock markets during the 1990s. In the present sectoral model, the number of equations to be estimated is a multiple of the number of sectors. Thus, in the interest of keeping the estimation simple and stable, we treat the beta coefficients as constant and allow only the degree of integration to vary over time. Later on, we do present tests of structural stability, which fail to reject the constancy of betas in most of the cases.

Note that by computing excess returns over a common EU risk-free rate rather than over the local risk-free rate, the left-hand side of Eq. (1) does not include the effect of risk-free interest rate convergence on the cost of capital. We choose this method of measuring equity risk premia because we are interested in the cost of capital of a project for a pan-European investor. For this type of investor, interest rate convergence did not affect the cost of capital since she had access to the lowest funding costs even prior to EMU. Hence, if there were a saving in the cost of capital for this type of investor, the saving was related to a decline in the equity premium and/or a decline in the common EU risk-free rate, but it was not related to the convergence of real risk-free rates.[6]

Finally, in order to keep our model simple, Eq. (1) does not explicitly incorporate a separate currency risk component.[7] Currency risk is implicitly incorporated in the EU-wide risk premium, $\phi_{i,t-1}(\boldsymbol{\beta}_i^{\mathrm{EU}} r_t^{\mathrm{EU}})$. Since we account for a time-varying degree of integration, $\phi_{i,t-1}$, the effect of the elimination of intra-European currency risk on required returns prior to January 1999, is being captured by a stronger increase in stock market integration. In fact, as explained below, one of the variables we condition the degree of integration is intra-European currency volatility.

The time-varying parameter $\phi_{i,t-1}$ is conditioned on a set of variables that are intended to measure the degree of integration:

$$\phi_{i,t-1} = \exp(-|\boldsymbol{\gamma}_i' \mathbf{X}_{i,t-1}^{I}|) \tag{2}$$

where $\exp(\cdot)$ denotes exponentiation, $|\cdot|$ denotes absolute value, $\boldsymbol{\gamma}_i$ is a vector of country-specific parameters (including a constant) and $\mathbf{X}_{i,t-1}^{I}$ is a vector of country-specific predetermined information variables related to convergence towards EMU. Observe that by

[6] Our empirical estimates quantify only the effect of EMU on the equity risk premium. To the extent that EMU also led to a decrease in the common real risk-free rate, this effect has led to an additional decrease in the cost of capital, so that our estimates under-report the beneficial effects of EMU on the cost of capital. Note that it is hard to estimate the effect of EMU on the real risk-free rate primarily because it is hard to distinguish it from, say, a temporary drop originating from the European business cycle, rather than the prospect of EMU. Moreover, although both European interest rates and inflation rates converged towards the German levels in the run-up to EMU, there is no a priori reason to assume that nominal convergence led to a decrease in the common real risk-free rate as well.

[7] In a more general model, Hardouvelis et al. (2006) estimate the effect of intra-European currency risk on expected excess returns. They find that, prior to the launch of the euro, intra-European currency risk contributed, on average, about one-quarter of the equity risk premium across EU countries.

construction, $\phi_{i,t-1}$ takes a value between zero and unity. By taking the absolute value of $\gamma_i'\mathbf{X}^I_{i,t-1}$, we assume that deviations of the information variables from zero, independently of their sign, reduce the degree of integration.

Note that the specification of the parameter of the degree of integration in Eq. (2) differs from that in Bekaert and Harvey (1997), who model the degree of integration as a logistic function. This is because, in our context, the integration parameter is conditioned on a set of interest rate, inflation and growth rate differentials as well as intra-European currency volatility, which tend to zero as the probability of joining EMU increases, whereas Bekaert and Harvey condition on a set of non-zero mean level variables, like dividend yields and market capitalization-to-GDP ratios. As a result, our integration parameter has the form of a bell-shaped probability density function, whereas in Bekaert and Harvey, it has the form of a cumulative probability density function.

4. Data

4.1. Returns

Of the 11 countries which joined the single currency on January 1, 1999, we have sectoral data for Belgium, France, Germany, Italy, Netherlands and Spain.[8] Data on the following ten major industrial sectors are collected: Resources, Basic Industries, General Industrial, Utilities, Information Technology, Financials, Cyclical Consumer Goods, Non-Cyclical Consumer Goods, Cyclical Services and Non-Cyclical Services. We use weekly, euro-denominated, total, continuously compounded stock returns based on Friday closing prices. A value-weighted index of the 11 EMU countries is used to proxy the EU market portfolio. We calculate excess returns as national returns in euros minus the German one-month eurocurrency interest rate, which is transformed to reflect the return over a weekly horizon. The data source is Datastream International. The sample period for the analysis is 01:02:1992–26:6:1998. The selection of both the countries and the sample period is dictated by the availability of interest rate swaps, which are used to calculate forward interest rate differentials.[9]

Table 2 presents summary statistics on the euro-denominated excess returns of the individual sectors in the EU countries. The excess returns display some interesting properties. For example, there is considerable cross-sectional variation in both mean excess returns and volatilities. Average volatility is highest in the IT and Cyclical Consumer Goods sectors and lowest in the Cyclical Services and the Utilities sectors. There is no observable pattern between mean excess returns and volatilities across sectors. For example, the Information Technology sector has the highest excess returns while the Cyclical Consumer Goods sector has the second smallest excess return, both being sectors with high return volatility.

Table 2 also reports correlation coefficients between the excess returns in each sector and those of the local and EU market portfolios. These reveal that in all but two cases (Germany: Resources, France: Utilities), the correlation coefficient with the local market index is higher than with the EU index. The highest average correlations with the local market index are in the Financial, Basic Industries, General Industrial and Cyclical Services sectors. The highest

[8] The 11 members of the single currency are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. Greece became the 12th member of EMU two years later, on January 1, 2001.

[9] The following sectoral data were not available over the sample period for a sufficient period of time: Utilities in the Netherlands, Information Technology in Spain, and Cyclical Consumer Goods in Belgium.

Table 2
Summary statistics on excess returns

	BE	FR	GE	IT	NL	SP	Average
Resources							
r	0.041	0.228	0.019	0.319	0.295	0.248	0.191
σ	2.620	3.441	2.534	4.391	2.386	2.719	3.015
ρ_L	0.442	0.449	0.023	0.371	0.418	0.467	0.361
ρ_{EU}	0.193	0.420	0.039	0.212	0.361	0.371	0.266
$\rho_L - \rho_{EU}$	0.249	0.029	−0.016	0.159	0.057	0.096	0.095
Basic							
r	0.175	0.166	0.201	−0.058	0.221	0.185	0.148
σ	2.142	2.297	2.178	3.664	2.384	2.853	2.586
ρ_L	0.522	0.543	0.417	0.496	0.310	0.472	0.460
ρ_{EU}	0.314	0.488	0.370	0.337	0.273	0.386	0.361
$\rho_L - \rho_{EU}$	0.208	0.055	0.047	0.159	0.037	0.086	0.099
General Industrials							
r	0.308	0.184	0.138	−0.089	0.364	0.286	0.199
σ	2.081	2.556	2.012	3.730	3.706	2.506	2.765
ρ_L	0.484	0.559	0.495	0.528	0.231	0.440	0.456
ρ_{EU}	0.304	0.515	0.419	0.384	0.198	0.347	0.361
$\rho_L - \rho_{EU}$	0.180	0.044	0.076	0.144	0.033	0.093	0.095
Utilities							
r	0.259	0.272	0.169	0.253		0.343	0.259
σ	1.734	3.437	1.236	3.616		2.678	2.540
ρ_L	0.436	0.228	0.157	0.528		0.594	0.389
ρ_{EU}	0.210	0.229	0.141	0.385		0.465	0.286
$\rho_L - \rho_{EU}$	0.226	−0.001	0.016	0.143		0.129	0.103
Information Technology							
r	0.792	0.227	0.971	−0.073	0.395		0.462
σ	5.504	3.271	4.786	3.889	4.192		4.328
ρ_L	0.071	0.472	0.168	0.376	0.267		0.271
ρ_{EU}	0.047	0.481	0.147	0.233	0.234		0.228
$\rho_L - \rho_{EU}$	0.024	−0.009	0.021	0.143	0.033		0.043
Financials							
r	0.315	0.189	0.198	0.165	0.370	0.356	0.266
σ	1.714	2.505	2.219	2.994	1.939	2.550	2.320
ρ_L	0.522	0.503	0.375	0.587	0.456	0.533	0.496
ρ_{EU}	0.341	0.432	0.262	0.383	0.385	0.419	0.370
$\rho_L - \rho_{EU}$	0.149	0.016	0.077	0.199	0.045	0.094	0.126
Cyclical Consumer Goods							
r		0.196	0.280	0.233	0.191	−0.018	0.176
σ		2.460	2.515	3.489	3.364	5.709	3.507
ρ_L		0.499	0.397	0.552	0.174	0.113	0.347
ρ_{EU}		0.449	0.371	0.361	0.151	0.089	0.284
$\rho_L - \rho_{EU}$		0.050	0.026	0.191	0.023	0.024	0.063
Non-Cyclical Consumer Goods							
r	0.442	0.221	0.146	0.230	0.291	0.217	0.258
σ	2.586	2.323	1.727	3.489	1.760	2.769	2.442
ρ_L	0.397	0.586	0.377	0.429	0.335	0.467	0.432
ρ_{EU}	0.321	0.531	0.326	0.291	0.292	0.322	0.347
$\rho_L - \rho_{EU}$	0.076	0.055	0.051	0.138	0.043	0.145	0.085

Table 2 (*continued*)

	BE	FR	GE	IT	NL	SP	Average
Cyclical Services							
r	0.243	0.135	0.131	0.087	0.299	0.338	0.206
σ	2.056	1.949	2.284	2.660	1.760	2.475	2.197
ρ_L	0.472	0.515	0.382	0.468	0.432	0.552	0.470
ρ_{EU}	0.329	0.465	0.340	0.360	0.386	0.401	0.380
$\rho_L - \rho_{EU}$	0.143	0.050	0.042	0.108	0.046	0.151	0.090
Non-Cyclical Services							
r	0.056	0.463	0.281	0.452	0.289	0.419	0.327
σ	3.015	2.710	2.848	4.219	2.453	3.141	3.064
ρ_L	0.463	0.409	0.412	0.507	0.309	0.500	0.433
ρ_{EU}	0.282	0.389	0.363	0.394	0.309	0.364	0.350
$\rho_L - \rho_{EU}$	0.181	0.020	0.049	0.113	0.000	0.136	0.083

The weekly excess returns are measured as national returns in euros minus the one-month euro interest rate, which is transformed to reflect the return over a weekly horizon. Columns refer to countries as follows: BE: Belgium, FR: France, GE: Germany, IT: Italy, NL: Netherlands, SP: Spain. All statistics are reported separately for each sector. The first row reports the mean excess return, r. The second row reports the standard deviation of the excess return, σ. The third row reports correlation coefficient, ρ_L, of excess returns between the sector and its local market index. The fourth row reports the correlation coefficient, ρ_{EU}, of excess returns between the sector and the EU-11 market index. The fifth row reports the difference between the two correlation coefficients, $\rho_L - \rho_{EU}$. The final column of the table reports the average for the sector across all countries. The local market excess returns are total market excess returns. The EU-11 index is a value-weighted average of the 11 EMU countries. All data are collected from Datastream and are sampled from 01:02:92 to 26:06:98. When sector data are not available a blank is recorded in the table.

difference between the local market and the EU market correlation coefficient is in the Financial sector. The smallest difference is in the IT sector where, if Italy is ignored, the correlation coefficients are essentially the same.

4.2. Conditioning variables

We condition the time-varying degree of integration of each country on a set of country-specific instruments, which capture economic and monetary convergence towards EMU. We use forward interest rate differentials as a proxy of the probability of joining EMU. We use inflation and short-term interest rate differentials as proxies for nominal convergence, whereas industrial production growth differentials as proxies for real convergence. Finally, we use intra-European currency volatility as a proxy of currency risk. Below, we discuss these proxies in more detail. All data are from Datastream International.

For each country we calculate the eight-year forward interest rate differential relative to Germany two years ahead. During the 1990s, forward interest rate differentials were widely used by market analysts as a proxy of the probability that an EU country would eventually manage to join EMU.[10] Our choice of the particular forward rate is dictated by data availability and the desire to capture market expectations about convergence in long-term yields, one of the main Maastricht criteria for joining EMU. The eight-year rate is closest to the 10-year maturity, which is the most liquid segment of the government bond market. Forward rates of longer

[10] See, e.g., JP Morgan, "The EMU Calculator", October 1996; Goldman Sachs, "European Bond Spreads and the Probability of EMU", May 1996; Paribas, "EMU Countdown", February 1997.

maturity than eight years could not be constructed, as no swap rates existed with maturities shorter than two years.

Interest rate swap yields are used to calculate forward interest differentials. The eight-year forward rate two years from now is computed as

$$f^{8}_{i,2,t} = \left[\frac{(1+w_{i,10,t})^{10}}{(1+w_{i,2,t})^{2}}\right]^{1/8} - 1,$$

where $w_{i,10,t}$ ($w_{i,2,t}$) is the swap rate at time t in country i for an interest rate contract in which the interest payments of a variable rate government bond with 10 (2) years to maturity are exchanged against the interest payments of a fixed rate government bond with the same years to maturity and the same notional principal. Subsequently, we calculate spreads for each market vis-à-vis Germany, the anchor-country, as $s_{i,t} = \ln(1+f^{8}_{i,2,t}) - \ln(1+f^{8}_{\mathrm{GE},2,t})$. For Germany itself, we construct the spread between the German forward rate and the ECU forward rate. Finally, in order to account for the downward trend in German interest rates over the 1990s, we compute the forward interest rate spreads as fractions of the German long bond yield (FSPREAD).

Currency volatility can lead to lower stock market integration if it increases the cost of diversifying into a foreign equity market. This is because investors may avoid a foreign equity market when the costs of investing there outweigh the benefits of diversification (Stulz, 1981). We measure local currency volatility by a 52-week moving average of the standard deviation of the local currency return relative to the Deutschmark (CURVOL).

We proxy nominal convergence with inflation differentials. An important criterion of joining EMU was to have a level of inflation no higher than 2 percentage points above the average of the best three performing states in terms of inflation. For each country we calculate the inflation differential vis-à-vis the benchmark inflation rate, which is the average of the three countries with the lowest inflation in the EU. Inflation is measured as the change in the log of the consumer price index. In order to account for the downward trend in EU inflation over the 1990s, for each country we use the local inflation differential divided by the benchmark inflation rate. Weekly inflation differentials, INFD, were linearly interpolated from monthly observations.

As an additional proxy of nominal convergence we use short-term interest differentials vis-à-vis Germany. Although there was no legal requirement that short-term interest rates had to converge prior to joining EMU, a convergence of short-term interest rates towards German levels indicates that the country's monetary authority was in no pressure to follow an unusually strict policy in order to satisfy the Maastricht criteria. Short-term interest rates are one-month Eurocurrency rates. As in the construction of the previous instruments, we divide the local interest rate differential by the German short-term interest rate which produces the conditioning variable SRD.

Monetary and fiscal policy coordination may have led to increased synchronization of business cycles among EMU member countries, which in turn could have led to increased correlation of expected corporate earnings and more homogeneous valuations of European equities.[11] We proxy business-cycle convergence with the difference between a country's industrial production growth from the average industrial production growth in the EU (IPD). Average EU

[11] Artis et al. (1999) find evidence that economic integration has resulted in business-cycle convergence. Erb et al. (1994) show that cross-country return correlations and business cycles are related.

industrial production is computed as a GDP-weighted average of industrial production of the EU-11 countries. Data are monthly observations, interpolated linearly to a weekly frequency.

Table 3 reports summary statistics of the conditioning variables. Forward interest rate differentials are lower in countries that are considered to be the core EU countries (France, Belgium and the Netherlands) than in countries that were struggling to fulfil the Maastricht criteria for EMU participation (Italy and Spain). Germany has a negative mean differential with the ECU rate, reinforcing our choice of Germany as the benchmark country. Similar cross-country patterns can be observed for currency volatility, inflation and short-term interest rate differentials. The summary statistics for the business-cycle convergence indicate substantial differences across countries with the two largest economies (Germany, France) showing the lowest growth on average.

5. Empirical results

5.1. Model estimates

In order to obtain estimates for the degree of integration, $\phi_{i,t-1}$, and the betas, $\boldsymbol{\beta}_i^{\mathrm{EU}}$ and $\boldsymbol{\beta}_i^{\mathrm{L}}$, the system of Eqs. (1) and (2) is estimated for each country i by maximum likelihood. One system is estimated for each country at a time. By doing this we are able to impose the restriction that the level of integration in the country is the same across all sectors.[12] Table 4 reports the estimates of the betas, $\boldsymbol{\beta}_i^{\mathrm{EU}}$ and $\boldsymbol{\beta}_i^{\mathrm{L}}$, and of the coefficients $\boldsymbol{\gamma}_i$ of the conditioning variables of the integration parameters.

There are a number of common patterns across countries in the estimated slope coefficients $\boldsymbol{\gamma}_i$ of Eq. (2). First, in all countries the estimate of $\boldsymbol{\gamma}_1$, which relates the level of integration to the forward rate spread, is statistically significant suggesting that as the spreads converged stock market integration increased. In five of the six countries we find that the inflation differential is statistically significant indicating that as a country's inflation rate converged, integration increased. In three countries we find that a reduction in currency volatility also leads to an increase in stock market integration. In one case, Germany, we find that business-cycle convergence leads to an increase in stock market integration. We find no evidence to suggest that short-term interest rate differentials are important determinants of the degree of integration.

The betas with respect to the EU and local indices are reported for each sector, country by country. In the vast majority of cases, the local beta is greater than the EU beta. The most interesting exceptions here are the IT, Non-Cyclical Services and Non-Cyclical Goods where EU betas are bigger in half of the countries. Furthermore, the highest recorded betas are in the IT sector with respect to the EU index, probably due to the strong international nature of this sector. It is also interesting to note that EU betas of Financials are sometimes bigger than the local betas. The betas in this sector are in sharp contrast to the Resources, Basic Industries and General Industrial sectors, where in most cases the local betas are larger than the EU betas.

[12] By estimating country by country and not as one system we run the risk of losing some efficiency if the residuals across countries are correlated. However, estimating a full system is not possible due to the large number of parameters that would need to be estimated. To get a feel for the extent of the problem we calculated the correlation coefficients of the residuals from different countries. The average is around 0.2 and thus the problem does not appear to be too serious.

Table 3
Integration instruments

Country	FSPREAD	CURVOL	SRD	INFD	IPD
Belgium	0.05 (0.04)	0.13 (0.17)	0.31 (0.81)	0.41 (0.53)	0.12 (2.30)
France	0.04 (0.06)	0.24 (0.13)	0.86 (1.09)	0.15 (0.47)	−0.44 (0.46)
Germany	−0.07 (0.05)	NA (NA)	NA (NA)	1.08 (0.95)	−1.13 (1.38)
Italy	0.36 (0.20)	0.75 (0.36)	4.04 (1.75)	2.33 (1.10)	0.45 (1.99)
Netherlands	0.006 (0.02)	0.04 (0.01)	−0.18 (0.23)	0.76 (0.46)	1.11 (1.58)
Spain	0.34 (0.20)	0.57 (0.31)	3.61 (1.64)	2.26 (1.05)	0.59 (2.10)

This table reports summary statistics for the set of integration instruments. Means and standard deviations (in parentheses) are expressed in annualized percentage points. The instruments are defined as follows: FSPREAD is the country's eight-year forward rate two years ahead, constructed from swap rates, minus the corresponding German forward rate, with the difference being divided by the German 10-year government bond yield. In the case of Germany, FSPREAD reflects the difference of the German forward rate from the ECU forward rate (divided by the German 10-year bond yield). CURVOL is the 52-week moving average of the standard deviation of the local weekly currency return relative to the Deutschmark. SRD is the one-month Eurocurrency rate minus the corresponding German one, divided by the German one-month Eurocurrency rate. INFD is the country's change in the log of the consumer price index minus the corresponding benchmark inflation rate, with the difference being divided by the benchmark inflation rate. The benchmark inflation is the average inflation of the three best-performing countries. IPD is the difference between a country's industrial production growth from the average industrial production growth in the EU. Average EU industrial production is computed as a GDP-weighted average of industrial production of the EU-11 countries. Weekly data on INFD and IPD were linearly interpolated from monthly observations.

5.2. Calculating the benefit from integration

The next step in calculating the cost of equity is to multiply the estimated betas by their respective equity market risk premium. It is conventional to estimate the equity risk premium using a long historical time period. For example, in the US, the equity premium is often calculated from annual data going back to the early twentieth century, or at least to the end of World War II. Data over such a long time period are more difficult to obtain for our sample of countries. We employ total return data from 1973 provided by Datastream to estimate the equity market premium.

Table 5 reports the arithmetic mean equity premia. The excess returns are calculated in euros. The EU index is a market value-weighted average of the EU-11 countries. The risk-free rate is the short-term German rate since no euro rates are available back to 1973. The equity premium is highest in Italy. It is approximately double that of Germany and Belgium. Germany has the lowest equity premium. The average premium across the EU-11 is 9.76%.

Table 6 reports the total cumulative saving in the cost of equity over the whole sample. Recall that by construction, the cost of equity of sector j in country i, $r_{ij,t}$, is a weighted average of a local premium and an EMU premium, where the weights are time-varying but the two premia are fixed.[13] Thus the cost of equity varies over time due entirely to the time-variability of the level of integration, $\phi_{i,t-1}$, of country i. It is, therefore, possible to track how a change in the level of integration affects the cost of capital of sector j in country i by taking the partial derivative of expected returns with respect to the conditional degree of integration:

$$\frac{\partial r_{ij,t}}{\partial \phi_{i,t-1}}\Delta\phi_{i,t-1} = \left(\beta_{ij}^{\mathrm{EU}}\overline{r}^{\mathrm{EU}} - \beta_{ij}^{\mathrm{L}}\overline{r}_i^{\mathrm{L}}\right)\left(\phi_{i,t-1} - \phi_{i,t-2}\right), \tag{3}$$

[13] We later test the assumption of constant premia and find it not to be violated by the data.

Table 4
Equity betas and integration parameters

	RS	BS	GI	UT	IT	FI	CG	NG	CS	NS
Belgium										
β^{EU}	0.26* (0.12)	0.39* (0.07)	0.37* (0.06)	0.07 (0.05)	0.22 (0.25)	0.39* (0.05)	–	0.68* (0.08)	0.48* (0.06)	0.62* (0.13)
β^{L}	0.93* (0.09)	0.81* (0.07)	0.72* (0.07)	0.64* (0.07)	0.19 (0.26)	0.58* (0.05)	–	0.54* (0.12)	0.63* (0.07)	0.90* (0.12)
	γ_1	γ_2	γ_3	γ_4	γ_5					
	51.03* (5.98)	7.43* (3.00)	0.81 (1.03)	2.19 (1.91)	10.47 (79.1)					
France										
β^{EU}	0.63* (0.05)	0.55 (0.49)	0.67* (0.19)	–	0.89* (0.07)	0.43* (0.06)	0.56* (0.07)	0.76* (0.36)	0.44* (0.08)	0.61 (0.57)
β^{L}	0.96* (0.21)	0.67* (0.15)	0.76* (0.15)	–	0.71* (0.29)	0.83* (0.14)	0.63* (0.27)	0.56 (0.46)	0.55* (0.22)	0.54** (0.32)
	γ_1	γ_2	γ_3	γ_4	γ_5					
	13.03* (1.02)	1.08* (0.51)	0.85 (0.71)	18.72† (11.05)	2.12 (16.06)					
Germany										
β^{EU}	0.07 (0.13)	0.41* (0.05)	0.45* (0.02)	0.18* (0.06)	0.75* (0.13)	0.28* (0.05)	0.54* (0.05)	0.22* (0.04)	0.44* (0.06)	0.54* (0.08)
β^{L}	−0.11 (0.09)	0.59* (0.07)	0.56* (0.06)	0.02 (0.05)	0.15 (0.14)	0.58* (0.07)	0.54* (0.07)	0.44* (0.05)	0.43* (0.09)	0.65* (0.07)
	γ_1	γ_2	γ_3	γ_4	γ_5					
	13.45* (3.40)	–	–	2.28* (0.76)	20.29* (1.97)					
Italy										
β^{EU}	0.50* (0.47)	0.56** (0.31)	0.43 (0.31)	0.91* (0.23)	0.71† (0.21)	0.78* (0.13)	0.41* (0.18)	0.84* (0.27)	1.04* (0.19)	0.78† (0.43)
β^{L}	0.54* (0.07)	0.57* (0.03)	0.57* (0.04)	0.60* (0.04)	0.54* (0.05)	0.53* (0.03)	0.64* (0.03)	0.46* (0.05)	0.33* (0.03)	0.67* (0.04)
	γ_1	γ_2	γ_3	γ_4	γ_5					
	16.34* (1.51)	0.11 (0.32)	0.72 (0.51)	1.28* (0.17)	1.41 (15.32)					
Netherlands										
β^{EU}	0.46* (0.06)	0.38* (0.07)	0.32* (0.06)	–	0.53* (0.09)	0.50* (0.04)	0.33* (0.10)	0.38* (0.05)	0.41* (0.07)	0.55* (0.08)
β^{L}	1.05* (0.13)	0.65* (0.16)	1.28* (0.26)	–	0.98* (0.28)	0.63* (0.08)	0.45 (0.37)	0.49* (0.11)	0.59* (0.10)	0.36* (0.18)
	γ_1	γ_2	γ_3	γ_4	γ_5					
	34.90* (2.31)	2.09* (0.22)	0.03 (0.18)	11.64* (4.96)	0.11 (1.29)					

(*continued on next page*)

Table 4 (*continued*)

	RS	BS	GI	UT	IT	FI	CG	NG	CS	NS
Spain										
β^{EU}	0.44 (0.16)	0.53* (0.46)	0.59* (0.18)	0.57* (0.10)	–	0.88* (0.07)	0.73 (0.51)	0.52* (0.12)	0.48* (0.09)	0.78* (0.14)
β^{L}	0.58* (0.04)	0.59* (0.17)	0.44* (0.04)	0.66 (0.04)	–	0.58* (0.03)	0.15 (0.13)	0.53* (0.04)	0.57* (0.04)	0.62* (0.05)
	γ_1	γ_2	γ_3	γ_4	γ_5					
	13.73* (2.45)	0.22 (0.63)	0.20 (1.00)	2.06* (0.40)	0.00 (18.70)					

Estimates of local and global betas and the integration parameter from the following regression are reported:

$$\mathbf{r}_{i,t} = \phi_{i,t-1}\left(\boldsymbol{\beta}_i^{EU} r_t^{EU}\right) + \left(1 - \phi_{i,t-1}\right)\left(\boldsymbol{\beta}_i^{L} r_t^{L}\right) + \mathbf{e}_{i,t}$$
$$\phi_{i,t-1} = \exp(-|\boldsymbol{\gamma}_i' \mathbf{X}_{i,t-1}^{I}|),$$

where $\mathbf{r}_{i,t}$ is the 1×10 vector of sector excess returns in country *i*, $\boldsymbol{\beta}_i^{EU}$ is a 1×10 vector of sector betas with respect to the EU-wide index, defined as r_t^{EU}, $\boldsymbol{\beta}_i^{L}$ is a 1×10 vector of sector betas with respect to the local index of country *i*, defined as r_t^{L}, $\phi_{i,t-1}$ is the degree of integration of country *i* into the EU market, conditional on information up to time $t-1$ and $\mathbf{e}_{i,t}$ is a vector of sector residuals. $\mathbf{X}_{i,t-1}^{I}$ is the set of integration instruments defined in Table 3: γ_1, the forward interest rate differential with Germany, γ_2, currency volatility, γ_3, the one-month interest rate differential with Germany, γ_4, the inflation differential with the best three performing countries, and γ_5, the industrial production growth differential with the EU. The abbreviations are as follows: RS: Resources, BS: Basic Industries, GI: General Industrials, UT: Utilities, IT: Information Technology, FI: Financials, CG: Cyclical Consumer Goods, NG: Non-Cyclical Consumer Goods, CS: Cyclical Services, NS: Non-Cyclical Services. All data were collected from Datastream International and are sampled from 01:02:1992 to 26:06:1998. Robust standard errors are in parentheses. * (†) denotes statistically significant at the 5% (10%) level.

Table 5
The size and volatility of equity market premia 1973–1998

	BE	FR	GE	IT	NL	SP	EU-11
Mean	8.09	12.85	6.18	15.10	10.57	13.52	9.76
Standard deviation	21.89	31.77	23.70	41.94	21.83	29.08	22.65

The arithmetic equity premium for each country is calculated using annual data over the period 1973–1998. The excess returns are calculated in euros and are expressed in percentages. The EU index is a market value-weighted average of the EU-11 countries that joined EMU. The risk-free rate is the short-term German rate.

where $\Delta\phi_{i,t-1}$ is the change in ϕ_i between time $t-1$ and t conditional on information at time $t-2$ and $t-1$, respectively, β_{ij}^{EU} is the beta of sector j in country i with respect to the EU index, $\bar{r}^{\mathrm{EU}}$ is the long-term equity market premium on the EU index, β_{ij}^{L} is the beta of sector j in country i with respect to the local market index and $\bar{r}_i^{\mathrm{L}}$ is the long-term equity market premium on the local market i index.

In Panel A of Table 6, the cumulative saving in the cost of capital for each sector j is averaged across countries using equal cross-country weights. Over the 1990s, the reduction in the cost of equity was substantial in the old economy industries of Resources, General Industries and Basic Industries, where the cost of equity has decreased by between 1.7 and 2.7 percentage points. The Financial sector and Utilities recorded a more modest fall in the cost of equity of 1.1 and 1.4 percentage points, respectively. In contrast, the IT and Non-Cyclical Consumer Goods sectors experienced no change in the cost of equity. The remaining various Goods and Services sectors display more modest, but still significant falls, except for Cyclical Services, where the change in the cost of capital is negative but statistically insignificant.

Panel B of Table 6 reports the average reduction in the cost of equity within a country. We take an equal weight of the ten sectors in each country and then cumulate the saving in the cost of equity. All countries except Germany show a statistically significant fall in the cost of equity capital in the range of 1–2 percentage points. In contrast, Germany shows a significant increase of 0.88 percentage points.

Overall, the impact of EMU, through its impact in the level of stock market integration, led to a significant reduction in the cost of equity. There are, of course, some differences in the impact across different sectors or countries, which likely reflect the different international versus local nature of the sectors.

Table 6
The cumulative effect of integration on the cost of equity

Panel A: Sectoral effect

RS	BS	GI	UT	IT	FI	CG	NG	CS	NS
−2.72*	−1.72*	−2.09*	−1.40*	0.10	−1.08*	−0.27*	0.05	−0.24	−0.38*

Panel B: Country effect

	Belgium	France	Germany	Italy	Netherlands	Spain
All industries	−1.42*	−1.96*	0.88*	−0.90*	−1.95*	−0.85*

Panel A reports for each sector the cross-country average of the cumulative change in the cost of equity using equal weights.

Panel B reports for each country the cross-sectoral average of the cumulative change in the cost of equity using equal weights. * denotes statistically significant at the 5% level.

5.3. Is there a reduction in the dispersion of the equity premium across sectors and across countries?

The earlier finding that the cost of equity in Europe decreased over the 1990s as a result of higher stock market integration does not necessarily imply that the cost of equity converged across sectors in a particular country, or across countries in a particular sector. By convergence we mean the tendency towards a reduction over time of the dispersion in the cost of equity across sectors or across countries. In this section we examine if the cost of equity has, indeed, converged over time across sectors and countries. This issue is of particular importance for both corporate managers and investors. If, for example, the cost of equity converges across countries, then cross-listed firms face no comparative advantage in raising equity capital. Similarly, the importance of country allocation strategies for international investors decreases.

In perfectly integrated markets, the dispersion of the cost of equity is reduced only if the exposure of firms to different risk factors converges over time. For example, in the framework of the standard CAPM, the cost of equity across sectors converges if there is a tendency for the exposure of sectors to market risk (betas) to approach each other over time. However, there is no a priori economic reason why this should happen.

In partially integrated markets, however, convergence in the cost of equity can be related to the evolution over time of the degree of market integration plus the degree of convergence in betas. We would expect that, as stock markets become more integrated, the cost of equity in a particular sector should converge across countries due to the elimination of local risk. Convergence in the cost of equity should be positively related to the degree of market integration the higher is the cross-country dispersion of local betas and local market premia and the lower is the cross-country dispersion of global betas.

To illustrate this claim, consider the cost of equity for sector j in country i from Eq. (1). In the case of perfect segmentation ($\phi_{i,t-1}=0$), $r_{ij,t}=\beta_{ij}^{\mathrm{L}}\bar{r}_i^{\mathrm{L}}$, whereas in the case of perfect integration ($\phi_{i,t-1}=1$), $r_{ij,t}=\beta_{ij}^{\mathrm{EU}}\bar{r}^{\mathrm{EU}}$. Assume for simplicity that the sectors' exposures to market risk are equal across countries, $\beta_{ij}^{\mathrm{L}}=\beta_j^{\mathrm{L}},\ \beta_{ij}^{\mathrm{EU}}=\beta_j^{\mathrm{EU}}$. The variance of the cost of equity in sector j across countries in the case of perfect segmentation is given as $(\beta_j^{\mathrm{L}})^2\mathrm{var}(\bar{r}_i^{\mathrm{L}})$. In words, the within-sector cross-country variance of the cost of equity is positively related to the cross-country variance of market premia.

When markets are perfectly integrated, however, the cross-country variance of the cost of equity in sector j is $(\beta_j^{\mathrm{EU}})^2\mathrm{var}(\bar{r}_i^{\mathrm{EU}})=0,$ since $\mathrm{var}(\bar{r}_i^{\mathrm{EU}})=0$. That is, given that stocks are exposed to a single, identical risk factor (the EU market portfolio), the cost of equity shows no cross-country variation. Of course, this result is subject to our simplifying assumption that betas are equal across countries. Allowing betas to differ across countries generally introduces a lower bound on the cross-country variance of local betas for the cost of equity to converge when the degree of integration increases. This lower bound is given as a weighted difference between the cross-country variance of global betas and the cross-country variance of local market premia.[14]

[14] This can be obtained from a first order Taylor series approximation of returns as follows: for $\phi_{i,t-1}=0$ returns can be approximated as $r_{ij}=\beta_{ij,0}^{\mathrm{L}}(\bar{r}_i^{\mathrm{L}}-\bar{r}_{i,0}^{\mathrm{L}})+\bar{r}_{i,0}^{\mathrm{L}}(\beta_{ij}^{\mathrm{L}}-\beta_{ij,0}^{\mathrm{L}})$, where $\beta_{ij,0}^{\mathrm{L}}$ is the cross-country mean of the local beta and $\bar{r}_{i,0}^{\mathrm{L}}$ is the cross-country mean of the local market premium. Similarly, for $\phi_{i,t-1}=1$ returns can be approximated as $r_{ij}=\bar{r}_0^{\mathrm{EU}}(\beta_{ij}^{\mathrm{EU}}-\beta_{ij,0}^{\mathrm{EU}})$. Computing the variance of returns for $\phi_{i,t-1}=0$ and $\phi_{i,t-1}=1$ gives $(\bar{r}_{i,0}^{\mathrm{L}})^2\mathrm{var}(\beta_{ij}^{\mathrm{L}})+(\beta_{ij,0}^{\mathrm{L}})^2\mathrm{var}(\bar{r}_i^{\mathrm{L}})$ and $(\bar{r}_0^{\mathrm{EU}})^2\mathrm{var}(\beta_{ij}^{\mathrm{EU}})$, respectively. Hence, when the markets go from a state of perfect segmentation to a state of perfect integration, the cross-country variance of the cost of equity decreases if $\mathrm{var}(\beta_{ij}^{\mathrm{L}})>(\bar{r}^{\mathrm{EU}}/\bar{r}_i^{\mathrm{L}})^2\mathrm{var}(\beta_{ij}^{\mathrm{EU}})-(\overline{\beta_{ij}^{\mathrm{L}}}/\overline{\beta_{ij}^{\mathrm{EU}}})^2\mathrm{var}(\bar{r}_i^{\mathrm{L}})$.

Given the empirical evidence that variations in market risk premia are more important than variations in betas (Braun et al., 1995), this lower bound should be easy to meet under a fairly wide range of parameter values.

To test the hypothesis that increased market integration in Europe led to a convergence in the cost of equity, we compute the dispersion of the cost of equity across countries and sectors and test whether this dispersion decreases over time by regressing it on a constant and a time trend. Table 7, Panel A, reports the results of convergence in the cost of equity across countries within a given sector. In all sectors, to varying degrees, we observe that the dispersion of the cost of equity across countries decreases over time. The estimates of the trend coefficient suggest that dispersion decreases by 0.1–0.5% per week, corresponding to roughly 5–25% per annum. Interestingly, some of the sectors experiencing the greatest convergence in the cost of equity across countries are also those which experienced the highest saving in the cost of equity due to integration (Resources, General Industrials). Also, some of the sectors with the lowest convergence are sectors in which integration did not lead to a substantial decrease in the cost of equity (Non-cyclical Goods and the Service sectors). Nevertheless, there is no clear-cut strong relationship between saving in the cost of capital due to integration and convergence in the cost of capital across countries. For example, the IT sector experiences no saving in the cost of capital but a high degree of convergence across countries. This observation suggests that in sectors with high international exposure like the IT sector, convergence in the cost of equity was driven mainly by global factors rather than factors related to economic and monetary integration.

Panel B of Table 7 reports the results of convergence in the cost of equity across sectors within a given country. The results are mixed. The two main stock markets of France and Germany experienced a divergence in the cost of equity across sectors. The remaining four countries experienced a convergence in the cost of equity across sectors, although this convergence is modest in the case of Italy.

Fig. 1 plots the average cross-country dispersion in the cost of equity within a sector over time. The figure flushes out the results in Table 7, Panel A, and illustrates more clearly the downward trend in the cross-country variation of the sector equity premia which essentially

Table 7
Is there convergence in the cost of equity over time?

Panel A: The time trend in the cross-country dispersion of a given sector ($\sigma_{jt} = a_0 + a_1\text{time} + u_{jt}$)

	RS	BS	GI	UT	IT	FI	CG	NG	CS	NS
a_1	−0.005*	−0.001*	−0.003*	−0.002*	−0.004*	−0.001*	−0.003*	−0.002*	−0.002*	−0.001*

Panel B: The time trend in the cross-sectoral dispersion of a given country ($\sigma_{it} = a_0 + a_1\text{time} + u_{it}$)

	BE	FR	GE	IT	NL	SP
a_1	−0.002*	0.002*	0.003*	−0.001*	−0.002*	−0.002*

Panel A reports estimates of the trend coefficient in the cost of equity across countries. For a given sector j, we compute the cross-country standard deviation of the cost of equity in each week t, σ_{jt}, and test for the existence of a negative trend over time from the following regression: $\sigma_{jt} = a_0 + a_1\text{time} + u_{jt}$, where a_0 and a_1 are estimated coefficients and u_{jt} is an error term.
Panel B reports estimates of the trend coefficient in the cost of equity across sectors. For a given country i, we compute the cross-sectoral standard deviation of the cost of equity in each week t, σ_{jt}, and test for the existence of a negative trend over time from the following regression: $\sigma_{it} = a_0 + a_1\text{trend} + u_{it}$, where a_0 and a_1 are estimated coefficients and u_{it} is an error term. * denotes statistical significance at the 5% level.

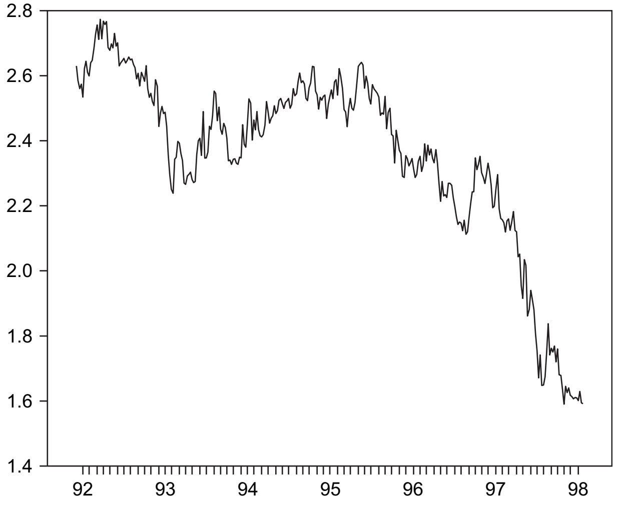

Fig. 1. Average cross-country dispersion in the cost of equity within a sector.

occurs in the second half of the sample. The effect of integration on the cost of equity is relatively low during the first half of the sample, when markets were less integrated, and relatively high towards the second half of the sample, the time when most of the convergence in European bond yields took place. It should be noted that, according to the Maastricht Treaty, 1997 was the year during which the convergence criteria had to be satisfied for joining EMU in 1999.

Fig. 2 plots the average cross-sectoral dispersion of the cost of equity for the six EMU countries. The figure confirms the mixed results of Table 7, Panel B. There appears at best only a slight fall over the sample period in the cross-sectoral variance of the cost of equity within a country.

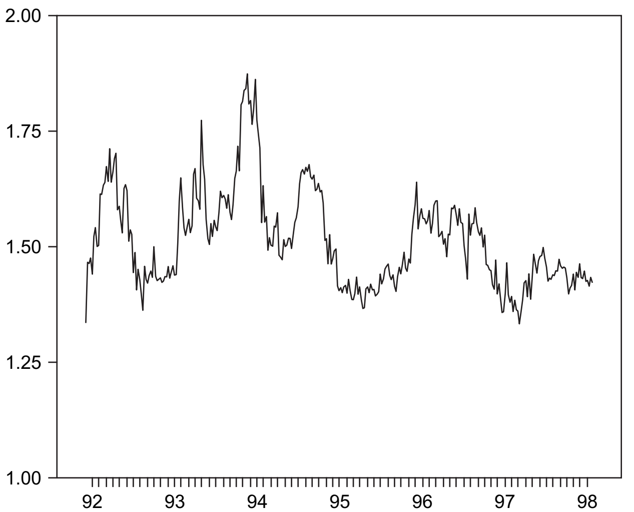

Fig. 2. Average cross-sectoral dispersion in the cost of equity capital within a country.

Overall, our results have important implications for both corporate managers and investors. First, convergence in the cost of equity across countries within a given sector implies that cross-listing of companies in different national bourses as a strategy to take advantage of differences in cost of equity capital is increasingly loosing its importance. Second, evidence of cross-country convergence in the sector cost of equity indicates that country allocation effects are becoming less important as markets become more integrated. Hence, sector allocation strategies gain in importance.

6. Are the results robust and causal?

We now turn to the issue of how robust are our results to alternative specifications. We first search for potential misspecification of the empirical model, which could originate from our assumptions regarding the nature of the variability of the required excess returns. Subsequently, we explore the question of whether our estimated relations are truly causal, running from the prospect of EMU to the reduction in the cost of capital. We thus extend the analysis to three additional EU countries, which did not join the Eurozone: Denmark, Sweden and the UK. We estimate the model in these three countries and compare the results with our earlier results of the EMU countries.

6.1. Tests of model misspecification

Our empirical estimates of the effect of European stock market integration on the cost of equity may be sensitive to the assumption that all the variability in expected excess returns is absorbed by the time-varying integration parameter. This assumption was made for practical considerations, thus it is important to know if it has caused unwanted side effects. We therefore proceed with a battery of specification tests. The rationale of our specification tests rests on the argument that if our model is misspecified, then variables which have proven to have power to predict excess returns, would be able to predict the residuals of our model. A plethora of studies in the US and in other countries have shown, for example, that financial variables such as the dividend yield, the term structure spread, or the bond quality spread have the ability to predict excess returns; namely, they are able to track the predictable variation in risk premia.

We thus proceed to examine if the model residuals are orthogonal to a set of instrumental variables that have been used in many studies to proxy time variation in the equity risk premium. The local instruments that are chosen to track changes in the local equity market premium are the first lags of the local market dividend yield, the change in the term structure, and the change in the short-term rate. The EU-wide instruments that are chosen to track changes in the EU equity market premium are the first lags of the change in the ECU term structure, the change in the short-term ECU interest rate, the aggregate EU stock market dividend yield, and a measure of EU default risk.[15]

An alternative specification test would be to test if the equity betas have changed over time. We thus perform a Chow test for structural stability of the betas. This is undertaken by splitting the sample into an initial period between February 1992 and December 1996 and a second period from January 1997 to June 1998. We choose this period because most of the convergence in the integration parameter took place after 1996.

[15] The term structure is the difference between the 10-year government bond yield and the one-month eurocurrency interest rate, the short-term interest rate is the one-month eurocurrency interest rate, the default spread is the difference between the BBB corporate bond yield and the 10-year government bond yield. All data are from Datastream International.

Table 8
Model misspecification tests

Number of rejections at the 5% level					
	Orthogonality			Constancy of betas	
	Local instruments	EU instruments	Integration instruments	Local β	EU β
BE	1	1	1	2	3
FR	1	0	1	1	2
GE	1	1	2	3	2
IT	0	0	0	2	3
NL	0	1	1	1	0
SP	0	1	1	3	2

In each column, the total number of tests performed is 57 (6 countries × 10 sectors, minus 3 missing sectors). Columns 2, 3, and 4 report the number of rejections of the null hypothesis of no predictability in the model's residuals. The rejections are based on chi-squared tests with degrees of freedom that reflect the total number of instruments per case. The regressors in Column 2 are a set of local instruments: A constant plus the first lag of: the country dividend yield (DIV), the change in the country's term structure spread between the 10-year bond yield and the one-month eurocurrency rate (ΔTERM), and the change in the country's one-month eurocurrency rate (ΔSHORT). The regressors in Column 3 are a set of EU instruments: A constant plus the first lag of: the aggregate EU dividend yield (DIV), the change on the ECU term structure spread between the 10-year yield and the one-month eurocurrency rate (ΔTERM), the change in the ECU one-month eurocurrency rate (ΔSHORT), and the EU default spread measured as the difference between the BBB bond yield and the 10-year government bond yield (DEF). The regressors in Column 4 are: A constant plus the first lag of the integration instruments of Table 3 (FSPREAD, CURVOL, SRD, INFD, IPD). Columns 5 and 6 report the number of rejections of a Chow test of constant local and EU betas, respectively.

Table 8 reports a summary of the results for these misspecification tests. Column 2 reports the number of sectors in each country that reject the orthogonality conditions between the sector's residuals and a set of local instruments. A Chi-squared test is undertaken on the restrictions that the instruments are orthogonal to the residuals. Out of the 57 cases that we have (six countries times ten sectors, minus three missing sectors), the test is rejected in only three cases. Column 3 presents a similar test as in Column 2, but utilizes the EU instruments. We can reject the orthogonality conditions with respect to the EU instruments in four cases out of 57. Column 4 utilizes the integration instruments of Table 3. These instruments were used to estimate the integration parameters $\phi_{i,t}$ but were prevented from affecting the betas. So the test is essentially a test of whether the betas vary as a function of the integration parameters. Again, we reject the null hypothesis in only six cases out of 57. Overall, the model appears robust to all these specification tests, providing support for our maintained hypothesis that the main driving force of time variation in equity premia over the sample period was the change in the degree of market integration.

Columns 4 and 5 test for the stability of the estimated betas by performing the usual Chow test. We find that just over 20% (12 out of 57 cases) of the local and EU betas are unstable. Although assuming constant betas does not appear to be too restrictive for the vast majority of sectors and countries, the number of rejections may not be the result of type II error alone. Given the evidence from our earlier specification tests, the most likely cause of the small number of observed rejections must be an exogenous factor, which is not being picked up by the usual financial ratios, such as the dividend yield or the various yield spreads. Perhaps the culprit is the elimination of currency risk premia in EMU. Apart from allowing currency risk to affect the integration parameter, we do not explicitly model currency risk in Eq. (1). Nevertheless, it may have had an influence on betas even prior to the advent of euro, as markets positioned themselves in anticipation of the elimination of currency fluctuations.

Previous empirical work on the impact of the euro on currency risk exposure suggests that the elimination of currency risk in Europe has led to a decline in total market risk exposure of European stocks – see Bartram and Karolyi (2003), Bris et al. (2003) and Hardouvelis et al. (2006). Bartram and Karolyi (2003) find that EU-market betas have decreased by about 0.2 with the introduction of the euro and Hardouvelis et al. find that about 22% of total risk of European stocks is due to the intra-European currency risk premium, which has been eliminated with the launch of the euro. In light of these studies, our estimates of the impact of EMU on the cost of capital should be on the conservative side.

6.2. Did the cost of capital decrease in countries outside the Eurozone?

In order to gain insight on the nature of causality in our results, we examine whether or not the observed patterns in the cost of equity capital are also present in EU countries, which are not members of EMU. This group of countries consists of Denmark, Sweden and the United Kingdom. Data for the UK are available over the full sample for all ten sector classifications. For Denmark, the data on interest rate swap yields start in February 1993 and there are no data for the Resources and IT sectors. In Sweden, all sectors are available with the exception of Non-Cyclical Services. Equity market risk premia, betas and the level of integration are calculated as in the case for members of the single currency. We adjust the earlier EMU market index to also include these members of the EU. From these results (available on request) we generate the cumulative saving in the cost of equity.[16]

For the EU countries outside the Eurozone we would not expect the impact on the cost of equity to be as large as that for members of the single currency. Table 9 reports the cumulative saving in the cost of equity for each sector across the three countries. In Panel A we report the results for the sectors. With the exception of Cyclical Services, there is a fall in the cost of equity. However, unlike the case of the Eurozone countries, the cumulative effect is economically small over the sample period and is never statistically significant. In Panel B of Table 9, we report the impact across the three countries. This impact is negative but economically small and statistically insignificant.

In sum, there are clear economic differences between the impact on the cost of equity for the EMU members and the non-EMU members. Unlike the EMU members, countries outside EMU have not experienced a significant fall in the cost of equity capital. It thus appears that the relation between the prospect of joining EMU and the reduction in the cost of capital is causal.

7. Conclusion

This paper examines whether the process of economic and monetary integration in Europe during the 1990s and the adoption of the euro has led to a reduction in the cost of equity capital and whether it has led to a convergence of the cost of equity within given sectors of the EU.

We use a conditional asset pricing model in order to assess the impact of economic and monetary integration on the cost of equity capital, which has the attractive feature of tying the impact of EMU on the cost of equity to the change in the level of stock market integration. Using data from various EU sectors, we show that economic and monetary integration in Europe led to a significant reduction in the cost of equity in the vast majority of sectors. At the

[16] We do not test for convergence in the cost of equity in these countries as we have only three observations on the cost of equity at one point in time in order to calculate the dispersion.

Table 9
The cumulative effect of integration on the cost of equity: non-euro EU members

Panel A: Sectoral effect

RS	BS	GI	UT	IT	FI	CG	NG	CS	NS
−0.68	−0.47	−0.53	−0.14	−0.61	−1.00	−0.82	−1.13	0.12	−1.04

Panel B: Country effect

	Denmark	Sweden	UK
All industries	−0.52	−0.97	−0.37

For each sector in Panel A, the cross-country average of the total change in the cost of equity is tabulated using equal cross-country weights. For each country in Panel B, the cross-sectoral average of the total change in the cost of equity is tabulated using equal cross-sectoral weights. * denotes statistical significance at the 5% level.

country level, the sector results translate into a significant fall in the cost of equity in all countries but Germany. Overall, on average, European stock market integration led to a significant reduction in the cost of equity. This, in turn, should lead to more profitable investment opportunities as net present values rise, boosting economic growth and improving welfare. Various tests reveal that the results are, generally, robust to assumptions regarding the measurement of the equity market risk premium and equity betas.

We repeat our analysis on the three EU countries, Denmark, Sweden and the UK, which decided not to join the single currency. Here, a different picture emerges regarding the cost of equity. While we find some reduction in the cost of equity, it is both economically smaller than that in EMU countries and statistically insignificant. This evidence corroborates the important causal influence of EMU on European stock market integration and the reduction in the cost of equity capital.

Finally, we assess the nature of convergence over time in the cost of equity both across sectors and across countries. As integration increases, returns are increasingly determined by global rather than local risk factors. This implies a gradual convergence of the sector cost of equity across countries. This issue is important given the growth in cross-border equity business. On the other hand, convergence in the equity cost of capital across different sectors is much less pronounced, continuing to reflect the differences in EU sector betas.

The results on convergence have potentially far-reaching implications for portfolio management. In EMU, differences between sectors seem to remain, while differences between countries seem to be disappearing. Therefore, a fruitful avenue for future research is the role of country and sector effects in portfolio management.

Acknowledgement

We are grateful to the Fondation Banque de France for financial support. We thank Henri Pagès, Jesper Rangvid, Bernt Arne Ødegaard, Jesper Rangvid, Joseph Bisignano, an anonymous referee, and seminar participants at the Banque de France for helpful comments and Intersec Research for providing us with data.

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