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Abstract

We use monthly stock market indices for 58 countries to construct pairwise correlations of returns and to explain these correlations with differences in the industrial structure across these countries. We find that countries with similar industries have stock markets that exhibit high correlation of returns. The results are robust to the inclusion of other regressors like differences in income per capita, stock market capitalizations, measures of institutions, as well as various fixed time, country and country-pair effects. We also find that differences in the structure of exports explain stock market correlations quite well. Our results are consistent with an aggregate returns model in which the impact of each industry-specific shock is proportional to the share of this industry in the overall industrial output of the country. We also show that differences in production structures have higher explanatory power for segmented markets rather than for markets that are integrated.

JEL Classification: G15, G11, O14

Keywords: International stock market correlations; GARCH, industry structure; trade structure.

1 Introduction

In recent years, we have witnessed a huge increase in capital flows to emerging markets, with portfolio flows (fixed income and equity) becoming an ever important source of foreign capital (Bekaert and Harvey, 2000). Financial markets throughout the world have steadily become more open to foreign investors with $645 billion worth of equity flows across borders in 2004 (IFS). With the slow and steady erosion of barriers to portfolio flows, even in emerging markets, and with risk premia being determined globally, comovements in stock prices around the world are becoming increasingly pronounced. The average of all country-pair correlations of MSCI indices for 58 countries was in excess of 0.6 in 2006. The comovements in stock returns also exhibits significant volatility. Figure 1 shows that the average cross country correlations for 325 pairs of countries has substantial variation over time.[1]

A number of authors have argued that the observed stock return comovement appears excessive relative to fundamentals. For example, Shiller (1989) argues that the comovement between U.K. and U.S. stock prices is too large to be fully explained by comovement in dividends. Lee, Shleifer, and Thaler (1991), Pindyck and Rotemberg (1993) and Froot and Dabora (1999) also provide evidence on comovements that are in excess relative to fundamentals. King, Sentana and Wadhwani (1994) find only weak evidence of association between correlations in monthly national index returns for 16 markets and economic factors. Using higher frequency data Karolyi and Stulz (1996) examine, intraday returns across the USA and Japan for indexes, portfolios of stocks and ADRs. They too find that correlations are not significantly related to macroeconomic news, interest rate and exchange rate shocks,

[1] Computed using monthly returns over a 60 month rolling window. The country pair correlations range from -0.75 in the year 1989 for India and Japan to 0.98 in the year 2006 between Germany and Japan. To calculate the average correlations, we use only 26 countries for whom we have data for each year, over the period 1970-2006. This is to avoid composition effects.

dividend yields, and even trading volume.[2]

The study of correlations also attracted a lot of academic attention after a series of well-publicized crises in emerging markets. Crises seem to create excessive correlations between countries that some have termed "contagion." King and Wadhwani (1990) applied this concept to international stock returns: a shock in one market leads investors to withdraw funds from other markets because of irrational fears and thus leads to unusually high comovements of asset prices. Calvo and Reinhart (1996) showed that correlations of weekly returns on equities and Brady bonds for Asian and Latin American emerging markets was higher after the Mexican crisis than before. A significant increase in correlations among different markets, however, may not be a proof of contagion. Forbes and Rigobon (2001, 2002) show that increases in volatility around crises leads to heteroskedasticity so that an increase in correlation could simply be a continuation of strong transmission mechanisms that exist in more stable periods.

Early studies by Grubel (1968), Levy and Sarnat (1970), and Solnik (1974) document low correlations between index returns in different countries and argue that the benefits of international diversification outweigh the costs. The correlation of index returns and its changes over time, has important ramifications for investors looking to diversify their portfolios. More importantly, it requires a clear understanding of the where exactly are the sources of gains from diversification. While some maintain that the gains stem from the diversity of economic conditions underlying foreign capital markets due to differences in monetary and fiscal policies, movements in interest rates, budget deficits, and national growth rates, others propose that the benefits from international diversification come largely from the diversity of industrial structures across countries. Therefore, a second stream of

[2] See Roll (1987) and Karolyi and Stulz (2003) for surveys.

research has focused on whether correlations differ systematically across countries and what accounts for these differences. Longin and Solnik (1995) test the equality of covariance and correlation matrices of returns for seven developed markets across different 5-year periods between 1960 and 1990. They reject the hypothesis of equality in 10 of 16 comparisons and find that correlations increase over time. In their multivariate GARCH model they allow for a trend factor in conditional correlations and in market returns, dividend yields, and interest rates. However, they find that market and economic factors are not reliably significant in accounting for comovements.

Lessard (1974) first considered the importance of differences in industrial composition for explaining the variation in global stock returns. This sparked a debate regarding the relative importance of country vs. industry factors as drivers of volatility and comovement of returns across national stock markets. While Roll (1992) confirms the importance of industry factors others such as Heston and Rouwenhorst (1994, 1995) on the other hand, show that country factors are more important drivers of volatility and comovements than are industry factors. Bekaert et al (2005) confirm this result as well - that country factors are more important in fitting the covariance structure of country-industry portfolios than are industry dummies. Griffin and Karolyi (1998) find that this is true even for a broader sample that includes emerging markets, where global industry factors explain only around four percent of the variation in national stock. However, more recently Baca et al., 2000, Cavaglia et al., 2000, Brooks and Del Negro, 2004 and Flavin, 2004 have shown that the industry effects have leveled or even surpassed the country effects in recent years.

To summarize, the literature on comovements has attempted to answer four questions: 1) Are comovements constant over time? 2) Is there evidence for contagion? and 3) Are global, regional or local factors driving these correlations? 4) Are country effects more important than industry effects?

Figures 2 and 3 show the evolution of stock market indices for various country-pairs. For USA and UK, we see that the stock indices track each other very closely. For USA and Singapore, the comovement in stock indices is less pronounced than is the case for USA and UK. But to a large degree this can be attributed to an initial time period between 1970 and 1985 where Singapore's growth miracle story was being played out and to the Asian crisis of 1997 which led to significant capital outflows from the region. Comparing USA and Japan, we observe a similar pattern.. The stock indices diverge after the banking crisis in the 1990s which witnessed the bursting of an asset bubble in the end of the 1980s and a steady deterioration in the health of the banking sector accompanied by failing banks and sclerotic GDP growth. As the last figure in the post 1997 period shows, the US and Japanese stock indices have closely tracked each other ever since. Figure 3 shows the stock indices for India and the US and for India and Mexico. The stock indices for India and Mexico seem to track each other much more closely than the indices for India and US. While we present the evolution of stock indices for only a small subset of country-pairs, we do observe some intriguing patterns. Developed country pairs such as US and UK exhibit high degrees of comovement as do the emerging market pair of India and Mexico. At the same time, countries that have made the transition from developing to developed such as Japan in the 1970s and Singapore in the 1990s have experienced rising comovements. This raises the question whether it is simply the degree of development that leads to high correlations between country-pairs or whether there is something more fundamental that could be a potential driver of such correlations.

In this paper, we build on the existing literature by studying directly the link between stock market comovements and focus on one such fundamental - similarities in the industrial structure across pairs of countries. In particular, we construct time-varying, country-pair-specific indices of differences in the production and trade and examine whether comovements between stock market returns are driven by similarities/differences in these indices. We expect that countries that are similar in their production structure will exhibit higher degree of comovements. The intuition behind this is simple. Consider a pair of countries that are similarly specialized in the production of a set of goods. In such a setting, global sector specific shocks will see a movement of returns in both countries in the same direction and we should observe a high correlation in national stock market returns. Country-pairs that are specialized in different sectors may also move together if the covariance of the shocks in the sectors that they produce in is high. Country-pairs that specialize in very different sectors and where the covariance of sectoral shocks is low or close to zero will exhibit low comovements in stock returns. We start by showing that the *unconditional correlations* in stock returns depend negatively on difference in the structure of production and trade. Next, we estimate two asset pricing models and use the residuals from these models to calculate *conditional correlations*. The first is the two-factor Fama-French model (Fama and French 1996, 1998) with an asymmetric GARCH specification for the error terms. Fama and French argue that returns may be related to the style of the stocks involved and explain the variation in mean returns by variation in regression slope coefficients on two new "factors," the HML portfolio of value minus growth firms and the SMB portfolio of small minus large firms. The second asset pricing model is an international and regional CAPM model where we follow Bekaert and Harvey (1995, 1997) and estimate the model using time-varying betas and an asymmetric GARCH specification for the error terms. This allows us to control for comovements that may be ascribed to variations in world and regional integration for different countries, to take into account time-variation in the degree of world and regional integration and capture the heteroskedasticity in the variance of returns. Using the results from the CAPM estimation and the Fama-French model, we show that conditional correlations are also higher for country-pairs with similar production structures.

After reporting the key results that link industrial structure to stock market comovements, we use a standard factor model to derive the link between industrial structure and stock markets. Our key argument is that countries with similar industries experience similar sectoral shocks, which in turn affect stock market returns. The explicit derivation of the correlation between stock market returns shows that in addition to the simple differences in production structure, one has to take into account volatility of shocks in different industries, as well as covariances across industries. To operationalize this insight we use the methodology developed by Koren and Tenreyro (2007) to calculate the variance-covariance matrix of global shocks at the sectoral level and construct a risk-adjusted (or volatility-weighted) differences in production structures. This variable is a summary measure that explicitly takes into account a) differences in production shares between pairs of countries; b) volatility of sectoral shocks and c) covariances between sectoral shocks. Pairs of countries with smaller risk-adjusted production structure differences tend to exhibit similar movements in stock market returns.

We show that all of the results documented in the paper are robust to controlling for a wide range of differences between country-pairs that may plausibly affect return correlations - these span differences in levels of development, in financial sector development, differences in political institutions, trade links between these countries, and geographic proximity. We also show that our results hold not just using pooled OLS but also in within-estimates over time. This implies that if the industrial structure within a pair of countries becomes more similar over time, then the correlation of stock returns for this pair increases over time. This is a potential candidate for explaining why stock market comovements have increased over time. An old literature in economics (Clark, 1957; Kuznets, 1959) posits that countries move through various stages of development in a predictable fashion. Initially, the production and trade structure is overwhelmingly skewed towards agriculture and primary products, while in later developments stage, we observe a transition to capital-intensive followed by skill-intensive manufacturing and services. Therefore, as more and more emerging countries grow and catch up to the levels of development of advanced economies, we are likely to observe a convergence in industry structures across countries over time and a subsequent rise in stock market comovements over time.

The paper focuses exclusively on the production side of the economy and investigates how industry-specific shocks play a role in explaining comovements in stock prices. Needless to say, there are other important factors that also generate cross-country comovements – reduction in capital controls, improved access to foreign markets, increased stock market participation or sharp swings in liquidity are candidates that may affect investors' behavior and lead to changes in stock market dynamics across countries. While acknowledging their importance, we leave these considerations for future work.

The rest of the paper is organized as follows: in section 2 we provide a brief description of our data, the data sources and present various summary statistics; section 3 presents regression results showing the relationship between differences in industry and trade structure and unconditional stock market correlations between pairs of countries; section 4 uses conditional correlations in lieu of unconditional ones; section 5 constructs a measure of risk-adjusted difference in production structure that takes into account not simply the differences in production structure but also the variance-covariance structure of sectoral shocks; section 6 examines differences in trade structure and examines whether our results are robust to various sub-samples and to episodes of country-specific stock market liberalization; section 7 concludes.

2 Data and Variables

2.1 Stock Returns

Our dependent variable is the correlation between returns on country stock indices. Our sample of national equity markets includes data for both developed markets, as compiled by Morgan Stanley Capital International (MSCI), and emerging markets from S&P's Emerging Market Database (EMDB). We use monthly data from MSCI for stock market indices, over the period 1970-2006. We complement this data with monthly stock indices from EMDB that covers 35 emerging country markets with data beginning in 1975.[3] Next, we calculated monthly returns and subtracted the 1-year risk free T-bill rate for the US to obtain excess returns. We used this data to calculate two versions of the correlations between stock returns of country pairs by varying the time windows over which the correlations are measured. a) First, we used this monthly excess return to calculate a simple pairwise correlations for the 12 months of each year b) Second, we expanded the 12 month window to a 60 month overlapping rolling window. We present our results mainly with the first measure since the results are qualitatively similar for the correlations calculated with the 60 month overlapping window.

2.2 Production and Trade Structure

To construct our main independent variable measuring differences in the industrial structure, we use industry-level panel data on both production and trade. The data on industry structure is from the UNIDO database which provides annual data on production, value-added, employment, and number of firms for 28 manufacturing sectors (3 digit ISIC codes

[3] EMDB also provides data for 25 Frontier markets with data starting in 1990. We do not include these countries due to sparse data over time and due to missing data for other variables.

are reported) for 183 countries over the time period 1979-2001. Data on production is the most comprehensive, both across countries and over time so we use the production data to measure industrial production structure. The data on production is in current US dollars. For each country-year, we calculate the proportion of production in each of the 28 3-digit manufacturing sector. Our measure of difference in industry structure is the sum of the squared differences in production shares between country-pairs i and j at time t, where the summation is carried out over the 28 manufacturing sectors.

$$Difference\ in\ Industry\ Structure_t^{i,j} = \sum_{k=1}^{28} \left(pshare_{kt}^{i} - pshare_{kt}^{j} \right)^2$$

k is the index for the 28 manufacturing sectors,

$$pshare_{kt}^{i} = \frac{prod_{kt}^{i}}{\sum_{k=1}^{28} prod_{kt}^{i}}$$

is the production share in the k^{th} manufacturing sector and $prod_{kt}^{i}$ is the production in sector k in country i at time t.

As a robustness check, we also examine if our results are robust to differences in trade structure. The advantage of examining differences in trade structure is that while the UNIDO data covers only the manufacturing sector, our trade data encompasses all merchandise trade. Trade data over the same time span come from the World Trade Database (Feenstra et al. 2005), which contains information on more than 150 countries. This database contains bilateral trade flows between pairs of countries, accounting for 98 percent of world trade. Trade flows are reported using the 4-digit SITC Revision 2 classification. We aggregate bilateral flows across countries to obtain total exports in each country and industry. At the 4-digit level, there are a number of instances, where the authors could not classify trade as falling into one of the 4-digit SITC categories, which leads to trade in a 3-digit being sometimes higher than the sum of the trade in the corresponding 4-digit sub-categories.

To minimize this problem, and for comparability to our measures of industrial structure, we use trade in 3-digit SITC categories. There are 241 3-digit categories. Our measure of difference in export structure between country-pairs i and j at time t is the sum of the squared differences in export shares between country-pairs i and j at time t, where the summation is carried out over the 241 3-digit sectors.

$$Difference\ in\ Export\ Structure_t^{i,j} = \sum_{k=1}^{241} \left(xshare_{kt}^{i} - xshare_{kt}^{j} \right)^2$$

k is the index for the 243 sectors that encompass merchandise trade,

$$xshare_{kt}^{i} = \frac{export_{kt}^{i}}{\sum_{k=1}^{241} export_{kt}^{i}}$$

is the export share in the k^{th} SITC sector and $export_{kt}^{i}$ is the exports by country i in sector k at time t.

2.3 Controls

Drawing on the gravity literature of bilateral trade flows we also include a series of gravity-type variables (See Baldwin and Taglioni, 2006 for a survey). We proxy a country's stock market development using the product of stock market capitalization (Portes and Rey, 2005). We also use the geographic distance between capital cities from the CEPII bilateral distance database.[4] We also measured country pair integration using data on bilateral trade flows from IMF's Direction of Trade Statistics database. We operationalized this variable as the average of bilateral export shares between pairs of countries. We also include a dummy variable that takes the value one if the two countries are part of a free trade area or a customs union since this facilitates the flow of goods and services between the two countries. To capture differences in degree of development, we add a control which equals the absolute

[4] The data is from: www.cepii.fr/anglaisgraph/bdd/distances.htm. We experimented with distance between financial centers and got similar results.

difference in per capita GDP in constant international dollars from the World Development Indicators. Next, we control for differences in political institutions by including a dummy variable that takes the value one if both countries may be classified as democracies, and zero otherwise. Following Giavazzi and Tabellini, (2004) and Persson (2005) we classify a country as a democracy if it receives a positive Polity score. This data is from Polity IV Project that classifies countries on a scale of -10 to 10 with higher numbers indicating more democratic regimes (Marshall, Jaggers and Gurr, 2000.) [5] We also include a variable that takes the value 1 if the two countries are from the same region.[6] Finally, we control for aggregate shocks such as a world business cycle, movements in the world rate of interest, or global capital market shocks using time dummies and control for region-specific shocks by using time-varying regional dummies.

Table 1 lists the summary statistics and the data source for each of the variables. Figure 4 plots the stock market correlation for the year 2000 against differences in production structure. We observe a clear negative relation between stock return correlations and difference in industry structure and between stock market correlations - a relation that holds not just for the year 2000 but for other years as well. The graphs also plots a fitted line that confirms this negative relationship.

[5] Note that we used the POLITY2 measure, which transforms the Polity "standardized authority codes" (i.e., -66, -77, and -88) to scaled POLITY scores so the POLITY scores may be used consistently in time-series analyses without losing crucial information by treating the "standardized authority scores" as missing values.

[6] We use the World Bank's 8-fold regional classification. North America, Latin America, Western Europe, East Europe and Central Asia, East Asia and Pacific, South Asia, Middle East and North Africa, and Sub Saharan Africa.

3 Unconditional Correlations and the Structure of Production

3.1 Production

Table 2 shows our first set of results where we regress the unconditional correlations on the differences in the structure of manufacturing production and other control variables. Column 1-3 present the pooled OLS results - column 2 adds time dummies to column 1, and column 3 adds country-specific effects. Column 4 presents the within-estimates, with country-pair specific fixed effects, time dummies, and time-varying regional effects. In column 1, we see a negative and significant coefficient on our industry structure variable - it implies that correlations between country pairs is higher if they have a similar industry structure. Column 2 shows that this effect persists even when we add time dummies to capture global movements in the world business cycle and/or trends in globalization to capture the increased flow of goods and capital across national borders. While the magnitude of the coefficient declines somewhat, it continues to be strongly significant. Column 3 adds time-invariant country-specific effects (two dummies are added for each country pair) to capture unobserved time-invariant country characteristics and shows that differences in industrial structure remain a significant driver of stock return correlations. Column 4 includes country-pair fixed effects so that the estimates are within-effects. The negative coefficient on differences in industry structure imply that country-pairs that have become similar in terms of industrial structure over time exhibit a higher degree of comovement in stock market returns. Since the regional dummy and the distance measure are time-invariant, they are automatically dropped for the within-estimates shown in column 4. However, column 4 also includes time-varying regional dummies, so we can be fairly confident that our measure of industrial structure is not simply a proxy for common region-specific shocks that arise out of geographic specialization of production.

For our control variables we find that countries with similar levels of stock market development, at similar levels of development in terms of per capita GDP and that have democratic political institutions exhibit higher comovements in stock returns.[7] We also find county-pairs that are geographically proximate to each other, those that exhibit a higher degree of bilateral trade and who are members of a common free trade area have larger stock return correlations. Free trade areas drive stock market comovements for both the pooled OLS and within-estimates while bilateral trade seems to play a role only in the pooled OLS specifications. Finally, stock markets of countries from the same region tend to move together. Our explanatory variables account for 14 to 35% of the variation in correlations across country-pairs and all models are jointly significant at the 1 % level.

In terms of the magnitude of effects, we find that for the estimates in column 3 (4), a one standard deviation increase in the difference in industry structure reduces correlations by 0.013 (0.01). A second way to understand the magnitude of effects is to consider two country pairs, one of which has similar production structure and another pair that has very different production structures. In 1999, the variable $Difference\ in\ Industry\ Structure$ takes the value 0.14 for the pair (USA, Pakistan) and the value 0.002 for (USA, UK). Our estimates in column 4 imply that if Pakistan's production structure became identical to that of the UK, its correlation with the USA would rise by 0.03. With an average correlation of 0.1 for (USA, Pakistan) this amounts to a 30% increase in the magnitude of correlations.

4 Conditional Correlations and the Structure of Production and Exports

So far we have focused on unconditional correlations and shown that these are significantly influenced by the structure of production and trade. However, as Longin and Solnik (1995)

[7] In a related paper (Dass, Dutt and Mihov, 2008), we invetsigate the role of political institutions for stock market returns, volatility and comovements.

argue, even if the conditional correlations are constant, unconditional correlations tend to be very unstable over time and that this could be driven solely by time variation in market expected returns and variances.[8] For instance, the variance of returns may be heteroskedastic. In fact, the conditional variance of national equity markets has been modelled with good success using a univariate GARCH approach for several national markets. Similarly, expected returns may depend on worldwide and region-specific variables. Another likely possibility is that the level of integration of national equity markets differs across countries and may be changing through time. Some countries are more integrated with the rest of the world and their returns are likely to be highly correlated. Similarly, countries within the same region may be more integrated and may have similar production structures (due to similar endowments.) Growing international and/or regional integration over time could also lead to a progressive increase in market correlation. It is important to consider conditional correlations, because unconditional correlations might be driven by changes in the volatility of either the world or regional factor, or by changes in the factor loadings. And if these changes in volatility coincide with changes in industrial structure, then our estimates will be biased and inconsistent.

Therefore, as a next step we take an asset pricing perspective and estimate two asset pricing models. The first is the Fama-French three factor model and the second is a two-factor model with time-varying factor loadings where one is a common world factor and the other is a regional factor. For the first, we use the parsimonious factor model proposed by Fama and French (1998) to capture style exposures in an international context. The world Fama-French model, has three factors, a world market factor, a size factor (WSMB) and a

[8] This goes back to Kaplanis (1988) who finds that the correlation matrix over four equal 46 months sub-periods is more stable than the counterpart covariance matrix. The instability in the covariance matrix is attributed to the non-stationarity of a few variances which cause a structural change in the level of the covariances.

value factor (WHML). The model in Fama and French (1998) only has the market factor and the value factor, the data for which is available from Kenneth French. In addition, we include not just world factors but also factors that are specific to the US which is the world's largest stock market. For the US, we include the excess return in the US, a US size factor (USSMB) and a US value factor (USHML). We estimate the following excess return equation

$$R_{it} = \beta_i^W \mu_t^W + \beta_i^{US} \mu_t^{US} + \beta_i^{WHML} WHML_t + \beta_i^{US} WSMB_t + \beta_i^{USHML} USHML_t + e_{it} \quad (1)$$

$$e_{it} \sim N(0, \sigma_{it}^2)$$

$$\sigma_{it}^2 = a_i + b_i \sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i \left[\max\{0, e_{it-1}\}\right]^2$$

The variance of the idiosyncratic return shock of market i follows a GARCH process in eq. (1) with asymmetric effects in conditional variance, as in Glosten, Jagannathan, and Runkle (1993). Previous research such as Longin and Solnik (1995); Erb, Harvey, and Viskanta (1994) and De Santis and Gerard 1997) find different correlations in up and down markets and that volatility reacts in an asymmetric fashion to positive and negative news. For the second factor model, we follow closely the setup used by Bekaert and Harvey (1997) and Bekaert, Harvey and Ng (2005). This model in addition to the asymmetric GARCH specification also incorporates time-varying factor loadings, where the factor loadings are influenced by trade patterns. Chen and Zhang (1997) and Bekaert, Harvey and Ng (2005) find that the crossmarket correlations of stock returns are related to external trade among countries. For each country, we estimate the following excess return equation

$$R_{it} = \beta_{it}^W \mu_t^W + \beta_{it}^{REG} \mu_t^{REG} + e_{it} \quad (2)$$

$$e_{it} \sim N(0, \sigma_{it}^2)$$

$$\sigma_{it}^2 = a_i + b_i \sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i \left[\max\{0, e_{it-1}\}\right]^2$$

where μ_t^W is the excess return on a world portfolio, μ_t^{REG} is the excess return on a regional portfolio and e_{it} is the idiosyncratic shock of any market i.[9] The sensitivity of each market i to the world and regional portfolios is measured by the time-varying parameters β_{it}^{W} and β_{it}^{REG}. These time-varying parameters are modeled as depending in a linear fashion on trade patterns with β_{it}^{W} a function of country i's trade (exports plus imports) with the world as a whole, and β_{it}^{REG} a function of country i's trade (exports plus imports) with all the other countries in its region. For each country, we use monthly data to estimate (1) and (2), extract the residual $\widehat{e}_{it}$ in each specification and calculate the conditional correlations over each year. This conditional correlations we subsequently use as our dependent variable.

Table 3 shows how the Fama-French conditional correlations are affected by differences in industry structure. As with the unconditional correlations, we find that bigger the differences in industry structure lower are the stock market comovements between pairs of countries. This result holds in a pooled OLS, when we add time dummies, when we add country-fixed effects, as well as in a within-estimation with country-pair fixed effects and time-varying regional dummies. Comparing the magnitude of the coefficients in table 4 to that in table 2 that uses unconditional correlations, we see that the magnitude increases substantially across specifications, with the increase especially pronounced for the within-estimates in column 5. For the coefficient estimates in column 5, we find that a one standard deviation decline in the difference in the structure of industry increases pairwise correlation by 0.03 which is nearly thrice as high as than the magnitude of the effect for unconditional correlations in column 5 of table 2. The explanatory power of our variables range from 13% for the pooled OLS without any fixed effects to 39% for the within-estimates that includes country-pair and time-varying regional fixed effects.

[9] For the world index, we use the MSCI World Market Index. For the regional indices we use the Asia, Middle East and Africa and Latin America indices from EMDB. For European countries we use the MSCI Europe Index, for Australia and New Zealand we use the MSCI Pacific Index, for Japan we use the Pacific Index excluding Japan, for Canada we use the US index. Finally, for the US given its overwhelming size in world markets we do not include any regional index.

Table 4 examines the conditional correlations based on the international and regional CAPM model with time varying betas. Once again across specifications, we find that countries who specialize and produce in different manufacturing sectors tend to exhibit lower conditional correlations. The relationship holds for both the pooled OLS specification and in the within-effects over time. We also observe a marked increase in the magnitude of the coefficients on production structure differences as compared to those in table 2, with a similar doubling (for the pooled OLS) and trebling (for the within-effects) as we obtained in table 3. Here as well, a one standard deviation decline in the difference in the structure of industry increases pairwise correlation by nearly 0.03.

5 Conditional Correlations and the Risk-Adjusted Structure of Production

In our regression estimates we have simply examined the differences in the structure of production. Implicitly we are assuming that the variance of common sectoral level shocks is the same across sectors and that the covariance in shocks across sectors equals zero. A more comprehensive modeling would take into account that returns of countries are more likely to move together if 1) they produce in the same sectors; 2) that this effects is magnified when they produce in similar sectors that have higher idiosyncratic volatility, that is sectors exposed to large and frequent shocks and 3) when they produce in different sectors but the covariance of sectoral shocks is high. In this section, we draw on Koren and Tenreyro (2007) and di Giovanni and Levchenko (2008) to capture the inherent volatility and comovement properties of sectors. We use the UNIDO production data to construct a covariance matrix for the sectors using a method similar to Koren and Tenreyro (2007), which produces a sector-level covariance matrix that is common across countries and years. We then use differences in production shares for each available country and time period to construct a summary measure that we term the risk-adjusted difference in production structure.

Assume that the excess stock return in country i at time t (in months) is written as before as either a three-factor Fama-French or a two-factor model with time-varying betas with an asymmetric GARCH specification for the residuals

$$\begin{aligned} R_{it} &= \beta_i^W \mu_t^W + \beta_i^{US} \mu_t^{US} + \beta_i^{WHML} WHML_t + \beta_i^{US} WSMB_t + \beta_i^{USHML} USHML_t + e_{it} \text{ or} \\ R_{it} &= \beta_{it}^W \mu_t^W + \beta_{it}^{REG} \mu_t^{REG} + e_{it} \\ & \quad e_{it} \text{ ~ } N(0, \sigma_{it}^2) \\ \sigma_{it}^2 &= a_i + b_i \sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i \max\left\{0, e_{it-1}^2\right\} \end{aligned}$$

Now assume that the residuals e_{it} can be written as a weighted average of sector-specific shocks ϵ_{kt} which is the global shock to sector k at time t.

$$e_{it} = \lambda \left[\sum_{k=1}^{28} pshare_{kt}^i \epsilon_{kt} \right]$$

We use λ as a scaling factor that links on average the industry-specific shock to the random component in the country's stock market return. Similarly, for country j in year t we can write

$$e_{jt} = \lambda \left[\sum_{k=1}^{28} pshare_{kt}^j \epsilon_{kt} \right]$$

Subtracting we get

$$e_{it} - e_{jt} = \lambda \left[\sum_{k=1}^{28} \left(pshare_{kt}^i - pshare_{kt}^j \right) \epsilon_{kt} \right]$$

We can calculate then the variance of this difference year-by-year as:

$$\sigma_{i,Y}^2 + \sigma_{j,Y}^2 - 2cov_Y\left(e_i, e_j\right) = \lambda^2 \mathbf{a}_{ij,Y}' \Omega \mathbf{a}_{ij,Y}$$

This expression shows the link between annual volatility of unexpected stock market returns in any pair of countries and the covariance between these returns as a function of the scaling parameter λ, the (28 x 1) vector of differences in production shares $\left(pshare_{k,Y}^i - pshare_{k,Y}^j\right)$

denoted by $\mathbf{a}_{ij,Y}$ and the variance-covariance matrix of global shocks to the 28 manufacturing sectors denoted by Ω. Since our value-added data is annual, we will not be able to calculate annual values for the variance-covariance matrix of shocks. We will use the full sample to obtain a time-invariant estimate for Ω. The conditional correlation of stock returns in each year Y is given by

$$\rho_{ij,Y} = \frac{\sigma_{i,Y}}{\sigma_{j,Y}} + \frac{\sigma_{j,Y}}{\sigma_{i,Y}} - \lambda^2 \frac{\mathbf{a}'_{ij,Y}\Omega\mathbf{a}_{ij,Y}}{\sigma_{i,Y}\sigma_{j,Y}} \tag{3}$$

5.1 Construction of the Sector Variance-Covariance Matrix Ω

Using annual data on industry-level value added per worker growth from the UNIDO database over 1979-2001, we construct a cross-sectoral variance-covariance matrix using the following procedure (see Koren and Tenreyro, 2007, for details). Let y_{ikt} be the growth rate of value added per worker in country i, sector k, in year t. We control for long-run differences in value added growth across countries in each sector, by demeaning y_{ikt} using the mean growth rate for each country and sector over the entire time period.

$$\widetilde{y}_{ikt} = y_{ikt} - \frac{1}{T}\sum_{t=1}^{T} y_{ikt}$$

Next for each year and sector we calculate the cross-country average of growth in value-added per worker.

$$Y_{kt} = \frac{\sum_{i=1}^{C} \widetilde{y}_{ikt}}{C}$$

where C is the set of countries. Y_{kt} is a time series of the average growth for each sector, and can be thought of as a global sector-specific shock. Using these time series, we calculate the sample variance for each sector, and the sample covariance for each combination of sectors along the time dimension. This results in a time-invariant 28 x 28 variance-covariance matrix of sectoral shocks, which is Ω. By virtue of its construction, we think of it as a matrix of variances and covariances of sectors, which is clearly time- and country-invariant. For the diagonal terms in Ω, which is simply the variance of sectoral shocks, the two most volatile sectors are petroleum refineries and miscellaneous petroleum and products (variance slightly higher than 0.01) and the least volatile is manufacturing of transport equipment (variance equal to 0.003).

We define $\frac{\mathbf{a}'_{ijY}\Omega\mathbf{a}_{ijY}}{\sigma_{iY}\sigma_{jY}}$ as the risk-adjusted difference in production and as with the unadjusted measure we expect that the coefficient on this variable will be negative. Note that this variable takes into account not simply the squared differences in the production sector but also sector-specific volatility and covariance structure of sectoral shocks. For the estimates presented in table 2-5 we were explicitly assuming that

$$\sigma_k^2 = 1 \text{ for all } k \text{ sectors}$$

$$\rho_{lm} = 0 \text{ for all pairs of sectors } k \text{ and } m$$

This variable ranges from a low of 0.0004 between France and Spain in 1987 to a high of 0.43 between Chile and Ireland in 1996.

Tables 5 and 6 shows the effect of the risk-adjusted difference in production structure on conditional correlations of stock returns - table 5 is based on conditional correlations calculated on the Fama-French model while table 6 uses the international and regional CAPM model with time-varying betas.[10] In line with equation (3) we obtain a negative and significant coefficient on this variable. The negative coefficient is significant for all specifications, regardless of whether we control for time, country and country-pair fixed effects. The estimates shown in column 5 of table 5 (table 6) imply that a one standard deviation increase in our measure of risk-adjusted production differences reduces stock market conditional correlations by 0.025 (0.02).

[10] Our results also hold if we simply use unconditional correlations.

6 Extensions and Robustness

6.1 Exports

In order to explore how the industrial structure affects stock market comovements, we also look at the structure of country's exports. The data on exports covers all merchandise trade while the data on industry structure spans only the manufacturing sector. The summary statistics in table 1 reflect this difference in our two main data sets by documenting larger differences in export structure as compared to industry structure. Table 7 reports how the conditional correlations are affected by differences in the structure of exports. As with the structure of production, we find that across all specifications, a bigger difference in export structure implies a smaller correlation between country-pairs.[11]

The most demanding specification is the one with time, country-pair and time-varying regional fixed effects as shown in columns 2 and 4. This is the specification where we obtain a higher coefficient on differences in export structure (as compared to columns 1 and 3), both in terms of magnitude and in terms of statistical significance. According to this specification, a one standard deviation increase in the difference in the structure of exports reduces stock return correlations by 0.03. That the magnitude of this effect is nearly twice as high for differences in export structure as compared to the magnitude of the effect for differences in production structure seems reasonable. First, as mentioned earlier, data on exports are much more comprehensive and covers all merchandise trade and as such may be even a better proxy for the overall industrial and production structure of the country. Second, research on export at the firm level has shown that a very small percentage of firms account for an overwhelming proportion of exports (e.g., of the 5.5 million firms operating in the United States in 2000,

[11] We also find that there is an increase in the absolute magnitude of the coefficient on export differences when we restrict our sample to non-oil exporting countries. This implies that the comovements of the stock markets in oil-producing economies with the rest of the world cannot be predicted well by the export structure because of the skewed nature of exports.

just 4 percent were exporters. Among these exporting firms, the top 10 percent accounted for 96 percent of total U.S. exports. See Bernard et al, 2008.) These firms tend to be the large multinationals that receive large weights in the construction of country stock indices. Therefore, common worldwide shocks weighted by exports structure differences are tied more closely to comovements in stock returns.

6.2 Segmentation vs. integration

The literature on international stock market comovements analyzes also the effect of financial liberalization for correlations and more generally it studies trends in financial integration (e.g. Bekaert and Harvey, 2000; Bekaert, Hodrick, and Zhang, 2005). If financial markets are integrated than the degree of correlation will be affected more by investors' preferences and other demand-driven idiosyncratic factors. Analogously, variations in segmented markets will be driven more by local investors and by the industry-specific shocks. We test this hypotheses in Table 8. We use data on stock market liberalization dates from Bekaert, Harvey and Lundblad (2005). Using this data we created two dummy variables – one for cases when one market is integrated (liberalized) while the other is segmented and a dummy variable that takes a value of 1 when both markets are segmented. The default option captured by the constant term is when both markets are liberalized. Our interest is to see how the role of industrial structure changes with financial liberalization. To estimate this effect we include our measure of risk-adjusted production structure and we also include interactions of this variable with the two dummy variables capturing the state of financial liberalization. Column 1 of Table 8 shows that industrial differences still remain an important explanatory variable for cross-country stock comovements, but the effect differs depending on the level of integration. While the coefficient on industrial structure for two liberalized economies is -0.724, for countries where at least one of the markets is segmented the coefficients increases in absolute value by about 1.5 to 1.7. In other words, industrial structure differences matter much more for countries that do not have liberalized financial markets.

In the last two columns we investigate the effect of financial liberalization by using a difference-in-difference estimator. Column 3 includes both the dummy that takes the value of 1 once the country is liberalized and the interaction term with industrial structure, while column 2 includes only the dummy variable.[12] In both cases liberalization raises cross-markets correlations, but we do not see evidence that the role of industrial structure changes in countries that have liberalized within our sample period.

7 Conclusion

In this paper we have focused on the role of industry-specific shocks in explaining cross-country comovements in stock market indices. We have documented that differences in industrial structure as well as differences in export structure across pairs of countries are significant and robust predictors of stock market correlations. This finding can be easily rationalized in a model where the stochastic component of stock market returns is affected by industry-specific shocks, which then influence the overall stock market return through the share that this industry takes in the overall economic activity in the country. Thus, we show that fundamentals as captured by idiosyncratic sectoral shocks do explain comovements in stock market indices.

There are two issues that arise from the results in this paper. First, the explanatory power of industrial structure is not overwhelming – we explain in the best case scenario about five percentage points of pairwise correlations with industrial differences. The variable

[12] Columns 2 and 3 include time fixed effects and country-pair fixed effects. The dummy variable captures the event when a pair of countries made the transition to a situation where both can be classified as having integrated stock markets. It takes the value 1 in all years after both countries had made a switch to liberalized stock markets. It takes the value 0 if either country has a segmented market or if both countries had liberalized stock markets on or before 1975.

is highly significant from a statistical point of view, but it's economic significance is somewhat low. One of the reasons for the low economic significance is that we do not investigate industry-specific portfolios. One can use the methodology of the paper to investigate to what extent cross-country correlations of industry-based portfolios are explained by industry specific shocks. Second, we do recognize that to have a more complete explanation of the observed correlations, one has to go beyond the production side and analyze also the role capital controls, liquidity fluctuations, regulation, etc. and in particular their relationship to the role of the industrial structure. Some of these topics have been already discussed in the literature (e.g. Bekaert, Hodrick, and Zhang, 2005), others we leave for future research.

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Figure 1: Average Correlations for 26 pairs of Countries (1970-2006)

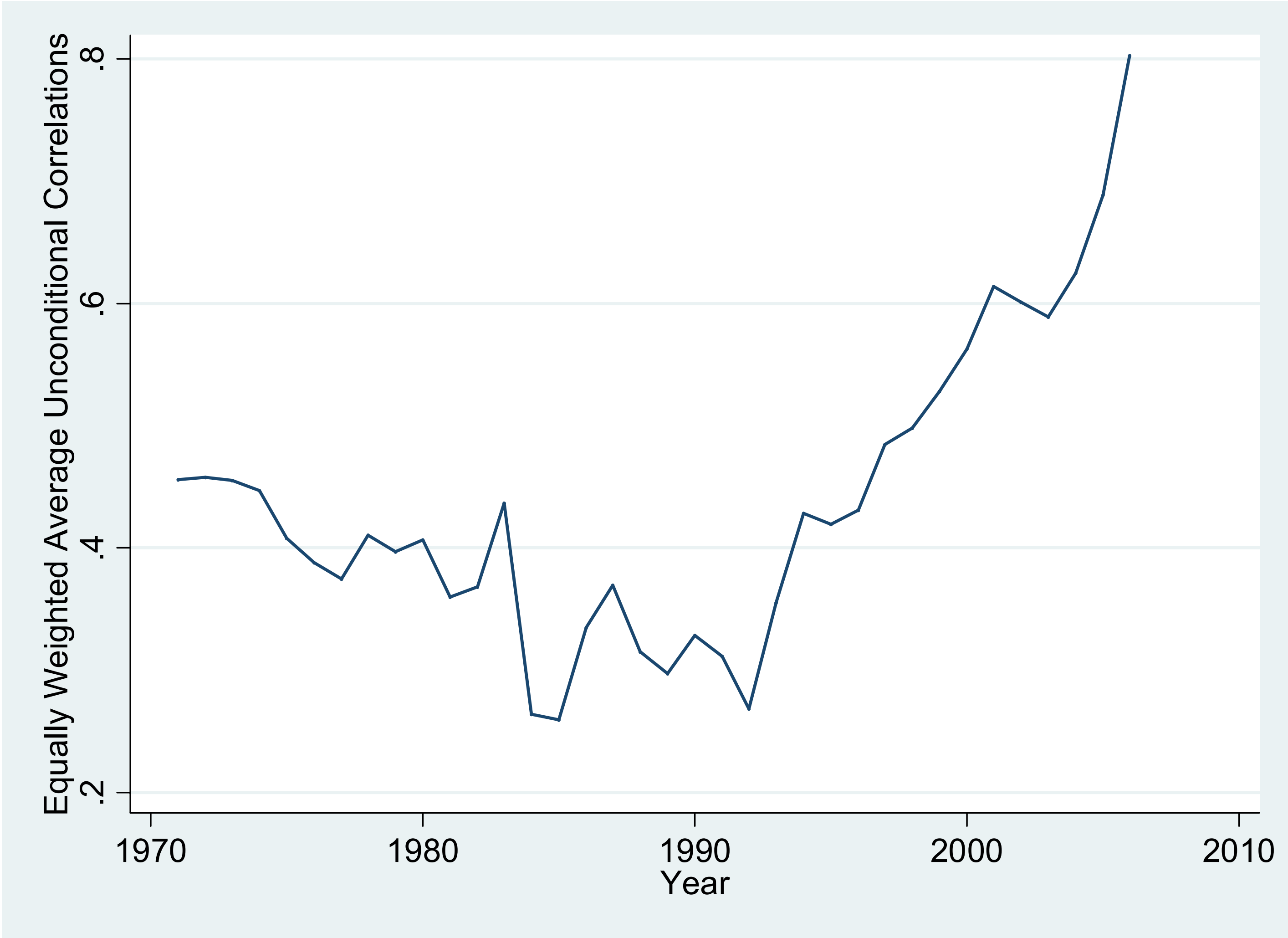

Figure 2: Stock Indices for Various Country-Pairs

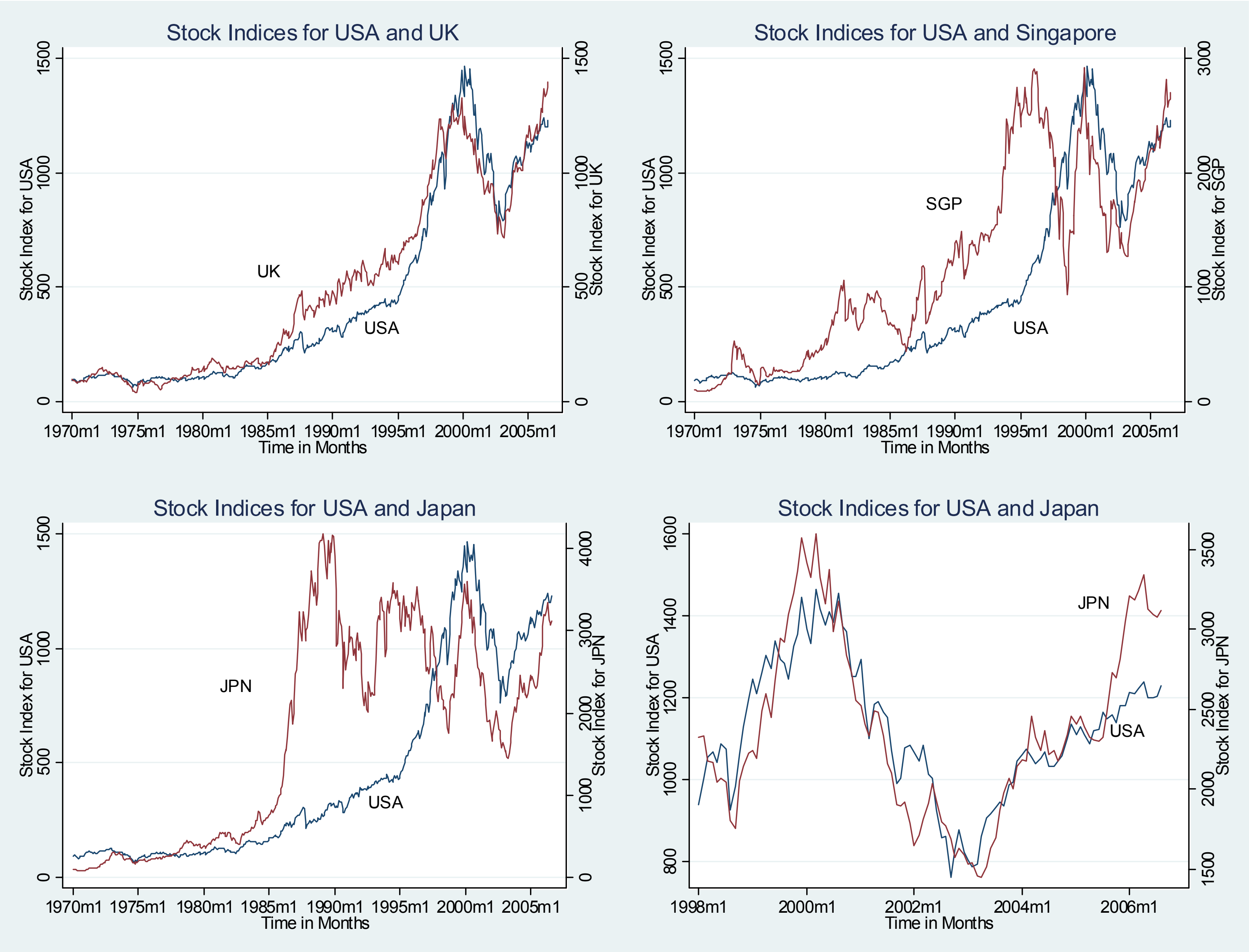

Figure 3: Stock Indices for Various Country-Pairs

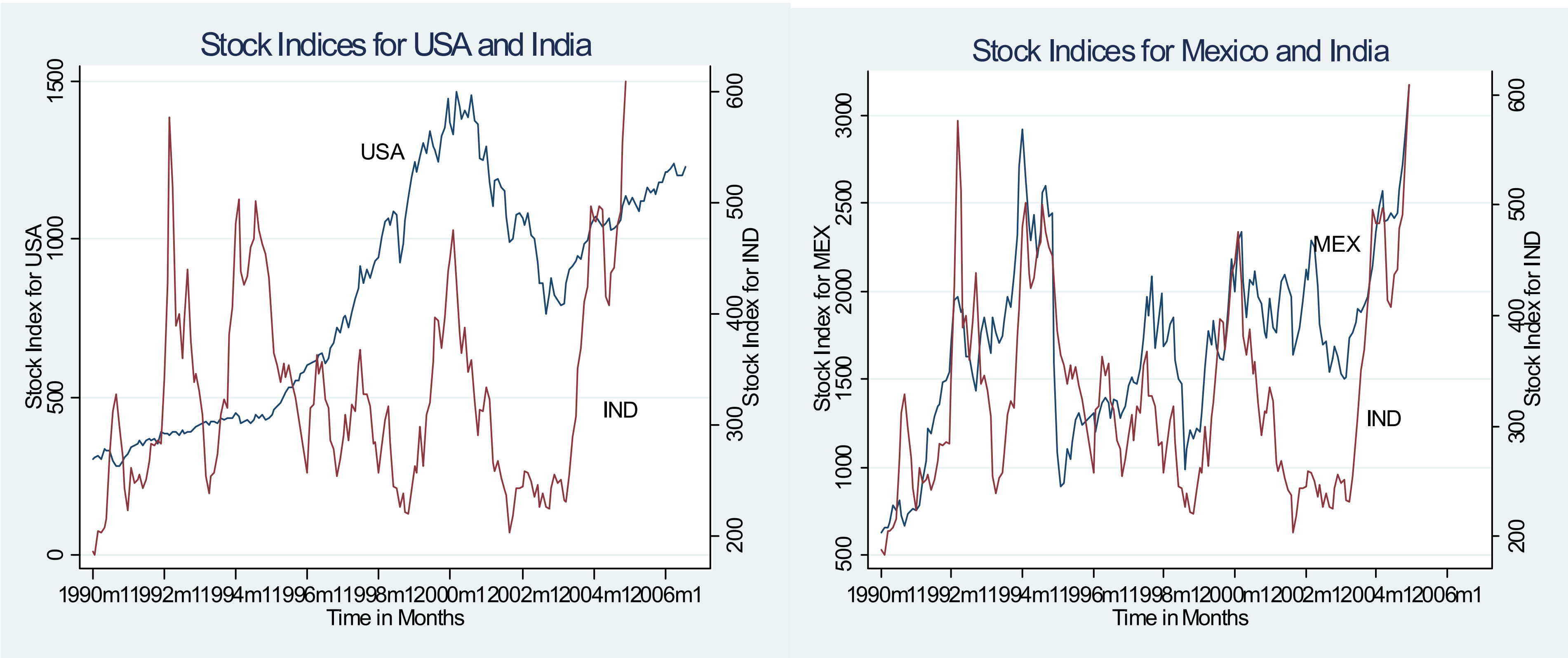

Figure 4: Unconditional Correlations and Differences in Production Structure in 2000

Table 1: Variables, Summary Statistics and Data Sources

Variable	*N*	*Mean*	*Std. Dev.*	*Data Source*
Unconditional correlations	27446	0.277	0.347	MSCI and EMDB databases
Conditional correlations (Fama-French)	22443	0.312	0.338	MSCI and EMDB databases; Fama-French website
Conditional correlations (International+Regional CAPM)	19423	0.297	0.328	MSCI and EMDB databases
Difference in production structure	12843	0.052	0.042	UNIDO database
Difference in export structure	10687	0.084	0.093	World Trade Database, NBER
Risk-adjusted difference in production structure	12843	0.022	0.038	UNIDO database
Product of stock market capitalization (logged)	24833	-2.231	1.691	Database of Financial Sector Development World Bank
Difference in per capita GDP	26538	0.95	0.791	World Development Indicators, World Bank
Dummy =1 if both countries are democratic	21336	0.672	0.469	Polity IV Project
Distance (logged)	27446	8.62	0.968	www.cepii.org
Average of bilateral trade as a proportion of total trade	22763	0.018	0.046	Direction of Trade Statistics, IMF
Dummy =1 if countries from the same region	27446	0.198	0.399	www.cepii.org
Dummy =1 if countries are members of FTA or Customs Union	22867	0.161	0.367	www.cepii.org

Table 2: Unconditional Stock Market Correlations and Structure of Production

	(1)	(2)	(3)	(4)
	Unconditional correlation	Unconditional correlation	Unconditional correlation	Unconditional correlation
difference in production structure	-0.281***	-0.149**	-0.308***	-0.233*
	(0.073)	(0.071)	(0.111)	(0.141)
product of stock market capitalization	0.034***	0.032***	0.024***	0.024***
	(0.002)	(0.002)	(0.004)	(0.004)
difference in per capita GDP	-0.040***	-0.041***	-0.051***	0.041**
	(0.004)	(0.004)	(0.004)	(0.019)
both democracies	0.073***	0.077***	0.065***	0.065***
	(0.006)	(0.006)	(0.010)	(0.011)
average of bilateral export shares	0.294***	0.322***	0.226***	0.112
	(0.053)	(0.051)	(0.065)	(0.156)
free trade area	0.122***	0.124***	0.057***	0.071***
	(0.010)	(0.010)	(0.011)	(0.019)
distance	-0.008*	-0.006	-0.023***	
	(0.004)	(0.004)	(0.006)	
same region	0.065***	0.069***	0.041***	
	(0.009)	(0.009)	(0.011)	
Constant	0.352***	0.402***	0.518***	0.081**
	(0.041)	(0.048)	(0.085)	(0.035)
Observations	15066	15066	15066	15066
R-squared	0.14	0.22	0.29	0.35
Joint significance test	364.65***	162.41***	57.64***	48.15***
Time fixed effects	No	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No
Pair fixed effects	No	No	No	Yes
Time-varying regional fixed effects	No	No	No	Yes

Standard errors in parentheses are adjusted for clustering on country-pairs; * significant at 10%; ** significant at 5%; *** significant at 1%
The dependent variable is the unconditional correlation of monthly stock market excess returns over each year.

Table 3: Conditional Stock Market Correlations (Fama-French) and Structure of Production

	(1)	(2)	(3)	(4)
	Conditional correlations	Conditional correlations	Conditional correlations	Conditional correlations
difference in production structure	-0.461***	-0.344***	-0.449***	-0.661***
	(0.082)	(0.076)	(0.134)	(0.197)
product of stock market capitalization	0.037***	0.040***	0.032***	0.029***
	(0.002)	(0.002)	(0.004)	(0.005)
difference in per capita GDP	-0.053***	-0.045***	-0.052***	0.007
	(0.004)	(0.004)	(0.005)	(0.034)
both democracies	0.032***	0.031***	0.081***	0.074***
	(0.009)	(0.008)	(0.015)	(0.016)
average of bilateral export shares	0.359***	0.337***	0.264***	0.224
	(0.054)	(0.059)	(0.065)	(0.165)
free trade area	0.111***	0.120***	0.056***	0.060***
	(0.011)	(0.011)	(0.012)	(0.018)
distance	0.001	0.005	-0.017***	
	(0.005)	(0.005)	(0.006)	
same region	0.081***	0.081***	0.046***	
	(0.010)	(0.009)	(0.011)	
Constant	0.347***	0.703***	0.765***	0.340***
	(0.046)	(0.052)	(0.097)	(0.056)
Observations	11568	11568	11568	11568
R-squared	0.13	0.23	0.31	0.39
Joint significance test	259.80***	107.96***	49.60***	50.30***
Time fixed effects	No	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No
Pair fixed effects	No	No	No	Yes
Time-varying regional fixed effects	No	No	No	Yes

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. We estimate the following 3-factor Fama-French model country-by-country

$$R_{it} = \beta_i^W \mu_t^W + \beta_i^{US} \mu_t^{US} + \beta_i^{WHML} WHML_t + \beta_i^{US} WSMB_t + \beta_i^{USHML} USHML_t + e_{it}$$

$$e_{it} \sim N(0, \sigma_{it}^2)$$

$$\sigma_{it}^2 = a_i + b_i \sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i [\max\{0, e_{it-1}\}]^2$$

For each year, the correlation for country-pairs is calculated over a 12-month horizon.

Table 4: Conditional Stock Market Correlations (International+Regional CAPM) and Structure of Production

	(1)	(2)	(3)	(4)
	Conditional correlations	Conditional correlations	Conditional correlations	Conditional correlations
difference in production structure	-0.449***	-0.344***	-0.411***	-0.621***
	(0.081)	(0.076)	(0.135)	(0.198)
product of stock market capitalization	0.039***	0.042***	0.032***	0.030***
	(0.002)	(0.002)	(0.004)	(0.005)
difference in per capita GDP	-0.053***	-0.046***	-0.052***	-0.003
	(0.004)	(0.004)	(0.005)	(0.034)
both democracies	0.024***	0.022***	0.082***	0.074***
	(0.009)	(0.008)	(0.015)	(0.016)
average of bilateral export shares	0.367***	0.345***	0.275***	0.243
	(0.053)	(0.059)	(0.065)	(0.163)
free trade area	0.107***	0.115***	0.060***	0.063***
	(0.011)	(0.011)	(0.012)	(0.018)
distance	-0.004	-0.001	-0.018***	
	(0.005)	(0.005)	(0.006)	
same region	0.072***	0.072***	0.043***	
	(0.010)	(0.009)	(0.011)	
Constant	0.415***	0.407***	0.508***	0.613***
	(0.047)	(0.052)	(0.093)	(0.043)
Observations	11451	11451	11451	11451
R-squared	0.13	0.23	0.31	0.39
Joint significance test	263.19***	105.90***	49.21***	48.62***
Time fixed effects	No	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No
Pair fixed effects	No	No	No	Yes
Time-varying regional fixed effects	No	No	No	Yes

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. We estimate the following 2-factor GARCH equation country-by-country

$$
\begin{aligned}
R_{it} &= \beta_{it}^{W}\mu_t^{W} + \beta_{it}^{REG}\mu_t^{REG} + e_{it} \\
e_{it} &\sim N(0, \sigma_{it}^2) \\
\sigma_{it}^2 &= a_i + b_i\sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i[\max\{0, e_{it-1}\}]^2
\end{aligned}
$$

For each year, the correlation for country-pairs is calculated over a 12-month horizon.

Table 5: Stock Market Correlations (Fama-French) and Risk-Adjusted Structure of Production

	(1)	(2)	(3)	(4)
	Conditional correlations	Conditional correlations	Conditional correlations	Conditional correlations
Risk-adjusted difference in production structure	-1.353***	-0.900***	-0.588***	-0.745***
	(0.139)	(0.111)	(0.134)	(0.140)
product of stock mkt. capitalization	0.040***	0.042***	0.028***	0.025***
	(0.002)	(0.002)	(0.004)	(0.005)
difference in per capita GDP	-0.056***	-0.048***	-0.047***	0.000
	(0.004)	(0.004)	(0.005)	(0.033)
both democracies	0.022***	0.023***	0.087***	0.085***
	(0.008)	(0.008)	(0.015)	(0.016)
average of bilateral export shares	0.358***	0.336***	0.265***	0.157
	(0.053)	(0.051)	(0.065)	(0.171)
free trade area	0.104***	0.113***	0.055***	0.059***
	(0.011)	(0.010)	(0.012)	(0.019)
distance	-0.004	-0.000	-0.018***	
	(0.005)	(0.005)	(0.006)	
same region	0.061***	0.063***	0.039***	
	(0.010)	(0.009)	(0.012)	
Constant	0.509***	0.839***	0.834***	0.675***
	(0.048)	(0.050)	(0.097)	(0.048)
Observations	11456	11456	11456	11456
R-squared	0.15	0.24	0.32	0.39
Joint significance test	249.36***	140.92***	49.85***	45.09***
Time fixed effects	No	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No
Pair fixed effects	No	No	No	Yes
Time-varying regional fixed effects	No	No	No	Yes

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%;. We estimate the following 2-factor GARCH equation country-by-country

$$R_{it} = \beta_i^W \mu_t^W + \beta_i^{US} \mu_t^{US} + \beta_i^{WHML} WHML_t + \beta_i^{US} WSMB_t + \beta_i^{USHML} USHML_t + e_{it}$$

$$e_{it} \sim N(0, \sigma_{it}^2)$$

$$\sigma_{it}^2 = a_i + b_i \sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i [\max\{0, e_{it-1}\}]^2$$

For each year, the correlation for country-pairs is calculated over a 12-month horizon. Each column includes a variable $(\sigma_i^2 + \sigma_j^2)/\sigma_i \sigma_j$ where σ_i is the standard deviation of the return residuals.

Table 6: Stock Market Correlations (International and Regional CAPM) and Risk-Adjusted Structure of Production

	(1)	(2)	(3)	(4)
	Conditional correlations	Conditional correlations	Conditional correlations	Conditional correlations
Risk-adjusted difference in production structure	-1.214***	-0.778***	-0.368**	-0.495***
	(0.176)	(0.150)	(0.184)	(0.159)
product of stock mkt. capitalization	0.041***	0.043***	0.028***	0.025***
	(0.002)	(0.002)	(0.004)	(0.005)
difference in per capita GDP	-0.054***	-0.047***	-0.048***	-0.016
	(0.004)	(0.004)	(0.005)	(0.034)
both democracies	0.021**	0.023***	0.091***	0.087***
	(0.008)	(0.008)	(0.015)	(0.016)
average of bilateral export shares	0.375***	0.357***	0.276***	0.189
	(0.052)	(0.051)	(0.064)	(0.164)
free trade area	0.102***	0.110***	0.059***	0.063***
	(0.011)	(0.010)	(0.012)	(0.018)
distance	-0.007	-0.004	-0.019***	
	(0.005)	(0.005)	(0.006)	
same region	0.056***	0.059***	0.035***	
	(0.010)	(0.009)	(0.012)	
Constant	0.555***	0.390***	0.520***	0.671***
	(0.048)	(0.055)	(0.091)	(0.044)
Observations	11451	11451	11451	11451
R-squared	0.15	0.24	0.32	0.39
Joint significance test	251.50***	137.89***	50.09***	49.94***
Time fixed effects	No	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No
Pair fixed effects	No	No	No	Yes
Time-varying regional fixed effects	No	No	No	Yes

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%;. We estimate the following 2-factor GARCH equation country-by-country

$$R_{it} = \beta_{it}^{W}\mu_t^{W} + \beta_{it}^{REG}\mu_t^{REG} + e_{it}$$

$$e_{it} \sim N(0, \sigma_{it}^2)$$

$$\sigma_{it}^2 = a_i + b_i\sigma_{it-1}^2 + c_i e_{it-1}^2 + d_i[\max\{0, e_{it-1}\}]^2$$

For each year, the correlation for country-pairs is calculated over a 12-month horizon. Each column includes a variable $(\sigma_i^2 + \sigma_j^2)/\sigma_i \sigma_j$ where σ_i is the standard deviation of the return residuals.

Table 7: Conditional Stock Market Correlations and Structure of Exports

	(1)	(2)	(3)	(4)
	Fama-French	Fama-French	International & Regional CAPM	International & Regional CAPM
difference in export structure	-0.124***	-0.335***	-0.120***	-0.394***
	(0.037)	(0.127)	(0.037)	(0.131)
product of stock mkt. capitalization	0.038***	0.027***	0.041***	0.032***
	(0.002)	(0.005)	(0.002)	(0.005)
difference in per capita GDP	-0.051***	0.023	-0.050***	0.016
	(0.005)	(0.037)	(0.005)	(0.037)
both democracies	0.038***	0.078***	0.029***	0.081***
	(0.008)	(0.019)	(0.009)	(0.019)
average of bilateral export shares	0.359***	0.312*	0.359***	0.311*
	(0.054)	(0.170)	(0.054)	(0.169)
free trade area	0.131***	0.064***	0.126***	0.066***
	(0.012)	(0.021)	(0.012)	(0.021)
distance	0.017***		0.010*	
	(0.005)		(0.005)	
same region	0.084***		0.075***	
	(0.010)		(0.010)	
Constant	0.242***	0.565***	0.616***	0.583***
	(0.060)	(0.049)	(0.058)	(0.049)
Observations	9775	9775	9657	9657
R-squared	0.22	0.40	0.22	0.40
Joint significance test	115.54***	43.64***	113.41***	42.65***
Time fixed effects	Yes	Yes	Yes	Yes
Pair fixed effects	No	Yes	No	Yes
Time-varying regional fixed effects	No	Yes	No	Yes

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%;. Columns 1-3 use Fama-French 3 factor model to extract residuals and calculate correlations. Columns 5-6 use the time-varying international plus regional CAPM model to extract residuals and calculate correlations. For each year, the correlation for country-pairs is calculated over a 12-month horizon.

Table 8: Conditional Stock Market Correlations and Structure of Production (Segmentation vs. Integration)

	(1)	(2)	(3)
	Fama-French	Fama-French	Fama-French
Risk-adjusted difference in production structure	-0.724***	-0.734***	-0.691***
	(0.103)	(0.142)	(0.183)
one integrated and one segmented market	0.021**		
	(0.009)		
one integrated & one segmented market*Risk-adjusted production structure difference	-1.684***		
	(0.291)		
both segmented markets	0.028		
	(0.026)		
both segmented markets* risk-adjusted production structure difference	-1.554**		
	(0.733)		
stock market liberalization dummy		0.050***	0.052***
		(0.012)	(0.013)
stock market liberalization dummy*risk-adjusted production structure difference			-0.088
			(0.229)
product of stock mkt. capitalization	0.042***	0.026***	0.026***
	(0.003)	(0.005)	(0.005)
difference in per capita GDP	-0.046***	-0.032	-0.034
	(0.004)	(0.034)	(0.034)
both democracies	0.023***	0.087***	0.087***
	(0.008)	(0.016)	(0.016)
average of bilateral export shares	0.330***	0.095	0.097
	(0.051)	(0.164)	(0.164)
free trade area	0.115***	0.055***	0.055***
	(0.010)	(0.018)	(0.018)
distance	-0.000		
	(0.005)		
same region	0.061***		
	(0.010)		
Constant	0.838***	0.681***	0.682***
	(0.050)	(0.043)	(0.043)
Observations	11456	11456	11456
R-squared	0.25	0.39	0.39
Joint significance test	126.89***	81.87***	79.42***
Time fixed effects	Yes	Yes	Yes
Country-pair fixed effects	No	Yes	Yes
Test: coeff [prod. structure difference] + coeff [one integrated one segmented markets*production structure difference] = 0	74.9***		
Test: coeff [prod. structure difference] + coeff [one segmented markets*production structure difference] = 0	9.84***		

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

We use Fama-French 3 factor model to extract residuals and calculate conditional correlations. The both integrated dummy =1 if both markets are integrated; The one integrated dummy =1 if exactly one of the country-pairs is integrated while the other is segmented. The both segmented dummy =1 if both markets are segmented. The stock market liberalization dummy takes the value 1 in all years after both countries had made a switch to liberalized stock markets. It takes the value 0 if either country has a segmented market or if both countries had liberalized stock markets on or before 1975. Stock market liberalization dates are from Bekaert et al (2005).