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AN INTERTEMPORAL APPROACH

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In 2008 all ECB publications feature a motif taken from the €10 banknote.

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2 All authors: European Central Bank, Kaiserstrasse 29, 60311 Frankfurt am Main, Germany; e-mail: lorenzo.cappiello@ecb.europa.eu, marco.lo_duca@ecb.europa.eu, and angela.maddaloni@ecb.europa.eu; tel.: +49 69 1344 8765, +49 69 1344 5690 and +49 69 1344 8768, respectively.

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Website
http://www.ecb.europa.eu

Fax
+49 69 1344 6000

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Abstract

This paper provides new evidence on the dynamics of equity risk premia in euro area stock markets across country and industry portfolios. We develop and estimate a conditional intertemporal CAPM where returns on aggregate euro area, country and industry portfolios depend on the market risk as well as on the risk that the investment opportunity set changes over time. Prices of risks are time-varying, according to a Kalman filter approach. We find that both market and intertemporal risks are significantly priced. When we include country and industry-specific risk factors they turn out to be not significantly priced for most industries, suggesting that euro area equity markets are well integrated. Overall, the analysis indicates that omitting the intertemporal factor leads to mispricing and misleading conclusions regarding the degree of financial integration across sectors and countries.

Keywords: conditional asset pricing, intertemporal risk, financial integration, multivariate GARCH, Kalman filter

JEL classification: G12, F37, C32

Non-technical Summary

Over the last decades one of the central issues in financial economics has been the estimation of the equity premia and the identification of their determinants. The equity premium is the compensation in excess of the risk free rate that investors require to hold companies' shares. Recent empirical research, mostly applied to the US market, has shown that traditional one-factor frameworks, like the Capital Asset Pricing Model (CAPM), typically generate biased estimates. In contrast, multifactor models appear to mitigate this issue. The Intertemporal Capital Asset Pricing Model (ICAPM) of Merton (1973) represents an elegant, micro-founded example of this second class of models. In Merton's ICAPM, expected returns on equity depend on the "market risk" premium, as in the traditional CAPM, and a host of "intertemporal risk" premia. In our context, while the market risk premium is given by the product of the market risk exposure and the coefficient of risk aversion, the intertemporal risk premia are computed by multiplying the risk exposure to additional pricing factors by the appropriate coefficients (the "intertemporal" prices of risk). Additional risk factors aim at capturing changes in economic conditions.

The purpose of this paper is to provide new evidence on the dynamics and on the determinants of equity risk premia across country and industry portfolios for five euro area economies, France, Germany, Italy, the Netherlands and Spain. To this end, we use a framework in the spirit of the ICAPM of Merton (1973). In addition, we assess the state of financial integration of euro area equity markets and its evolution over a sample period from 1992 to 2007.

Concerning the focus of our research, the start of the European monetary union in January 1999 and the consequent disappearance of exchange rate risk among the euro area markets encouraged the adoption of strategies of portfolio allocation based on sector rather than on country diversification. Therefore, the analysis of equity premia for industry portfolio has become of particular interest.

We model country equity premia as a function of two risk factors: (i) the returns on a global (euro area) market portfolio and (ii) a factor reflecting changes in economic conditions, the intertemporal risk. Since investors anticipate and hedge that the investment opportunity set may change in the future, in equilibrium they hold a combination of two distinct portfolios of risky assets, the market and the hedging portfolio. In the empirical specification of the model, we assume that a common intertemporal risk factor determines expected equity returns in all countries and industries. We proxy this intertemporal factor with the returns on a portfolio of long-term government bonds in excess of the short-term interest rate. This risk factor has the advantage that it encompasses the leading indicator properties typical of the yield

curve: returns on long-term bonds capture expectations of general macroeconomic conditions, while short-term interest rates are linked to the monetary policy stance decided by central banks.

As for expected returns on specific industries in each countries, we model them employing a country and an industry specific risk factors in addition to the market and the intertemporal risks. The analysis of industry as opposed to aggregate country equity premia is essential in evaluating the degree of financial integration. It can occur, for example, that the exposures to idiosyncratic factors of different industries may offset each other and thus disappear when looking at aggregate national indices. In integrated markets, country and industry specific factors should not be significantly priced. Our intertemporal model suggests that euro area equity markets are well integrated across countries and sectors since risks arising from country and industry specific factors are generally not statistically significant.

On a more technical note, we let the coefficients associated with the market and the intertemporal risk exposures (the prices of market and intertemporal risk) be time-varying, using a very flexible methodology (Kalman filter). Contrary to previous studies, this approach does not require imposing any dependence on predetermined variables. Yet, it can incorporate possible changes in preferences and risk appetite and thus it is particularly suited to analyze the move towards a monetary union. Indeed, this methodology accommodates for the possibility that investors may have incorporated the economic impact of the introduction of the euro in their model of assets' evaluation *before* January 1999.

Two main conclusions arise from our study. First, we find that both the market and the intertemporal factor are significant determinants of country and industry premia. While the main driver of total equity premia over the entire sample is the market premium, in some periods the intertemporal premium is economically significant. To illustrate, since summer 2007, in conjunction with the financial turmoil triggered by the US sub-prime crisis, the intertemporal premium contributed to increasing the total premium over what would be implied by the sole market premium. Apparently, at that juncture investors judged that equity markets could not provide a hedge against future changes in investment opportunities and therefore required a higher premium. Second, concerning financial integration, our intertemporal model suggests that euro area equity markets are well integrated across countries and sectors.

1 Introduction

Over the last decades one of the central issues in financial economics has been the estimation of equity premia and the identification of their determinants. Recent empirical research in asset pricing has highlighted a number of stylized facts related to this question. *Inter alia*, research has shown that while single-factor models typically generate biased estimates, multi-factor frameworks mitigate this problem and exhibit a better forecasting performance. The Intertemporal Capital Asset Pricing Model (ICAPM) of Merton (1973) represents an elegant, micro-founded example of this second class of models. Moreover, in terms of market geography, most of the empirical literature attempting to evaluate equity premia has focused on US markets, partly due to the abundance of long time series for pricing factors.

Since January 1999 fifteen European countries have joined in a monetary union.[1] From the point of view of portfolio allocation, the disappearance of exchange rate risk in the euro area encouraged strategies based on sector rather than country diversification (see, for example, Adjouté and Danthine, 2003).

Against this background, this paper provides new evidence on the dynamics of equity risk premia across country and industry portfolios for five euro area economies, France, Germany, Italy, the Netherlands and Spain. We contribute to the empirical asset pricing literature along several dimensions.

First, we develop a two-tier model based on Merton's (1973) ICAPM and Campbell et al. (2001) returns' decomposition, where the first layer estimates equity premia at country level, while the second layer captures equity premia at industry level. In an ICAPM framework the investment opportunity set varies over time and these changes are governed by one or more state variables. Since investors anticipate and hedge that the investment opportunity set may (adversely) change in the future, in equilibrium expected returns depend on the systematic or market risk (as in the traditional "static" CAPM) and on a host of risk factors reflecting changes in economic conditions, i.e. the "intertemporal" risks.[2] In our empirical specification we assume that only one intertemporal risk factor determines expected returns. Therefore, our representative investor will hold a combination of two distinct portfolios of risky assets, the market and the hedging portfolios.

Second, our framework allows drawing conclusions about the state and the development of financial integration in the euro area. As underlined, *inter alia*, by

[1] The countries which joined the euro area in 1999 are: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. Greece joined the monetary union in January 2001, Slovenia in January 2007, and Cyprus and Malta in January 2008.

[2] Note that the term "static" CAPM will be used throughout the paper as opposed to the model which includes intertemporal factors.

Carrieri, Errunza and Sarkissian (2004), to evaluate the degree of financial integration it is important to disaggregate national market indices at sectoral level. It can occur, for example, that the exposures to idiosyncratic factors of different industries may offset each other and thus disappear when looking at aggregate national indices. Consistently with this reasoning, we break down national equity indices into sectors along the lines proposed by Campbell et al. (2001). We model expected returns on a specific industry in each country as a function of the risk exposure to the global market returns, the country specific returns and the intertemporal risk factor. Furthermore, the model is extended by adding industry specific global risks. If markets become increasingly integrated, country and industry specific factors should lose their importance as pricing risk factors.

Third, we let the prices of risk associated with the market and the intertemporal risk factors be time-varying, using a Kalman filter approach. Unlike previous literature, we do not assume that the prices of risk depend on predetermined variables.[3] Rather, the framework we adopt has the advantage to let the data "speak itself." Using time-varying prices of risk we can capture changes in preferences and risk appetite (if any). Furthermore, and more importantly, this approach is particularly suited in a context characterized by a structural shift, such as the move to a monetary union. Indeed, the Kalman filter methodology accommodates for the possibility that investors may have incorporated the economic impact of the introduction of the euro in their model of assets' evaluation *before* January 1999.

In the empirical specification of the model, we assume that a common intertemporal risk factor determines expected returns in all countries and industries. Following the approaches of Scruggs (1998) and Gérard and Wu (2006), changes in investment opportunities are proxied by returns on a portfolio of long-term government bonds in excess of the short-term interest rate. This intertemporal risk factor can be interpreted as a hedging portfolio, and it also encompasses the leading indicator properties typical of the yield curve (see Estrella and Hardouvelis, 1991, and Estrella and Mishkin, 1997). Returns on long-term bonds capture expectations of general macroeconomic conditions, while money market rates are linked to the monetary policy stance decided by central banks. We construct a common intertemporal factor for the five euro area economies by taking the first principal component of the excess returns of long-term bonds in the five countries under analysis. In terms of empirical methodology, we adopt a two-step estimation strategy.[4]

[3] See, for instance, Bekaert and Harvey (1995), De Santis and Gérard (1997 and 1998), Carrieri, Errunza and Sarkissian (2004), Gérard and Wu (2006), and Hardouvelis, Malliaropulos, and Priestley (2006).

[4] For a similar approach, see, for instance, Bekaert and Harvey (1995), Carrieri, Errunza and Sarkissian (2004) and Hardouvelis, Malliaropulos and Priestley (2006).

First, we estimate market and intertemporal premia at country level, proxing the global equity market portfolio with the euro area market portfolio.[5] Second, we estimate equity premia at sectoral level, using information obtained from the first step estimation. The second moments implied by the model are estimated employing the Generalized Autoregressive Conditionally Heteroskedastic (GARCH) process proposed by Ding and Engle (2001).

The results of our study can be summarized as follows. We find that both market and intertemporal factors are significantly priced and the relation between risk and market return is always positive. While the main driver of total equity premia over the entire sample is the market premium, in some periods the intertemporal premium is economically significant, rendering the overall premium different from that obtained with a static CAPM. To illustrate, since summer 2007, in conjunction with the financial turmoil triggered by the US sub-prime crisis, the intertemporal premium contributed to increasing the total premium, suggesting that around these times investors did not value equities as a good hedge against changes in investment opportunities. Overall, however, the intertemporal risk premium is often negative and contributes to decreasing the total premium, a result comparable, for instance, to that obtained by Guo and Whitelaw (2006) for the US market. This outcome indicates that investors believe that equities can be a good hedge vis-à-vis adverse shift in the investment opportunity set.

Our results are broadly in line with previous literature on multi-factor models. Since Merton's (1973) seminal work, several researchers have estimated different specifications of the ICAPM. Scruggs (1998), Gérard and Wu (2006), Guo and Whitelaw (2006), Lo and Wang (2006) and Bali (2008) are examples of ICAPM estimations adopting different proxies for the intertemporal factors. This strand of research emphasizes that the omission of significant intertemporal factors generates mispriced equity valuations.[6]

[6]Scruggs (1988) and Gérard and Wu (2006) use long-term interest rates to construct the hedging portfolio, while Guo and Whitelaw (2006) employ the consumption-wealth ratio and the detrended risk-free rate. In Lo and Wang (2006) the hedging component subsumes the risk of changes in market conditions and the hedging portfolio is built from measures of trading volume of individual stocks. Returns on this hedging portfolio outperform other predictive variables in forecasting the returns on the market portfolio. Bali (2008) focuses on the intertemporal and on cross-sectional implications of the ICAPM, first estimating the slope of a covariance regression model and then the coefficient of a beta-regression framework.

Concerning financial integration, our intertemporal model suggests that euro area equity markets are well integrated across countries and sectors since risks arising from country and industry specific factors are generally not statistically significant, a finding qualitatively similar to that of Bekaert, Hodrick and Zhang (2008). Conversely, when estimating the static CAPM, some country specific risks continue to be significantly priced even after the introduction of the single currency, seemingly indicating a low degree of integration for some sectors and countries of the euro area.

All in all our findings underline the importance of using dynamic asset pricing models vis-à-vis static frameworks: traditional CAPM-type models can be mispriced and generate spurious results when evaluating total equity premia, due to the omission of intertemporal pricing factors. Moreover, static models can lead to misleading conclusions concerning financial integration.

The remainder of the paper is organized as follows. Section 2 describes the theoretical model; section 3 discusses the empirical methodology, including the specification of second moments and time-varying prices of risk; section 4 describes the data and section 5 outlines the empirical results. Finally, section 6 concludes.

2 The model

This section describes the theoretical framework used to estimate the equity premium at a country and industry level in the euro area. We assume that investors' optimal portfolio choices are based on the ICAPM first proposed by Merton (1973). While the *static* CAPM rests on the assumption that investors live for only one period, typically consumption and investment decisions span over longer horizons. In such a dynamic economy, the investment opportunity set changes over time. It is assumed that these changes are governed by one or more state variables, $x_{l,t}$, $l = 1, ..., m$. Risk averse agents anticipate future developments and hedge against the possibility that investment opportunities may change adversely in the future. This implies that equilibrium expected returns depend not only on the "systematic" or "market" risk (as in the traditional CAPM), but also on "intertemporal" risks.

In each country we model the equity return on a specific industry as a function of three components: the risk exposure *vis-à-vis* the global (euro area) market return, the country return and the intertemporal risk factors. For each country we can identify the evolution over time of the covariances between (i) sector returns and global market returns, (ii) sector returns and local market returns, and (iii) sector returns and the intertemporal factors. Finally, we also take into account the possibility that sector returns can be affected by a global sector-specific shock. This is captured by the covariance between sector returns and the a global industry-specific risk. A distinct time-varying price is associated with each covariance.

Let $J(w_t, \mathbf{x}_t, t)$ be the derived utility function of wealth of a risk-averse representative investor. $J(\cdot)$ is a function of wealth, w_t, and of a vector of state variables, $\mathbf{x}_t$, driving the changes in the investment opportunity set. Let $r_{i,t}$ denote the return on the equity market of country i and $r_{m,t}$ the return on a global portfolio, the euro area equity market. Returns are in excess of the risk-free rate. At each point in time, the weighted sum of returns on the different national markets is equal to the return on market m: $r_{m,t} = \sum_{i \in m} \omega_{i,t} r_{i,t}$, where $\omega_{i,t}$ is the weight of equity market i in the global market m. If $x_{i,t}$ is a factor-mimicking portfolio which proxies for the state variable, in equilibrium the following pricing restrictions must hold:

$$r_{i,t} = \beta_{im,t} r_{m,t} + \beta_{ix_i,t} x_{i,t} + \varepsilon_{i,t}, \tag{1}$$

where $\beta_{im,t}$ and $\beta_{ix_i,t}$ are, respectively, the betas for the equity market return $r_{i,t}$ with respect to the global market return $r_{m,t}$ and the state variable portfolio $x_{i,t}$, which may differ across countries. $\varepsilon_{i,t}$ is the country-specific residual. Since $\varepsilon_{i,t}$ is orthogonal to $r_{m,t}$ and $x_{i,t}$, equation (1) can be written as follows:

$$r_{i,t} = \lambda_{m,t} Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1} \right.\right) + \lambda_{x_i,t} Cov\left(r_{i,t}, x_{i,t} \left| \Im_{t-1} \right.\right) + \varepsilon_{i,t}, \tag{2}$$

where $\lambda_{m,t} \equiv r_{m,t}/Var\left(r_{m,t} \left| \Im_{t-1} \right.\right)$ and $\lambda_{x_i,t} \equiv x_{i,t}/Var\left(x_{i,t} \left| \Im_{t-1} \right.\right)$. $\lambda_{m,t}$ is commonly interpreted as the *market price of risk* and $\lambda_{x_i,t}$ as the *intertemporal price of risk* (see, for instance, Scruggs, 1998, Gérard and Wu, 2006, and Lo and Wang, 2006). In this context, $\lambda_{m,t}$ can be defined as the "global", i.e. euro area, market price of risk. It is possible to show that $\lambda_{m,t} = -J_{ww,t} w_t / J_{w,t}$, i.e. the Arrow-Pratt coefficient of relative risk-aversion, where $J_{w,t}$ and $J_{ww,t}$ denote the first and second derivatives, respectively, of $J(\cdot)$ with respect to w_t (see, for instance, Merton 1973 and 1980, and Scruggs, 1998). Similarly, it can be shown that $\lambda_{x_i,t}$ is equal to $-J_{wx_i,t} w_t / J_{w,t}$ $\forall i$. As before, $J_{wx_i,t}$ is the derivative of the marginal utility of wealth with respect to the state variable $x_{i,t}$.[7] All second moments and prices of risk are conditional to the information set $\Im_{t-1}$.

Along the same lines, the excess returns on each sector s in country i, $r_{si,t}$, is a component of the country return, i.e. $r_{i,t} = \sum_{s \in i} \omega_{s,t} r_{si,t}$, where $\omega_{s,t}$ is the weight of industry s in market i. Using the pricing equation for $r_{i,t}$, the pricing equation for $r_{si,t}$ can be formulated as follows:

[7] The risk aversion assumption requires that $J_{w,t} > 0$ and $J_{ww,t} < 0$, implying that $\lambda_{m,t}$ has to be positive. However, the model does not impose any restriction on the sign of the price of intertemporal risk. If $J_{wx_i,t} < 0$ (> 0) then $\lambda_{x_i,t}$ will be negative (positive).

$$r_{si,t} = \beta_{si,t} r_{i,t} + \varepsilon_{si,t} \quad (3)$$
$$= \beta_{si,t}\beta_{im,t} r_{m,t} + \beta_{si,t}\beta_{ix_i,t} x_{i,t} + \beta_{si,t}\varepsilon_{i,t} + \varepsilon_{si,t},$$

where $\beta_{si,t}$ denotes the beta for the sector return s with respect to the country return $r_{i,t}$ and $\varepsilon_{si,t}$ is the industry country-specific residual. By construction $\varepsilon_{si,t}$ is orthogonal to the country equity return $r_{i,t}$. In addition, we also assume that $\varepsilon_{si,t}$ is orthogonal to $r_{m,t}$, $x_{i,t}$ and $\varepsilon_{i,t}$, which implies that $\beta_{sm,t} = \beta_{si,t}\beta_{im,t}$ and $\beta_{sx_i,t} = \beta_{si,t}\beta_{ix_i,t}$ (see Campbell et al., 2001).[8] Thus, equation (3) can be written as:

$$r_{si,t} = \lambda_{m,t} Cov\left(r_{si,t}, r_{m,t} \left| \Im_{t-1} \right.\right) + \lambda_{x_i,t} Cov\left(r_{si,t}, x_{i,t} \left| \Im_{t-1} \right.\right) + \quad (4)$$
$$+\lambda_{i,t} Cov\left(r_{si,t}, r_{i,t} \left| \Im_{t-1} \right.\right) + \varepsilon_{si,t},$$

where $\lambda_{i,t} \equiv \varepsilon_{i,t}/Var\left(r_{i,t} \left| \Im_{t-1} \right.\right)$. $\lambda_{i,t}$ can be interpreted as the price that the investor has to pay for the risk that cannot be diversified away when investing in the industry s in country i.[9] We define $\lambda_{i,t}$ as the *"national" market price of risk* and, as such, it will be country-specific. If euro area national markets become more integrated, the market risk premium, $\lambda_{m,t} Cov\left(r_{si,t}, r_{m,t} \left| \Im_{t-1} \right.\right)$ should become more important relative to the country risk premium $\lambda_{i,t} Cov\left(r_{si,t}, r_{i,t} \left| \Im_{t-1} \right.\right)$. If markets were fully integrated, the country premium should not be significantly priced.

The state variable $x_{i,t}$ captures the general macroeconomic conditions relative to country i. As such it affects returns on the national equity index and on the single industries.

From the general model described by equations (1) and (3) we can generate two special cases: a static CAPM and an ICAPM where the state variables are common

[8] Assuming that $\beta_{sx_i,t} = \beta_{si,t}\beta_{ix_i,t}$ is equivalent to hypothesize that the effect of the state variables on sector s is subsumed in the impact of the local market i.

[9] It is easy to show that the covariances of equation (4) follow from the combination of equations (1) and (3). Conditional Ordinary Least Square (OLS) estimates of $\beta_{im,t}$, $\beta_{ix_i,t}$, and $\beta_{si,t}$ are, respectively, given by:

$$\widehat{\beta}_{im,t} = \frac{Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1} \right.\right)}{Var\left(r_{m,t} \left| \Im_{t-1} \right.\right)}, \quad (i)$$

$$\widehat{\beta}_{ix_i,t} = \frac{Cov\left(r_{i,t}, x_{i,t} \left| \Im_{t-1} \right.\right)}{Var\left(x_{i,t} \left| \Im_{t-1} \right.\right)}, \quad (ii)$$

$$\widehat{\beta}_{si,t} = \frac{Cov\left(r_{si,t}, r_{i,t} \left| \Im_{t-1} \right.\right)}{Var\left(r_{i,t} \left| \Im_{t-1} \right.\right)}. \quad (iii)$$

When equation (1) and (3) are combined we obtain:

$$r_{si,t} = \beta_{si,t}\left(\beta_{im,t} r_{m,t} + \beta_{ix_i,t} x_{i,t} + \varepsilon_{i,t}\right) + \varepsilon_{si,t},$$

and the conditional OLS estimate of $\beta_{si,t}$ is equal to expressions (iii). Therefore equation (4) follows.

to all countries. Furthermore, we consider a case where industry-specific shocks are taken into account.

Static CAPM - The static CAPM can be derived from the ICAPM if $\beta_{ix_i,t} = 0$, or equivalently, if $J_{wx_i,t} = 0$. In this case equations (2) and (4) reduce to:

$$r_{i,t} = \lambda_{m,t} Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1} \right.\right) + \eta_{i,t}, \tag{5}$$

and

$$r_{si,t} = \lambda_{m,t} Cov\left(r_{si,t}, r_{m,t} \left| \Im_{t-1} \right.\right) + \lambda_{i,t} Cov\left(r_{si,t}, r_{i,t} \left| \Im_{t-1} \right.\right) + \eta_{si,t}. \tag{6}$$

where $\eta_{i,t}$ and $\eta_{si,t}$ are the country and country-sector specific residuals.

Intertemporal CAPM with a common state variable - Instead of considering distinct state variables for each country, we assume that a common global intertemporal factor is affecting all countries and industries. When the state variables do not vary across countries, i.e. $x_{i,t} = x_t \ \forall i$, equations (2) and (4) can be written as:

$$r_{i,t} = \lambda_{m,t} Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1} \right.\right) + \lambda_{x,t} Cov\left(r_{i,t}, x_t \left| \Im_{t-1} \right.\right) + \epsilon_{i,t}, \tag{7}$$

and

$$\begin{aligned} r_{si,t} &= \lambda_{m,t} Cov\left(r_{si,t}, r_{m,t} \left| \Im_{t-1} \right.\right) + \lambda_{x,t} Cov\left(r_{si,t}, x_t \left| \Im_{t-1} \right.\right) + \\ &\quad + \lambda_{i,t} Cov\left(r_{si,t}, r_{i,t} \left| \Im_{t-1} \right.\right) + \epsilon_{si,t}, \end{aligned} \tag{8}$$

where $\lambda_{x,t} \equiv x_t / Var\left(x_t \left| \Im_{t-1} \right.\right)$. $\epsilon_{i,t}$ and $\epsilon_{si,t}$ are the country and country-sector specific residuals.

Intertemporal CAPM with different state variables across countries and industries - An important pricing risk factor for a national industry could be its exposure to a global industry risk. The intertemporal models described by equations (1) and (3) accommodate this possibility if we include sector-specific state variables, $x_{s,t}$, in addition to a country-specific state variables (see, for instance, Moskowitz and Grinblatt, 1999, and Carrieri, Errunza and Sarkissian, 2004). In this case equation (3) becomes:

$$\begin{aligned} r_{si,t} &= \beta_{si,t} r_{i,t} + \beta_{sx_s,t} x_{s,t} + \zeta_{si,t} \\ &= \beta_{si,t} \beta_{im,t} r_{m,t} + \beta_{si,t} \beta_{ix_i,t} x_{i,t} + \beta_{si,t} \varepsilon_{i,t} + \beta_{sx_s,t} x_{s,t} + \zeta_{si,t}. \end{aligned} \tag{9}$$

By construction $\zeta_{si,t}$ is orthogonal to $r_{i,t}$ and $x_{s,t}$. Assuming that $\zeta_{si,t}$ is also orthogonal to $r_{m,t}$, $x_{i,t}$ and $\varepsilon_{i,t}$, which implies that $\beta_{sm,t} = \beta_{si,t}\beta_{im,t}$ and $\beta_{sx_i,t} = \beta_{si,t}\beta_{ix_i,t}$, equation (9) can be written in terms of second moments:

$$\begin{aligned} r_{si,t} &= \lambda_{m,t}Cov\left(r_{si,t}, r_{m,t}\left|\Im_{t-1}\right.\right) + \lambda_{i,t}Cov\left(r_{si,t}, r_{i,t}\left|\Im_{t-1}\right.\right) + \\ &+\lambda_{x_i,t}Cov\left(r_{si,t}, x_{i,t}\left|\Im_{t-1}\right.\right) + \lambda_{x_s,t}Cov\left(r_{si,t}, x_{s,t}\left|\Im_{t-1}\right.\right) + \zeta_{si,t}, \end{aligned} \tag{10}$$

where $\lambda_{x_s,t} \equiv x_{s,t}/Var(x_{s,t}\Im_{t-1})$ denotes the *industry (sector) price of risk* and $\zeta_{si,t}$ the residual.[10]

3 Empirical methodology

To render the models described by equations (2) and (4) – ICAPM, (5) and (6) – CAPM, (7) and (8) – ICAPM with one common intertemporal factor, and (2) and (10) – ICAPM with industry-specific factor – empirically tractable, the estimation procedure is carried out in two steps (see, for instance, Bekaert and Harvey, 1995, Carrieri, Errunza and Sarkissian, 2004, and Hardouvelis, Malliaropulos and Priestley, 2006).

In the first step we estimate a system of equity returns which only includes country and global equity markets (without industry returns). Therefore, if the analysis focuses on n national equity markets plus a global market portfolio, we will estimate a system of $n+1$ equations as in (2).

The theoretical model does not impose any restriction on the parameterization of the dynamics of the intertemporal pricing factors. Therefore, one can choose a functional form of the kind:

$$x_{i,t} = \mathbf{k}_i'\mathbf{y}_{i,t-1} + \varepsilon_{x_i,t}, \quad i = 1, ..., n+1, \tag{11}$$

where $\mathbf{y}_{i,t-1}$ are $k \times 1$ vectors of variables which have predictive power with respect to the factors and $\mathbf{k}_i$ are $k \times 1$ vectors of parameters, respectively.[11]

We collect the disturbance terms $\varepsilon_{i,t}$ and $\varepsilon_{x_i,t}$ from equations (2) and (11), respectively, in a $2(n+1) \times 1$ vector $\boldsymbol{\psi}_t = [\varepsilon_{1,t}, \ldots, \varepsilon_{n,t}, \varepsilon_{m,t}, \varepsilon_{x_1,t}, \ldots, \varepsilon_{x_n,t}, \varepsilon_{x_m,t}]'$, where

[10] If only one state variable is used across countries, the equation (10) reduces to

$$\begin{aligned} r_{si,t} &= \lambda_{m,t}Cov\left(r_{si,t}, r_{m,t}\left|\Im_{t-1}\right.\right) + \lambda_{i,t}Cov\left(r_{si,t}, r_{i,t}\left|\Im_{t-1}\right.\right) + \\ &+\lambda_{x,t}Cov\left(r_{si,t}, x_{t}\left|\Im_{t-1}\right.\right) + \lambda_{x_s,t}Cov\left(r_{si,t}, x_{s,t}\left|\Im_{t-1}\right.\right) + \zeta_{si,t}. \end{aligned}$$

[11] The specification of equation (11) considers the most general case where changes in investment opportunities of the global market are governed by a distinct state variable.

the subscript m refers to the error terms relative to the global market portfolio. $\boldsymbol{\psi}_t$ is assumed to have a conditional normal distribution:

$$\boldsymbol{\psi}_t \left| \Im_{t-1} \right. \sim N\left(\mathbf{0}, \mathbf{H}_{\psi,t}\right), \tag{12}$$

where $\mathbf{H}_{\psi,t}$ is a $2(n+1) \times 2(n+1)$ conditional covariance matrix of equity returns and pricing factors. Note that the conditional covariance terms in equation (2), $Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1} \right.\right)$ and $Cov\left(r_{i,t}, x_{i,t} \left| \Im_{t-1} \right.\right)$, are estimated using the $(n+1)$th and the $(n+1+j)$th, $j = 1, ..., n+1$, columns of $\mathbf{H}_{\psi,t}$, respectively.

In the second step, for *each* country we estimate the asset pricing equations relative to the sector returns in line with equation (4). From the first step estimation we retrieve the estimated residuals for each country equity return, $\widehat{\varepsilon}_{i,t}$, the estimated error terms for the global market portfolio, $\widehat{\varepsilon}_{m,t}$, and the estimated residuals for the state variable, $\widehat{\varepsilon}_{x_i,t}$. Next, for each national equity return, a $(S+3) \times 1$ vector of error terms, $\boldsymbol{\varphi}_{si,t}$, which includes the residuals of equation (4) as well as $\widehat{\varepsilon}_{i,t}$, $\widehat{\varepsilon}_{m,t}$ and $\widehat{\varepsilon}_{x_i,t}$, is constructed, i.e. $\boldsymbol{\varphi}_{si,t} = [\varepsilon_{1i,t}, \ldots, \varepsilon_{Si,t}, \widehat{\varepsilon}_{i,t}, \widehat{\varepsilon}_{m,t}, \widehat{\varepsilon}_{x_i,t}]'$. Similarly to $\boldsymbol{\psi}_t$, $\boldsymbol{\varphi}_{si,t}$ is assumed to have a conditional normal distribution:

$$\boldsymbol{\varphi}_{si,t} \left| \Im_{t-1} \right. \sim N\left(\mathbf{0}, \mathbf{H}_{\boldsymbol{\varphi}_{si},t}\right), \tag{13}$$

where $\mathbf{H}_{\boldsymbol{\varphi}_{si},t}$ is a $(S+3) \times (S+3)$ conditional covariance matrix of equity returns and pricing factors. Note that the conditional covariance terms in equation (4), $Cov\left(r_{si,t}, r_{m,t} \left| \Im_{t-1} \right.\right)$, $Cov\left(r_{si,t}, x_{i,t} \left| \Im_{t-1} \right.\right)$ and $Cov\left(r_{si,t}, r_{i,t} \left| \Im_{t-1} \right.\right)$ are estimated using the $(S+1)$th, the $(S+2)$th and the $(S+3)$th columns of $\mathbf{H}_{\boldsymbol{\varphi}_{si},t}$, respectively. The second step estimation is conditional not only to the estimates of the error terms $\widehat{\varepsilon}_{i,t}$, $\widehat{\varepsilon}_{m,t}$ and $\widehat{\varepsilon}_{x_i,t}$, but also to the estimates of the global market price of risk, $\widehat{\lambda}_{m,t}$, the intertemporal price of risk, $\widehat{\lambda}_{x_i,t}$, as well as the parameters relative to the specification of $Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1} \right.\right)$, $Cov\left(r_{i,t}, x_{i,t} \left| \Im_{t-1} \right.\right)$, $Cov\left(r_{m,t}, x_t \left| \Im_{t-1} \right.\right)$ and $Var\left(r_{m,t} \left| \Im_{t-1} \right.\right)$ obtained in the first step through the estimation of $\mathbf{H}_{\psi,t}$. This two-step approach has the disadvantage that standard errors may be smaller than the true ones since the first step sampling errors are ignored in the second step estimation. However, by imposing the same market price of risk, it has the advantage that it will lead to more powerful tests (see Bekaert and Harvey, 1995).

We apply the empirical methodology just described to estimate: (i) the static CAPM; (ii) the intertemporal CAPM with a common state variable across countries, i.e. equations (2) and (4) with $x_{i,t} = x_t$ $\forall i$; and (iii) the intertemporal CAPM with a common state variable and different sector-specific factors.

In line with Carrieri, Errunza and Sarkissian (2004), we estimate industry-specific state variables $x_{s,t}$ as the residual of the following regression:

$$r_{s,t} = \alpha_{s0} + \alpha_{s1} r_{m,t} + \sum_{i=1}^{n} \gamma_{si} r_{si,t} + x_{s,t}. \tag{14}$$

where, by construction, $x_{s,t}$ is orthogonal to the global market portfolio and to the country-industry equity returns. Industry-specific shocks, in turn, can be modelled as follows:

$$x_{s,t} = \lambda_{x_s,t} Var\left(x_{s,t} \left| \Im_{t-1} \right.\right) + \zeta_{s,t}, \tag{15}$$

where $Var\left(x_{s,t} \left| \Im_{t-1} \right.\right)$ is the conditional variance of $x_{s,t}$.[12] Note that equation (15) is stacked to the system of equations (10). In this case second moments are estimated using a $(S+4)\times 1$ vector of error terms, $\boldsymbol{\phi}_{si,t}$, which includes the residuals from equation (10) and (15), as well as $\widehat{\varepsilon}_{i,t}$, $\widehat{\varepsilon}_{m,t}$ and $\widehat{\varepsilon}_{x_i,t}$, i.e. $\boldsymbol{\phi}_{si,t} = \left[\zeta_{1i,t}, \ldots, \zeta_{Si,t}, \zeta_{s,t}, \widehat{\varepsilon}_{i,t}, \widehat{\varepsilon}_{m,t}, \widehat{\varepsilon}_{x_i,t}\right]'$. As before, $\boldsymbol{\phi}_{si,t}$ is assumed to have a conditional normal distribution:

$$\boldsymbol{\phi}_{si,t} \left| \Im_{t-1} \right. \sim N\left(\mathbf{0}, \mathbf{H}_{\phi_{si},t}\right), \tag{16}$$

where $\mathbf{H}_{\phi_{si,t}}$ is a $(S+4)\times(S+4)$ conditional covariance matrix of equity returns and pricing factors.

3.1 Estimation of second moments

We assume that the conditional covariance matrix follows a multivariate GARCH(1,1) process, according to Ding and Engle (2001):

$$\mathbf{H}_t = \mathbf{H}_0 \odot \left(\boldsymbol{\iota\iota}' - \mathbf{aa}' - \mathbf{bb}'\right) + \mathbf{aa}' \odot \boldsymbol{\xi}_{t-1}\boldsymbol{\xi}_{t-1}' + \mathbf{bb}' \odot \mathbf{H}_{t-1}, \tag{17}$$

where $\mathbf{H}_0$ is the unconditional correlation matrix of the error terms, i.e. $\mathbf{H}_0 = E\left(\boldsymbol{\xi}_t\boldsymbol{\xi}_t'\right)$; $\boldsymbol{\iota}$ represents the unit vector; $\mathbf{a}$ and $\mathbf{b}$ are vectors of parameters; and, finally, $\odot$ is the Hadamard (element by element) matrix product. Since expectations are unfeasible for $\mathbf{H}_0$, they are first replaced by sample analogs, $T^{-1}\sum_{t=1}^{T} \boldsymbol{\xi}_t\boldsymbol{\xi}_t'$, and then updated at each iteration with the value of the covariance matrix of estimated residuals (see De Santis and Gérard, 1997 and 1998). Relative to other multivariate GARCH specifications, the Ding and Engle (2001) parameterization has the advantage of being parsimonious in the number of unknown parameters (see, for instance, Engle and Kroner, 1995). In our two-step procedure, we estimate two covariance matrices of the kind represented by (17), one for each estimation step.

[12] In equation (15) we do not use autoregressive terms since $x_{s,t}$ should not be autocorrelated.

3.2 Estimation of prices of risk

The estimation of the market, intertemporal, country and sectoral prices of risk is carried out following two different approaches.

First, we let the prices of risk change in correspondence with the introduction of the euro in January 1999 using a dummy variable. Therefore, the prices of risk are modelled as follows:

$$\lambda_{k,t} = \lambda_{k0} + \lambda_{k1} d_t, \tag{18}$$

where $k = m$, x_i, i and x_s, whether $\lambda_{k,t}$ represents the market, the intertemporal, the country-specific (national), or the sector-specific price of risk, respectively; d_t is a dummy variable which is equal to zero from the beginning of the sample until end-December 1998 and equal to one thereafter.

Second, along the lines of Chou, Engle and Kane (1992), we estimate the linear projection of the prices of risk with a Kalman filter. Differently from previous studies (see, for instance, Bekaert and Harvey, 1995, De Santis and Gérard, 1997 and 1998, Carrieri, Errunza and Sarkissian, 2004, Gérard and Wu, 2006, and Hardouvelis, Malliaropulos, and Priestley, 2006), we do not impose any positivity constraints to the prices of risk nor any dependence on predetermined variables.[13] Instead, we assume that the λ's are latent time-varying parameters, which follow a linear dynamic. In appendix A we discuss the Kalman filter estimation of the prices of risk.

3.3 Likelihood function

In each estimation stage, we use the Quasi Maximum Likelihood (QML) method of Bollerslev and Wooldridge (1992) to estimate the unknown parameters of the model.[14] To this end, assuming that equity returns and pricing factors have a conditional normal distribution, we maximize the following log likelihood function with respect to $\boldsymbol{\theta}$, the vector of unknown coefficients:

$$L\left(\mathbf{z}_t \left| \Im_{t-1}; \boldsymbol{\theta}\right.\right) = -\frac{zT}{2}\ln\left(2\pi\right) - \frac{1}{2}\sum_{t=1}^{T}\ln\left[\left|\mathbf{H}_t\left(\boldsymbol{\theta}\right)\right|\right] - \frac{1}{2}\sum_{t=1}^{T}\boldsymbol{\xi}_t\left(\boldsymbol{\theta}\right)'\,\mathbf{H}_t\left(\boldsymbol{\theta}\right)^{-1}\boldsymbol{\xi}_t\left(\boldsymbol{\theta}\right), \tag{19}$$

[13] This line of research assumes that the variation in the market price of risk is determined by some information variables aimed at capturing variation in market sentiments and business cycle. The non-negativity of the market price of risk is ensured assuming specific functional forms (e.g. the exponential function).

[14] The QML methodology provides standard errors which are robust to departure from normality (see Bollerslev and Wooldridge, 1992, for further details).

where $\mathbf{z}_t$ is the vector of returns and pricing factors, z is the total number of assets and pricing factors and T the sample size.

4 Data

We use continuously compounded returns on stock indices for five countries (France, Germany, Italy, the Netherlands and Spain) and a set of six equity industry portfolios in each country (Basic Materials, Industrials, Consumer Goods, Consumer Services, Financials and Healthcare). We proxy the global market portfolio with the euro area equity market index. The choice to restrict the analysis to five countries and six sectors is the result of a compromise between the need to cover a large portion of the equity market values and the need to limit the size of the system and keep the estimation feasible. The five country indices cover on average around 87% of the market capitalization of the euro area index, while the six industry indices represent on average between 53% (for Spain) and 82% (for Germany) of the national index in each country. Data are observed at a weekly frequency, taking Thursday closing stock prices (in recognition of the Friday-effect). The sample period starts on April 1991 and ends on December 2007 for a total of 873 observations. The indices are value-weighted and include dividends. All equity indices are provided by Thomson Financial Datastream (see Appendix B for a detailed description of the indices).

We take the point of view of a euro area investor and therefore we analyze returns denominated in ECU currency until December 1998 and in euro currency thereafter.[15] We compute excess returns by subtracting the risk-free rate from the returns of each portfolio. The risk-free rate is the three-month Eurodeposit rate denominated in ECU until December 1998 and in euro from January 1999. These Eurodeposit rates are also observed at weekly frequency and are taken from the database of the Bank of International Settlements (BIS).

The state variable which drives changes in the investment opportunity set is derived from the excess returns of long-term bonds. In each country we take the difference between the returns on a long-term (ten-year) government bond index and the three-month Eurodeposit rate. The data on long-term bond indices are from Thomson Financial Datastream. In order to construct a unique state variable for the euro area and to overcome the problem of different yield curves in each country, we carry out a principal component analysis and use the first component as a proxy for the intertemporal pricing factor.[16]

[15] The ECU was a basket currency made up of the sum of fixed amounts of the 12 currencies which in 1999 entered Stage Three of the European Monetary Union. The value of the ECU was calculated as a weighted average of the value of its component currencies. It was replaced by the euro on a one-for-one basis on 1 January 1999.

[16] Over the entire sample the estimated principal component explains around 76% of the variance of the original series (59% until end-1998 and 95% thereafter).

Summary statistics for the excess equity return series, the risk-free rate and the intertemporal factor are reported in Table 1, Panel A. Over the entire sample, the average annual excess returns on the euro area market and on the country markets are comparable. However, average returns on the German and the Italian markets are relatively low and the Italian market is also characterized by the highest standard deviation. Panel B shows that excess returns tend to be positively correlated across markets and with the common state variable.

Table 2 shows summary statistics for the six equity industry portfolios entering the euro area equity market index.[17] The six industries we consider are the industries with highest market capitalization, for which data are available for all the countries and over the entire sample.[18] Looking at the realized excess returns, Basic Materials and Healthcare are the best performing sectors, with the latter industry showing also the lowest standard deviation. In terms of correlation (shown in Panel B), all sectors are positively correlated among themselves, but the Healthcare industry is relatively less correlated with the other sectors. The Financials sector is the industry with the highest market capitalization in the euro area index and in the country indices, although significant differences exist among countries.

5 Empirical results

In this section we discuss the estimation results for the conditional ICAPM and we compare them with the findings obtained when estimating the static CAPM. We restrict the estimation of the ICAPM to the case with a common state variable across countries, but we consider different sector-specific factors.[19]

Estimation results are presented in two different subsections. First, we report the results relative to the estimation of country risk premia for the static and intertemporal CAPM with a common state variable, in line with equations (5) and (7). Prices of risk are first kept constant, although we include a time dummy in correspondence

[17] Due to space constraints we do not report summary statistics relative to each sector in each of the five countries.

[18] These industries are chosen among the ten *economic sectors* as defined by Thomson Financial Datastream.

[19] Estimates can be carried out using different state variables for each country (see sections 2 and 3). However, this choice significantly increases the dimensionality of the system and makes it computationally difficult. At the same time, the convergence of interest rates across countries belonging to the EMU over the sample periods justify the adoption of a common state variable.

with the introduction of the euro in January 1999, and then modelled with a Kalman filter, which allows them to vary over time. When showing the results of the estimation of the ICAPM we decompose the total premium into a market and intertemporal premium, and provide some intuition behind the observed patterns. This set of results corresponds to the first-step estimation. We also conduct a robustness check to test whether world factors not captured by the euro area market portfolio have explanatory power for equity returns.

In the second subsection we report the estimated *industry risk premia* for the static and intertemporal CAPM with a common state variable, in line with equations (6) and (8). We also estimate industry risk premia with a common intertemporal factor and an industry-specific factor as in equation (10). This set of results corresponds to the second-step estimation and, as such, each equation also includes a country-specific risk factor.

5.1 Estimation of country equity premia

Table 3 shows the estimation results of equations (5) and (7) jointly for all five countries and the euro area market. The first two columns of Panel A report the estimates for the prices of risk and the relative standard errors for the static and intertemporal CAPM, respectively. All the estimated GARCH parameters (not reported in the table) are highly significant, supporting the parameterization of the variance-covariance matrix we propose.[20]

The estimated coefficient for the market price of risk, $\lambda_{m,t}$, is statistically significant in both models. Differently from previous approaches (see the references reported in section 3.2), we do not impose any non-negativity constraints and/or a functional structure on the price of market risk. Nevertheless, the estimate of the market price of risk is always positive, thus consistent with the interpretation of $\lambda_{m,t}$ as a risk aversion coefficient. As for the coefficient of the intertemporal risk, $\lambda_{x,t}$, it turns out to be negative and significantly priced at 10% confidence level. The introduction of the dummy variable in correspondence with the introduction of the euro in January 1999 in both models does not possess explanatory power, suggesting that the time-varying patterns of the prices of risk cannot be described satisfactorily imposing a one-time structural change.[21]

Before proceeding further, we test whether world factors not encompassed in the euro area equity market portfolio affect risk premia, and thus if our two-factor model should be extended to include an additional factor. We construct this additional

[20] Parameter estimates relative to the GARCH processes are available from the authors upon request.

[21] To save space we do not report the results of the estimation of both models with dummy variables.

factor to be orthogonal to the euro area market portfolio by regressing the returns of a world market portfolio on the returns on the euro area market portfolio and use the residuals from this regression as a new risk factor.[22] Next we estimate the CAPM and the ICAPM with this additional pricing factor. The results of these estimations are shown in the third and fourth column of Panel A of Table 3. In the static CAPM the additional risk factor is not priced, since the coefficient associated to it, λ_G, is not significant. When we estimate an ICAPM with the additional risk factor, we find that no factor is statically priced. This inflation in the variance of the estimators can be related to the inclusion of irrelevant variables as shown, for instance, in Greene (2008). The results do not change when we include dummy variables (not shown). Overall these findings suggest that neglecting additional world-related factors does not lead to misspecification of our empirical model.[23]

Panel B and C report some diagnostic test statistics on the residuals of the models. The inclusion of an intertemporal factor improves the performance of the model as reflected in the higher values of the Loglikelihood function for the ICAPM with respect to the static CAPM.

Next we estimate both models with time-varying prices of risk using a Kalman filter methodology. This approach accommodates a (possibly) gradual incorporation in market participants' expectations of the impact of the euro before January 1999.

The results of the estimation of the time-varying prices of risk, which we model as an autoregressive process of order one and estimate with a Kalman filter (see the system of equations (A2) of appendix A) are shown in Table 4, Panel A.[24] The autoregressive coefficient is significant only for the intertemporal price of risk, $\lambda_{x,t}$, while for the market price of risk, $\lambda_{m,t}$, there is no evidence of time variation.[25] The log likelihood function values and the residual diagnostics are reported in Panel B. Figure 1 plots the evolution of the market and intertemporal prices of risk over time. $\lambda_{m,t}$ is stable and its estimate changes very little when the CAPM (not shown in the figure) or the ICAPM is used. On the contrary, $\lambda_{x,t}$, the price of intertemporal risk, exhibit a high volatility and it is almost always negative (consistent with the coefficient estimated in an ICAPM with fixed prices of risk as shown in Table 3).

[22] The world equity market index is from Thomson Financial Datastream.

[23] As a robustness check, we have also used the US stock market as a proxy for the additional global factor and obtained the same qualitative results.

[24] Due to space constraints, we only report results relative to the intertemporal CAPM. Estimates of the time-varying market price of risk for the static CAPM are qualitatively similar to those obtained for the intertemporal model and are available from the authors upon request.

[25] The variances of the coefficients cannot be estimated with precision. Note that if the prices of risk are estimated with a white noise process, the estimation of the variances is highly significant.

Figure 2 plots the weekly equity premia estimated with the ICAPM and time-varying λ's for each country and for the euro area. In each chart the market premium, $\lambda_{m,t} Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1}\right.\right)$, the intertemporal premium, $\lambda_{x,t} Cov\left(r_{i,t}, x_t \left| \Im_{t-1}\right.\right)$, and the total premium, which is given by the sum of two, are displayed. The same broad results hold for all countries. With regard to the market risk component, it has been relatively stable up to mid-1998 when it started to increase in correspondence with the Asian and the Russian crises to reach a peak ahead of the burst of the stock market bubble. Later on, the market premium reached a historical high at the end of 2002, when the accounting scandals surrounding companies both in the US and in Europe increased the systematic risk of equity as perceived by investors.

The contribution of the intertemporal component is almost always negative, implying that, on average, the premium due to hedging demand has contributed to lower the overall equity premium.[26] As explained, the intertemporal factor can be interpreted as a *portfolio hedging* against adverse changes in investment opportunities. This factor is related to the steepness of the yield curve, and in particular to the relative level of long and short interest rates.

The level of long-term rates is determined by inflation and economic growth expectations. A favorable economic outlook should let investors decrease the premium they demand to hold equities. For example in 1994-1995, the occurrence of the "inflation scare" and the subsequent crises in the bond market drove investors away from long-term bonds and caused the yield curve to steepen significantly. At this time, investors valued equity as a good hedge against inflation and were ready to hold equities at a lower expected premium. Conversely, since the beginning of the financial turmoil triggered by the US sub-prime crises in the summer of 2007, increased global uncertainty and subsequent "flight to quality" drove funds away from the stock markets towards the bond markets, which resulted in a negative covariance between equity returns and the intertemporal factor. As a consequence, over the last months of the sample, the hedging component has been positively contributing to the equity premium.[27]

The level of short-term interest rates is directly related to the monetary policy decisions of central banks. The level of interest rates decided by central banks influence the price of equities (and therefore the equity premium) through several channels, for instance via a substitution effect between short-term government bonds and equities,

[26] Within the euro area, national bond yields have converged to the German yields while approaching the introduction of the euro in 1999. Therefore the variance explained by the principal component increases after 1999. This implies that the pricing performance of the intertemporal factor has increased over the second part of the sample, reflecting the higher synchronisation of market cycles across countries.

[27] Note that, in recent months, the negative intertemporal price of risk (see figure 1) and the negative covariance generate a positive premium.

the discounting of the future stream of expected dividends, the sheer liquidity they provide to the system, etc. Typically a decrease in short-term rates tends to generate an increase in equity prices and a reduction in equity premia (see, for instance, Bernanke and Kuttner, 2004). Between mid-2002 and mid-2003, for example, the *market premium* tended to be very high because of the occurrence of the accounting scandals in the US and in Europe. However, at the same time, the accommodative monetary policy stance of central banks, coupled with positive expectations of economic growth, which the intertemporal factor subsumes, contributed in lowering the total equity premium.

The disaggregation between market and intertemporal risk at the country level is broadly similar to the one obtained for the euro area. The equity premium after the introduction of the single currency follows a very similar path in all the countries considered. In earlier periods some differences are notable, in particular concerning the impact of the intertemporal premium in Italy and in Spain during the 1994-1995 crises.

Over the entire sample the average market and intertemporal premia are different in sign as well as in size. While the market premia tends to be economically significant, with an annual average of around 10.5%, the intertemporal premium is on average negative and close to 3% in absolute value. However, as discussed above, the intertemporal risk premium has been large in some periods and the introduction of an intertemporal pricing factor improves the performance of the model.

5.2 Estimation of industry equity premia

As discussed in section 2, estimation is carried out in two steps. The market and intertemporal prices of risk, the relevant error terms and second moment parameters estimated in the first step are then used in the second step estimation, where industry premia in each country are evaluated.

Table 5 reports the coefficients of the country prices of risk, $\lambda_{i,t}$, when estimating industry premia for six sectors in each country.[28] Panel A shows these coefficients when industry premia are estimated using a CAPM as in equation (6) and the market price of risk, $\lambda_{m,t}$, has been estimated in the first step. The coefficient of the country risk factor is never statistically significant before the introduction of the single currency and it becomes significant for two countries (Germany and the Netherlands) after January 1999. For all countries the value of the coefficient increases after the

[28] The estimates of the country prices of risk with a Kalman filter do not show any significant dynamics. Therefore, we only report results obtained with fixed prices of risk and a dummy variable in correspondence with the introduction of the euro in January 1999.

introduction of the euro. Therefore, these results would suggest that the importance of country factors has increased over the last few years and that the euro area equity market has become more segmented.

However, the outcome changes if we introduce an intertemporal pricing factor and estimate an ICAPM. Panel B shows estimates corresponding to equation (8). Again, estimates for the market and the intertemporal prices of risk are obtained in the first step. In this framework, the country price of risk, $\lambda_{i,t}$, is never statistically significant except for Germany before the introduction of the euro. In addition, the country prices of risk, albeit not significant, decrease in value for four of the five countries. The influence of the country factor is subsumed by the intertemporal factor: this implies that omitting the intertemporal factor can lead to erroneous conclusions regarding financial integration. When looking at stock return comovements for the core EU countries, our results are qualitatively consistent with those obtained by Bekaert, Hodrick and Zhang (2008).[29] The study argues that the increased correlation among these countries is consistent with a process of global integration which possibly started in the mid-1980s, with the abolition of capital controls. Panel C shows summary statistics and diagnostics for the residuals of the ICAPM estimation.

Since the impact of country factors is not statistically significant, the decomposition of the total equity premia at the industry level between market and intertemporal premia is qualitatively similar to the decomposition observed for country premia. Moreover, industry premia exhibit an analogous pattern across countries, although there are differences across sectors. Even though the market premium remains the main determinant of the total premium, at times the required premium in certain sectors is more affected by the intertemporal premium. Figure 3 shows the decomposition between market, intertemporal and country premium for the Financials and Healthcare sectors in France. For example, in 2002, corresponding to the accounting scandals surfaced in the US and in Europe, the market premium increased significantly for all stocks, but relatively more for stocks belonging to the Financials industry than to the Healthcare industry. The intertemporal factor at that time exerted downward pressure on the overall premium, but its effect was more significant for equities belonging to the Healthcare sector, which were perceived to be a good hedge during the market turbulence.

Finally, in line with equation (10) in the case of a common state variable, we estimate sector returns adding an industry-specific factor, in addition to market,

[29] This group of countries include: Belgium, France, Germany, Italy and the Netherlands.

intertemporal and country risks.[30] Country and industry-specific prices of risk estimated with this four-factor model are reported in Table 6.[31] Most of the estimated prices of risk are not statistically significant, thus supporting the use of the ICAPM with two factors also at industry level. However, there are some differences across countries. Italy and the Netherlands are the markets where more often the sectoral prices of risk are priced. In particular, in Italy the coefficient of the Industrials sector is always significant and the price of risk for the Consumer Goods and the Healthcare sectors are significant after January 1999. In the Netherlands the coefficient for the Basic Materials is always significant as well as the price of risk for the Financials industry after the introduction of the euro. The inclusion of an industry-specific state variable improves the performance of the ICAPM for sector returns as shown in the value of the log likelihood function reported in Table 6.

6 Conclusions

In this article we estimate equity premia at country and industry level for five euro area markets: France, Germany, Italy, the Netherlands and Spain. We use a conditional intertemporal CAPM along the lines of Merton (1973), where, besides the traditional market portfolio, we also include a hedging portfolio as an additional pricing factor. We compute a common intertemporal risk factor by taking the first principal component from the difference between the returns on ten-year government bonds in each country and the three-month Eurodeposit rate. Therefore this factor can capture investors' expectations about general macroeconomic conditions as well as the impact of the monetary policy stance decided by central banks. We compare the equity premia estimated with an intertemporal model with the estimates arising from a static CAPM. Consistently with the results already documented in the literature, our findings emphasize that traditional CAPM-type models can be mispriced and generate spurious outcomes.

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[30] In equation (10) the industry-specific factor is calculated as the residual of the regression

$$r_{sm,t} = \gamma_0 r_{m,t} + \gamma_1 r_{sj,t} + \gamma_2 r_{sl,t} + x_{s,t},$$

where $r_{sm,t}$ denotes the return on a euro area industry index s; $r_{m,t}$ the return on the euro area market portfolio index; and $x_{sj,t}$ and $x_{sl,t}$ the returns of the same industry s in country j and l, respectively. Country j and l are those where industry s has the highest market capitalization. For example, the returns on the euro area Basic Material sector are regressed on the returns on the euro area market and on the returns on the Basic Materials sectors in France and Germany. Considering the sectors for all the five countries would generate multicollinearity. Moreover, for the sake of simplicity, we do not assume any structure for the residuals $x_{s,t}$.

[31] Estimates of market and intertemporal prices of risk as well as those relative to second moments are available from the authors upon request.

The market and intertemporal prices of risk are first kept constant (although a time dummy is included in correspondence with the introduction of the euro in January 1999) and then let be time-varying according to a Kalman filter. This approach can accommodate changes in preferences, but also capture the possibility that investors may have incorporated the economic impact of the introduction of the single currency before 1999.

For each country we decompose industry risk premia into four components, which depend on the risk exposure to (i) the euro area market returns, (ii) an intertemporal risk factor, (iii) the country-specific returns, and (iv) an industry-specific factor.

We find that both the market and the intertemporal risk are significantly priced. On average, the market premium is the main determinant of the total premium, although at times the intertemporal premium significantly affects the overall premia required by investors to hold equities. For example, in the second half of 2002 the intertemporal premium contributed to decreasing the total premium, while the reverse has happened between the summer of 2007 and the end of the sample in correspondence with the US sub-prime crises.

Our framework also sheds light on the degree of financial integration across sectors and countries in the euro area. When estimating expected returns with an ICAPM country factors are not priced, suggesting that euro area equity markets were integrated throughout the sample period. Conversely, when the intertemporal factor is omitted, some country-specific prices of risk are significant. Therefore the adoption of a static model could lead to erroneous conclusions concerning the degree of financial integration in a region. As for industry-specific factors, they are also generally not priced although some differences exist across countries and sectors.

A Appendix: Estimation of the prices of risk with a Kalman filter methodology

As discussed in the main text, the evaluation of equity premia relies on a two step estimation methodology. In the first step we estimate the system of equations (2) and jointly evaluate $\lambda_{m,t}$ and $\lambda_{x,t}$ with a Kalman filter.[32] In state-space form, the system (2) constitutes the measurement equations, while the dynamics of the λ's determine the transition equations. We conveniently re-write the system (2) in matrix notation:

$$\mathbf{r}_t = \mathbf{\Xi}_t \boldsymbol{\lambda}_t + \boldsymbol{\varepsilon}_t, \tag{A1}$$

where $\mathbf{\Xi}_t$ denotes a $(n+1) \times 2$ matrix containing the relevant second moments and $\boldsymbol{\lambda}_t$ a 2×1 vector with the prices of market and intertemporal risk. For example, if $n = 1$, the matrix of second moment would be:

$$\mathbf{\Xi}_t = \begin{bmatrix} Cov\left(r_{1,t}, r_{m,t} \left| \Im_{t-1}\right.\right) & Cov\left(r_{1,t}, x_t \left| \Im_{t-1}\right.\right) \\ Var\left(r_{m,t} \left| \Im_{t-1}\right.\right) & Cov\left(r_{m,t}, x_t \left| \Im_{t-1}\right.\right) \end{bmatrix}.$$

The λ's are modelled as an autoregressive process of order one:

$$\boldsymbol{\lambda}_t = \mathbf{C} + \mathbf{G}\boldsymbol{\lambda}_{t-1} + \boldsymbol{\upsilon}_t, \tag{A2}$$

where $\mathbf{C} = [c_m, c_x]'$ is a 2×1 vector of constant coefficients, $\mathbf{G}$ is a 2×2 diagonal matrix with elements g_m and g_x on the main diagonal and $\boldsymbol{\upsilon}_t$ is a 2×1 vector of error terms. $\boldsymbol{\upsilon}_t$ is assumed to have a normal distribution with zero mean and variance-covariance matrix $\mathbf{\Sigma}$, i.e. $\boldsymbol{\upsilon}_t \sim N(\mathbf{0}, \mathbf{\Sigma})$.

The Kalman filter allows a recursive estimate of the prices of risk $\lambda_{m,t}$ and $\lambda_{x,t}$ according to the following equations:

$$\boldsymbol{\lambda}_{t|t-1} = \mathbf{C} + \mathbf{G}\boldsymbol{\lambda}_{t-1}, \tag{A3}$$

$$\mathbf{P}_{t|t-1} = \mathbf{G}\mathbf{P}_{t-1}\mathbf{G}' + \mathbf{\Sigma}, \tag{A4}$$

$$\widehat{\boldsymbol{\varepsilon}}_{t|t-1} = \mathbf{r}_t - \mathbf{\Xi}_t \boldsymbol{\lambda}_{t|t-1}, \tag{A5}$$

$$\mathbf{S}_{t|t-1} = \mathbf{\Xi}_t \mathbf{P}_{t|t-1} \mathbf{\Xi}_t' + \mathbf{H}_t, \tag{A6}$$

[32] We only consider the case where a common factor prices the returns in all national equity indices. This implies that $\lambda_{x_i,t} = \lambda_{x,t}\ \forall i$, i.e.the intertemporal price of risk is the same for all countries.

$$\boldsymbol{\lambda}_t = \boldsymbol{\lambda}_{t|t-1} + \left(\mathbf{P}_{t|t-1}\boldsymbol{\Xi}_t'\mathbf{S}_{t|t-1}^{-1}\right)\widehat{\varepsilon}_{t|t-1}, \tag{A7}$$

$$\mathbf{P}_t = \left[\mathbf{I} - \left(\mathbf{P}_{t|t-1}\boldsymbol{\Xi}_t'\mathbf{S}_{t|t-1}^{-1}\right)\boldsymbol{\Xi}_t\right]\mathbf{P}_{t|t-1}, \tag{A8}$$

where the subscript "$_{t|t-1}$" denotes that the time t forecast of the relevant variable is carried out on the basis of data observed through date $(t-1)$; $\mathbf{P}_t$ is a mean square error matrix associated with the forecast of $\boldsymbol{\lambda}_t$; $\widehat{\varepsilon}_t$ is the forecast error relative to equation (A1); $\mathbf{S}_t$ is a mean square error matrix associated with the forecast of $\mathbf{r}_t$; $\mathbf{H}_t$ is the covariance matrix of the error terms $\boldsymbol{\varepsilon}_t$, i.e. $E\left(\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t'\right) = \mathbf{H}_t$, which we assume to be a GARCH process; finally, equations (A7) and (A8) update the inference on $\boldsymbol{\lambda}_t$ and $\mathbf{P}_t$ on the basis of the information contained in equations (A5) and (A6), respectively.[33]

[33] Notice that $\mathbf{I}$ is a 2×2 identity matrix.

B Appendix: Datastream global indices

The returns on the equity markets are calculated from the Global Indices provided by Thomson Financial Datastream. These indices are calculated at national, regional and world level. For each market, a representative sample of stocks covering a minimum of 75% of total market capitalization is used to compute these *total market* indices. By aggregating market indices for regional groupings, regional and world indices are produced. Within each market, stocks are allocated to industrial sectors using the standard FTSE Global Classification System and consistently also sector indices are calculated.

To calculate equity returns we have used the *total return* indices, which are constructed taking into account the theoretical growth in value of a share holding starting from the beginning of the history of the index and assuming that dividends are re-invested to purchase additional units of the stock.

All indices are expressed in euro (ECU before 1999). The weekly excess returns of the indices have been computed as the difference between the return on the equity index and the three-month Eurodeposit rate (in ECU before 1999 and in euro currency thereafter) as published by the BIS.

To construct the intertemporal factor we have used Benchmark Indices as provided by Thomson Financial Datastream. These indices are based on single bonds. The bond chosen for each series is the most representative bond available for the given maturity band at each point in time. Benchmarks are selected according to the accepted conventions within each market. Generally, the benchmark is the latest issue within the given maturity band, but consideration is also given to liquidity, issue size and coupon. The *total return* indices, which are used in the paper, take into account the effect of re-investing into the bonds all the gross coupons received.

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Table 1: *Summary statistics for euro area and country returns*

Panel A: Summary statistics

	r_{euro}	r_{FR}	r_{GE}	r_{IT}	r_{NL}	r_{SP}	r_f	pc
Mean	0.119	0.132	0.095	0.058	0.139	0.135	0.090	0.128
Mean annual	6.175	6.874	4.938	2.991	7.247	7.045	4.676	6.676
Median	0.299	0.247	0.256	0.293	0.370	0.373	0.079	0.170
Standard deviation	2.166	2.419	2.421	2.938	2.305	2.511	0.047	1.750
Min	-10.213	-9.793	-12.065	-14.534	-11.512	-14.500	0.036	-8.147
Max	10.926	13.073	12.338	12.485	10.927	9.738	0.235	9.655

Panel B: Cross-correlations

	r_{euro}	r_{FR}	r_{GE}	r_{IT}	r_{NL}	r_{SP}	r_f	pc
r_{euro}	1							
r_{FR}	0.933	1						
r_{GE}	0.939	0.830	1					
r_{IT}	0.777	0.659	0.650	1				
r_{NL}	0.911	0.827	0.848	0.635	1			
r_{SP}	0.799	0.728	0.693	0.630	0.669	1		
r_f	-0.060	-0.045	-0.047	-0.080	-0.017	-0.081	1	
pc	0.096	0.084	0.027	0.241	0.005	0.212	-0.021	1

Euro area and country equity market excess returns are computed using the value-weighted Thomson Financial Datastream *total market* indices for France (FR), Germany (GE), Italy (IT), Spain (SP), the Netherlands (NL) and the euro area (euro) denominated in ECU until December 1998 and in euro thereafter. All returns are continuously compounded, espressed in percent per week (except Mean annual) and in excess of the risk free rate. The risk free rate is the 3-month Eurodeposit rate denominated in ECU until December 1998 and in euro thereafter. pc is the first principal component of the five series of excess returns of the ten-year bond indices (from Thomson Financial Datastream) in each country in excess of the risk free rate. The sample covers the period April 1991 through December 2007 (for a total of 873 observations).

Table 2: *Summary statistics for euro area industry returns*

Panel A: Summary statistics

	Industrials	*Cons Goods*	*Cons Svcs*	*Financials*	*Health Care*	*Basic Materials*
Mean	0.119	0.098	0.106	0.117	0.141	0.167
Mean annual	6.172	5.072	5.527	6.106	7.338	8.660
Median	0.337	0.265	0.159	0.246	0.176	0.333
Standard dev	2.563	2.760	2.325	2.452	2.009	2.272
Min	-13.171	-18.924	-11.072	-12.324	-8.797	-10.750
Max	11.905	14.594	10.815	13.016	8.368	8.503
Mk Cap	.10	.06	.08	.29	.09	.09

Panel B: Correlations

	Industrials	*Cons Goods*	*Cons Svcs*	*Financials*	*Healthcare*	*Basic Materials*
Industrials	1					
Cons Goods	0.805	1				
Cons Svcs	0.708	0.572	1			
Financials	0.702	0.644	0.819	1		
Healthcare	0.475	0.460	0.651	0.733	1	
Basic Materials	0.671	0.630	0.780	0.814	0.710	1

Industry excess returns are computed using the value-weighted Thomson Financial Datastream *total market* indices for six industries: Basic Materials, Industrials, Consumer goods (Cons Goods), Consumer services (Cons Svcs), Financials and Healthcare denominated in ECU until December 1998 and in euro thereafter. All returns are continuously compounded, expressed in percent per week and in excess of the risk free rate. The risk free rate is the 3-month Eurodeposit rate denominated in ECU until December 1998 and in euro thereafter. The sample covers the period April 1991 through December 2007 (for a total of 873 observations). Mk Cap is the share of the euro area index market capitalization due to a particular industry. It is calculated as average over the entire sample period (notice that Mk Cap does not sum up to one because not all the sectors are included in the analysis).

Table 3: *CAPM and ICAPM, step 1 estimation*

Panel A: Market and intertemporal prices of risk

	CAPM	ICAPM	CAPM with global factor	ICAPM with global factor
λ_m	0.0300*	0.0287*	0.0277*	0.0263
	(0.016)	(0.013)	(0.016)	(0.032)
λ_x		-0.0323*		-0.0273
		(0.018)		(0.030)
λ_G			0.0626	0.0435
			(0.640)	(1.994)

Panel B: Summary statistics and diagnostics for the residuals: CAPM

	Euro	*France*	*Germany*	*Italy*	*The Netherlands*	*Spain*
Stn. error residuals	2.42	2.42	2.94	2.31	2.51	2.17
Durbin-Watson	2.00	2.02	1.99	2.00	1.99	2.00
Q-stat (5)	0.00	0.00	0.15	0.02	0.10	0.12
Skewness	-0.65	-0.19	-0.39	-0.34	-0.70	-0.62
Kurtosis	6.23	4.91	3.68	4.37	4.85	5.03
Bera-Jarque	0.00	0.00	0.00	0.00	0.00	0.00
Log-likelihood function	8.49					

Panel C: Summary statistics and diagnostics for the residuals: ICAPM

	Euro	*France*	*Germany*	*Italy*	*The Netherlands*	*Spain*
Stn. error residuals	2.42	2.43	2.94	2.31	2.52	2.17
Durbin-Watson	1.99	2.01	1.99	2.00	1.98	2.00
Q-stat (5)	0.00	0.00	0.16	0.02	0.11	0.11
Skewness	-0.67	-0.09	-0.52	-0.41	-0.58	-0.58
Kurtosis	6.45	4.18	4.02	4.41	4.93	5.40
Bera-Jarque	0.00	0.00	0.00	0.00	0.00	0.00
Log-likelihood function	10.29					

Panel A reports estimates of the market price of risk, (λ_m), the intertemporal price of risk, (λ_x), and the residual world factor prices of risk, (λ_G). Estimates are based on weekly, continuously compounded equity returns from April 1991 through December 2007 (873 observations). QML standard errors are reported in parentheses. Asterisks indicate statistical significance of at least 10 percent confidence level. In Panels B and C we report diagnostic test statistics for the residuals and measures of fit for the CAPM and the ICAPM as in equations (5) and (7) respectively. P-values for the Q-stat(5) (the Ljung-Box test statistic of order five) and for the Bera-Jarque normality test statistic are also reported. The statistics are computed on standardised residuals.

Table 4: *ICAPM with Kalman filter, step 1 estimation*

Panel A: Market and intertemporal prices of risk

$$\binom{\lambda_{m,t}}{\lambda_{x,t}} = \begin{pmatrix} 0.0275 \\ (\mathit{0.046}) \\ -0.0003 \\ (\mathit{0.000}) \end{pmatrix} + \begin{pmatrix} \begin{matrix} 0.3543 \\ (\mathit{1.013}) \end{matrix} & 0 \\ 0 & \begin{matrix} 0.9954* \\ (\mathit{0.007}) \end{matrix} \end{pmatrix} \binom{\lambda_{m,t-1}}{\lambda_{x,t-1}} + \upsilon_t.$$

where $\boldsymbol{\upsilon}_t \sim N(\mathbf{0}, \boldsymbol{\Sigma})$

$$\Sigma = \begin{pmatrix} \begin{matrix} 0.0000 \\ (\mathit{0.035}) \end{matrix} & / \\ \begin{matrix} -0.0015 \\ (\mathit{0.003}) \end{matrix} & \begin{matrix} 0.0077 \\ (\mathit{0.005}) \end{matrix} \end{pmatrix}$$

Panel B: Summary statistics and diagnostics for the residuals: ICAPM

	Euro	*France*	*Germany*	*Italy*	*The Netherlands*	*Spain*
Stn. error residuals	2.42	2.42	2.94	2.30	2.52	2.17
Durbin-Watson	1.99	2.01	1.99	2.00	1.98	2.00
Q-stat (5)	0.00	0.00	0.11	0.02	0.17	0.09
Skewness	-0.65	-0.08	-0.48	-0.44	-0.59	-0.59
Kurtosis	6.42	4.22	3.89	4.39	4.78	5.38
Bera-Jarque	0.00	0.00	0.00	0.00	0.00	0.00
Log-likelihood function	10.30					

Panel A reports estimates of the time varying market and intertemporal prices of risk, $\lambda_{m,t}$, $\lambda_{x,t}$, respectively, using a Kalman filter approach according to equation (20) in appendix A. Estimates are based on weekly, continuously compounded equity returns from April 1991 through December 2007 (873 observations). QML standard errors are reported in parentheses. Asterisks indicate statistical significance of at least 10 percent confidence level. In Panel B we report diagnostic test statistics for the residuals and measures of fit for the ICAPM as in equation (8) where coefficient are modelled with a Kalman Filter. P-values for the Q-stat(5) (the Ljung-Box test statistic of order five) and for the Bera-Jarque normality test statistic are also reported. The statistics are computed on standardised residuals.

Table 5: *CAPM and ICAPM, step 2 estimation: Country prices of risk*

Panel A: Static CAPM

	France	*Germany*	*Italy*	*The Netherlands*	*Spain*
λ_{i0}	0.0066	0.0190	-0.0064	0.0195	0.0067
	(0.024)	(0.020)	(0.013)	(0.027)	(0.026)
$\lambda_{i0} + \lambda_{i1}$	0.0169	0.0284*	0.0141	0.0444*	0.0146
	(0.018)	(0.015)	(0.019)	(0.013)	(0.018)

Panel B: Intertemporal CAPM

	France	*Germany*	*Italy*	*The Netherlands*	*Spain*
λ_{i0}	0.0009	-0.0053*	-0.0029	0.0048	-0.0038
	(0.005)	(0.003)	(0.002)	(0.009)	(0.007)
$\lambda_{i0} + \lambda_{i1}$	0.0018	0.0014	0.0016	0.0018	-0.0014
	(0.003)	(0.003)	(0.006)	(0.004)	(0.006)

Panel C: Summary statistics and diagnostics for the residuals: ICAPM

	France	*Germany*	*Italy*	*The Netherlands*	*Spain*
Loglikelihood function	15.44	15.27	17.55	17.32	17.76
Industrials					
Stn. error residuals	2.87	2.76	3.72	4.74	2.69
Consumer goods					
Stn. error residuals	2.98	3.27	3.55	3.33	4.18
Consumer svcs					
Stn. error residuals	2.77	2.67	3.11	2.50	2.71
Financials					
Stn. error residuals	2.97	2.86	3.13	2.85	2.97
Healthcare					
Stn. error residuals	2.53	2.08	3.47	2.65	2.73
Basic Materials					
Stn. error residuals	2.66	2.68	3.52	3.05	2.76

The table reports estimates of the country price of risk, $(\lambda_{i,t} = \lambda_{i0} + \lambda_{i1} d_t)$, as in equation (1) where d_t is a dummy variable which takes on value zero until December 1998 and one thereafter. Panel A reports estimates based on the static CAPM, as in equation (6), while Panel B shows estimates with an intertemporal CAPM as in equation (8). Estimates are based on weekly, continuously compounded equity returns from April 1991 through December 2007 (873 observations). QML standard errors are reported in parentheses. Asterisks indicate statistical significance of at least 10 percent confidence level. Panel C reports the standard errors of residuals for each industry.

Table 6: *ICAPM, step 2 estimation: Country and industry prices of risk*

		France	*Germany*	*Italy*	*The Netherlands*	*Spain*
Country	λ_{i0}	0.0022	-0.0039	-0.0009	0.0125	0.0033
		(0.005)	(0.005)	(0.003)	(0.011)	(0.007)
	$\lambda_{i0} + \lambda_{i1}$	-0.0006	0.0042	0.0060	0.0087*	-0.0041
		(0.003)	(0.003)	(0.004)	(0.003)	(0.008)
	LogLike	19.42	19.00	21.79	20.65	22.13
Industrials	λ_{s0}	0.0255	0.0115	-0.5297*	-0.0921	-0.1231
		(0.265)	(0.761)	(0.236)	(0.115)	(1.139)
	$\lambda_{s0} + \lambda_{s1}$	-0.1124	-0.2301	-0.2204*	-0.0545	-0.4069
		(0.158)	(0.259)	(0.121)	(0.064)	(0.565)
	Stn error res	2.87	2.76	3.71	4.74	2.69
Cons Goods	λ_{s0}	-0.0381	-0.0046	0.0333	-0.0088	-0.2261
		(0.027)	(0.028)	(0.026)	(0.080)	(0.217)
	$\lambda_{s0} + \lambda_{s1}$	-0.0023	-0.0229	-0.0872*	0.0956	-0.0233
		(0.021)	(0.014)	(0.033)	(0.060)	(0.225)
	Stn error res	2.98	3.27	3.55	3.33	4.18
Cons Svcs	λ_{s0}	0.0085	-0.1151	-0.1069	0.3741	-0.0986
		(0.257)	(0.097)	(0.176)	(0.381)	(0.238)
	$\lambda_{s0} + \lambda_{s1}$	0.0250	-0.0462	-0.0238	-0.0679	-0.0839
		(0.089)	(0.074)	(0.061)	(0.127)	(0.144)
	Stn error res	2.77	2.67	3.11	2.50	2.71
Financials	λ_{s0}	0.0998	-0.0224	0.1044	-0.0926	-0.1463*
		(0.076)	(0.145)	(0.086)	(0.099)	(0.085)
	$\lambda_{s0} + \lambda_{s1}$	0.0331	-0.3176*	0.0566	-0.1413*	0.0461
		(0.057)	(0.076)	(0.081)	(0.044)	(0.084)
	Stn error res	2.97	2.86	3.13	2.85	2.97
Healthcare	λ_{s0}	0.1151	0.3144	-0.2813	-0.0256	-0.2059
		(0.375)	(0.472)	(0.389)	(0.089)	(0.407)
	$\lambda_{s0} + \lambda_{s1}$	0.2777	-0.3913	-1.3579*	0.0261	0.4518
		(0.351)	(0.497)	(0.362)	(0.054)	(0.385)
	Stn error res	2.53	2.08	3.46	2.65	2.73
Basic Materials	λ_{s0}	0.0968	-0.0543	0.0629	-0.2556*	-0.1877
		(0.322)	(0.331)	(0.126)	(0.146)	(0.131)
	$\lambda_{s0} + \lambda_{s1}$	0.0440	0.0750	0.0758	0.3021*	0.0899
		(0.162)	(0.155)	(0.120)	(0.094)	(0.146)
	Stn error res	2.66	2.68	3.52	3.05	2.76

This table reports estimates of the country and sector-specific prices of risk, $(\lambda_{i,t} = \lambda_{i0} + \lambda_{i1} d_t)$ and $(\lambda_{s,t} = \lambda_{s0} + \lambda_{s1} d_t)$, respectively, as in equation (10), where d_t is a dummy variable which takes on value zero until December 1998 and one thereafter. Estimates are based on weekly, continuously compounded returns from April 1991 through December 2007 (873 observations). QML standard errors are reported in parentheses. Asterisks indicate statistical significance of at least 10 percent confidence level. *LogLike* indicates the value of the Loglikelihood function and *Stn error res* indicates the *standard error of residuals*.

Figure 1: Time series of prices of risk

Figure 1 shows the time series of the market price of risk (solid line), $\lambda_{m,t}$, and the intertemporal price of risk (dashed line), $\lambda_{x,t}$, estimated using a Kalman filter as illustrated in Appendix A. Estimates refer to the model as in equation (4) and are based on weekly, continuously compounded equity returns from April 1991 through December 2007 (873 observations).

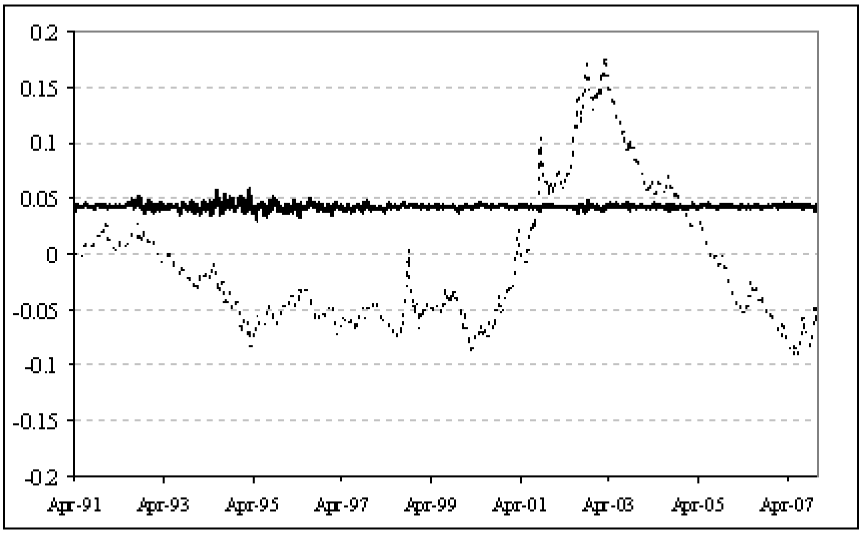
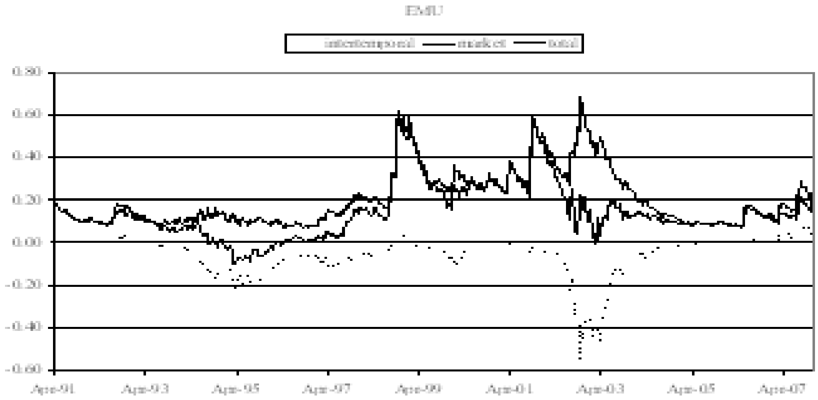
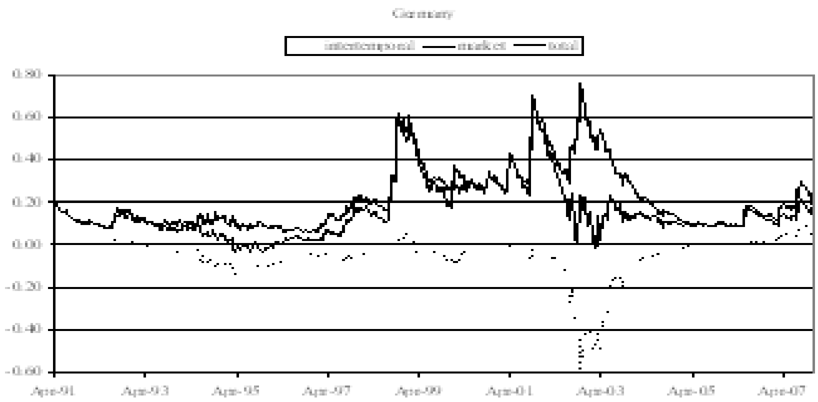


Figure 2: Decomposition of estimated country equity premium

Figure 2 plots equity premia estimated with the ICAPM for national equity markets and the euro area. Market price of risk, $\lambda_{m,t}$ and intertemporal price of risk, $\lambda_{x,t}$, vary over time according to a Kalman filter as ilustrated in Appendix A. The figure shows the decomposition of the total premium (bold line) into the market premium (solid line) and the intertemporal premium (dashed line), measured by $\lambda_{m,t}Cov\left(r_{i,t}, r_{m,t} \left| \Im_{t-1}\right.\right)$ and $\lambda_{x,t}Cov\left(r_{i,t}, x_t \left| \Im_{t-1}\right.\right)$, respectively, as in equation (7). Estimates are based on weekly, continuously compounded equity returns from April 1991 through December 2007 (873 observations).





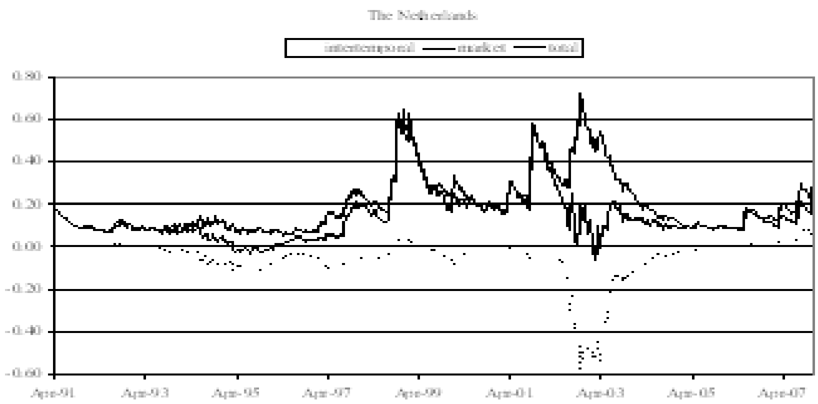


Figure 2: Continued

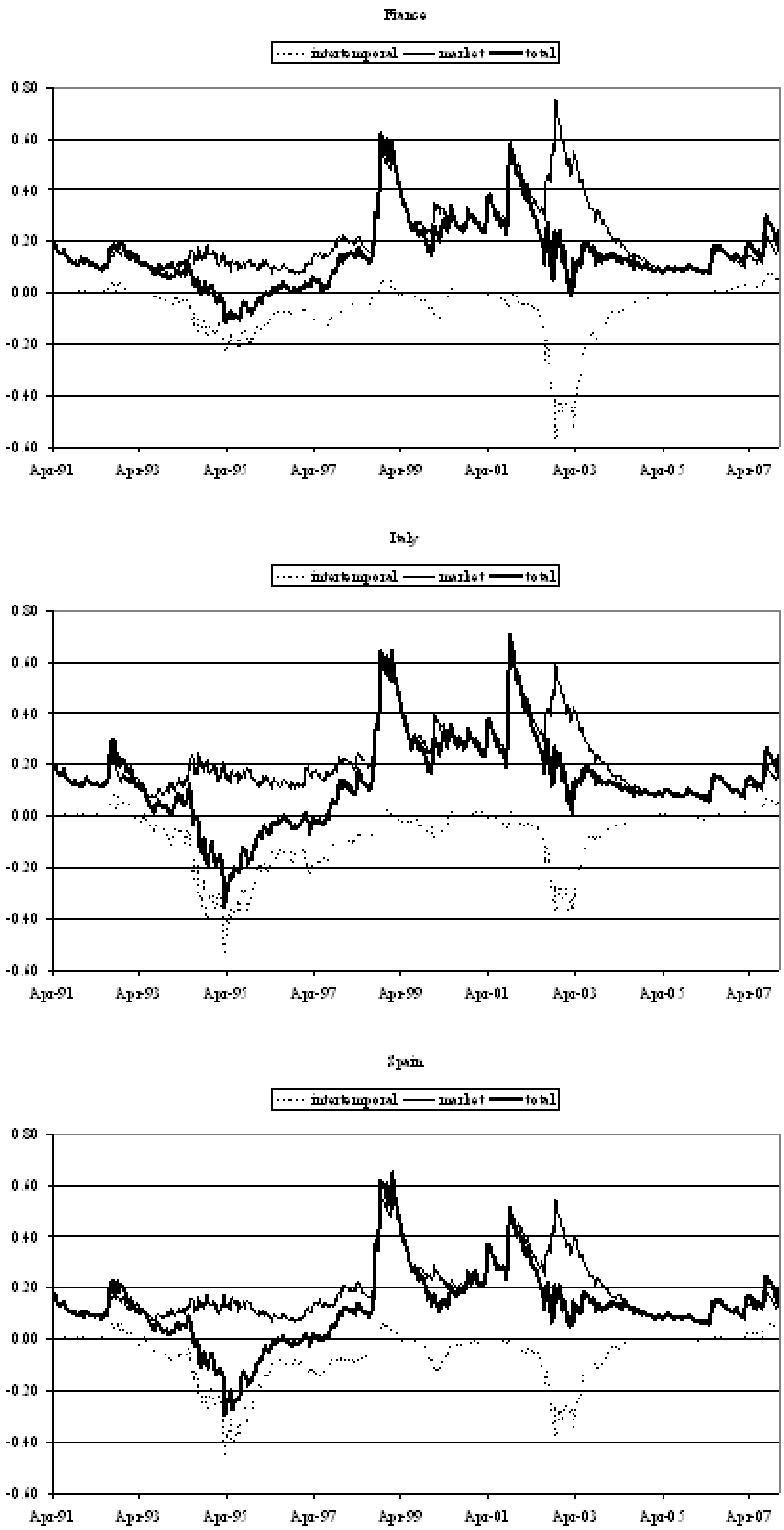
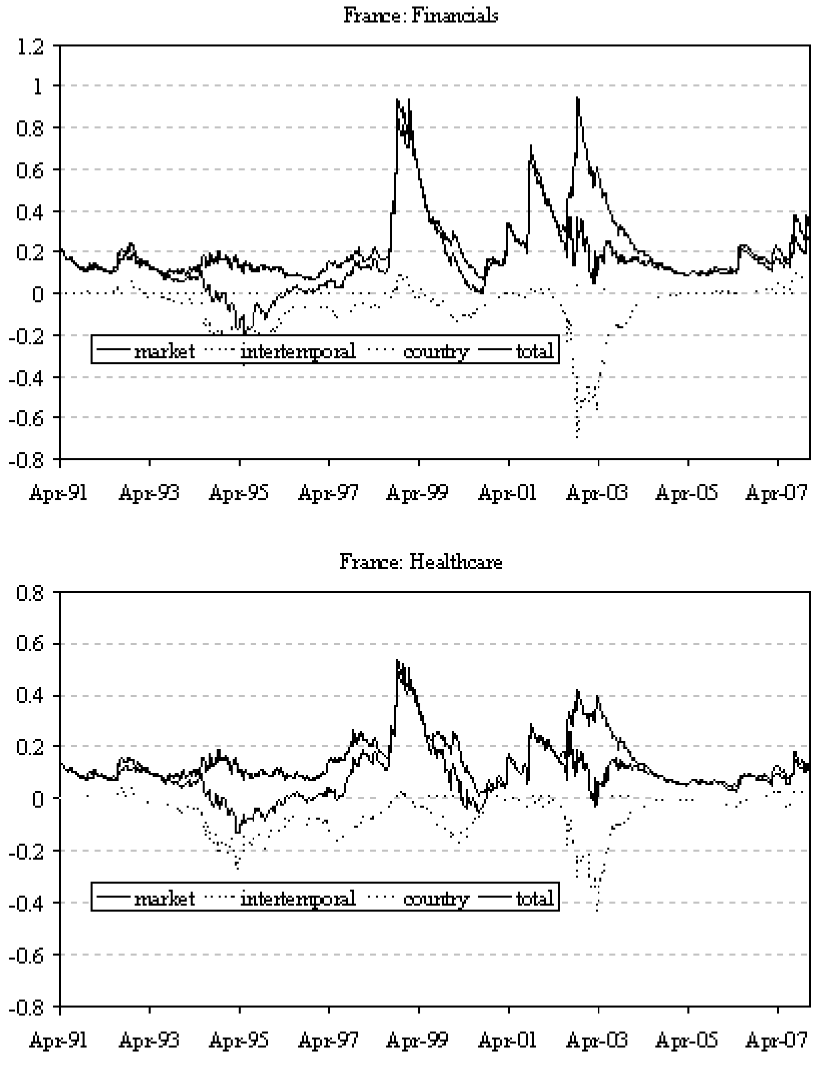


Figure 3: Decomposition of estimated industry equity premium

Figure 3 plots equity premia estimated with the ICAPM for the French Financials and Healthcare sectors. The market price of risk, $\lambda_{m,t}$ and the intertemporal price of risk, $\lambda_{x,t}$, vary over time according to a Kalman filter as illustrated in Appendix A. The figure shows the decomposition of the total premium (bold line) into the market premium (solid line),the intertemporal premium (dashed line) and the country premium (dotted line), measured by $\lambda_{m,t}Cov\left(r_{si,t}, r_{m,t}\left|\Im_{t-1}\right.\right)$, $\lambda_{x,t}Cov\left(r_{si,t}, x_t\left|\Im_{t-1}\right.\right)$ and $\lambda_{i,t}Cov\left(r_{si,t}, r_{i,t}\left|\Im_{t-1}\right.\right)$ respectivelyas in equation (8). Estimates are based on weekly, continuously compounded equity returns from April 1991 through December 2007 (873 observations).



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