Structural versus Temporary Drivers of Country and Industry Risk [1]

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Structural versus Temporary Drivers of Country and Industry Risk

Abstract

This paper analyzes the dynamics *and* determinants of the relative benefits of geographical and industry diversification over the last 30 years. First, we develop a new structural regime-switching volatility spillover model to decompose total risk into a systematic and a country (industry) specific component. Contrary to most other studies, we explicitly allow market betas and asset-specific risks to vary with both structural and temporary changes in the economic and financial environment. In a second step, we investigate the relative benefits of geographical and industry diversification by comparing average asset-specific volatilities and model-implied correlations across countries and industries. We find a large positive (negative) effect of the structural factors on country betas (country-specific volatility), especially in Europe, while industry betas are mainly determined by temporary factors. Not taking into account the time variation in betas leads to biases in measures of industry and country-specific risk of up to 33 percent. After correcting for this bias, we find that under the influence of globalization and regionial integration, the traditional dominance geographical over industry diversification has been eroded, and that over the last years geographical and industry diversification roughly yield the same diversification benefits. Finally, our results indicate that the surge in industry risk at the end of the 1990s was partly (but not fully) related to the TMT bubble.

JEL Classification: G11, G12, G15, C32, F37

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I Introduction

Given the large potential benefits of international diversification, should investors diversify their portfolios primarily across countries or across industries? Until the mid-1990s, the answer to this important question seemed crystal clear, as nearly all available evidence pointed towards a clear outperformance of country over industry diversification (see Heston and Rouwenhorst (1994) and Griffin and Karolyi (1998) among many others). The debate lit again in the second half of the 1990's, as more and more papers reported an increase in industry-specific risk large enough to shift the balance in favor of industry diversification (see among others Baca et al. (2000), Brooks and Catão (2000), Cavaglia et al. (2001), and Eiling et al. (2004)). The question this paper wants to answer is to what extent the sudden relative increase in the potential of industry diversification is permanent, i.e. the result of structural changes in the economic and financial environment, or whether it is merely a temporary phenomenon. The answer to this question is of obvious importance for portfolio managers deciding whether they should organize their international allocation strategy on a country or industry basis.

From a fundamental perspective, time-varying economic and financial integration, both at a regional and global level, arise as key candidates to explain a structural decrease in the potential of geographical diversification. In fact, a large literature (see e.g. Longin and Solnik (1995), Bekaert and Harvey (2000), Ang and Bekaert (2002a), Goetzmann et al. (2005), and Carrieri et al. (2004)) has documented that equity market correlations tend to rise considerably when markets become increasingly economically and financially integrated. Further economic integration should lead to a convergence in cross-country cash flows, while financial integration results in a more homogeneous valuation of those cash flows. A reduction in exchange rate risk may contribute further to an increase in international correlations (see e.g. De Santis and Gerard (1998)). The latter channel is likely to be especially important in Europe, where 11 countries introduced a single currency, the euro, in January 1999[2]. The effect of further integration on industry risk and correlations is less clear. At the one hand, one would expect that global factors will play an increasingly important role in pricing of securities (see e.g. Diermeier and Solnik (2001)). In an integrated world, at the other hand, investors can increasingly focus on industry-specific factors in their pricing of equities. While the first effect would, ceteris paribus, imply increasing cross-industry correlations, the second effect may lead to the opposite.

The relative potential of geographical and industry diversification may, however, also vary with

[2]Greece joined in 2001.

temporary factors. First, there is a large body of research documenting that correlations between international equity returns are higher during bear markets than during bull markets (see Aydemir (2004), Das and Uppal (2004), Ang and Bekaert (2002a), Longin and Solnik (2001), and De Santis and Gerard (1997) among others). Ferreira and Gama (2004), Hong and Zhou (2004), Ang and Chen (2002) report similar evidence of asymmetric correlations between industry portfolios. To what extent asymmetric correlations affect the relative potential of geographical and industry diversification over time remains, however, unclear. Second, the recent surge in industry risk may be an artifact of the emergence and burst of the Technology, Media, and Telecom (TMT) bubble. Evidence by among others Brooks and Negro (2004) suggests that the TMT bubble is at least in part responsible for the surge in industry-specific risk at the end of the 1990s.

Previous studies analyzing the effect of structural (temporary) factors in the relative potential of geographical and industry diversification have typically relied upon the dummy variable model of Heston and Rouwenhorst (1994). More recently, Ferreira and Gama (2005) extended the methodology of Campbell et al. (2001) to investigate the evolution of global, country, and local industry risk over time. While both methods have a lot of attractive features, they both impose assets (e.g. country and industry portfolios) to have a unit exposure to common market shocks. Previous literature suggests, however, that the impact of both structural and temporary factors on country and industry risk is likely to go specifically through time variation in market betas. First, papers by Bekaert and Harvey (1997), Chen and Zhang (1997), Ng (2000), Bekaert et al. (2005), and Baele (2005) show that an increase in the degree of economic and financial integration leads to a *structural* increase in the countries' global (and regional) market betas, and hence, ceteris paribus, higher cross-market correlations and lower diversifiable risk. Second, there is considerable evidence that market betas vary through time even in the absence of structural shifts in the economy. For instance, evidence in Ferson (1989), Ferson and Harvey (1991), Ferson and Harvey (1993), Ferson and Korajczyk (1995), Jagannathan and Wang (1996), and more recently Santos and Veronesi (2004) indicates that betas are a function of economic state variables. While Ghysels and Jacquier (2005) find only a limited role for macro-economic or firm-specific variables, they do confirm that substantial time variation in market betas. Third, Santos and Veronesi (2004) show that not only the level but also the dispersion in betas changes over time. This effect is of particular importance in the context of this paper, as biases in measures of geographical (industry) risk introduced by the assumption of unit or constant betas will be especially large when the dispersion in betas is high (see further). Finally, industry betas may change through time as to reflect changing industry characteristics. For instance, the market risk of European bank stocks may have increased after the liberalization of the European banking market initiated by the 1989 Second Banking Directive. Similarly, betas of many of the telecom stocks may now be higher compared to when these firms were still state owned.

The main contribution of this paper is that we analyze the relative potential of geographical and industry diversification in a fully conditional setting that explicitly allows betas and conditional volatilities to vary through time. In a first step, we estimate an extended version of the volatility spillover model of Bekaert and Harvey (1997) on index returns from 4 regions, 21 countries, and 21 global industries over the period 1973-2003. We make two methodological contributions to the existing volatility spillover literature. First, we make the global (regional) market betas conditional on both a number of structural economic instruments *and* a latent regime variable. This specification essentially combines the structural variables approach of Bekaert and Harvey (1997), Ng (2000) and Bekaert et al. (2005) at the one hand, and the regime-switching spillover model proposed by Baele (2005) at the other hand. The main advantage of this model is that it allows for and distinguishes between structural and temporary changes in market betas. Second, and new to the volatility spillover literature, we also add structural economic variables to the traditional Asymmetric GARCH specification for the conditional asset-specific volatility. By not including this channel, previous volatility spillover papers inherently assume that structural increases in market betas leads to a systematic increase in the assets' total risk, an implication that - at least at the country and industry level - contradicts most previous evidence (see e.g. Ferreira and Gama (2005)). By including structural instruments both in the beta and the volatility, we allow structural changes in the betas to have a compensating effect on asset-specific volatility.

Based on the estimates of our structural regime-switching spillover model at the regional, country, and industry level, we calculate and compare two indicators of diversification potential. First, we investigate whether the relative size of average idiosyncratic volatility at the regional, country, and global industry level has changed over time. Investors will want to pursue strategies that maximally reduce their exposure to idiosyncratic risk. A relative increase in the potential of industry diversification would be consistent with a relative increase in average industry-specific relative to country-specific idiosyncratic volatility. Second, we analyze how the correlation structure implied by our model estimates has changed over time. A structural increase in cross-country correlations that is not matched by a similar increase in cross-industry correlations would be a further confirmation of a relative increase in the potential of industry diversification.

Finally, we theoretically and empirically investigate to what extent the results from previous research is biased by the typical assumption of unit or constant market betas.

The (main) results of this paper can be summarized as follows. First, we find that the assumption of unit and constant betas is strongly rejected both at the country and industry level. Structural instruments have a large effect on the market betas of most countries, and lead, especially in Europe, to a substantial increase in both global and regional maket betas. The time variation in the industry betas, at the other hand, seems mainly driven by temporary factors. A similar pattern is found in the volatility specification: While our structural instruments lead to a substantial reduction in country-specific risk for many countries, we do not find such effects for industry-specific risk. Second, we investigate to what extent previous measures of geographical and industry diversification potential are biased by their implicit assumption of unit or constant betas. We find that the bias in measures of average country and industry-specific risk is potentially large, i.e. exceeding 30 percent. The bias in industry-specific risk is generally below 10 percent, but rises to 33 percent in the period corresponding to the the TMT bubble. For countries, the bias is especially large in the early 1970s and during 1985-1995. Interestingly, it was specifically during the latter period that previous studies found the benefits from geographical diversification to be far superior to those from industry diversification, while the opposite was true in the period corresponding to the TMT bubble. Third, after correcting for these biases, we find that over the last 30 years average country-specific risk was typically substantially higher than average industry-specific risk, confirming previous results on the superiority of geographical over industry diversification. At the end of the 1990s, however, we observe a strong rise in the level of industry-specific risk, an increase that is only partially matched by an increase in country-specific risk. Industry-specific risk surpassed country-specific risk briefly in 1999-2001 period, to stay at similar levels from 2003 on. A similar pattern emerges from a comparison of model-implied cross-country and industry correlations. While over the last 30 years cross-country correlations were typically below cross-industry correlations, the structurally-driven convergence of cross-country betas towards one and the corresponding decrease in country-specific risk resulted in a gradual increase in cross-country correlations. From 2000 on, average correlations across countries and industries fluctuated roughly at the same level. Finally, we carefully analyze whether the convergence of geographical and industry potential is not a pure artifact of the TMT bubble, and find this to be not the case.

The remainder of this paper is organized as follows. Section II develops a structural regime-switching methodology that allows both betas and idiosyncratic volatility to vary with both temporary and structural factors. Section III describes the stock return data as well as the structural instruments used in the estimation process. Section IV discusses the estimation results from the volatilty spillover model. In Section V, we analyze the portfolio implication of our model estimates. Finally, Section VI concludes.

II A Structural Regime-Switching Volatility Spillover Model

In this section, we develop a volatility spillover model that decomposes total volatility at the regional, country, and global industry level in a systematic and an idiosyncratic component. To correctly separate systematic and idiosyncratic risk, we allow the exposures to global and regional market shocks to vary with both structural and cyclical changes in the economic environment.

A Model Specification

Consider the vector of returns r_t =$(r_{w,t}, r_{reg,t}, r_{c,t}, r_{gi,t})$. This vector contains respectively the world equity market return $r_{w,t}$, N_{reg} regional equity market returns $r_{reg,t}$, N_c country returns $r_{c,t}$, and N_{gi} global industry returns $r_{gi,t}$. The return vector r_t has an expected component $\mu_{t|t-1}$ and an unexpected component ε_t, so that $r_t = \mu_{t|t-1} + \varepsilon_t$. We decompose the unexpected return as follows:

$$\varepsilon_t = \mathbf{\Theta}_{t|t-1} e_t. \tag{1}$$

where e_t =$(e_{w,t}, e_{reg,t}, e_{c,t}, e_{gi,t})$ represent the asset-specific shocks. The matrix $\mathbf{\Theta}_{t|t-1}$ determines to what extent time t shocks in one asset class spill over to other asset classes. We propose the following structure for $\mathbf{\Theta}_{t|t-1}$:

$$\mathbf{\Theta}_{t|t-1} = \begin{bmatrix} 1 & \mathbf{0}_{1\times N_{reg}} & \mathbf{0}_{1\times N_c} & \mathbf{0}_{1\times N_{gi}} \\ \beta^w_{reg,t} & \mathbf{I}_{N_{reg}} & \mathbf{0}_{N_{reg}\times N_c} & \mathbf{0}_{N_{reg}\times N_{gi}} \\ \beta^w_{c,t} & \mathbf{\Gamma}_{N_c\times N_{reg},t} & \mathbf{I}_{N_c} & \mathbf{0}_{N_c\times N_{gi}} \\ \beta^w_{gi,t} & \mathbf{0}_{N_{gi}\times N_{reg}} & \mathbf{0}_{N_{gi}\times N_c} & \mathbf{I}_{N_{gi}} \end{bmatrix} \tag{2}$$

The matrix $\mathbf{\Theta}$ has $1 + N_{reg} + N_c + N_{gi}$ rows and columns. Global market shocks (first line of $\mathbf{\Theta}$) are assumed to be exogenous. At a regional level (second line of $\mathbf{\Theta}$), we decompose the total return shock $\varepsilon_{reg,t}$ in a region-specific shock $e_{reg,t}$ and a spillover from world equity markets. The dependence of the regional shocks $\varepsilon_{reg,t}$ on world shocks is determined by the $N_{reg} \times 1$ vector $\beta^w_{reg,t}$. This model corresponds to the volatility spillover model of Bekaert and

Harvey (1997). The third line decomposes country shocks into a country-specific shock $e_{c,t}$ and a spillover from respectively the world and the region the country belongs to. The exposure of country shocks $\varepsilon_{c,t}$ to global market shocks is governed by the $N_c \times 1$ vector $\beta^w_{c,t}$. The matrix $\mathbf{\Gamma}_{N_c \times N_{reg},t}$ determines the relationship between the country shocks $\varepsilon_{c,t}$ and the regional shocks. We suppose that a country is exposed only to return shocks in the region it belongs to. As a consequence, each row of $\mathbf{\Gamma}_{N_c \times N_{reg},t}$ consists of zeros except for the element that corresponds to the relevant region, in which case the parameter equals $\beta^{reg}_{c,t}$. This specification corresponds to the two-factor volatility spillover model of Ng (2000), Bekaert et al. (2005), and Baele (2005). The main advantage of this specification is that it allows to differentiate between global and regional integration. Notice, moreover, that this model collapses to the world volatility spillover model of Bekaert and Harvey (1997) when $\beta^{reg}_{c,t} = 0$, and to the volatility decomposition of Ferreira and Gama (2005) when $\beta^{reg}_{c,t} = 0$ and $\beta^w_{c,t} = 1$. Finally, global industry shocks (fourth line of $\mathbf{\Theta}$) are separated in a global industry-specific shock $e_{gi,t}$ and a world influence. The dependence of global industry shocks on world shocks is determined by the $N_{gi} \times 1$ vector $\beta^w_{gi,t}$.

The existing spillover literature has made the global (regional) market betas time-varying by making them conditional on some structural information variables (see e.g. Bekaert and Harvey (1997), Ng (2000) and Bekaert et al. (2005)) or on a latent regime variable (see Baele (2005)). Both specifications individually are, however, potentially misspecified. While the first approach allows betas to change with structural changes in the economic and financial environment, it cannot accommodate cyclical variation in the betas. The second approach does allow betas to vary over the cycle, but is less suited to deal with *permanent* changes in market betas. A first methodological innovation of this paper is that we condition the global (regional) market betas both on a number of structural economic instruments *and* a latent regime variable, hereby allowing for both structural and cyclical changes in market betas. The general specification for the global (regional) market betas is given by:

$$\beta^{om}_{rm,t} = \beta^{om}_{rm}(S_{rm,t}) + \beta^{om}_{rm} X_{rm,t-1} \tag{3}$$

where subscript $om = \{w, reg, gi\}$ indicates the market (industry) where the shocks originate, and subscript $rm = \{reg, c, gi\}$ the receiving market (industry). The latent regime variables $S_{rm,t}$, the instruments $X_{rm,t-1}$, and the sensitivity to the instruments are all allowed to be different for each receiving market or industry.

A second methodological contribution of this paper is that we allow structural changes in the market betas to have a feedback effect on the level of asset-specific conditional volatility.For instance, for a constant level of total volatility, one would expect an increase in market betas to have a dampening effect on the level of idiosyncratic volatility. Methodologically, we assume the asset-specific shocks to be distributed as follows:

$$e_t \sim N\left(0, \Xi_t\right)$$

where $\Xi_t = diag\left(h_{z,t}\right)$ and $z = \{w, reg, c, gi\}$. We assume hence that all covariance between the asset returns is accommodated through the respective (time-varying) betas and asset volatilities. In its most general form, the conditional volatility for asset z is given by:

$$h_{z,t} = \varkappa Q_{z,t-1} + \psi_{z,0}\left(S_{z,t}^V\right) + \psi_{z,1}\left(S_{z,t}^V\right)\varepsilon_{z,t-1}^2 + \psi_{z,2}\left(S_{z,t}^V\right)h_{z,t-1} + \psi_{z,3}\left(S_{z,t}^V\right)\varepsilon_{z,t-1}^2 I\{\varepsilon_{z,t-1} < 0\} \tag{4}$$

where $S_{z,t}^V$ is a latent regime variable governing the volatility state. The vector Q_{t-1} contains a number of information variables that may affect the level of the conditional asset return volatility. $I\{\varepsilon_{z,t-1} < 0\}$ is an indicator function that takes on the value of 1 when $\varepsilon_{z,t-1} < 0$ and zero otherwise. In the case of one regime and $\varkappa = 0$, this model collapses to the asymmetric GARCH model of Glosten et al. (1993). Similarly, a regime-switching GARCH model is obtained when $\varkappa = \psi_{z,3} = 0$. If one furthermore assumes that $\psi_{z,1} = \psi_{z,2} = 0$, the model reduces to a regime-switching normal model. Notice that a (regime-switching) (asymmetric) GARCH model is inherently a stationary model. By including structural instruments Q_{t-1} in the variance specifications, we allow for structural change in an otherwise stationary conditional volatility model. This constitutes an important part of our model, as it allows a structural change in the exposure to systematic risk to be associated with a change in the level and dynamics of idiosyncratic risk. This additional channel is generally omitted in the (volatility spillover) literature. We choose for a regime-switching volatility specification for two reasons. First, a number of recent papers show that regime-switching volatility models are better suited for dealing with spurious persistence often observed in GARCH estimates (see e.g. Lamoureux and Lastrapes (1990), Hamilton and Susmel (1994), and Cai (1994)). Second, regime-switching models typically accommodate some of the nonlinearities that may show up in higher order moments, such as skewness and kurtosis, as well as asymmetric volatility (see e.g. Perez-Quiros and Timmermann (2001)).

A correct identification of the various shocks also requires an appropriate specification of the expected market, industry, and country returns. To separate as much as possible the time-variation in world shock sensitivities from those in expected returns, we propose the following expected return specification:

$$\mu_{z,t-1} = \gamma_{z,0} + \gamma_z Z_{t-1} \tag{5}$$

where Z_{t-1} represents a vector of information variables part of the information set Ω_{t-1} that have been shown to predict equity returns.

B Estimation procedure and Specification Tests

To keep estimation feasible, we use a three step procedure. First, we estimate the global market shocks. Second, we relate the different regional and global industry returns to the market shocks obtained in the first step. To keep the estimation tractable, we estimate all specifications region (industry) by region (industry). Third, we relate country shocks to both world and regional shocks. As in the second step, we estimate the specification for each country individually. All estimates are obtained by maximum likelihood.

1 Specification of the Transition Probability Matrix

To limit the number parameters to be estimated, we put some additional assumptions on the general model outlined in Section A. First, we allow for regime-switches in the A-GARCH parameters only in the conditional variance specification of the world shocks. For the other series, we resort to a specification that contains both structural instruments and A-GARCH. Second, at the country level, we impose the same latent regime variable on both the global and regional market beta, or $S^{w}_{c,t} = S^{reg}_{c,t}$. Notice that this does not mean that we impose global and regional shocks to have the same evolution over time, as global and regional betas are still allowed to have a specific exposure to global (region)-specific structural instruments. By making these two assumptions, we limit the number of latent regime variables per asset to one. By additionally assuming that each latent variable $S_{rm,t}$, with $rm = \{reg, c, gi\}$, can take only two states, the specification for the transition probability matrix is conveniently given by

$$\Pi = \begin{bmatrix} P & 1-P \\ 1-Q & Q \end{bmatrix}$$

where the constant transition probabilities are given by $P = prob\left(S_t = 1 \,|S_{t-1} = 1\right)$, and $P = prob\left(S_t = 2 \,|S_{t-1} = 2\right)$ .The maximum likelihood algorithm first introduced by Hamilton (1989) is used for the estimation of the regime-switching beta specifications, and the one of Gray (1996) for the regime-switching A-GARCH models.

2 Specification Tests

In Section A, we presented a very general volatility spillover model. In practice, however, we may not need all the flexibility offered by this complex specification. To differentiate between various restricted versions of this model, we use three types of specification tests, namely (empirical) likelihood ratio tests, a GMM test of normality of the standardized residuals, and a regime-classification measure. Conditional on the optimal models, we do two additional tests. First, we investigate whether there is any residual correlation left between the regional, industry, and country shocks. Second, we test whether the market-weighted sum of respectively regional and global industry betas is equal to one.

Likelihood Ratio Tests To distinguish between nested models, we use standard Likelihood Ratio tests. Unfortunately, standard asymptotic theory does not apply for tests of multiple regimes against the alternative of one regime because of the presence of nuisance parameters under the null of one regime. Similar to Ang and Bekaert (2002a), we use an empirical likelihood ratio test. In a first step, the likelihood ratio statistic of the regime-switching model against the null of one regime is calculated. Second, N series (of length $T,$ the sample length) are generated based upon the model with no regime switches. For each of the N series, both the model with and without regime switches is estimated. The likelihood values are stored in respectively L_{RS} and L_{NRS}. For each simulated series, as well as for the sample data, the Likelihood Ratio (LR) test is calculated as $LR_{NRS\leftrightarrow RS} = -2\log\left(L_{NRS} - L_{RS}\right)$. Finally, the significance of the LR test statistic is obtained by calculating how many of the LR test values on the simulated series are larger than the LR statistic for the actual data.

Test on Standardized Residuals To check whether the models are correctly specified, as well as to choose the best performing model, we follow a procedure similar to the one proposed by Richardson and Smith (1993) and Bekaert and Harvey (1997). Standardized residuals are calculated as $\hat{\vartheta}_{z,t} = e_{z,t}/h_{z,t}$. Under the null that the model is correctly specified, the following conditions should hold:

$$\text{(a) } E[\hat{\vartheta}_{z,t}\hat{\vartheta}_{z,t-j}] = 0 \qquad \text{(b) } E[(\hat{\vartheta}^2_{z,t} - 1)(\hat{\vartheta}^2_{z,t-j} - 1)] = 0$$

for $j = 1, ..., \tau,$ and $z \in \{w; reg = 1, ..., N_{reg}; c = 1, ..., N_c; gi = 1, ..., N_{gi}\}$. Conditions (a) and (b) test respectively for serial correlation in standardized and squared standardized residuals. Test statistics are obtained through a GMM procedure similar to Bekaert and Harvey

(1997), and are asymptotically distributed as χ^2 with τ degrees of freedom. Similarly, to investigate skewness and excess kurtosis, we test whether the following orthogonality conditions hold:

$$(c)E[\hat{\vartheta}_{z,t}^3] = 0 \qquad (d)E[\hat{\vartheta}_{z,t}^4 - 3] = 0$$

Both tests are $\chi^2(1)$ distributed. Finally, to test whether the different volatility models capture volatility asymmetry, we check the validity of the following orthogonality conditions:

(d) $E[(\hat{\vartheta}_{z,t}^2 - 1)I\left\{\hat{\vartheta}_{z,t-1} < 0\right\} = 0$ (e) $E[(\hat{\vartheta}_{z,t}^2 - 1)I\left\{\hat{\vartheta}_{z,t-1} < 0\right\}\hat{\vartheta}_{z,t-1} = 0$

(f) $E[(\hat{\vartheta}_{z,t}^2 - 1)I\left\{\hat{\vartheta}_{z,t-1} \geq 0\right\}\hat{\vartheta}_{z,t-1} = 0$

These conditions correspond to respectively the Sign Bias test, the Negative Sign Bias test, and the Positive Sign Bias test of Engle and Ng (1993). The joint test is distributed as χ^2 with 3 degrees of freedom.

Regime Classification Measure Ang and Bekaert (2002b) developed a summary statistic which captures the quality of a model's regime qualification performance. They argue that a good regime-switching model should be able to classify regimes sharply. This is the case when the smoothed (ex-post) regime probabilities $p_{j,t} = P\left(S_{i,t} = j|\Omega_T\right)$ are close to either one or zero. For $k = 2$, the regime classification measure (*RCM*) is given by

$$RCM = 400 \times \frac{1}{T}\sum_{t=1}^{T} p_t\left(1 - p_t\right) \tag{6}$$

where the constant serves to normalize the statistic to be between 0 and 100. A perfect model will be associated with a RCM close to zero, while a model that cannot distinguish between regimes at all will produce a RCM close to 100. When the model contains more than one regime variable, we use the extended RCM measure developed in Baele (2005).

III Data

A Stock Return Data

The dataset consists of weekly US dollar denominated total return indices and market capitalizations for 4 regions, 21 countries, and 21 global industries (see Table 1) over the period January 1973 - November 2003. Given their size, both the US and Japanese markets are treated as regions. All indices are value-weighted and are obtained from Datastream International. Our sample contains 14 European countries, both from within and outside the EMU, 4 Pacific countries, as well as Canada, Japan, and the US. The industry classification is based on the broad distinction of 36 economic industries according to the FTSE Actuaries Classification System. To make our results on countries and industries as comparable as possible, we reduce the number of industries to 21, the number of countries[3]. The Datastream indices cover approximately 80% of the total market capitalization. To compute excess returns we make use of the US 1-Month Treasury Bill rate as the risk free rate. The world portfolio we use is value-weighted and is restricted to the countries in our sample.

Table 2 shows some descriptive statistics on the weekly excess returns of respectively the regional and country portfolios (Panel A) and the global industry portfolios (Panel B). Means and standard deviations are expressed as percent per year[4]. A first observation is that country returns are on average more volatile than industry returns. For instance, 13 of the 21 countries have an (average) annual volatility above 20 percent compared to only 4 out of 21 industries. Not surprisingly, the world portfolio has the lowest volatility (about 14 percent) except for the Utilities and Food & Tobacco industries. The large difference in volatility between the global market and country portfolios suggests an important role for international diversification in reducing portfolio risk. The relatively smaller difference between global market and industry risks would suggest that country diversification has more potential than industry diversification. In what follows, we will investigate whether the results from this unconditional analysis are also representative for the present period.

Table 3 provides some preliminary evidence on the correlation between regional, country, and industry returns. The diagonal of the left panel contains the average unconditional correlation within regions, industries, and countries. Interestingly, average intra-industry correlations (58%) are considerably higher than average country (41%) and regional (42%) correlations, a further confirmation that over the last 30 years, the potential of geographical diversification was on average larger than of industry diversification. The first row of the left panel reports

[3]Our number of industries keeps a balance between the Datastream's relatively restricted level-3 industry classification (10 industries) and their level-4 classification (36 industries).

[4]Other distributional statistics in Table 2 show that most country and industry portfolios are negatively skewed and display a high degree of kurtosis. The Jarque-Bera test rejects the null hypothesis of normally distributed returns for all portfolios at a 1 percent significance level. The Ljung-Box test indicates significant autocorrelations for all portfolios, while an ARCH test reveals strong heteroscedasticity for all portfolio returns, and hence the need for a conditional volatility model.

the average correlation of regions, industries, and countries with global market returns. Market correlations are typically much higher for industries (76%) than for countries (52%). The off-diagonal elements in row 2 and 3 indicate that there is considerable correlation across the various asset classes, suggesting an important role for global market returns as a common factor. Finally, the right panel of Table 3 reports the average within-region, within-industry, and within-country correlations over different subperiods. The results seem to indicate an increase in the average within-countries' correlation, and a decrease in the average within-industries' correlation.

B Structural Instruments

One of the goals of this paper is to investigate to what extent globalization and regional integration have structurally changed the correlation structure of international equity market returns, both across countries (regions) and industries. We allow the (gradual) process of further integration to affect cross-asset correlations by conditioning both the global (regional) market betas and the conditional volatility process on a number of structural economic variables. We focus on two main information variables, namely a trade and an alignment measure. All measures are available at the regional, country, and industry level.

1 Trade Integration

At the country level, the trade integration measure is calculated as the ratio of imports plus exports over GDP. The empirical model distinguishes between global and regional market shocks, and so does our trade measure. More specifically, the trade integration measure entering the regional market beta only considers the country's trade with other countries within the region the country belongs to. Similarly, the trade variable entering the global market beta contains the country's trade with all countries outside its region. In the same spirit, our trade integration measure at the regional level is calculated as the sum of exports and imports of the region with the rest of the word over the region's GDP. All data is quarterly and has been obtained from the OECD[5]. Previous studies have successfully linked similar trade integration indicators to cross-country equity returns. Chen and Zhang (1997) for instance found that countries with heavier bilateral trade with a region also tend to have higher return correlations with that region. Bekaert and Harvey (1997), Ng (2000), Bekaert et al. (2005), and Baele (2005) found that the exposure

[5]The Import and Export data are from the module 'Monthly Foreign Trade Statistics' from the OECD. All data is seasonally adjusted and converted from a quarterly to a weekly frequency through interpolation.

of country returns to global (regional) equity market typically increases with measures of trade integration. Trade integration may also proxy for financial integration, and hence a convergence of cross-country risk premiums. For instance, Bekaert and Harvey (1995) found that countries with open economies are generally better integrated with world capital markets.

This study is the first to our knowledge to investigate the effect of trade openness at the industry level on industry betas[6]. We measure industry trade openness by calculating the ratio of the industry's trade relative to its value added. Both the trade and production data is obtained from the STructural ANalysis (STAN) database of the OECD[7]. Theory gives little guidance on the expected effect of trade openness on industry betas. On the one hand, further trade, especially with other industries, may increase the industry's exposure to global market shocks. For instance, Diermeier and Solnik (2001) found that the sensitivity of firm-level stock returns to global market shocks is positively related to the firms' foreign to total sales ratios. On the other hand, further integration, here instrumented by industry openness, may induce investors to focus more and more on industry-specific factors. The effect of the latter channel on betas is, however, unclear.

The evolution of the trade integration measures is depicted in Table 4, for industries and regions in Panel A and for countries in Panel B. Trade has increased during the last 15 years for regions, countries as well as for industries. For most countries, especially in Europe, within-region trade is substantially more important than trade with other countries.

2 Misalignment

At the regional and country level, equity market returns could deviate because of differences in the index' industrial composition, as pointed out by e.g. Roll (1992). This means that as the industrial structure of a region or country gets more aligned to that of another region or country, the returns of the equity portfolios should become more similar. Moreover, as the industrial structure of a particular region or country resembles that of the world portfolio, the equity portfolio of that region or country should behave in a similar way as the world portfolio. This implies that the world beta of regions and countries should should converge to levels closer to one as industry misalignment decreases. The misalignment of the industrial composition of

[6] Campa and Fernandez (2004) use a similar measure to explain industry effects within the Heston and Rouwenhorst framework.

[7] Industry trade data is available for traded-goods industries and at the yearly frequency only. We transform the trade variable to the weekly frequency by means of interpolation. Traded-goods industries are defined in Table 1.

regions/countries relative to the world is measured as the square root of the mean squared errors between industry weights, i.e.

$$X^{w}_{reg(c),t} = \sqrt{\sum\nolimits_{i=1}^{N_{reg}} \left(w_i^{reg(c)} - w_i^{w} \right)^2}, \tag{7}$$

where N_{reg} is the number of industries, $w_i^{reg(c)}$ the weight of industry i in region reg (country c) and w_i^w the weight of industry i in the world. Weights are computed as the market capitalization of a certain industry in a particular region (country) to the total market capitalization in that region (country). Market capitalizations are obtained from Datastream International. For countries, we also compute the misalignment of the industrial structure of the country relative to the region it belongs to.

As in Carrieri et al. (2004), we construct a measure for the (mis)alignment of the regional (country) composition within a industry relative to the regional (country) composition of the world portfolio. An industry which is mainly located in one region (country) is likely to be less affected by world shocks, especially when the particular region (country) only makes up a small part of the world. The regional (country) misalignment measure is computed as in equation 7. We expect the world beta of a industry to be negatively related to the misalignment measure.

Table 4 reports some descriptive statistics for the misalignment measure. Panel A shows the results for regions and industries, Panel B for the different countries. The industrial misalignment of Europe, the Pacific, and Japan has decreased substantially over the period 1973-1996. In all three regions, though, we observe a substantial increase in the period 1997-2004. We suspect this increase is at least partially due to the TMT bubble. Misalignment in the US is relatively low over most of the sample, except in the period following the 1987 crash, when it increases substantially. The countries generally follow the evolution of the region they belong to, even though there is considerably cross-sectional variation even within regions. For most industries, we observe a substantial amount of variation in the misalignment measure over time. We do find evidence of a structural decrease for the sectors Media, Telecom, Utilities, Banks, and Investment Companies, but an increase for Automobiles and Parts.

IV Estimation results for Structural RS Spillover Model

This section summarizes the main estimation results for the structural regime-switching model outlined in Section II. Section IV.A discusses the estimation results for the world market return model. Sections IV.B and IV.C report estimates for the spillover model at respectively the regional - industry and country level.

A World Market Return Models

Since the work market shocks and variances are critical inputs in the regional, country, and global industry models, it is important to select the best model possible. Given the focus of this paper and the relatively low degree of predictability in weekly returns[8], we direct most of our efforts to finding the correct specification for the conditional variance. More specifically, we estimate the most general conditional volatility model defined in equation 4 as well as restricted versions of it. After a careful analysis of the specification tests outlined in Section 2, we withhold the Regime-Switching Asymmetric GARCH (RS-AGARCH) specification as our best model[9]. The specification tests indicate that this model outperforms more restricted models especially in accommodating asymmetric volatility and kurtosis. The Likelihood Ratio statistic for a test of a RS-AGARCH model against the alternative of an asymmetric GARCH and a regime-switching normal model are respectively 57.7 and 58.5. While these statistics do not follow a standard distribution, the increase in the likelihood value seems substantial enough to reject the restricted models in favour of the RS-AGARCH model[10].

The first row of Table 5 reports the specification tests in more detail. We cannot reject the null hypothesis that the standardized residuals obtained from the RS-AGARCH model exhibit no fourth-order autocorrelation in both the standardized and squared standardized residuals, no asymmetry, and no remaining skewness (at 5 percent level) or excess kurtosis. Moreover, the regime classification measure (RCM), as discussed in Section II.2, indicates that the model distinguishes very well between regimes[11].

Panel A of Table 7 reports the estimation results for the RS-AGARCH model. We find strong evidence for the existence of a high and a low volatility state. The GARCH intercepts would

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[8]The expected exces world market return is modelled as a linear function of lagged values of the US short rate, dividend yield, term spread, default spread, as well as own returns. We find some evidence of predictability for dividend yields and the default spread.

[9]Detailed results for all models are available upon request.

[10]The complexity of the Regime-Switching Asymmetric GARCH model prevents us from performing an Empirical Likelihood Ratio test.

[11]The Regime Classification Measure equals 34.96, implying that on average the most likely regime has a probability of about 90 percent.

imply the level of volatility to be more than two times higher in the high volatility state[12]. The estimation results contain a number of interesting findings. First, as can be seen from the transition probabilities, both volatility regimes are highly persistent, the low volatility regime slightly more so than the high volatility regime. Second, the estimate of the GARCH parameter decreases considerably when regimes are allowed for, namely from 0.88 in the AGARCH model to about 0.63 in the case of a RS-AGARCH model. This suggests that the persistence in stock market volatility is also caused by the persistence in the volatility regime and only partly by the within-regime volatility persistence. This confirms previous findings by Hamilton and Susmel (1994). We do not find evidence, however, that persistence is lower in the high volatility regime. Third, we find substantial differences across regimes in the way the conditional volatility reacts to (negative) shocks. While both the ARCH and asymmetry parameters are insignificant in the low volatility regime, both are strongly significant in the high volatility state. Interestingly, in the high volatility state, the conditional volatility increases strongly with negative shocks, but actually decreases in response to positive news. This further underlines the need to allow for multiple regimes in conditional volatility models.

Finally, we also test for the effect of globalization on the level of world market volatility by including respectively a time trend and the ratio of world trade over GDP in the RS-AGARCH specification. Conform with the findings of e.g Schwert (1989), we do not find evidence of an upward of downward trend in global market volatility.

Figure 1 plots the smoothed probability of being in the high volatility state. The smoothed regime probability is always close to either zero or one, confirming that the states are clearly identified. Most of the time, the process wanders in the low volatility regime, to switch for short periods of time to the high volatility regime. Peaks coincide with the debt crisis in 1982, the October 1987 stock market crash, and the economic crisis at the beginning of the 1990s and the 2000s. Not surprisingly, the financial crises in Asia and Russia and the LTCM debacle also had a strong impact on market volatility.

B Regional and Global Industry Return Models

At the regional and global industry level, we decompose unexpected returns into a global market component and an idiosyncratic shock. We choose among three classes of models, namely unit beta, constant beta, and time-varying beta models. For the latter, we test whether the time

[12] A simple Wald test points out that this difference is highly significant.

variation in the betas is best described by structural instruments, by a latent regime variable, or by a combination of both. We choose the best model using a battery of (empirical) Likelihood Ratio tests as well as a number of specification tests. When the compared models are not nested or results are ambiguous, we follow Pagan and Schwert (1990) and choose the model with the highest R^2 for a regression of the realized variance, proxied by the squared returns $r_{z,t}^2$ on the predicted total variance ($\left(\beta_{z,t}^w\right)^2 \sigma_{w,t}^2 + \sigma_{z,t}^2$), where $z = \{reg, gi\}$. Conditional on the choice for the dynamics of the market beta, we investigate whether adding additional instruments and/or a latent regime variable improves the specification of the conditional variance relative to a standard AGARCH model.

Panel A of Table 5 presents the specification tests for the selected models as well as a number of likelihood ratio tests for the four regions in our sample. The first column reports the selected model. For all regions, we find strong evidence in favour of a time-varying world market beta. Using an empirical likelihood ratio test, we reject the null hypothesis of no regime switches in the market betas at the 1 percent level for all regions. For Europe, Japan and the US, the specification of the betas improves further when instruments are added to the regime-switching beta model. For these regions, the instruments also have a significant influence on the volatility, resulting in a regime switching beta model with instruments in beta and volatility as best performing model. For the Pacific, we retain the regime-switching beta model without instruments in neither the conditional beta nor volatility specification. The specification tests are generally in favour of the models chosen. For Japan and the US, though, we cannot reject the null hypothesis of zero skewness and excess kurtosis. Finally, the regime-classification measure indicates that the regimes in the regional betas are clearly distinguished.

Panel B of Table 5 presents the results for the global industries. For all industries, the null hypothesis of unit or constant betas is rejected in favour of time-varying betas. An empirical likelihood ratio test strongly rejects the constant beta model in favour of a regime-switching specification. Moreover, for 13 of the 21 industries, instruments have an additional effect on the betas. The instruments in the volatility specification are only statistically (economically) significant in 4 (2) out of 21 cases (see last column), contrary to the regions where 3 out of 4 where significant. This gives a first indication that regional volatility appears to be more driven by structural factors than industry volatility. Except for kurtosis and in some cases skewness, the standardized residuals of the best performing models are generally well specified. The classification measures imply regime probabilities ranging from 0.80 to 0.98, clearly pointing to well identified states for all industries.

Tables 6 and 7 report the estimation results for respectively the beta and variance specifications. Panel A contains the results for regions, Panel B for the global industries. In our discussion, we first focus on betas and then on volatilities. As can be seen from Table 6, Panel A, regional market betas differ significantly over regimes, both statistically[13] and economically. More specifically, the percentage difference between the low and high betas ranges from 39 percent for the US to 122 percent for Japan. As mentioned before, for Europe, Japan, and the US, time-variation in the market betas is not only driven by the latent regime variable, but also by trade integration and industry misalignment. The European market beta is positively and significantly related to the trade integration measure, suggesting that globalization made Europe more exposed to global shocks. This result seems, however, to be specific for Europe, as the Japanese market beta appears to be negatively related to the trade integration variable. A similar result is found for the US, even though the effect is only marginally significant. The second structural instrument, industry misalignment, has the expected negative relationship for all regions, and is strongly significant in the US and marginally significant for the European betas. This indicates that betas tend to decrease when a region becomes increasingly different in its industrial structure from global markets.

Panel A of Table 6 also reports the evolution of the betas over different subperiods[14]. The European market beta has increased substantially, from about 0.72 in the period 1973-1982 to about 0.91 in the period 1997-2004. The lowest betas (about 0.45) were observed in the early 1970s, the highest ones (about 1.2) during the period coinciding with the burst of the TMT bubble. Given its size, it is not surprising that the US market beta is close to one during most of the sample, the exception being the period 1988-1992, when the beta was substantially lower than one (about 0.71). The beta of Japan is rising substantially from about 0.3 in the early 1970s to about 1.6 in the mid-1990s. The global market beta decreased substantially (to about 0.7) after 1995, a period during which Japan faced a prolonged economic crisis. Finally, the Pacific's global market beta is driven mainly by cyclical movements, being higher in downturns than in upturns.

As can be seen from Table 6, Panel B, also industry betas tend to be statistically and economically different across regimes. An empirical likelihood ratio test rejects the null hypothesis of constant betas for all industries. The trade variable has a statistically significant effect on

[13]Using a Wald test, we reject the null hypothesis that betas are idential across states at the 1 percent level for all regions.

[14]Plots of the time-varying betas are available upon request.

the betas of four industries, even though the effect is only economically important for the IT (Hardware) industry. The effect of our country misalignment measure on the other hand is negative and significant for 10 industries. Panel B of Table 6 also reports the industry betas for a number of subperiods. A first important observation is that industry betas are relatively close to one over all different subperiods. Second, most industry betas do not show a tendency in either direction. The only exceptions are the Telecom and Banking industry, which have witnessed a gradual increase in their market betas. Third, we observe a strong increase in the betas of the IT (both hardware and software) industry at the end of our sample period. The effect is, however, less pronounced for the other TMT industries, namely Media and Telecom, suggesting that a large part of the effects of the TMT bubble can be traced back to the IT sector.

In Table 7, we analyze to what extent the structural change in market betas observed for many regions and global industries is associated with a structural change in the level of idiosyncratic risk. To investigate this possibility, we allow the trade and alignment instruments to also enter the conditional variance specification. Panel A shows the results for the different regions. For Europe, we find a statistically significant decrease in the level of idiosyncratic volatility due to increasing trade integration and industry alignment. The rise in the European market beta and the corresponding decrease in European-specific volatility imply a relative shift from idiosyncratic to systematic risk, and hence a reduction in diversification potential. Both for Japan and the US, we find the level of idiosyncratic volatility to be positively and significantly related to the industry misalignment indicator. The trade variable is statistically significant for the US, but has the surprising positive sign, suggesting that trade increased rather than decreased US-specific volatility. Panel B contains the estimation results at the industry level. We find little evidence that increasing industry trade and country alignment had an important effect on the level of industry risk. The trade and alignment variables are statistically and economically significant only for respectively the IT (Hardware) and household industries.

The right-hand side of Panel A of Table 7 reports average region-specific volatilities over a number of subperiods. For Europe, the Pacific, and Japan, we find an important decrease in the level of idiosyncratic volatility over the period 1973-1996. Despite the structurally-driven decrease in the level of idiosyncratic risk, large market shocks pushed up volatility substantially in the period 1997-2004, especially in Japan. The level of US volatility is considerably lower than in the other regions, especially relative to the Pacific and Japan. The relatively low level of US-specific volatility is in part explained by the fact that the US constitutes a large part of the global market portfolio, i.e. most of its total risk is systematic by construction[15]. Interestingly, the period of relatively high US-specific volatility corresponds to the time when the US market beta was relatively low, i.e. in the aftermath of the 1987 crash. As a conclusion, the reduction in the fundamental level in region-specific risk would suggest that the benefits of regional diversification strategies have structurally decreased over time.

The evolution of industry-specific risk is reported in the right-hand side of Panel B of Table 7. A first observation is that idiosyncratic volatility at the industry level is typically lower than for regions, suggesting that the potential of industry diversification is indeed lower than of geographical diversification. However, during the period 1997-2004, industry-specific risk has increased substantially more than region-specific risk. We will investigate these patterns and their implications for optimal diversification strategies in more detail in Section V.

C Country Return Models

This section discusses the results for a decomposition of country return shocks in a global, regional, and country-specific component. As for regions and global industries, we distinguish between three classes of models, namely unit beta, constant beta, and time-varying beta models. Finally, we also test for structural shifts in the level of country-specific volatility by allowing structural instruments to enter the conditional variance specification.

Panel C of Table 5 reports a number of likelihood ratio tests. First, for all countries, an empirical Likelihood Ratio test rejects the null hypothesis of no regimes in the global market betas at the 5 percent level. Second, for all countries except New Zealand and Norway, we find strong evidence that the instruments add information to the beta beyond a regime switch. As a consequence, in line with the results for the regions, the systematic risk component of the countries appears to be driven also by structural factors. Finally, the inclusion of structural instruments in the volatility specification is justified in 11 out of 19 countries, suggesting that structural changes in the economic environment did not only affect betas but also the level of country-specific volatility.

The specification tests for the optimal model, reported in Table 5, shows that the standardized residuals and the squared standardized residuals do not exhibit fourth-order autocorrelation,

[15]Another potential explanation for the relatively low level of US equity market volatility is that the volatility in other regions is pushed upwards by exchange rate risk, even though we expect this effect to be small.

except for two cases. Moreover the asymmetry is captured very well. There is, however, some remaining skewness and especially kurtosis. The Regime Classification Measure indicates that the selected models distinguish sufficiently well between regimes[16].

Panel C and D of Table 6 detail the beta estimations. As can be seen from Panel C, the within-regime betas differ substantially across regimes. According to a Wald test, the global and regional market betas are statistically different from one another in respectively 13 and 17 of the countries. Confirming the regional analysis, the betas of many European countries are not only driven by a latent regime variable, but also by the structural trade variable. Here we can differentiate between extraregional and intraregional trade. The former impacts the world market betas and is a measure for the degree of world globalization. The latter impacts the regional betas and proxies for economic regional integration. For the euro area countries, the trade variable has a positive and significant effect on the global beta for all countries except Austria and Spain[17]. For Austria, France, Germany, and the Netherlands, trade has an additional positive and significant effect on the regional market beta. For the other European countries, we find a significant influence of the trade variables for Denmark, Sweden, and Switzerland, but not for Norway and the United Kingdom. Outside Europe, the trade variable has very little effect on both global and regional market betas. The stronger effect of trade on the betas of the European countries - and especially those now part of the euro area - shows that the process of European economic integration has lead to a more homogeneous valuation of European equities[18]. However, our finding that the effect of trade is stronger for the global than for the regional betas suggests that globalization may be at least as important in this respect as regional integration. Similar to the trade variable, the industry misalignment instrument is mainly related to the global market betas in Europe. In 6 of the 10 cases this variable enters significantly with expected negative sign.

Panel D of Table 6 reports the global and regional betas over a number of subperiods. In the euro area, both global and regional betas are more than 40 percent higher in the period 1997-2004 compared to the period 1973-1982. For the other European countries, large increases are observed in Denmark, Sweden, and Switzerland. While the betas have stayed relatively constant

[16]The RCM measures imply that on average the most likely regime has a probability ranging from 0.99 to 0.84 percent.

[17]For Ireland and Italy, the trade variable is significant at a 10 percent level only.

[18]As argued before, the trade variable may not only proxy for economic, but also for monetary and financial integration. Indeed, we find a high correlation between our trade variable and the Quinn measure of capital account openess (see e.g. Quinn (1997)).

in Norway, the beta of the UK with respect to the regional European market has decreased by more than 30 percent. The global market betas of the non-European countries exhibit less variation. We do observe though a strong increase (decrease) in the regional beta of Singapore (Canada).

In Panel D of Table 7, we investigate to what extent the structural changes in both the global and regional market betas are associated with a structural change in the level of country-specific risk. First, in 11 of the 19 countries, we find a statistically significant role for our two structural instruments. Contrary to the beta specifications, the strongest effects are found for the industry misalignment measure. This variable enters positively and significantly in 9 out of 11 countries. This confirms our hypothesis that the level of country-specific risk decreases when the industrial structure of a country's index becomes more aligned with global equity markets. The trade variable enters significantly negative in France, Italy, and Australia, indicating that for these countries trade contributed to a decrease in the level of country-specific risk. The AGARCH estimates imply a persistent volatility process for most countries. Asymmetry is only detected in 5 countries. Volatility asymmetry in the other countries is likely to be captured by the world or regional shocks or by the (regime-switching) betas. In the following section, we investigate to what extent structural changes in global (regional) market betas and asset-specific risks have changed the relative potential of country and industry diversification.

D Additional Model Checks

Our three-step estimation procedure requires that the factor models are sufficiently rich to eliminate all residual correlation between the region, country, and industry-specific shocks. Table 8 reports average correlations both within and across regions, countries, and industries. Residual correlations are typically lower than 0.03 in absolute terms, and statistically insignificant. We do find some negative correlation though between regions, even though the residual correlation is much lower than the sample correlation. Generally, this test suggests that our time-varying factor model does very well in describing cross-asset correlations.

Theoretically, our market betas, either at the regional, country, or industry level, should add up to one. A potential disadvantage of allowing both betas and conditional volatilities to vary through time is that we have to estimate the specification asset by asset, and hence that we cannot impose this assumption. An ex-post analysis reveals, however, that a market-weighted average of betas either across regions, countries, and industries is very close to one (respectively, 0.982, 0.975, and 0.982). Moreover, over time, aggregate betas typically fluctuate in the narrow range of 0.95 - 1.05.

V Implications for Portfolio Diversification

We focus on two indicators to assess the portfolio implications of our models. First, we investigate whether the relative size of average idiosyncratic volatility at the regional, country, and global industry level has changed over time. Investors will want to pursue strategies that maximally reduce their exposure to idiosyncratic risk. A rise in the potential of industry diversification would be consistent with a relative increase in average industry-specific relative to country-specific idiosyncratic volatility. Moreover, we quantify the bias in the measures of average idiosyncratic risk that would be induced by not allowing for structural (cyclical) variation in the exposure to common factors and the level of idiosyncratic risk. Second, we analyze how the correlation structure implied by our model estimates has changed over time. A structural increase in cross-country correlations that is not matched by a similar increase in cross-industry correlations would be a further confirmation of relative increase in the potential of industry diversification.

A Evolution of idiosyncratic volatility

We measure average idiosyncratic volatility as follows:

$$\sigma_{Z,t} = \sum\nolimits_{z \in Z} w_z h_{z,t}^{1/2}$$

where w_z and $h_{z,t}$ represent asset z's market weight and idiosyncratic volatility at time t, and Z contains all assets over which one wants to aggregate.

Panel A of Figure 2 plots the results of this aggregation at the regional, country, and industry level. The shaded areas represent global recession periods. We find a number of interesting results. First, even after correcting for structural and cyclical variation in market betas, our results indicate that average idiosyncratic risk both across countries (regions) and industries shows a strongly procyclical pattern. Second, we find that a considerable part of country-specific risk can be eliminated by diversifying regionally. However, diversifying not only across regions but also across countries results in non-negligible further risk-reduction benefits. Third, similar to Griffin and Karolyi (1998), we observe a substantial difference in measures of industry-specific risk for different levels of aggregation (21 versus 10 global industries), indicating that a sufficient level of disaggregation is needed to make a sensible comparison between country and industry-specific risk. Fourth, over the period 1973-1999, industry-specific volatility is consistently lower than both region- and country-specific volatility. This confirms findings in previous papers that during this period investors were better off diversifying their portfolios across countries rather than across industries. At the end of the 1990s, however, we observe a strong rise in the level of industry-specific risk, an increase that is only partially matched by an increase in country-specific risk. In 1999, industry-specific risk surpassed country-specific risk for the first time in nearly 30 years, to peak at the end of 2001. Industry-specific risk decined substantially afterwards, to levels (slighty) below average country-specific risk from 2003 onwards.

Brooks and Negro (2004) suggested that the relative increase in industry risk at the end of the 1990s may have been a purely temporary phenomenon related to the TMT bubble. To analyze this, we calculate the average industry-specific risk taking into account all but the TMT industries[19]. To fully eliminate the effect of the TMT bubble, we remove the TMT industries from all regional and country indices, and re-estimate the optimal volatility spillover models. In Panel B of Figure 2 , we plot average region, country, and industry-specific volatility excluding the TMT industries over time. While the level of average region and country-specific volatility is relatively unaffected, excluding the TMT industries leads to a substantial decrease in the level of industry-specific risk at the end of the 1990s. Interestingly, even after excluding the TMT industries, we still find a significant increase in industry-specific risk, suggesting that the TMT bubble was only partially responsible for the surge in industry risk at the end of the 1990s. The rise in industry-specific risk is, however, not substantial enough to make industry diversification significantly superior to geographical diversification, not even in the bubble period.

To have a better understanding of diversification potential within industries, we make a distinction between traded and non-traded goods industries. One would expect that industries that are involved in international trade have a higher exposure to global (regional) market shocks, and ceteris paribus a lower level of industry-specific volatility and diversification potential (see e.g. Griffin and Karolyi (1998), Diermeier and Solnik (2001), and Brooks and Negro (2004)). In Figure 3, we analyze to what extent industry-specific volatility is different for the average traded-goods and non-traded goods industry. We find a shift in the relative size of traded and non-traded goods industries around 1995. While non-traded goods industries were slightly

[19] More specifically, we remove the Telecom, Media, IT Hardware, and IT Software industries.

more volatile before 1995, the opposite is true afterwards. When we control, however, for the influence of the IT sector, we find that the traded goods industries have a level of asset-specific volatility consistently below the non-traded goods industries, and hence a lower level of diversification potential.

Finally, we investigate to what extent the evolution of country-specific risk is different for Europe. Given that over the last 20 years Europe has gone through an extraordinary period of economic, monetary, and financial integration, it is not surprising that structural changes both in the market beta and idiosyncratic volatility were most apparent in Europe. Figure 4 plots the different components of total risk for the (weighted) average European country. We find a number of interesting patterns. First, we observe a very clear downward trend in the average idiosyncratic volatility. This decrease is substantial in economic terms, from about 15% in the early 1970s to about 10% in the more recent period, or a decrease with more than 30 percent. Second, we find a similar yet slightly less outspoken downward trend in the average regional risk component across countries. This is mainly the result of a gradual reduction in the level of European-specific risk resulting from an increased exposure of the aggregate European market to global market shocks. Third, we observe a relatively small increase in the importance of global market risk over the period 1973-1996. The market component increases substantially, though, during the 1997-2000 period, reaching an all-time peak in April 2001. This rise is, however, to a large extent the result of the temporary surge in global market volatility observed in this period.

B Biases in measures of idiosyncratic volatility

In the introduction, we argued that the assumption of unit (constant) betas typically made in the country-industry literature is not only likely to be rejected by the data, but that it may also lead to substantial biases in measures of the potential in geographical and industry diversification strategies. In this section, we first quantify the bias in measures of average region, country, and industry-specific risk induced by not allowing betas to be different from one or time-varying. Second, we investigate what extensions of the unit beta model are most important, i.e. are crucial in reducing the total bias. This should help future studies deciding about the optimal level of model complexity.

In Appendix Appendix A, we show that the biases induced by assuming unit betas in case of a one-factor (for regions, industries) and a two-factor (for countries) model are given respectively by

$$bias^1_{Z,t} = \frac{\left(\sum_{z\in Z} w_{z,t}(\beta^w_{z,t}-1)^2\right)\sigma^2_{w,t}}{\sum_{z\in Z} w_{z,t}\sigma^2_{z,t}} \quad . \tag{8}$$

and

$$bias^1_{C,t} = \frac{\left(\sum_{c\in C} w_{c,t}(\beta^{reg(c)}_{c,t}-1)^2\right)\sigma^2_{reg(c),t} + \left(\sum_{c\in C} w_{c,t}\left[(\beta^w_{c,t}-1)-(\beta^w_{reg(c),t}-1)\right]^2\right)\sigma^2_{w,t}}{\sum_{c\in C} w_{c,t}\sigma^2_{c,t}} \quad . \tag{9}$$

where Z contains either the regions or the global industries, and C the countries over wich one want to aggregate. $reg(c)$ refers to the regional market r the country c belongs to. Appendix Appendix A shows that the biases induced by constant betas can be derived in a similar way. Equation (8) indicates that measures of average region (industry)-specific volatility using unit market betas are positively biased relative to our measure by the average cross-sectional variance in the betas (relative to unit betas) times the conditional world market variance. Similarly, equation (9) shows that unit beta models typically overestimate average country-specific volatility by an amount that is positively related to first the average cross-sectional variance of the country's global market exposure relative to the region's global market exposure times the world variance and second by the average cross-sectional variance of the region's global market exposure relative to unit beta case times the region-specific variance. Notice that the country bias reflects the bias in country-specific risk only, excluding the bias in region-specific risk. To make the biases in industry and country diversification potential comparable, however, we need to aggregate the region and country-specific biases. The last section of Appendix Appendix A shows how this can be accomplished.

Figure 5 plots the bias in the measures of average idiosyncratic risk resulting from imposing respectively unit (Panel A) and constant betas (Panel B). A number of interesting patterns emerge. First, assuming unit betas creates a potentially large bias in measures of both industry and country risk. For countries, the bias amounts to nearly 30 percent in the early 1970s and about 20 percent in the period 1985-1995. The bias in average industry-specific risk is generally below 10 percent, except during the years corresponding to the IT bubble when it increases to about 33 percent. The size and timing of this bias is not without consequences for a large number of related papers that have focused specifically on the post-1985 period using the Heston and Rouwenhorst (1994) dummy variable model. More specifically, our results suggest that these studies considerably overstated the potential of geographical diversification in the period 1985-1995 relative to industry diversification, whereas the opposite was the case in the post-2000 period. Second, the bias in average industry-specific risk decreases substantially when the IT sector is not taken into account, from more than 30 percent to slightly below 20 percent. This is easily understood by observing that the betas of especially the IT sectors during this period are considerably above one and hence contribute substantially to the first term in the bias, $\left(\sum_{z\in Z} w_{z,t}(\beta^w_{z,t}-1)^2\right)$. Third, as can be seen from Panel B, the bias at the country level does not decrease substantially when constant instead of unit betas are allowed for, further underlining the need for time-varying betas at the country level. At the industry level, however, a considerable part of the bias disappears when betas are allowed to be different from one but constant, except for during the IT bubble when the bias remains considerable (about 17 (10) percent including (excluding) the TMT industries).

Finally, we investigate what features of our model are most important for reducing the total bias. We respectively quantify the contribution of allowing betas to be constant instead of being unity, of allowing structural instruments instruments in the betas (relative to the constant beta case), of allowing regime-switches in the betas (relative to the beta specification with instruments), and finally of also allowing for structural shifts in the asset-specific volatility specification (relative to model with time-varying betas and an AGARCH volatility specification). The individual contributions sum up to the total bias. Figure 6 reports the decomposition at the country level (Panel A) and at the industry level (Panel B). The decomposition yields a number of interesting insights. First, the bias in industry-specific risk is reduced considerably when constant instead of unit market betas are allowed for. Not surprisingly, the exception is the period corresponding to the TMT bubble, during which both the instruments and the regime-switching component contribute to a reduction in the total bias. Second, the bias in total country-specific risk reduces only marginally when betas are alllowed to be constant instead of unity. Both instruments and the latent regime variable are required to bring down the bias to zero. Finally, the contribution of instrumenting also the asset-specific volatility with the structural instruments is relatively small.

C Evolution of model-implied correlations

In this section, we investigate the evolution of average conditional correlations over time, both across countries (regions) and industries. We focus on three questions. First, we investigate to what extent correlations are asymmetric, i.e. higher in highly volatile periods. Second, we analyze whether further integration and globalization has lead to a structural increase in cross-country correlations. Last but not least, we compare the relative size of cross-country and cross-industry correlations over time. A structural increase in cross-country correlations that is not matched by a similar increase in cross-industry correlations would be consistent with a decrease (increase) in the potential of geographical (industry) diversification.

Assume that the asset-specific shocks e_t are uncorrelated. Under this assumption, the conditional correlation between two regions or industries i and j is given by

$$\rho_{i,j,t} = \beta_{i,t}^{w}\beta_{j,t}^{w}\frac{\sqrt{h_{w,t}}}{\sqrt{\left(\beta_{i,t}^{w}\right)^{2}h_{w,t}+h_{i,t}}}\frac{\sqrt{h_{w,t}}}{\sqrt{\left(\beta_{j,t}^{w}\right)^{2}h_{w,t}+h_{j,t}}} \tag{10}$$

where the symbols are defined as before. Given the substantial evidence in this and previous papers of no trend in global equity market volatility, equation (10) clearly shows that a *structural* increase in cross-asset correlations is generated by a structural increase in the assets' market beta and/or a fundamental decrease in the level of asset-specific risk. A similar formula can be derived for the cross-country correlations, which will in addition be driven by the time-varying regional market betas as well as the regional market's volatility. We calculate average market-weighted correlations as follows:

$$\bar{\rho} = \frac{\sum_{i\in Z}\sum_{j\in Z,j\neq i}\omega_i\omega_j\rho_{i,j}}{\sum_{i\in Z}\sum_{j\in Z,j\neq i}\omega_i\omega_j}. \tag{11}$$

where Z contains respectively all regions, countries, or global industries.

Figure 7 plots the evolution over time of the average market-weighted conditional correlations across regions, countries, and industries. As before, we distinguish between return series including (Panel A) and excluding the TMT industries. A number of interesting patterns emerge. First, we observe a clear cyclical pattern in the average correlations for all asset classes: correlations are on average substantially higher in recessions than in expansions, i.e. asymmetric. Second, there is a strong upward trend in average cross-regional and cross-country correlations, indicating a reduction in the benefits from international diversification. In the case of countries, average correlation was typically below 40 percent in the 1970 compared to up to 65 percent in the recent years. The increase is even more substantial (up to nearly 80 percent) when we look specifically at the continental European equity markets. This suggests that globalization and regional integration both contribute to increasing international correlations. Third, for nearly the entire sample, cross-industry correlations are substantially higher than cross-country correlations, confirming the superiority of geographical relative to industry diversification strategies. Fourth, the period around the IT bubble had a strong but temporary effect on both average industry and country (regional) correlations. In 2000, the decrease and increase in respectively industry and country correlations made the latter to be (slightly) higher than the former for the first time in nearly 30 years. From 2002, cross-industry correlations rose again above cross-country correlations, even though the margin is very small. Finally, the relative increase in cross-country correlations is less pronounced when the TMT industries are taken out, and, even though the difference becomes smaller, cross-country correlations are never larger than cross-industry correlations.

VI Conclusion

In this paper, we investigate the effect of both structural and temporary changes in the economic and financial environment on the relative potential of geographical and industry diversification. We develop a new structural regime-switching volatility spillover model that decomposes total risk at the regional, country, and industry level into a systematic and a diversifiable component. The main advantage of this methodology is that it allows us to quantify the respective benefits of diversifying across countries or industries in a fully conditional setting that explicitly allows betas and conditional volatilities to vary through time. We make market betas conditional upon a latent regime variable and two structural economic instruments, namely industry (country) alignment and trade integration. An additional innovative feature of our model is that we allow the same structural instruments to have an (opposite) effect on the level of idiosyncratic volatility. We estimate the volatility spillover model for a set of 4 regions, 21 countries, and 21 global industries over the period January 1973-December 2003. Based upon those estimates, we calculate and compare two indicators of diversification potential both for countries and industries, namely average asset-specific volatilties and model-implied correlations.

Our main results can be summarized as follows. First, we find strong evidence in favor of time-varying betas, both at the country (regional) and industry level. Both the assumption of unit and constant betas is easily rejected for (nearly) all series. The determinants of betas, however, differ between countries and industries. While the effect of trade integration and industry alignment on country betas is large both in economic and statistical terms, the time variation in the industry betas seems mainly driven by temporary factors. The effect of trade integration is especially large in Europe, a region that has gone through an extraordinary period of further economic and financial integration. Finally, we find a strong negative effect of both trade integration and industry alignment on country and region-specific risk. Evidence that the structural instruments also influence industry-specific risk is relatively weak.

Second, we show that the often made assumption of unit market betas may lead to substantial biases in measures of both industry and country risk. In our sample, we find biases in average country and industry-specific risk of more than 30 percent. The bias in industry-specific risk is generally below 10 percent, but rises to 33 percent in the period corresponding to the the TMT bubble. For countries, the bias is especially large in the early 1970s and between 1985-1995. Interestingly, it was especially during the latter period that previous studies found the benefits from geographical diversification to be far superior to those from industry diversification, while the opposite was true in the period corresponding to the TMT bubble. Allowing for constant instead of unit betas reduces but does not eliminate the bias at the industry level, especially not during the TMT bubble period. For countries, the bias is only reduced when time variation in the betas is allowed for.

Third, after correcting for these biases, we find that over the last 30 years average country-specific risk was typically higher than average industry-specific risk, confirming previous results on the superiority of geographical over industry diversification. At the end of the 1990s, however, we observe a strong rise in the level of industry-specific risk, an increase that is only partially matched by an increase in country-specific risk. Industry-specific risk surpassed country-specific risk briefly in 1999-2001 period, to stay at similar levels from 2003 on. These results indicate that the benefits of geographical and industry are now of a comparable size.

Fourth, we observe a gradual increase in cross-country correlations, a trend that started well before the start of the TMT bubble. While over the last 30 years cross-country correlations were typically below cross-industry correlations, the structurally-driven convergence of cross-country betas towards one and corresponding decrease in country-specific risk resulted in a gradual increase in cross-country correlations. A similar upward trend is not found in cross-industry correlations. From 2000 on, average correlations across countries and industries fluctuated roughly at the same level, providing further evidence that geographical and industry diversification now yield about the same benefits.

Finally, we find that the substantial increase (decrease) in industry-specific risk (cross-industry) correlations at the end of the 1990s is not a pure artifact of the TMT bubble. More specifically, we still find a similar yet slightly less pronounced pattern when the TMT industries are removed from the analysis. We find that without the TMT industries geographical diversification continues being superior to industry diversification, even though the difference is relatively small.

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Appendix A Derivation of Theoretical Biases in Measures of Idiosyncratic Volatility

In this section, we derive the theoretical biases in measures of average asset-specific risk by respectively assuming unit and constant betas as used in Section V.B.

I One Factor Model

The region- and industry-specific shocks are identified using the following one factor model:

$$\varepsilon_{z,t} = \beta^{w}_{z,t} e_{w,t} + e_{z,t} \tag{12}$$

with $z = \{reg, gi\}$. The restricted unit and constant beta models are respectively given by

$$\varepsilon_{z,t} = e_{w,t} + \tilde{e}_{z,t} \tag{13}$$

$$\varepsilon_{z,t} = \beta^{w}_{z} e_{w,t} + \hat{e}_{z,t}. \tag{14}$$

Equating (13) and (14) with (12) and after rearranging, we become

$$\tilde{e}_{z,t} = \left(\beta^{w}_{z,t} - 1\right) e_{w,t} + e_{z,t} \tag{15}$$

$$\hat{e}_{z,t} = \left(\beta^{w}_{z,t} - \beta^{w}_{z}\right) e_{w,t} + e_{z,t}. \tag{16}$$

After taking variances of both sides and aggregating over regions (industries), we have

$$\sum_{z\epsilon Z} w_{z,t}\tilde{\sigma}^2_{z,t} = \sum_{z\epsilon Z} w_{z,t}(\beta^{w}_{z,t} - 1)^2 \sigma^2_{w,t} + \sum_{z\epsilon Z} w_{z,t}\sigma^2_{z,t}$$
$$\sum_{z\epsilon Z} w_{z,t}\hat{\sigma}^2_{z,t} = \sum_{z\epsilon Z} w_{z,t}(\beta^{w}_{z,t} - \beta^{w}_{z})^2 \sigma^2_{w,t} + \sum_{z\epsilon Z} w_{z,t}\sigma^2_{z,t},$$

where $w_{z,t}$ represents asset z's market weight. The first term of the right-hand side reflects the positive bias in average region (industry)-specific risk when one miscorrectly uses unit and constant beta models. The relative bias for respectively unit and constant beta models is given by

$$bias^{1}_{Z,t} = \frac{\left(\sum_{z\in Z} w_{z,t}(\beta^{w}_{z,t} - 1)^2\right)\sigma^2_{w,t}}{\sum_{z\in Z} w_{z,t}\sigma^2_{z,t}} \tag{17}$$

and

$$bias^{2}_{Z,t} = \frac{\left(\sum_{z\in Z} w_{z,t}(\beta^{w}_{z,t} - \beta^{w}_{z})^2\right)\sigma^2_{w,t}}{\sum_{z\in Z} w_{z,t}\sigma^2_{z,t}}. \tag{18}$$

II Two Factor Model

Country-specific shocks are related to respectively a global and a regional market shock:

$$\varepsilon_{c,t} = \beta^{w}_{c,t} e_{w,t} + \beta^{reg}_{c,t} e_{reg,t} + e_{c,t}, \tag{19}$$

The corresponding unit and constant beta models are respectively given by

$$\varepsilon_{c,t} = e_{w,t} + \tilde{e}_{reg,t} + \tilde{e}_{c,t} \tag{20}$$

$$\varepsilon_{c,t} = \beta^{w}_{c} e_{w,t} + \beta^{reg}_{c} \hat{e}_{reg,t} + \hat{e}_{c,t} \tag{21}$$

By equating (20) and (21) with (19) and replacing $\tilde{e}_{reg,t}$ and $\hat{e}_{reg,t}$ by respectively equation 15 and 16, we obtain after rearranging:

$$\tilde{e}_{c,t} = \left(\beta^{w}_{c,t} - 1\right) e_{w,t} - \left(\beta^{w}_{reg,t} - 1\right) e_{w,t} + \left(\beta^{reg}_{c,t} - 1\right) e_{reg,t} + e_{c,t} \tag{22}$$

$$\hat{e}_{c,t} = \left(\beta^{w}_{c,t} - \beta^{w}_{c}\right) e_{w,t} - \left(\beta^{reg}_{c}\beta^{w}_{reg,t} - \beta^{reg}_{c}\beta^{w}_{reg}\right) e_{w,t} + \left(\beta^{reg}_{c,t} - \beta^{reg}_{c}\right) e_{reg,t} + e_{c,t}. \tag{23}$$

Noting that all shocks at the RHS are mutually orthogonal and after taking variances of both sides and aggregating over countries, we obtain:

$$\begin{aligned}
\textstyle\sum_c w_{c,t}\tilde{\sigma}_{c,t} &= \left(\textstyle\sum_c w_{c,t}\left[(\beta^{w}_{c,t} - 1) - (\beta^{w}_{reg(c),t} - 1)\right]^2\right)\sigma^2_{w,t} \\
&\quad + \left(\textstyle\sum_c w_{c,t}\left(\beta^{reg(c)}_{c,t} - 1\right)^2\right)\sigma^2_{reg(c),t} + \textstyle\sum_c w_{c,t}\sigma^2_{c,t} \\
\textstyle\sum_c w_{c,t}\hat{\sigma}_{c,t} &= \left(\textstyle\sum_c w_{c,t}\left[\left(\beta^{w}_{c,t} - \beta^{w}_{c}\right) - \beta^{reg(c)}_{c}\left(\beta^{w}_{reg(c),t} - \beta^{w}_{reg(c)}\right)\right]^2\right)\sigma^2_{w,t} \\
&\quad + \left(\textstyle\sum_c w_{c,t}\left(\beta^{reg(c)}_{c,t} - \beta^{reg(c)}_{c}\right)^2\right)\sigma^2_{reg(c),t} + \textstyle\sum_c w_{c,t}\sigma^2_{c,t}.
\end{aligned}$$

with $reg(c)$ the region which the country c belongs too. The relative biases in country-specific risk (expressed as percentage of the correct country-specific risk) from respectively assuming unit and constant beta models is given by

$$bias^1_{C,t} = \frac{\left(\sum_c w_{c,t}\left[(\beta^{w}_{c,t} - 1) - (\beta^{w}_{reg(c),t} - 1)\right]^2\right)\sigma^2_{w,t} + \left(\sum_c w_{c,t}\left(\beta^{reg(c)}_{c,t} - 1\right)^2\right)\sigma^2_{reg(c),t}}{\sum_c w_{c,t}\sigma^2_{c,t}}$$

and

$$\begin{aligned}
bias^2_{C,t} &= \frac{\left(\sum_c w_{c,t}\left[\left(\beta^{w}_{c,t} - \beta^{w}_{c}\right) - \beta^{reg(c)}_{c}\left(\beta^{w}_{reg(c),t} - \beta^{w}_{reg(c)}\right)\right]^2\right)\sigma^2_{w,t}}{\sum_c w_{c,t}\sigma^2_{c,t}} \\
&\quad + \frac{\left(\sum_c w_{c,t}\left(\beta^{reg(c)}_{c,t} - \beta^{reg(c)}_{c}\right)^2\right)\sigma^2_{reg(c),t}}{\sum_c w_{c,t}\sigma^2_{c,t}}.
\end{aligned}$$

III Aggregated Bias

In this section, we show how the biases in region and country-specific volatility can be aggregated to a total country bias that is comparable in size with the bias in aggregate industry-specific risk. We show the derivation in case of unit betas. The constant beta case can be derived in a similar way. By equating (20) and (21) with (19) and after rearranging, we get

$$\tilde{e}_{c,t} + \tilde{e}_{reg,t} = \left(\beta^{w}_{c,t} - 1\right) e_{w,t} + \beta^{reg}_{c,t} e_{reg,t} + e_{c,t}.$$

Taking variances of both side, we get

$$\tilde{\sigma}^2_{c,t} + \tilde{\sigma}^2_{reg,t} + 2cov(\tilde{e}_{c,t}, \tilde{e}_{reg,t}) = \left(\beta^{w}_{c,t} - 1\right)^2 \sigma^2_{w,t} + \left(\beta^{reg}_{c,t}\right)^2 \sigma^2_{reg,t} + \sigma^2_{c,t}. \quad (24)$$

Replacing $\tilde{e}_{reg,t}$ and $\tilde{e}_{c,t}$ by respectively equation (15) and (22), we can write the covariance term as

$$cov(\tilde{e}_{c,t}, \tilde{e}_{reg,t}) = \left(\beta^{w}_{c,t} - 1\right)\left(\beta^{w}_{reg,t} - 1\right)\sigma^2_{w,t} - \left(\beta^{w}_{reg,t} - 1\right)^2 \sigma^2_{w,t} + \left(\beta^{reg}_{c,t} - 1\right)\sigma^2_{reg,t}.$$

After replacing the covariance term in equation 24 and after rearranging, we get

$$\tilde{\sigma}^2_{reg,t} + \tilde{\sigma}^2_{c,t} = \left(\beta^{w}_{c,t} - \beta^{w}_{reg,t}\right)^2 \sigma_{w,t} + \left(\beta^{w}_{reg,t} - 1\right)^2 \sigma_{w,t} - 2\left(\beta^{reg}_{c,t} - 1\right)\sigma^2_{reg,t} + \left(\beta^{reg}_{c,t}\right)^2 \sigma_{reg,t} + \sigma_{c,t}.$$

Notice that the left-hand side constitutes the total geographical-specific volatility of one individual country (consisting of a country and region-specific component) in the unit beta case. The last two terms on the right-hand side constitute the correct country-specific volatility. After aggregating over the different regions reg and countries c, the bias in total aggregate country-specific risk is given by

$$bias^1_{C,REG,t} = \frac{\left(\sum_c w_{c,t}\left[\left(\beta^{w}_{c,t} - \beta^{w}_{reg(c),t}\right)\right]^2\right)\sigma^2_{w,t} + \left(\sum_{reg} w_{reg,t}\left(\beta^{w}_{reg,t} - 1\right)^2\right)\sigma^2_{w,t}}{\sum_{reg} w_{reg,t}\sum_c w_{c,reg,t}\left(\beta^{reg(c)}_{c,t}\right)^2 \sigma^2_{reg(c),t} + \sum_c w_{c,t}\sigma^2_{c,t}} - \frac{2\sum_c w_{c,t}\left(\beta^{reg(c)}_{c,t} - 1\right)\sigma^2_{reg(c),t}}{\sum_{reg} w_{reg,t}\sum_c w_{c,reg,t}\left(\beta^{reg(c)}_{c,t}\right)^2 \sigma^2_{reg(c),t} + \sum_c w_{c,t}\sigma^2_{c,t}}$$

with $w_{c,reg,t}$ the relative weight of the country c within the region reg. The first component of this ratio reflects the bias due to the country world beta to be different from the world beta of the region the country belongs to. The second component reflects the bias due to regional betas to be different form one. The last component should in fact be close to zero as $\sum_c w_{c,t}\beta^{reg(c)}_{c,t}$ should be equal to one for each subset of countries belonging to one region, and should be considered as an estimation error rather than a bias.

Table 1: Regions, Countries and Industries

The region Europe is disaggregated over 14 European countries. The region Pacific consists of 4 countries (Australia, Hong Kong, New Zealand and Singapore). This results in 21 geographical entities. The 21 industries are constructed by aggregating over the 36 economic industries from the FTSE Actuaries Classification System. The traded-goods industries are marked with a 'T', the non-traded-goods industries with a 'NT'.

Region	**Codes**	**Region**	**Codes**
Europe	EU	Japan	JP
Pacific	PC	United States	US
Country	**Codes**	**Country**	**Codes**
Australia	AU	Italy	IT
Austria	OE	Netherlands	NL
Belgium	BG	New Zealand	NZ
Canada	CN	Norway	NW
Denmark	DK	Singapore	SG
Finland	FN	Spain	ES
France	FR	Sweden	SD
Germany	BD	Switzerland	SW
Hong Kong	HK	UK	UK
Ireland	IR	**World**	**WD**
Industry	**Codes**	**Industry**	**Codes**
Basic Industries (T)	BASIC	Non-Cyclical Services (NT)	NCYSR
General Industrials (T)	GENIN	- *Food Retailers*	
Cyclical Consumer Goods (T)	CYCGD	- *Telecom*	
- *Automobiles & Parts*		Information Technology (T)	ITECH
- *Household Goods*		- *IT Hardware*	
Non-Cyclical Consumer Goods (T)	NCYCG	- *IT Software*	
- *Food Prod & Tobacco*		Financials (NT)	TOTLF
- *Health & Pharma*		- *Banks*	
Cyclical Services (NT)	CYSER	- *Insurance*	
- *General Retailers*		- *Real Estate*	
- *Leisure*		- *Investment Companies*	
- *Media*		Resources (NT)	RESOR
- *Transport*		- *Mining*	
Utilities (NT)	UTILS	- *Oil & Gas*	

Table 2: Summary Statistics of World, Regional, Country and Global Industry Portfolios

All data are weekly US denominated total returns over the period january 1973 - november 2003, for a total of 1611 observations. The returns are in excess of the U.S. one-month Treasury-bill rate. Panel A displays the results for the world, regions and countries. Panel B shows the results for the industries. Country portfolio returns are computed as the value-weighted averages of the local industry portfolio returns. Region portfolio returns are computed by aggregating over the relevant countries in the dataset. World portfolio returns are computed by aggregating over the 4 regions. The industry portfolio returns are computed as the value-weighted average of country industry portfolio returns. The mean and standard deviation values are annualized. Obs is the number of observations, Skewn stands for skewness, Kurtos for kurtosis, JB is the Jarque-Bera test for normality, ARCH(4) is a standard LM test for autoregressive conditional heteroscedasticity of order 4, Q(4) tests for fourth-order autocorrelation, Size is the market value of the portfolio as a percentage of the total world market value, and NrFirms is the average number of firms in the portfolio. * denotes significant at a 1 percent level.

Panel A

	Obs	Mean	Stdev	Skewn	Kurtos	JB	ARCH(4)	Q(4)	Size	NrFirms
World	1612	4.78	13.84	-0.31	5.39	409*	94.94*	134.55*	100.00%	3011
Europe	1612	6.41	15.48	-0.32	5.68	508*	181.95*	233.72*	27.49%	1215
Pacific	1612	6.08	20.66	-0.62	9.39	2848*	197.27*	254.23*	3.96%	247
Japan	1612	4.33	20.97	0.26	4.78	233*	91.36*	127.91*	21.24%	729
United States	1612	5.80	16.26	-0.29	5.42	417*	120.02*	155.52*	44.90%	676
Australia	1612	6.21	22.04	-0.57	11.01	4391*	87.22*	110.04*	1.49%	87
Austria	1612	5.54	18.95	0.63	8.70	2284*	205.96*	318.66*	0.15%	24
Belgium	1612	6.59	17.51	-0.05	6.35	754*	131.84*	176.79*	0.56%	49
Canada	1612	4.41	15.98	-0.34	5.56	472*	114.41*	133.34*	2.41%	144
Denmark	1612	8.02	19.41	0.12	8.39	1958*	66.57*	60.69*	0.34%	30
Finland	817	11.27	31.45	-0.15	6.27	368*	46.15*	64.63*	0.50%	36
France	1612	8.41	21.29	-0.27	4.96	276*	146.26*	202.38*	3.64%	116
Germany	1612	5.46	18.36	-0.21	4.89	253*	125.51*	183.99*	3.97%	130
Hong Kong	1612	11.04	31.98	-0.24	7.37	1298*	247.57*	356.41*	1.78%	72
Ireland	1612	9.40	22.19	0.10	6.55	851*	191.51*	190.61*	0.21%	28
Italy	1612	5.88	24.91	-0.15	4.59	176*	66.24*	86.20*	1.97%	86
Netherlands	1612	8.17	17.01	-0.19	6.66	910*	180.92*	247.38*	2.31%	85
New Zealand	829	6.52	20.38	0.14	5.68	251*	17.09*	22.96*	0.11%	32
Norway	1247	6.27	24.20	-0.15	5.06	225*	68.36*	96.08*	0.23%	29
Singapore	1612	4.27	25.31	-0.33	11.83	5269*	58.42*	77.71*	0.58%	56
Spain	873	7.37	21.03	-0.34	4.71	123*	33.32*	34.73*	1.22%	93
Sweden	1142	11.16	25.37	-0.20	5.05	207*	84.96*	108.64*	0.85%	43
Switzerland	1612	6.82	17.00	-0.31	5.36	401*	162.08*	213.29*	2.24%	93
UK	1612	7.53	20.33	0.41	8.88	2367*	209.95*	274.95*	9.30%	373

Panel B

	Obs	Mean	Stdev	Skewn	Kurtos	JB	ARCH(4)	Q(4)	Size	NrFirms
Basic Industries	1612	3.78	15.37	-0.22	5.44	413*	65.19*	88.63*	6.83%	203
General Industrials	1612	4.83	15.42	-0.48	6.04	682*	159.05*	216.01*	9.33%	165
Automobiles & Parts	1612	3.45	17.11	-0.14	5.67	483*	78.49*	109.79*	3.19%	52
Household Goods	1612	3.74	17.96	-0.18	5.04	290*	101.55*	131.52*	1.40%	28
Food Prod & Tobacco	1612	6.78	13.16	-0.34	5.87	584*	108.23*	140.85*	5.31%	120
Health & Pharma	1612	6.55	15.59	-0.19	5.46	417*	84.37*	110.05*	9.92%	108
General Retailers	1612	5.26	18.30	0.05	6.13	660*	60.58*	81.14*	3.65%	57
Leisure	1612	4.84	17.51	-0.48	6.05	686*	202.43*	287.27*	2.49%	100
Media	1612	3.72	17.61	-0.44	5.92	622*	121.93*	162.18*	2.96%	37
Transport	1612	3.98	15.27	-0.05	4.92	247*	77.96*	107.95*	2.41%	46
Food Retailers	1612	7.65	14.68	-0.17	5.62	469*	65.55*	89.17*	1.43%	53
Telecom	1612	4.89	17.10	0.16	5.84	549*	193.19*	330.99*	7.28%	81
Utilities	1612	5.05	13.35	0.13	5.07	292*	167.29*	264.12*	4.57%	122
IT Hardware	1612	5.80	24.17	-0.20	5.30	366*	227.62*	386.04*	7.21%	32
IT Software	1612	7.51	26.44	-0.24	5.20	341*	159.11*	200.34*	3.35%	82
Banks	1612	6.32	17.07	0.67	11.08	4505*	36.09*	44.29*	11.14%	82
Insurance	1612	6.53	15.84	-0.06	6.54	841*	152.30*	207.70*	4.85%	83
Real Estate	1612	4.73	18.73	-0.06	4.93	251*	109.84*	163.25*	1.52%	46
Investment Companies	1612	6.70	20.61	0.13	5.26	346*	127.63*	191.74*	4.45%	134
Mining	1612	5.66	22.99	-0.26	7.64	1463*	72.06*	85.53*	0.68%	78
Oil & Gas	1612	6.80	17.30	0.05	4.79	217*	99.55*	132.08*	6.03%	47

Table 3: Average Cross-Correlations and Subsample Within-Correlations of World, Regional, Global Industry and Country Returns

The left pane displays the average unconditional correlations between the different sets of portfolio returns. The right pane shows the average unconditional correlations between respectively region returns, industry returns and country returns over different subsamples. Individual correlations are averaged using the market capitalizations as weights.

	World	**Region**	**Industry**	**Country**	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**
World	1.00	0.70	0.76	0.52					
Region	0.70	0.42	0.55	0.43	0.53	0.52	0.44	0.42	0.56
Industry	0.76	0.55	0.58	0.41	0.61	0.60	0.65	0.54	0.56
Country	0.52	0.43	0.41	0.41	0.42	0.41	0.44	0.38	0.57

Table 4: Structural Instruments for World, Regions, Global Industries and Countries over Different Subperiods

Panel A displays the full-period and the subperiod averages of the structural instruments for respectively regions and industries. Panel B shows the results for the countries. The trade integration measure for regions and countries is calculated as the ratio of imports plus exports over GDP. Data is obtained from the OECD. For the countries, we make a distinction between trade with the world (W) and trade with the region (R) the country belongs too. At the industry level, the integration measure is calculated as the ratio of the industry's trade relative to its value added. The data is obtained from the STructural ANalysis (STAN) database of the OECD. The misalignment measure for regions is computed as the square root of the mean squared errors between the industry weights of the region and the industry weights of the world. For the countries, we make a distinction between the errors relative to the weights of the world (W) and the errors relative to the weights of the region (R) the country belongs too. For the industries the misalignment measure is computed as the square root of the mean squared errors between the country weights of the industry and the country weights of the world.

Panel A

Region / Industry	**Trade Integration**						**Misalignment**					
	Mean	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**	**Mean**	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**
Europe	9.08%	8.58%	9.38%	8.02%	8.49%	10.68%	10.75%	14.46%	12.78%	6.32%	5.89%	9.95%
Pacific	23.31%	16.45%	20.90%	24.96%	29.44%	30.23%	26.12%	30.95%	26.16%	18.77%	22.02%	26.81%
Japan	14.84%	16.67%	16.48%	12.91%	11.75%	14.18%	15.42%	18.69%	13.78%	12.04%	12.61%	15.96%
US	11.24%	9.28%	9.75%	11.41%	12.76%	14.13%	11.37%	9.94%	11.41%	16.36%	12.34%	9.25%
Basic Industries	11.26%	8.46%	11.31%	11.39%	12.43%	14.45%	17.95%	17.61%	15.94%	16.15%	17.54%	21.42%
General Industrials	15.43%	11.01%	13.85%	15.13%	17.29%	22.05%	10.87%	12.79%	10.29%	8.56%	9.75%	10.84%
Automobiles & Parts	29.71%	28.00%	25.24%	27.96%	29.36%	34.88%	24.00%	14.58%	16.09%	18.66%	26.31%	45.71%
Household Goods	19.40%	11.76%	15.45%	18.35%	22.66%	32.08%	34.49%	43.11%	31.70%	27.45%	26.38%	33.85%
Food Prod & Tobacco	11.28%	12.59%	10.42%	10.20%	10.71%	12.64%	16.35%	12.32%	16.47%	27.27%	21.16%	11.41%
Health & Pharma	18.25%	19.53%	16.04%	15.53%	17.29%	21.97%	24.59%	24.36%	18.75%	34.09%	29.44%	19.48%
General Retailers							16.91%	11.26%	19.67%	19.52%	18.16%	20.41%
Leisure							18.34%	19.84%	18.01%	22.40%	21.26%	11.82%
Media							19.50%	24.02%	21.04%	19.01%	18.74%	12.70%
Transport							29.19%	37.22%	17.24%	25.19%	27.01%	30.37%
Food Retailers							24.86%	28.37%	27.25%	28.51%	17.38%	19.75%
Telecom							26.96%	41.02%	35.48%	15.66%	14.48%	15.91%
Utilities							13.15%	14.63%	17.66%	12.33%	9.69%	10.37%
IT Hardware	44.65%	24.68%	21.17%	31.61%	50.52%	73.33%	22.81%	26.50%	19.41%	16.32%	20.50%	25.96%
IT Software	44.65%	24.68%	21.17%	31.61%	50.52%	73.33%	45.84%	48.71%	49.56%	53.89%	49.69%	31.04%
Banks							32.12%	43.52%	37.93%	30.23%	25.61%	16.65%
Insurance							20.32%	18.86%	21.43%	25.66%	23.47%	15.99%
Real Estate							42.81%	56.49%	39.71%	31.57%	44.16%	32.74%
Investment Companies							27.32%	35.21%	33.36%	29.12%	23.50%	12.54%
Mining							71.51%	76.47%	69.94%	72.05%	68.59%	66.84%
Oil & Gas							26.94%	23.48%	30.18%	40.06%	29.27%	18.77%

Panel B

Country	W/R	Trade Integration						Misalignment					
		Mean	73-82	83-87	88-92	93-96	97-04	Mean	73-82	83-87	88-92	93-96	97-04
Austria	**W**	6.65%	5.81%	7.04%	6.57%	6.19%	7.91%	32.50%	33.00%	40.82%	31.41%	25.05%	30.85%
	R	35.97%	31.92%	33.96%	36.67%	34.85%	43.40%	25.56%	22.61%	32.57%	28.85%	24.25%	23.13%
Belgium	**W**	15.72%	13.65%	16.65%	14.31%	14.76%	19.61%	34.30%	38.85%	28.67%	26.73%	30.84%	39.27%
	R	74.61%	65.33%	81.04%	80.44%	73.67%	79.68%	31.71%	36.37%	28.99%	26.73%	30.46%	31.30%
Denmark	**W**	7.70%	7.05%	8.85%	7.45%	7.41%	8.16%	28.16%	32.45%	27.79%	27.41%	23.45%	25.50%
	R	33.45%	32.35%	34.37%	32.63%	32.87%	35.28%	28.84%	33.51%	29.04%	27.71%	23.45%	25.90%
Finland	**W**	13.23%	12.76%	14.68%	9.44%	12.89%	15.77%	18.45%	-	-	18.96%	35.11%	48.32%
	R	26.35%	25.89%	23.88%	22.80%	28.33%	30.21%	21.52%	-	-	18.45%	38.56%	60.39%
France	**W**	6.78%	6.43%	6.75%	6.19%	6.32%	7.99%	16.97%	21.72%	21.61%	11.83%	11.42%	13.71%
	R	20.13%	17.44%	19.39%	20.77%	20.14%	24.07%	20.01%	27.37%	22.64%	14.35%	13.33%	15.47%
Germany	**W**	8.92%	7.70%	9.56%	8.71%	8.15%	10.83%	25.40%	25.40%	27.52%	25.50%	25.86%	23.54%
	R	26.18%	23.47%	28.23%	28.16%	23.04%	28.96%	26.52%	26.65%	27.23%	28.22%	28.94%	23.22%
Ireland	**W**	19.13%	11.75%	16.22%	16.42%	22.48%	31.86%	38.21%	44.35%	42.53%	30.74%	29.88%	36.47%
	R	60.86%	56.34%	57.71%	61.06%	64.29%	67.58%	32.74%	36.40%	37.28%	29.69%	27.63%	29.34%
Italy	**W**	7.26%	8.00%	7.67%	5.38%	6.54%	7.66%	42.42%	51.08%	45.02%	38.22%	36.97%	34.27%
	R	19.71%	18.63%	18.46%	18.72%	20.22%	22.60%	37.38%	41.87%	40.76%	40.12%	38.12%	26.10%
Netherlands	**W**	14.12%	12.50%	14.18%	12.02%	12.82%	18.68%	31.16%	33.32%	35.97%	33.89%	26.18%	25.51%
	R	53.75%	48.13%	56.17%	55.71%	47.99%	61.99%	28.34%	32.63%	34.58%	32.04%	24.20%	17.39%
Norway	**W**	7.82%	7.45%	6.90%	7.12%	8.18%	9.32%	33.31%	17.69%	43.18%	43.63%	38.53%	38.19%
	R	32.98%	33.29%	34.92%	32.03%	32.04%	32.37%	32.06%	18.19%	42.64%	42.09%	36.34%	34.66%
Spain	**W**	6.25%	6.60%	7.52%	4.98%	5.13%	6.41%	16.66%	-	-	28.52%	30.51%	33.08%
	R	15.88%	9.05%	12.64%	15.99%	19.36%	25.96%	15.69%	-	-	29.62%	31.98%	26.64%
Sweden	**W**	10.68%	7.82%	10.45%	10.11%	12.50%	14.31%	18.05%	-	25.67%	26.66%	28.37%	22.19%
	R	33.70%	26.59%	33.59%	33.54%	39.12%	41.01%	20.54%	-	26.97%	27.45%	32.22%	29.79%
Switzerland	**W**	9.65%	9.59%	10.02%	9.20%	8.28%	10.61%	42.66%	44.37%	37.15%	41.78%	48.29%	41.59%
	R	33.12%	36.48%	33.03%	31.02%	26.66%	33.61%	42.40%	44.82%	34.28%	41.70%	48.93%	41.52%
UK	**W**	11.68%	12.31%	11.37%	10.21%	11.57%	12.12%	18.16%	20.22%	17.41%	15.63%	14.56%	19.65%
	R	21.29%	20.21%	22.17%	21.54%	22.48%	21.33%	19.91%	19.62%	22.33%	24.11%	20.30%	15.32%
Australia	**W**	8.90%	8.72%	8.58%	8.73%	8.75%	9.58%	35.47%	44.80%	36.89%	30.46%	29.51%	28.07%
	R	12.99%	10.96%	12.02%	12.24%	14.76%	16.14%	51.82%	73.11%	58.63%	45.20%	42.79%	26.30%
Hong Kong	**W**	174.76%	200.61%	204.88%	181.46%	143.34%	129.15%	37.62%	45.28%	35.65%	27.52%	36.54%	35.95%
	R	81.98%	71.07%	79.32%	101.64%	101.18%	74.42%	34.22%	40.12%	30.65%	36.44%	35.79%	25.83%
New Zealand	**W**	14.03%		14.88%	13.31%	13.78%	14.62%	16.01%	-	-	29.62%	33.99%	30.38%
	R	22.59%		18.39%	20.25%	23.41%	24.18%	19.89%	-	-	36.07%	43.95%	37.28%
Singapore	**W**	249.63%	220.82%	246.91%	302.29%	259.14%	249.60%	36.92%	44.03%	41.69%	33.14%	31.09%	29.34%
	R	149.75%	152.31%	136.33%	180.35%	165.18%	124.92%	25.07%	28.62%	28.88%	26.81%	25.32%	15.83%
Canada	**W**	9.21%	8.56%	8.07%	9.15%	9.75%	10.72%	24.00%	28.33%	23.31%	22.19%	25.05%	18.98%
	R	30.77%	23.59%	26.92%	25.15%	34.69%	45.64%	24.54%	28.36%	19.97%	24.10%	25.13%	22.30%

Table 5: Specification Tests and Model Selection

This table reports the specification and likelihood ratio tests for model selection. Panel A shows the results for the world and the regions, Panel B for the industries and Panel C for the countries. The second column displays the selected model based on the tests. The four-digit model code is defined as follows: the first number represents the assumptions about the beta (1 = unit, 2 = constant, 3 = time-varying); the second number denotes whether instruments are added to the beta specification (0 = no instruments, 1 = instruments), the third number represents whether regimes are allowed in the beta specification (0 = no regimes, 1 = regimes); the fourth number represents whether instruments are allowed in the volatility specification (0 = no instruments, 1 = instruments). The specification tests investigate whether the standardized residuals of the selected model violate the (orthogonality) conditions implied by a standard normal distribution. P-values are reported between brackets. RCM is the model's regime qualification performance measure as developed by Ang‘’ and Bekaert (2002b). The implied average smoothed (ex-post) regime probability is reported between brackets. The right-hand side of the table reports the likelihood ratios tests comparing the different models. ‘Cst>Unit’ compares the unit with the constant beta model. ‘Inst>Cst’ tests the significance of adding structural instruments to the constant beta specification. ‘RS>Cst’ tests whether regimes should be added to the beta specification using an empirical likelihood ratio test. Bold p-values indicate that our R measure favours the regime-switching beta specification over the instrumental beta specification (see section B). ‘RSInst>RS’ tests the significance of adding instruments to the regime-switching beta specification. Finally, ‘VInst>V’ tests for the inclusion of instruments in the volatility specification. P-values are reported between brackets.

Panel A

	Model	**Specification Tests**						**Likelihood Ratio Tests**				
		Mean	Var	Asym	Skewn	Kurt	RCM	Cst>Unit	Inst>Cst	RS>Cst	RSInst>RS	VInst>V
World	RS Garch	1.881	7.785	1.821	3.162	1.406	36.552					
		(0.865)	(0.455)	(0.610)	(0.075)	(0.236)	(0.898)					
Europe	3111	1.620	7.125	4.856	0.334	6.925	57.489	69.193	32.028	62.093	18.848	28.949
		(0.899)	(0.523)	(0.183)	(0.563)	(0.009)	(0.826)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.000)
Pacific	3010	1.945	5.832	2.325	1.782	2.424	51.236	86.581	3.697	36.544	-	-
		(0.857)	(0.666)	(0.508)	(0.182)	(0.120)	(0.849)	(0.000)	(0.158)	**(0.000)**		
Japan	3111	1.390	5.291	1.341	18.695	31.985	22.269	0.956	109.641	163.416	50.372	8.958
		(0.925)	(0.726)	(0.719)	(0.000)	(0.000)	(0.941)	(0.328)	(0.000)	**(0.000)**	(0.000)	(0.011)
US	3111	0.614	9.499	0.298	8.989	10.220	42.563	22.889	76.644	148.272	6.111	56.728
		(0.987)	(0.302)	(0.960)	(0.003)	(0.001)	(0.879)	(0.000)	(0.000)	**(0.000)**	(0.047)	(0.000)

Panel B

	Model	Specification Tests						Likelihood Ratio Tests				
		Mean	Var	Asym	Skewn	Kurt	RCM	Cst>Unit	Inst>Cst	RS>Cst	RSInst>RS	VInst>V
Basic Industries	3110	5.863	2.241	1.136	3.995	4.540	34.282	8.488	27.262	75.160	7.599	2.475
		(0.320)	(0.973)	(0.768)	(0.046)	(0.033)	(0.905)	(0.004)	(0.000)	**(0.000)**	(0.022)	(0.290)
General Industrials	3111	6.647	2.650	1.446	0.000	2.528	44.545	20.739	10.732	56.823	9.632	6.524
		(0.248)	(0.954)	(0.695)	(0.990)	(0.112)	(0.872)	(0.000)	(0.005)	**(0.000)**	(0.008)	(0.038)
Automobiles & Parts	3011	1.063	7.890	2.761	0.145	11.152	54.302	0.392	4.109	67.955	3.343	8.468
		(0.957)	(0.444)	(0.430)	(0.704)	(0.001)	(0.838)	(0.531)	(0.128)	**(0.000)**	(0.188)	(0.014)
Household Goods	3011	0.859	6.903	1.132	0.387	7.324	45.292	1.632	26.889	52.406	3.092	20.195
		(0.973)	(0.547)	(0.769)	(0.534)	(0.007)	(0.870)	(0.201)	(0.000)	**(0.000)**	(0.213)	(0.000)
Food Prod & Tobacco	3010	1.181	15.222	4.442	0.625	2.608	12.465	148.987	8.608	139.698	2.446	4.760
		(0.947)	(0.055)	(0.218)	(0.429)	(0.106)	(0.968)	(0.000)	(0.014)	**(0.000)**	(0.294)	(0.093)
Health & Pharma	3110	2.268	9.987	2.537	0.494	17.720	10.834	23.557	1.971	79.711	14.183	4.460
		(0.811)	(0.266)	(0.469)	(0.482)	(0.000)	(0.972)	(0.000)	(0.373)	**(0.000)**	(0.001)	(0.108)
General Retailers	3110	0.955	7.028	4.558	0.043	12.130	47.666	0.252	4.400	35.780	6.584	2.315
		(0.966)	(0.534)	(0.207)	(0.836)	(0.000)	(0.862)	(0.616)	(0.036)	**(0.000)**	(0.010)	(0.128)
Leisure	3110	1.793	10.829	1.175	3.780	8.237	17.421	0.211	8.363	59.459	23.446	0.001
		(0.877)	(0.212)	(0.759)	(0.052)	(0.004)	(0.954)	(0.646)	(0.004)	**(0.000)**	(0.000)	(0.982)
Media	3010	1.666	10.539	3.154	0.847	8.588	16.969	1.312	0.771	116.239	1.526	4.665
		(0.893)	(0.229)	(0.368)	(0.357)	(0.003)	(0.956)	(0.252)	(0.380)	**(0.000)**	(0.217)	(0.071)
Transport	3110	3.106	13.785	4.455	7.730	14.142	15.716	39.942	61.759	178.761	22.331	1.445
		(0.684)	(0.088)	(0.216)	(0.005)	(0.000)	(0.959)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.229)
Food Retailers	3111	0.818	8.326	0.616	0.468	5.470	35.802	122.371	19.175	44.406	24.999	9.477
		(0.976)	(0.402)	(0.893)	(0.494)	(0.019)	(0.901)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.002)
Telecom	3110	0.320	9.983	7.024	3.177	2.782	65.003	47.691	34.672	97.607	15.931	3.499
		(0.997)	(0.266)	(0.071)	(0.075)	(0.095)	(0.796)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.061)
Utilities	3110	1.624	11.263	1.600	5.378	20.190	21.729	366.308	3.301	73.068	6.652	0.012
		(0.898)	(0.187)	(0.659)	(0.020)	(0.000)	(0.942)	(0.000)	(0.069)	**(0.000)**	(0.010)	(0.912)
IT Hardware	3111	0.588	5.004	2.093	0.921	5.011	19.608	75.024	42.332	42.290	31.018	10.518
		(0.989)	(0.757)	(0.553)	(0.337)	(0.025)	(0.948)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.005)
IT Software	3110	0.885	4.553	1.085	1.521	3.556	43.747	80.961	39.629	96.053	2.298	1.682
		(0.971)	(0.804)	(0.781)	(0.217)	(0.059)	(0.875)	(0.000)	(0.000)	**(0.000)**	(0.317)	(0.431)
Banks	3110	6.241	3.297	0.503	4.605	5.306	17.193	5.949	131.402	242.383	28.015	1.594
		(0.283)	(0.914)	(0.918)	(0.032)	(0.021)	(0.955)	(0.015)	(0.000)	**(0.000)**	(0.000)	(0.207)
Insurance	3010	3.440	3.452	2.315	9.867	8.094	28.649	13.722	0.097	62.698	1.069	0.031
		(0.633)	(0.903)	(0.510)	(0.002)	(0.004)	(0.922)	(0.000)	(0.755)	**(0.000)**	(0.210)	(0.860)
Real Estate	3010	1.022	2.287	0.359	1.917	4.427	12.137	33.989	3.108	107.216	0.808	3.749
		(0.961)	(0.971)	(0.949)	(0.166)	(0.035)	(0.969)	(0.000)	(0.078)	**(0.000)**	(0.369)	(0.053)
Investment Companies	3110	4.228	2.715	0.344	4.275	4.481	7.634	110.977	18.813	84.724	28.985	1.007
		(0.517)	(0.951)	(0.951)	(0.039)	(0.034)	(0.981)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.316)
Mining	3110	1.240	3.959	1.268	0.439	7.693	43.208	55.714	0.671	65.861	3.851	0.012
		(0.941)	(0.861)	(0.737)	(0.507)	(0.006)	(0.877)	(0.000)	(0.413)	**(0.000)**	(0.050)	(0.914)
Oil & Gas	3010	2.409	6.016	0.772	0.955	11.190	11.122	63.852	20.371	79.285	3.056	1.632
		(0.790)	(0.645)	(0.856)	(0.328)	(0.001)	(0.971)	(0.000)	(0.000)	**(0.000)**	(0.080)	(0.201)

Panel C

	Model	Specification Tests						Likelihood Ratio Tests				
		Mean	Var	Asym	Skewn	Kurt	RCM	Cst>Unit	Inst>Cst	RS>Cst	RSInst>RS	VInst>V
Austria	3110	2.745	11.983	5.079	4.442	7.624	36.646	626.697	38.663	70.566	15.728	5.626
		(0.739)	(0.152)	(0.166)	(0.035)	(0.006)	(0.898)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.060)
Belgium	3110	1.323	7.579	2.357	1.635	1.774	52.046	337.181	36.576	94.872	22.897	5.363
		(0.933)	(0.476)	(0.502)	(0.201)	(0.183)	(0.846)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.068)
Denmark	3111	0.784	6.744	0.109	2.820	13.717	23.625	303.586	19.403	24.774	37.430	11.556
		(0.978)	(0.564)	(0.991)	(0.093)	(0.000)	(0.937)	(0.000)	(0.000)	**(0.009)**	(0.000)	(0.003)
Finland	3111	1.146	11.840	0.690	0.874	12.005	6.823	4.794	61.761	40.589	56.277	7.608
		(0.950)	(0.158)	(0.875)	(0.350)	(0.001)	(0.983)	(0.029)	(0.000)	**(0.004)**	(0.000)	(0.022)
France	3111	1.269	7.298	2.166	0.386	5.642	50.672	5.427	56.920	79.448	21.127	15.180
		(0.938)	(0.505)	(0.539)	(0.535)	(0.018)	(0.851)	(0.020)	(0.000)	**(0.000)**	(0.000)	(0.001)
Germany	3111	0.780	10.590	5.823	0.017	7.775	39.459	89.361	139.247	172.637	71.681	8.239
		(0.978)	(0.226)	(0.121)	(0.897)	(0.005)	(0.889)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.016)
Ireland	3111	0.315	13.026	9.818	4.358	24.154	20.573	94.892	15.091	41.149	14.440	8.894
		(0.997)	(0.111)	(0.020)	(0.037)	(0.000)	(0.946)	(0.000)	(0.001)	**(0.003)**	(0.001)	(0.012)
Italy	3111	2.446	14.970	0.609	5.013	11.608	20.039	45.589	35.687	46.429	10.392	33.285
		(0.785)	(0.060)	(0.894)	(0.025)	(0.001)	(0.947)	(0.000)	(0.000)	**(0.003)**	(0.006)	(0.000)
Netherlands	3110	1.133	7.281	4.163	0.741	4.201	31.616	200.596	109.415	139.617	65.147	5.045
		(0.951)	(0.507)	(0.244)	(0.389)	(0.040)	(0.913)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.080)
Norway	3011	1.300	5.167	0.516	1.977	4.927	53.902	59.462	0.781	26.002	1.695	10.315
		(0.935)	(0.740)	(0.915)	(0.160)	(0.026)	(0.839)	(0.000)	(0.677)	**(0.004)**	(0.428)	(0.006)
Spain	3110	0.454	5.414	1.748	1.428	6.419	32.291	17.021	17.047	16.614	13.867	1.936
		(0.994)	(0.713)	(0.626)	(0.232)	(0.011)	(0.911)	(0.000)	(0.000)	**(0.042)**	(0.001)	(0.380)
Sweden	3110	0.164	18.759	4.036	1.124	8.512	6.070	14.840	91.192	67.431	90.837	4.390
		(0.999)	(0.016)	(0.258)	(0.289)	(0.004)	(0.985)	(0.000)	(0.000)	**(0.002)**	(0.000)	(0.111)
Switzerland	3111	1.516	6.091	3.913	0.004	11.755	45.277	244.438	37.515	81.631	17.113	6.583
		(0.911)	(0.637)	(0.271)	(0.952)	(0.001)	(0.870)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.037)
UK	3111	0.453	7.109	3.022	3.981	6.413	26.401	115.425	26.247	109.527	31.551	8.176
		(0.994)	(0.525)	(0.388)	(0.046)	(0.011)	(0.929)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.017)
Australia	3111	1.426	22.305	0.036	0.009	5.804	38.009	308.368	50.696	185.576	21.104	10.555
		(0.921)	(0.004)	(0.998)	(0.925)	(0.016)	(0.894)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.005)
Hong Kong	3111	0.956	4.556	0.832	1.630	9.299	30.882	251.016	26.189	100.861	52.672	9.485
		(0.966)	(0.804)	(0.842)	(0.202)	(0.002)	(0.916)	(0.000)	(0.000)	**(0.000)**	(0.000)	(0.009)
New Zealand	3010	0.627	5.702	0.972	0.434	4.895	36.519	258.479	23.775	26.406	1.761	-
		(0.987)	(0.681)	(0.808)	(0.510)	(0.027)	(0.898)	(0.000)	(0.000)	**(0.009)**	(1.000)	-
Singapore	3110	0.621	7.758	1.169	5.116	5.116	52.570	303.104	26.762	68.824	17.152	5.784
		(0.987)	(0.457)	(0.760)	(0.024)	(0.024)	(0.844)	(0.000)	(0.000)	**(0.002)**	(0.000)	(0.055)
Canada	3110	1.037	8.364	0.826	3.050	12.118	22.887	352.629	27.938	78.519	7.448	0.999
		(0.960)	(0.399)	(0.843)	(0.081)	(0.000)	(0.939)	(0.000)	(0.000)	**(0.000)**	(0.024)	(0.607)

Table 6: Beta Specification and Significance Tests

This table reports the results for the beta specification of the selected model. Panel A shows the results for the regions, Panel B for the industries, Panel C and Panel D for the countries. The four-digit model code is defined as follows: the first number represents the assumptions about the beta (1 = unit, 2 = constant, 3 = time-varying); the second number denotes whether instruments are added to the beta specification (0 = no instruments, 1 = instruments), the third number represents whether regimes are allowed in the beta specification (0 = no regimes, 1 = regimes); the fourth number represents whether instruments are allowed in the volatility specification (0 = no instruments, 1 = instruments). The column 'β' shows the (restricted) constant beta. The p-value of the Wald test against the unit beta is reported between brackets. The next two colums show the betas over the two different regimes. The p-value of the (Wald) test whether betas are significantly different across regimes is reported between brackets. The columns 'Trade' and 'Align' show the coefficients of the two structural instruments in the beta specification (if applicable). P-values are reported between brackets. Next we have the transition probabilities of the regimes with the p-values between brackets. The last part of the table shows the full-period and subperiod average implied betas based on the selected model. The p-values of the t-test whether subperiod betas are equal to the full-period betas are reported between brackets. Note that for the countries, we make a distinction between the world market beta and the regional market beta of the country.

Panel A

	Model	β	β_1	β_2	**Trade**	**Align**	**P**	**Q**	**73-04**	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**
Europe	3111	0.836	0.641	1.076	0.095	-0.034	0.920	0.959	0.793	0.717	0.791	0.784	0.796	0.909
		(0.000)	(0.000)		(0.000)	(0.097)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pacific	3010	0.742	0.590	0.946			0.987	0.991	0.737	0.750	0.731	0.687	0.742	0.756
		(0.000)	(0.000)				(0.000)	(0.000)		(0.032)	(0.056)	(0.000)	(0.499)	(0.003)
Japan	3111	1.032	0.630	1.397	-0.205	-0.015	0.989	0.984	0.982	0.689	1.117	1.329	1.287	0.882
		(0.429)	(0.000)		(0.000)	(0.370)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
US	3111	1.073	0.830	1.155	-0.028	-0.153	0.970	0.975	1.000	1.144	0.956	0.707	0.910	1.088
		(0.000)	(0.000)		(0.055)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Panel B

	Model	β	β_1	β_2	Trade	Align	P	Q	73-04	73-82	83-87	88-92	93-96	97-04
Basic Industries	3110	1.038	0.793	1.103	-0.056	-0.014	0.962	0.988	1.017	1.064	1.056	1.086	1.023	0.869
		(0.011)	(0.000)		(0.013)	(0.365)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.011)	(0.000)
General Industrials	3111	1.046	1.097	0.872	0.035	0.021	0.976	0.945	1.030	1.017	0.974	1.010	1.062	1.084
		(0.000)	(0.000)		(0.009)	(0.145)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Automobiles & Parts	3010	0.988	1.174	0.737			0.972	0.966	0.976	0.995	0.946	0.974	1.026	0.946
		(0.624)	(0.000)				(0.000)	(0.000)		(0.054)	(0.000)	(0.023)	(0.000)	(0.000)
Household Goods	3111	1.024	0.912	1.195			0.985	0.991	1.062	1.106	1.060	1.082	1.090	0.967
		(0.294)	(0.005)				(0.137)	(0.101)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Food Prod & Tobacco	3010	0.828	0.465	0.870			0.978	0.997	0.789	0.855	0.857	0.845	0.772	0.613
		(0.000)	(0.000)				(0.002)	(0.002)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Health & Pharma	3110	0.917	1.255	0.817	-0.061	0.001	0.995	0.996	0.962	1.079	0.940	0.915	0.920	0.868
		(0.000)	(0.000)		(0.003)	(0.398)	(0.000)	(0.001)		(0.000)	(0.000)	(0.221)	(0.307)	(0.000)
General Retailers	3110	1.010	0.915	1.239		-0.058	0.990	0.980	1.029	1.104	1.049	0.970	0.956	0.991
		(0.679)	(0.000)			(0.025)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leisure	3110	1.008	0.888	1.362		-0.111	0.991	0.983	1.024	1.134	0.951	0.884	0.913	1.084
		(0.693)	(0.000)			(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Media	3010	0.980	1.274	0.868			0.987	0.994	1.021	1.112	0.972	0.908	0.896	1.079
		(0.364)	(0.000)				(0.000)	(0.000)		(0.000)	(0.112)	(0.000)	(0.000)	(0.000)
Transport	3110	0.873	1.098	0.672		-0.239	0.993	0.993	0.899	0.763	1.136	1.104	1.023	0.702
		(0.000)	(0.000)			(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Food Retailers	3111	0.796	0.643	0.927		0.127	0.983	0.989	0.807	0.892	0.851	0.881	0.686	0.671
		(0.000)	(0.000)			(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Telecom	3110	0.848	0.670	1.083		-0.147	0.953	0.926	0.833	0.673	0.748	0.918	0.975	0.981
		(0.000)	(0.000)			(0.000)	(0.000)	(0.001)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Utilities	3110	0.657	0.727	0.409		0.045	0.997	0.989	0.641	0.671	0.676	0.708	0.664	0.510
		(0.000)	(0.000)			(0.016)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IT Hardware	3111	1.224	1.087	1.518	0.301	-0.055	0.997	0.996	1.293	1.219	1.039	1.067	1.325	1.729
		(0.000)	(0.000)		(0.000)	(0.264)	(0.004)	(0.000)		(0.135)	(0.000)	(0.000)	(0.000)	(0.000)
IT Software	3110	1.330	1.097	1.891			0.979	0.949	1.338	1.424	1.243	1.081	1.190	1.556
		(0.000)	(0.086)				(0.002)	(0.233)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Banks	3110	0.950	1.100	0.720		-0.095	0.995	0.995	0.906	0.666	0.853	1.039	1.103	1.079
		(0.076)	(0.000)			(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Insurance	3010	0.941	1.253	0.891			0.962	0.992	0.956	0.925	0.954	0.960	0.924	1.018
		(0.001)	(0.000)				(0.000)	(0.000)		(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Real Estate	3010	0.857	0.551	1.013			1.000	0.999	0.879	0.832	0.992	1.010	1.004	0.701
		(0.000)	(0.000)				(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Investment Companies	3110	1.185	1.506	1.089		-0.092	0.993	0.999	1.218	1.018	1.235	1.400	1.425	1.241
		(0.000)	(0.000)			(0.000)	(0.000)	(0.011)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mining	3110	0.718	0.533	1.359		-0.082	0.987	0.969	0.781	0.815	0.860	0.668	0.816	0.735
		(0.000)	(0.000)			(0.071)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.007)
Oil & Gas	3010	0.786	1.025	0.626			0.999	0.999	0.806	0.994	0.868	0.646	0.647	0.699
		(0.000)	(0.000)				(0.034)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Panel C

	Model	Global Factor					Regional Factor						
		β	β_1	β_2	**Trade**	**Align**	β	β_1	β_2	**Trade**	**Align**	**P**	**Q**
Austria	3110	0.352	0.178	0.546	0.002	-0.040	0.540	0.507	0.712	0.134	0.104	0.994	0.995
		(0.000)	(0.000)		(0.398)	(0.214)	(0.000)	(0.025)		(0.001)	(0.061)	(0.000)	(0.000)
Belgium	3110	0.571	0.435	0.752	0.105	-0.069	0.694	0.507	0.992	0.049	-0.019	0.976	0.972
		(0.000)	(0.000)		(0.009)	(0.029)	(0.000)	(0.000)		(0.260)	(0.368)	(0.000)	(0.000)
Denmark	3111	0.563	0.505	0.578	0.085	0.055	0.637	0.314	0.902	0.019	0.056	0.997	0.996
		(0.000)	(0.434)		(0.026)	(0.180)	(0.000)	(0.000)		(0.391)	(0.200)	(0.000)	(0.000)
Finland	3111	1.044	1.044	1.419	0.258	0.188	0.823	0.768	4.369	0.201	-0.107	0.989	0.525
		(0.519)	(0.640)		(0.003)	(0.002)	(0.072)	(0.000)		(0.168)	(0.220)	(0.000)	(0.398)
France	3111	0.956	0.695	0.951	0.093	-0.004	1.017	0.738	1.071	0.104	-0.009	0.976	0.986
		(0.074)	(0.000)		(0.000)	(0.396)	(0.653)	(0.000)		(0.017)	(0.390)	(0.000)	(0.000)
Germany	3111	0.798	0.528	0.855	0.195	-0.062	0.880	0.612	1.081	0.083	-0.016	0.980	0.969
		(0.000)	(0.000)		(0.000)	(0.017)	(0.001)	(0.000)		(0.009)	(0.322)	(0.000)	(0.000)
Ireland	3111	0.719	0.623	0.708	0.051	-0.061	0.862	0.769	2.411	-0.100	0.068	0.935	0.000
		(0.000)	(0.698)		(0.087)	(0.049)	(0.006)	(0.004)		(0.070)	(0.125)	(0.015)	(0.049)
Italy	3111	0.815	0.588	0.823	0.062	-0.128	0.947	0.744	1.153	-0.013	-0.092	0.995	0.998
		(0.000)	(0.000)		(0.071)	(0.000)	(0.292)	(0.003)		(0.387)	(0.112)	(0.000)	(0.000)
Netherlands	3110	0.805	0.672	1.032	0.126	-0.058	0.743	0.725	0.882	0.094	-0.156	0.978	0.989
		(0.000)	(0.000)		(0.000)	(0.045)	(0.000)	(0.100)		(0.000)	(0.000)	(0.000)	(0.000)
Norway	3011	0.734	0.611	1.177			0.825	0.535	0.888			0.975	0.938
		(0.000)	(0.000)				(0.004)	(0.338)				(0.000)	(0.000)
Spain	3110	0.881	0.783	1.024	0.129	-0.026	0.986	0.864	1.294	0.167	-0.049	0.995	0.984
		(0.000)	(0.012)		(0.176)	(0.389)	(0.800)	(0.006)		(0.361)	(0.394)	(0.000)	(0.000)
Sweden	3110	1.042	0.731	1.009	0.335	0.047	0.786	0.781	4.445	0.284	0.060	0.460	0.986
		(0.393)	(0.471)		(0.002)	(0.363)	(0.003)	(0.000)		(0.005)	(0.337)	(0.392)	(0.000)
Switzerland	3111	0.730	0.544	0.800	0.032	0.000	0.717	0.464	0.966	-0.124	0.061	0.982	0.981
		(0.000)	(0.003)		(0.204)	(0.399)	(0.000)	(0.000)		(0.042)	(0.155)	(0.000)	(0.000)
UK	3111	0.844	0.797	0.901	0.016	-0.014	1.123	0.905	1.385	-0.028	0.143	0.988	0.993
		(0.000)	(0.008)		(0.264)	(0.261)	(0.000)	(0.000)		(0.283)	(0.000)	(0.000)	(0.000)
Australia	3111	0.636	0.640	0.647	-0.001	0.011	0.828	0.455	1.271	0.036	0.008	0.950	0.943
		(0.000)	(0.907)		(0.399)	(0.379)	(0.000)	(0.000)		(0.238)	(0.391)	(0.000)	(0.000)
Hong Kong	3111	0.805	0.702	0.876	-0.008	0.066	1.301	0.730	1.432	-0.044	0.030	0.971	0.984
		(0.000)	(0.000)		(0.387)	(0.051)	(0.000)	(0.000)		(0.230)	(0.297)	(0.000)	(0.000)
New Zealand	3010	0.496	0.447	0.512			0.491	0.402	1.007			0.993	0.977
		(0.000)	(0.783)				(0.000)	(0.000)				(0.000)	(0.011)
Singapore	3110	0.664	0.576	0.973	0.013	0.051	0.634	0.521	1.047	-0.074	-0.084	0.916	0.965
		(0.000)	(0.001)		(0.386)	(0.139)	(0.000)	(0.000)		(0.052)	(0.030)	(0.041)	(0.000)
Canada	3110	0.738	0.468	0.849	-0.019	-0.031	0.495	0.403	0.485	-0.178	-0.025	0.995	0.991
		(0.000)	(0.000)		(0.337)	(0.215)	(0.000)	(0.238)		(0.000)	(0.329)	(0.000)	(0.000)

Panel D

	Model	Global Factor						Regional Factor					
		73-04	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**	**73-04**	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**
Austria	3110	0.371	0.292	0.326	0.475	0.520	0.358	0.615	0.420	0.689	0.746	0.620	0.744
			(0.000)	(0.000)	(0.000)	(0.000)	(0.198)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Belgium	3110	0.563	0.419	0.619	0.602	0.561	0.701	0.703	0.612	0.684	0.762	0.697	0.807
			(0.000)	(0.000)	(0.000)	(0.050)	(0.000)		(0.000)	(0.032)	(0.000)	(0.358)	(0.000)
Denmark	3111	0.548	0.511	0.626	0.533	0.501	0.582	0.658	0.512	0.550	0.750	0.784	0.807
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Finland	3111	1.053			0.569	1.018	1.401	0.856			0.644	0.946	0.947
					(0.000)	(0.003)	(0.000)				(0.000)	(0.000)	(0.000)
France	3111	0.857	0.814	0.820	0.830	0.842	0.975	0.949	0.830	0.880	1.004	0.985	1.110
			(0.000)	(0.000)	(0.000)	(0.000)	(0.002)		(0.000)	(0.000)	(0.010)	(0.000)	(0.000)
Germany	3111	0.721	0.525	0.684	0.749	0.673	1.035	0.889	0.746	0.865	1.002	0.876	1.036
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.036)	(0.000)	(0.257)	(0.000)
Ireland	3111	0.703	0.619	0.652	0.766	0.794	0.762	0.869	0.970	0.969	0.820	0.757	0.749
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Italy	3111	0.687	0.548	0.620	0.606	0.820	0.917	0.915	0.784	0.808	0.915	1.064	1.097
			(0.000)	(0.000)	(0.000)	(0.277)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Netherlands	3110	0.794	0.755	0.776	0.667	0.743	0.985	0.778	0.673	0.657	0.690	0.825	1.055
			(0.000)	(0.001)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Norway	3011	0.768	0.810	0.760	0.752	0.793	0.754	0.790	0.764	0.795	0.800	0.775	0.799
			(0.000)	(0.000)	(0.000)	(0.000)	(0.001)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Spain	3110	0.856		0.774	0.781	0.831	0.935	0.996		0.633	0.785	0.982	1.195
				(0.000)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)	(0.188)	(0.000)
Sweden	3110	1.002	0.789	0.797	0.756	1.092	1.305	0.867	0.554	0.685	0.682	1.022	1.084
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Switzerland	3111	0.670	0.640	0.668	0.671	0.607	0.752	0.712	0.586	0.627	0.785	0.873	0.808
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UK	3111	0.850	0.881	0.864	0.802	0.845	0.833	1.149	1.303	1.297	1.153	1.025	0.888
			(0.000)	(0.000)	(0.000)	(0.471)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Australia	3111	0.738	0.742	0.784	0.640	0.685	0.802	0.461	0.591	0.564	0.553	0.370	0.184
			(0.214)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hong Kong	3111	0.644	0.657	0.646	0.637	0.634	0.633	0.869	0.890	0.958	0.962	0.833	0.725
			(0.000)	(0.000)	(0.043)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.365)	(0.000)
New Zealand	3010	0.820	0.860	0.758	0.702	0.868	0.863	1.205	1.203	1.112	1.096	1.302	1.300
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	(0.440)	(0.446)
Singapore	3110	0.499			0.491	0.506	0.501	0.520			0.591	0.459	0.505
					(0.000)	(0.000)	(0.000)				(0.000)	(0.000)	(0.010)
Canada	3110	0.687	0.716	0.708	0.717	0.610	0.654	0.669	0.613	0.623	0.619	0.584	0.867
			(0.000)	(0.000)	(0.000)	(0.000)	(0.016)		(0.000)	(0.030)	(0.016)	(0.000)	(0.000)

Table 7: Volatility Specification and Significance Tests

This table reports the results for the volatility specification of the selected model. The four-digit model code is defined as follows: the first number represents the assumptions about the beta (1 = unit, 2 = constant, 3 = time-varying); the second number denotes whether instruments are added to the beta specification (0 = no instruments, 1 = instruments), the third number represents whether regimes are allowed in the beta specification (0 = no regimes, 1 = regimes); the fourth number represents whether instruments are allowed in the volatility specification (0 = no instruments, 1 = instruments). The columns 'Trade' and 'Align' show the coefficients of the two structural instruments in the volatility specification (if applicable). The next four columns show the coefficients for the GARCH specification. Next we have the transition probabilities of the regimes. P-values are reported between brackets. The last part of the table shows the full-period and subperiod average implied volatility based on the selected model. The p-values of the t-test whether subperiod volatilities are equal to the full-period volatilities are reported between brackets. The volatility numbers are annualized.

Panel A

	Model	**Trade**	**Align**	**Const**	**GARCH**	**ARCH**	**Asym**	**P**	**Q**	**73-04**	**73-82**	**83-87**	**88-92**	**93-96**	**97-04**
World	State 1	-	-	0.007	0.624	0.027	0.063	0.986		0.135	0.129	0.132	0.140	0.100	0.158
				(0.000)	(0.000)	(0.271)	(0.184)	(0.000)		(0.000)	(0.001)	(0.137)	(0.024)	(0.000)	(0.000)
	State 2	-	-	0.018	0.648	-0.118	0.218		0.963						
				(0.000)	(0.000)	(0.000)	(0.007)		(0.000)						
Europe	3111	-0.250	0.619	0.004	0.802	0.076	-0.032			0.100	0.110	0.107	0.094	0.070	0.097
		(0.045)	(0.000)	(0.000)	(0.000)	(0.001)	(0.214)				(0.000)	(0.000)	(0.000)	(0.000)	(0.010)
Pacific	3010			0.004	0.842	0.089	0.039			0.167	0.188	0.174	0.149	0.143	0.153
				(0.000)	(0.000)	(0.001)	(0.218)				(0.000)	(0.151)	(0.000)	(0.000)	(0.000)
Japan	3111	0.134	0.792	0.005	0.799	0.038	0.120			0.150	0.150	0.127	0.126	0.116	0.191
		(0.348)	(0.058)	(0.000)	(0.000)	(0.032)	(0.047)				(0.424)	(0.000)	(0.000)	(0.000)	(0.000)
US	3111	0.170	1.098	0.004	0.750	0.064	0.026			0.082	0.066	0.087	0.113	0.080	0.073
		(0.005)	(0.000)	(0.000)	(0.000)	(0.029)	(0.297)				(0.000)	(0.030)	(0.000)	(0.001)	(0.000)

Panel B

	Model	Trade	Align	Const	GARCH	ARCH	Asym	P	Q	73-04	73-82	83-87	88-92	93-96	97-04
Basic Industries	3110			0.002	0.802	0.085	0.050			0.071	0.065	0.064	0.061	0.051	0.097
				(0.000)	(0.000)	(0.001)	(0.122)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
General Industrials	3111	-0.045	-0.045	0.001	0.870	0.053	0.023			0.056	0.052	0.064	0.058	0.036	0.062
		(0.048)	(0.046)	(0.000)	(0.035)	(0.001)	(0.295)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Automobiles & Parts	3010			0.003	0.844	0.075	-0.013			0.106	0.106	0.099	0.098	0.078	0.129
				(0.000)	(0.002)	(0.000)	(0.358)				(0.444)	(0.000)	(0.000)	(0.000)	(0.000)
Household Goods	3111	-0.211	0.299	-0.002	0.895	0.041	0.041			0.109	0.125	0.109	0.094	0.060	0.114
		(0.261)	(0.013)	(0.000)	(0.000)	(0.003)	(0.173)				(0.000)	(0.174)	(0.000)	(0.000)	(0.005)
Food Prod & Tobacco	3010			-0.002	0.867	0.073	0.006			0.079	0.060	0.064	0.066	0.072	0.117
				(0.000)	(0.018)	(0.000)	(0.389)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Health & Pharma	3110			-0.003	0.814	0.039	0.122			0.092	0.087	0.081	0.083	0.083	0.113
				(0.000)	(0.000)	(0.044)	(0.001)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
General Retailers	3110			-0.002	0.889	0.023	0.064			0.109	0.106	0.112	0.093	0.084	0.133
				(0.000)	(0.000)	(0.165)	(0.039)				(0.011)	(0.038)	(0.000)	(0.000)	(0.000)
Leisure	3110			0.003	0.858	0.040	0.012			0.091	0.098	0.087	0.082	0.075	0.097
				(0.000)	(0.000)	(0.083)	(0.366)				(0.000)	(0.011)	(0.000)	(0.000)	(0.000)
Media	3010			0.002	0.888	0.066	-0.008			0.094	0.106	0.093	0.076	0.058	0.104
				(0.000)	(0.012)	(0.000)	(0.383)				(0.000)	(0.360)	(0.000)	(0.000)	(0.000)
Transport	3110			-0.002	0.877	0.072	0.017			0.089	0.090	0.103	0.086	0.058	0.091
				(0.000)	(0.070)	(0.000)	(0.319)				(0.051)	(0.000)	(0.016)	(0.000)	(0.002)
Food Retailers	3111		0.119	0.002	0.926	0.025	0.024			0.097	0.098	0.093	0.098	0.063	0.113
			(0.032)	(0.000)	(0.011)	(0.151)	(0.277)				(0.070)	(0.000)	(0.161)	(0.000)	(0.000)
Telecom	3110			0.002	0.856	0.060	0.023			0.116	0.107	0.133	0.110	0.081	0.138
				(0.000)	(0.010)	(0.000)	(0.234)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Utilities	3110			0.001	0.909	0.094	-0.050			0.095	0.086	0.118	0.090	0.061	0.108
				(0.001)	(0.077)	(0.000)	(0.027)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IT Hardware	3111	0.527	-0.088	0.003	0.915	0.033	0.026			0.147	0.122	0.114	0.122	0.135	0.210
		(0.008)	(0.260)	(0.000)	(0.002)	(0.030)	(0.253)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IT Software	3110			0.008	0.834	0.009	0.014			0.177	0.180	0.172	0.168	0.158	0.192
				(0.000)	(0.000)	(0.372)	(0.321)				(0.004)	(0.004)	(0.000)	(0.000)	(0.000)
Banks	3110			-0.002	0.873	0.075	0.006			0.097	0.088	0.136	0.089	0.068	0.096
				(0.000)	(0.010)	(0.000)	(0.393)				(0.000)	(0.000)	(0.000)	(0.000)	(0.280)
Insurance	3010			0.002	0.835	0.077	0.021			0.083	0.076	0.082	0.078	0.063	0.104
				(0.000)	(0.000)	(0.000)	(0.317)				(0.000)	(0.248)	(0.000)	(0.000)	(0.000)
Real Estate	3010			0.003	0.837	0.140	-0.034			0.133	0.160	0.138	0.104	0.113	0.115
				(0.000)	(0.000)	(0.000)	(0.247)				(0.000)	(0.122)	(0.000)	(0.000)	(0.000)
Investment Companies	3110			0.003	0.840	0.116	-0.028			0.102	0.081	0.145	0.111	0.091	0.089
				(0.000)	(0.001)	(0.000)	(0.258)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mining	3110			0.004	0.885	0.048	0.020			0.200	0.207	0.209	0.180	0.161	0.217
				(0.000)	(0.006)	(0.001)	(0.273)				(0.002)	(0.021)	(0.000)	(0.000)	(0.000)
Oil & Gas	3010			0.002	0.933	0.053	-0.007			0.135	0.125	0.150	0.118	0.094	0.167
				(0.000)	(0.005)	(0.000)	(0.376)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Panel C

	Model	Trade	Align	Const	GARCH	ARCH	Asym	P	Q	73-04	73-82	83-87	88-92	93-96	97-04
Austria	3110			0.003	0.851	0.113	0.023			0.161	0.119	0.207	0.223	0.112	0.145
				(0.096)	(0.000)	(0.000)	(0.357)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Belgium	3110			0.002	0.892	0.037	0.028			0.128	0.129	0.142	0.125	0.095	0.135
				(0.358)	(0.000)	(0.001)	(0.140)				(0.297)	(0.000)	(0.005)	(0.000)	(0.000)
Denmark	3111	0.309	0.727	0.004	0.918	0.047	-0.030			0.164	0.189	0.187	0.141	0.114	0.145
		(0.129)	(0.018)	(0.000)	(0.000)	(0.028)	(0.231)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Finland	3111	0.789	2.051	0.007	0.843	-0.013	0.167			0.242			0.231	0.203	0.268
		(0.241)	(0.092)	(0.019)	(0.000)	(0.380)	(0.005)						(0.122)	(0.000)	(0.000)
France	3111	-0.647	0.369	0.004	0.841	0.071	0.067			0.142	0.179	0.168	0.119	0.095	0.088
		(0.000)	(0.004)	(0.000)	(0.000)	(0.004)	(0.100)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Germany	3111	-0.079	0.254	0.003	0.846	0.047	0.038			0.109	0.117	0.130	0.106	0.081	0.097
		(0.278)	(0.030)	(0.002)	(0.000)	(0.005)	(0.155)				(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Ireland	3111	0.089	0.465	-0.003	0.885	0.028	0.039			0.167	0.181	0.194	0.151	0.119	0.162
		(0.374)	(0.100)	(0.177)	(0.000)	(0.081)	(0.120)				(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Italy	3111	-0.825	2.785	0.007	0.815	0.125	-0.033			0.205	0.252	0.218	0.174	0.199	0.129
		(0.009)	(0.000)	(0.000)	(0.000)	(0.000)	(0.249)				(0.000)	(0.000)	(0.000)	(0.035)	(0.000)
Netherlands	3110			0.002	0.853	0.093	-0.034			0.088	0.096	0.099	0.079	0.068	0.085
				(0.048)	(0.000)	(0.000)	(0.252)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Norway	3011	0.150	2.085	0.005	0.844	0.058	0.061			0.197	0.250	0.220	0.204	0.136	0.178
		(0.379)	(0.005)	(0.004)	(0.000)	(0.017)	(0.068)				(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Spain	3110			0.003	0.871	0.047	0.042			0.130		0.209	0.127	0.131	0.119
				(0.389)	(0.000)	(0.072)	(0.221)					(0.000)	(0.064)	(0.158)	(0.000)
Sweden	3110			0.004	0.871	-0.009	0.065			0.180	0.222	0.204	0.185	0.147	0.169
				(0.132)	(0.000)	(0.358)	(0.049)				(0.000)	(0.000)	(0.135)	(0.000)	(0.000)
Switzerland	3111	0.133	0.278	0.004	0.842	0.065	-0.027			0.112	0.123	0.107	0.110	0.103	0.107
		(0.267)	(0.036)	(0.000)	(0.000)	(0.002)	(0.251)				(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
UK	3111	-0.038	0.226	0.002	0.887	0.005	0.098			0.097	0.121	0.095	0.085	0.062	0.082
		(0.336)	(0.008)	(0.001)	(0.000)	(0.372)	(0.000)				(0.000)	(0.088)	(0.000)	(0.000)	(0.000)
Australia	3111	-0.861	1.082	0.008	0.601	0.021	0.033			0.131	0.148	0.140	0.117	0.120	0.114
		(0.055)	(0.039)	(0.000)	(0.000)	(0.303)	(0.280)				(0.000)	(0.014)	(0.000)	(0.000)	(0.000)
Hong Kong	3111	0.462	0.742	0.004	0.807	0.073	0.078			0.175	0.223	0.214	0.146	0.096	0.103
		(0.025)	(0.019)	(0.006)	(0.000)	(0.001)	(0.045)				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
New Zealand	3010			0.003	0.930	0.011	0.029			0.166			0.187	0.144	0.162
				(0.000)	(0.000)	(0.338)	(0.327)						(0.000)	(0.000)	(0.001)
Singapore	3110			0.003	0.836	0.041	0.113			0.189	0.225	0.202	0.153	0.123	0.178
				(0.240)	(0.000)	(0.030)	(0.000)				(0.000)	(0.059)	(0.000)	(0.000)	(0.000)
Canada	3110			0.004	0.812	0.108	-0.002			0.111	0.120	0.112	0.099	0.102	0.109
				(0.046)	(0.000)	(0.000)	(0.399)				(0.000)	(0.170)	(0.000)	(0.000)	(0.059)

Table 8: Average Residual Correlations of Shocks Within and Across Asset Classes

In this table, we report average correlations between and across region, country, and industry-specific shocks. We also report correlations of all assets with world market shocks. To the extent that the chosen structural regime-switching volatility spillover model is capable of modelling cross-asset correlations, we expect residual correlations both within and between assets to be close to zero.

	World	**Region**	**Industry**	**Country**
World	1.00	0.02	0.00	0.02
Region	0.02	-0.16	0.03	0.01
Industry	0.00	0.03	0.00	0.00
Country	0.02	0.01	0.00	0.00

Figure 1: Smoothed Probabilities of the World Volatility Regimes

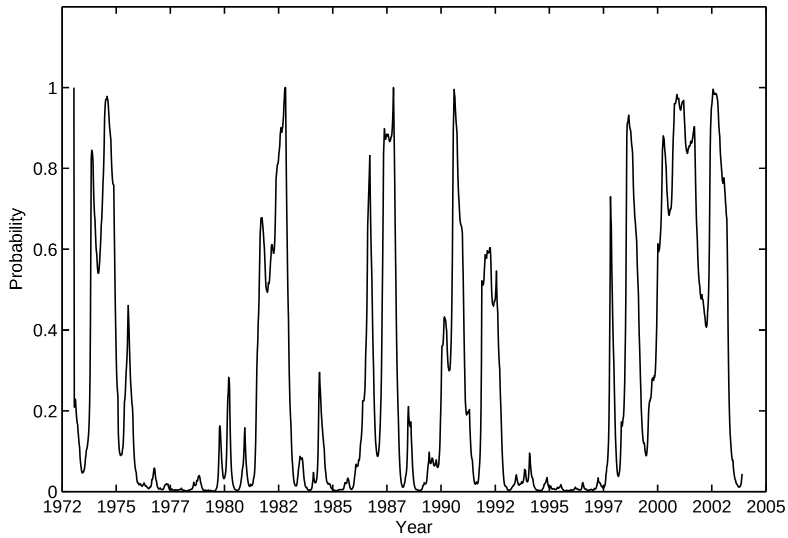
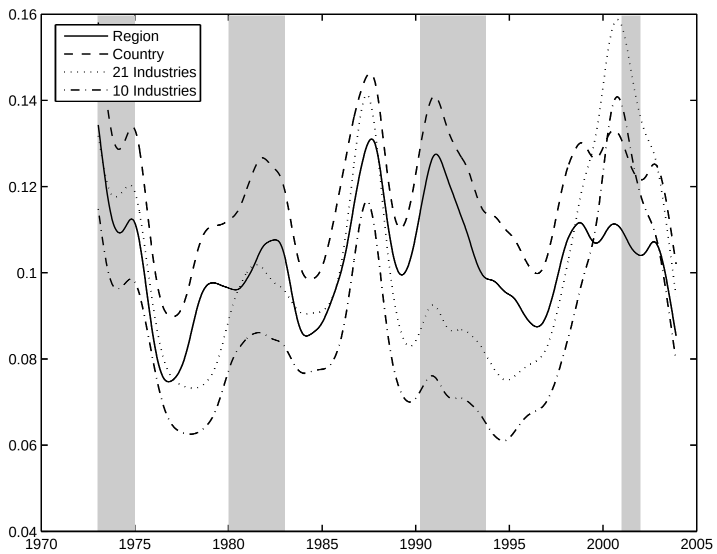


Figure 1 plots the smoothed probabilities that the world equity returns are in the high volatility state. The probabilities are obtained from estimating the regime-switching Asymmetric GARCH model outlined in II.A.

Figure 2: Idiosyncratic Volatility Aggregated over Regions, Countries and Industries

Panel A: Including TMT



Panel B: Excluding TMT

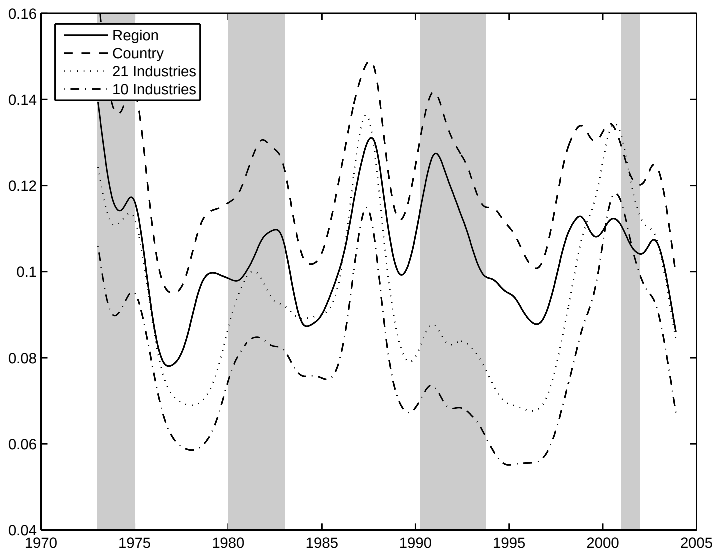


Figure 2 plots a backward 52-week moving average of the average idiosyncratic volatilities at the regional, country, and industry level, both including (Panel A) and excluding the TMT industries (Panel B). The latter are respectively the Telecom, Media, and Information Technology (both Software and Hardware) industries. We use market capitalization weights to average over the asset-specific volatilities. The latter are obtained by estimating the structural regime-switching model developed in Section II.A. World recessions are shaded in gray to illustrate cyclical movements in volatility. The recessions are identified as the periods from the peaks to the throughs of the detrended world GDP.

Figure 3: Idiosyncratic Volatility: Traded versus Non-Traded Industries

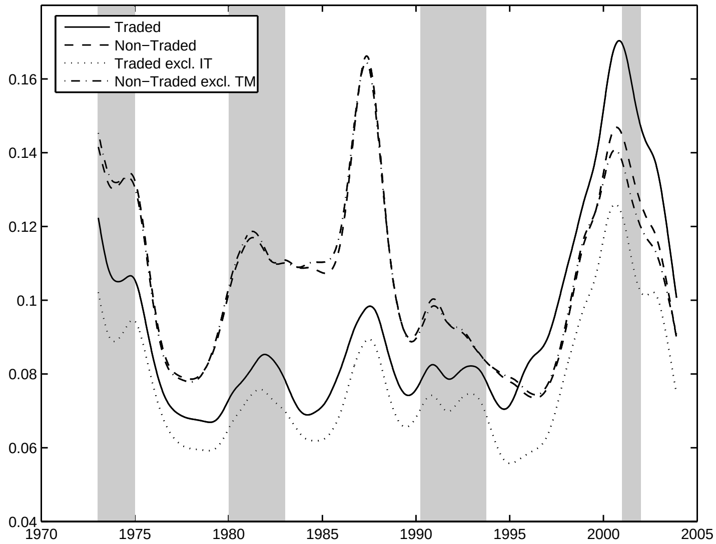


Figure 3 plots a backward 52-week moving average of the average idiosyncratic volatilities across traded industries, non-traded industies, as well as the traded industries without IT and the non-traded industries without Telecom and Media. We use market capitalization weights to average over the industry-specific volatilities. The latter are obtained by estimating the structural regime-switching model developed in Section II.A. World recessions are shaded in gray to illustrate cyclical movements in volatility. The recessions are identified as the periods from the peaks to the throughs of the detrended world GDP.

Figure 4: Volatility Decomposition for Aggregated European Countries

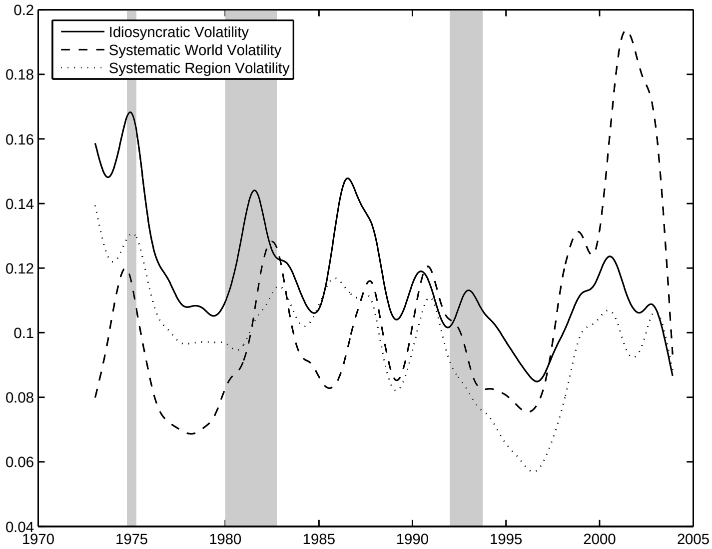
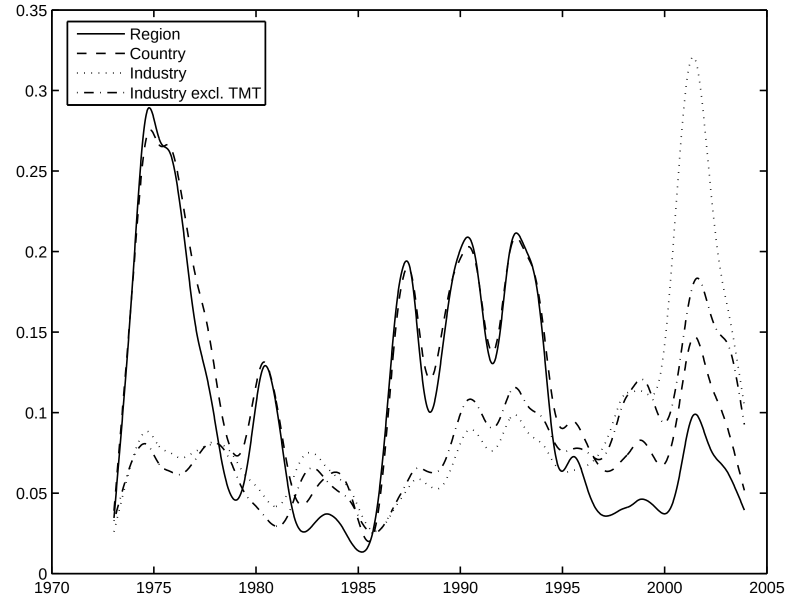


Figure 4 plots a backward 52-week moving average of the average idiosyncratic volatilities across European countries. The figure also plots the contibution of global and region-specific volatility to the total country volatility (in absolute value). We use market capitalization weights to average over the asset-specific volatilities. All idiosyncratic volatilities are obtained by estimating the structural regime-switching model developed in Section II.A. CEPR-dated recessions for Europe are shaded in gray to illustrate cyclical movements in volatility.

Figure 5: Quantification of Bias in Measures of Average Idiosyncratic Volatility

Panel A: Bias due to Assumption of Unit Betas



Panel B: Bias due to Assumption of Constant Betas

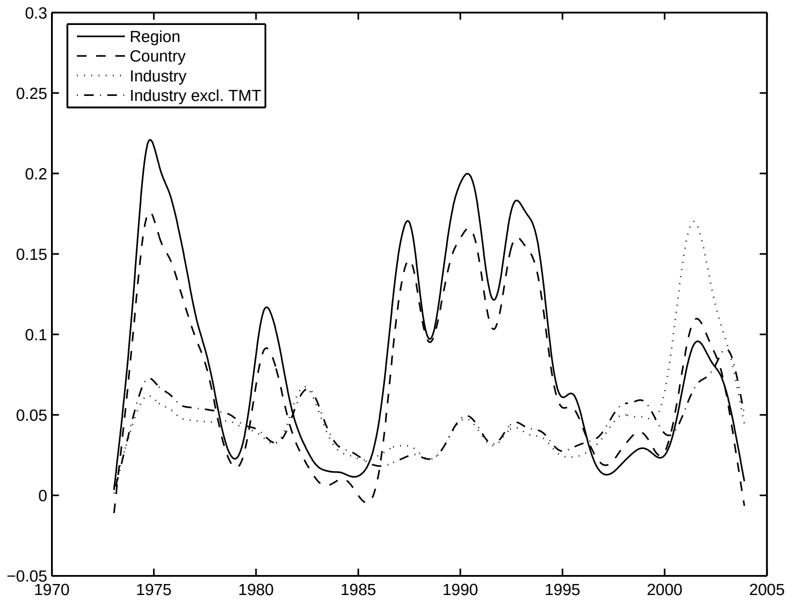
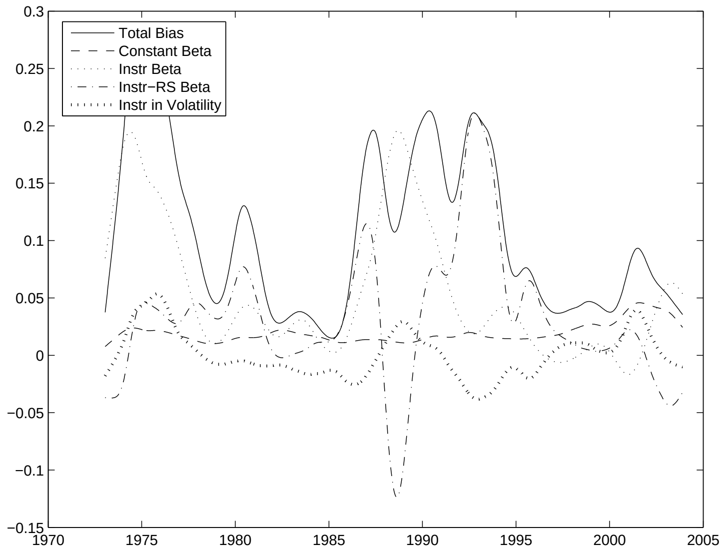


Figure 5 plots the bias in the measures of average idiosyncratic risk resulting from imposing unit betas (Panel A) and constant betas (Panel B) instead of time-varying betas. We refer to Section V.B. and to Appendix A for the derivation and exact specification of the biases.

Figure 6: The Decomposition of the Bias in the Nonsystematic Risk Component

Panel A: Decomposition of Bias at Country Level



Panel B: Decomposition of Bias at Industry Level

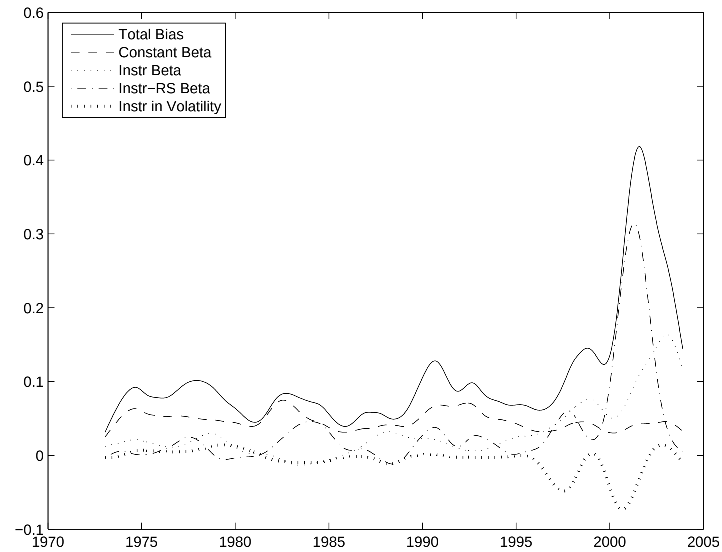
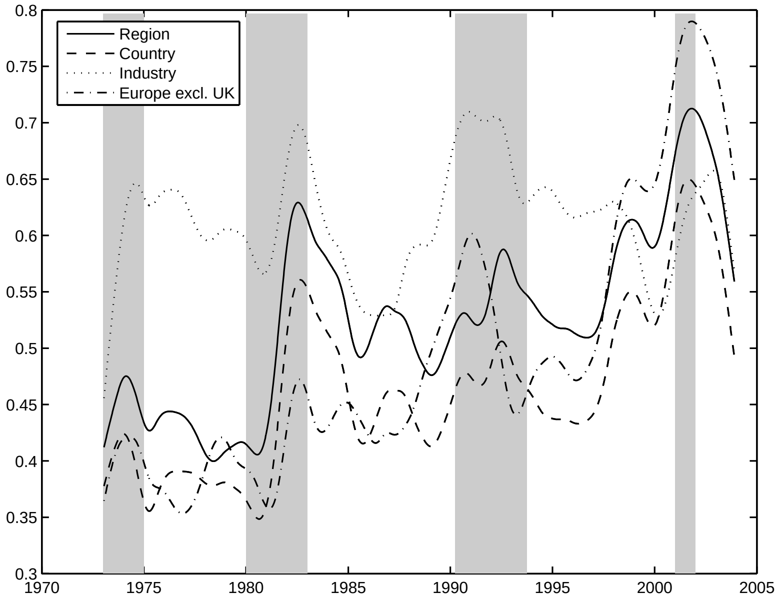


Figure 6 shows the individual contribution of adding various complexities to the volatility spillover model to a reduction in the total bias caused by imposing unit global market exposures. We respectively show the contribution of allowing betas to be constant instead of being unity, of allowing structural instruments instruments in the betas (relative to the constant beta case), of allowing regime-switches in the betas (relative to the beta specification with instruments), and finally of also allowing for structural shifts in the asset-specific volatility specification (relative to model with time-varying betas and an AGARCH volatility specification). The individual contributions sum up to the toal bias. We report the decomposition at the country level (Panel A) and at the industry level (Panel B).

Figure 7: Value-Weighted Model-Implied Correlations over Regions, Countries and Industries

Panel A: Including TMT



Panel B: Excluding TMT

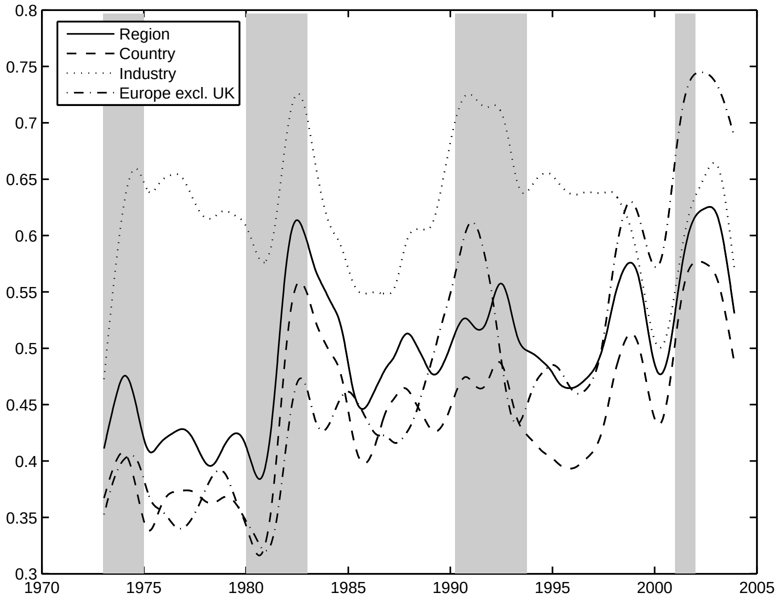


Figure 7 reports the average model-implied cross-regional, cross-industry, and cross-country correlations over time. For the cross-country correlations, we distinguish between all countries and the European countries. World recessions are shaded in gray to illustrate cyclical movements in volatility. The recessions are identified as the periods from the peaks to the throughs of the detrended world GDP.