

# A Decomposition of Global Linkages in Financial Markets Over Time\*

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**Abstract:** This paper tests if real and financial linkages between countries can explain why movements in the world's largest markets often have such large effects on other financial markets, and how these cross-market linkages have changed over time. It estimates a factor model in which a country's market returns are determined by: global, sectoral, and cross-country factors (returns in large financial markets), and country-specific effects. Then it uses a new data set on bilateral linkages between the world's 5 largest economies and about 40 other markets to decompose the cross-country factor loadings into: direct trade flows, competition in third markets, bank lending, and foreign direct investment. Estimates suggest that both cross-country and sectoral factors are important determinants of stock and bond returns, and that the U.S. factor has recently gained importance, while the Japanese and U.K. factors have lost importance. From 1996-2000, real and financial linkages became more important determinants of how shocks are transmitted from large economies to other markets. In particular, bilateral trade flows are large and significant determinants of cross-country linkages in both stock and bond markets. Bilateral foreign investment is usually insignificant. Therefore, despite the recent growth in global financial flows, direct trade still appears to be the most important determinant of how movements in the world's largest markets affect financial markets around the globe.

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## **I. Introduction**

In the first half of 2002, the U.S. was buffeted by a series of negative shocks — from disappointing economic growth, to terrorist threats and uncertainty about a potential war with Iraq, to continued fallout from a series of financial scandals that raised broader concerns about corporate governance. As a result, the U.S. stock market fell by about 17 percent over the first 6 months of the year.<sup>1</sup> Many other markets around the world declined in harmony; over the same 6-month period, Finland's stock market fell by 30 percent, Ireland's by 14 percent, Mexico's by 11 percent, and Hong Kong's by 6 percent. Other stock markets, however, performed relatively well and appeared to be isolated from the series of negative news in the U.S. For example, over the same period Iceland's stock market experienced positive returns of 26 percent, South Africa's of 21 percent, South Korea's of 12 percent, and Colombia's of 11 percent. Shocks to the world's largest economies and their financial markets often spread to some markets, while markets in other countries are relatively isolated.

This paper examines if real and financial linkages between countries can explain why the world's largest financial markets often appear to have such large, yet diverse, effects on other financial markets, and how these cross-market linkages have changed over time. More specifically, the paper attempts to answer four questions. First, how important are cross-country linkages with large financial markets, as compared to global and sectoral factors, in explaining financial market returns in countries around the world? Second, how important are bilateral trade flows, trade competition in third markets, bank lending, and investment exposure in explaining these cross-country linkages? Third, how has the relative importance of these various global linkages changed over time? Finally, how does the relative importance of these global linkages differ across stock markets and bond markets?

In order to answer these questions, this paper begins by developing a factor model of market returns in different countries. It assumes that a country's market returns are a function of: global factors (global interest rates, oil prices, gold prices, and commodity prices), sectoral factors (stock returns for 14 sectoral indices), cross-country factors (returns in other large financial markets), and country-specific effects. After estimating the importance of these factors for different countries and regions, the paper then focuses on the estimated cross-country linkages between the five largest economies (France, Germany, Japan, the U.K. and U.S) and about 40 developed countries and emerging markets around the world. It decomposes these cross-country linkages into four specific bilateral linkages: two real linkages (direct trade flows and competition in third markets) and two financial linkages (bank lending and foreign direct investment). After measuring the importance of each of these factors and bilateral linkages in stock markets between 1986 and 2000, the paper then examines how their relative importance has changed over time and differs in bond markets.

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<sup>1</sup> Aggregate stock market indices reported by Datastream. See Section IV for additional data information.

The paper finds that both cross-country factors and sectoral factors are important determinants of stock and bond returns in countries around the world (although it is often difficult to differentiate between these two sets of factors). Not surprisingly, movements in the largest regional economy tend to be the most important cross-country factor for nearby countries (such as the U.S. market for the Americas), although movements in the U.S. market are also important for most regions. In the later half of the 1990's, the U.S. factor and sectoral factors gained importance in most regions, while the Japanese and U.K. factors lost importance.

Results from the second-stage regressions that decompose the cross-country factor loadings into different real and financial linkages find that between 1986-90 and 1991-95, bilateral linkages are fairly unimportant and estimation results are highly sensitive to model specification. From 1996-2000, however, bilateral linkages through trade and finance become more significant determinants of how shocks are transmitted from large economies to markets around the world. More specifically, direct trade flows appear to be the strongest and most important determinant of cross-country linkages in both stock and bond markets. Bilateral bank lending and trade competition in third markets can also be significant determinants of cross-country linkages, although the importance of these bilateral linkages fluctuates across asset markets and model specifications. Bilateral foreign investment, however, is generally not a significant determinant of cross-country linkages. These results establish a connection between high-frequency movements in financial markets and lower-frequency real variables. These results also suggest that despite the recent growth in capital flows across countries, direct trade linkages are still more important than financial linkages in determining how shocks to the world's largest economies affect markets around the globe.

One contribution of this paper is a new data set on bilateral trade and financial linkages between the world's largest economies and about 40 developed countries and emerging markets. Although information on bilateral trade flows has been widely available for years, other variables are fairly new to this literature, such as the statistics measuring bilateral investment positions and trade competition in third markets based on 4-digit SITC industry information.<sup>2</sup> Perhaps most important, this is the first study to simultaneously control for direct trade flows, trade competition in third markets, bank lending, and foreign direct investment, when attempting to explain cross-country linkages. Other papers have controlled for one or two of these linkages to examine a range of questions, but since the four bilateral linkage variables could be highly correlated, omitting a subset of these variables could severely bias coefficient estimates. Therefore, by simultaneously controlling for all four types of bilateral linkages,

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<sup>2</sup> Forbes (2002) also constructs this trade competition variable for a series of "crisis countries" between 1997 and 2000. Mody et al. (2002) is one of the few papers to use the same foreign investment database.

this paper should provide more accurate estimates of the relative importance of different types of trade and financial channels in explaining cross-country comovement in financial markets.

The remainder of the paper is as follows. Section II briefly reviews related literature. Section III develops the models and estimation framework. Section IV describes the data set and construction of several new variables. It also examines trends in various bilateral linkages for different sets of countries. Section V provides initial results for stock markets over the full sample period from 1986 to 2000, and Section VI examines how the importance of various global linkages has evolved over time. Section VII performs a similar analysis for bond markets and compares results to those for stock markets. Section VIII summarizes an extensive series of sensitivity tests. Section IX concludes by summarizing how this paper's new dataset and the corresponding results provide insights on the changing nature of integration between the world's largest economies and financial markets around the world.

## **II. Related Literature**

This paper builds on an extensive literature that can be roughly grouped into four categories: asset market comovement and financial integration, business cycle synchronization and real integration, firm-level exposure to real and financial shocks, and the international transmission of crises.<sup>3</sup> The literature on cross-country correlations in asset returns can be traced back to the international-capital asset-pricing model, which posits that in completely segmented markets, local asset returns will be based on local factors. With integrated capital markets, however, expected asset returns are determined by the asset's covariance with the world market portfolio. A large body of research has therefore attempted to identify how the integration of previously segmented markets has changed patterns of cross-country equity correlations. Increased integration with global markets, however, does not necessarily generate increased correlations between domestic and global asset returns.

One reason why integration may not generate increased correlations is differences in industrial structures. Roll (1992) argues that industry structure and concentration are important determinants of a country's stock market behavior, and that countries with more similar industrial compositions tend to have more highly correlated stock market returns. In subsequent work, there has been an active debate on the relative importance of industry effects versus country-specific effects in explaining cross-country correlations and volatility.<sup>4</sup> One recent focus of this debate is whether the increased importance of sectoral factors in the late 1990's represents a long-term trend or cyclical effects from the bubble in telecommunications, media and technology (TMT).

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<sup>3</sup> See Forbes and Chinn (2003) for a more detailed summary of the literature reviewed in this section. Also see Karolyi and Stulz (2002) and Bekaert and Harvey (2002) for detailed surveys of related work.

<sup>4</sup> See Brooks and Del Negro (2002, 2003) for recent reviews of these debates.

In addition to this literature focusing on stock market returns and financial market comovement, there is also an extensive literature examining “synchronization” and the cross-country comovement in business cycles and real variables.<sup>5</sup> Some of these papers, such as Kose et al. (2003), examine how global integration has affected cross-country correlations in output, consumption and investment. Other papers attempt to explain these correlations based on country characteristics and specific measures of integration, such as trade, asset diversification, or output-composition. *A priori*, it is unclear if greater integration would increase or decrease business cycle correlations, but most of the empirical work on this subject finds that greater integration through trade and/or finance tends to increase correlations.

Connecting this branch of literature on real integration and business cycles with the former literature on asset market comovement is a related literature on firm-level exposure to exchange rate movements and real variables.<sup>6</sup> Most of this work finds that only a small percent of firms are significantly exposed to exchange-rate movements, and that the relationship between exchange rate exposure and real linkages with other countries (such as trade) is either weak or nonexistent. Brooks and Del Negro (2003) is one of the only papers to document a significant relationship between trade exposure and firm-level stock returns over annual periods, a connection that is also documented at the country level in this paper.

While most of the literature discussed above has focused on the determinants of cross-country correlations (in either financial markets or real variables) over long periods or around financial integration, another related literature focuses on asset market comovement during financial crises. Much of this work has focused on “contagion” and the international transmission of crises.<sup>7</sup> Several of these papers attempting to measure the different channels by which a shock to one country spreads to other countries are closely related to the decomposition of bilateral linkages performed in this paper.<sup>8</sup> For example, Eichengreen and Rose (1999), Glick and Rose (1999), and Forbes (2002) focus on the role of trade in the transmission of currency crises. Van Rijckeghem and Weder (2001, 2002) examine the role of bank lending, as well as trade. Forbes (2003) is one of the only papers to measure the importance of these trade and financial channels in the transmission of crises at the firm level.

Many of these papers find that trade linkages between countries—both direct trade flows and competition in third markets—were important determinants of how crises affected other countries. Some papers have also argued, however, that bilateral financial flows may be even more important than trade flows, although it can be difficult to isolate their independent effects. One limitation of all of these

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<sup>5</sup> See Imbs (2003) for a more thorough review of this literature.

<sup>6</sup> See Dominguez and Tesar (2001) for a detailed review of this literature.

<sup>7</sup> See Claessens and Forbes (2001) for a series of papers on this subject. In particular, see Claessens et al. (2001) for a detailed review of the literature and Forbes and Rigobon (2002) for a critical assessment of tests for contagion based on correlation coefficients.

<sup>8</sup> See Forbes (2002) for a much more detailed review of the literature discussed in this paragraph.

studies (which most authors candidly admit) is that since many bilateral linkages are highly correlated and difficult to measure, studies that only include a subset of these linkages could have problems with omitted-variable bias. For example, studies that control for trade linkages between countries, but not investment, are likely to overstate the importance of trade linkages.

This paper is the first study, to the best of our knowledge, to simultaneously control for direct trade flows, competition in third markets, bank lending, and foreign direct investment when measuring asset market comovements and the international transmission of shocks. This approach should therefore reduce any omitted-variable bias in the estimated importance of each of these bilateral linkages. Even this more comprehensive analysis, however, is incomplete, since there are numerous other cross-country linkages that are not included in this study due to limited bilateral data availability. For example, Kaminsky et al. (2001) show that mutual fund investments can be important mechanisms for the cross-country transmission of crises. Karolyi (2003) shows that cross-listing through American Depositary Receipts (ADRs) can affect stock market integration. Multinational exposure across borders or trade credit could also be important transmission mechanisms. All of these variables are likely to be correlated with bilateral foreign investment or trade flows, potentially biasing the relevant coefficient estimates. Therefore, although this paper's analysis of bilateral linkages is more complete than previous work, additional bilateral linkages that are not included in this analysis could still affect estimates.

### **III. Model and Estimation Framework**

This section describes the two-stage modeling framework used to estimate the importance of different cross-country linkages over long periods, as well as how their importance has changed over time. In the first stage, we estimate a factor model of returns, controlling for global, sectoral, and cross-country factors. In the second stage, we decompose the estimated cross-country factor loadings into four types of bilateral linkages: import demand, trade competition, bank lending, and foreign investment.

Returns in two countries could commove due to a number of factors. First, returns in both countries could be affected by global shocks, such as changes in: the world interest rate, oil prices, other commodity prices, or global risk aversion. Second, returns in both countries could be affected by sectoral shocks that simultaneously affect all countries that produce in or have exposure to the given sector. As discussed in Section II, one sectoral shock that has recently received substantial attention is the "bubble" in technology, media, and telecommunications in the late 1990's. Third, returns in two countries could co-move because shocks to one country are transmitted to other countries through cross-country linkages, such as bilateral trade, export competition in third markets, bilateral bank lending, or bilateral investment flows. Although these cross-country linkages are the focus of this paper, it is

important to control for any global or sectoral shocks in order to accurately estimate the magnitude of these linkages and avoid spuriously capturing changes in other factors that affect country comovement.

In order to isolate the importance of cross-country linkages, this paper uses a factor model of returns that controls for three sets of factors: global, sectoral, and cross-country. It also allows market returns in each country to be determined by a country-specific effect. For each country  $i$ , asset returns ( $R_{it}$ ) at each time  $t$  can be expressed as:

$$R_{it} = \alpha_i + \sum_{g=1}^G \phi_i^g f_t^g + \sum_{s=1}^S \gamma_i^s f_t^s + \sum_{c=1}^C \beta_i^c f_t^c + \varepsilon_{it}, \quad (1)$$

with  $E[\varepsilon_{it}] = 0$ ,  $E[\varepsilon_{it}^2] = \sigma_i^2$ , and  $E[\varepsilon_{it}\varepsilon_{jt}] = \sigma_{ij}^2$  for each 2 countries  $i$  and  $j$  with  $i \neq j$ . The  $f_t^g$  are the  $G$  global factors; the  $f_t^s$  are the  $S$  sectoral factors; the  $f_t^c$  are the  $C$  cross-country factors, corresponding to each large country  $c$ ;  $\phi_i^g$ ,  $\gamma_i^s$ , and  $\beta_i^c$  are the country-specific factor loadings for the global, sectoral and cross-country factors, respectively;  $\alpha_i$  is a country-specific effect; and  $\varepsilon_{it}$  is a normally-distributed error term, with errors not necessarily independent across countries. Factor loadings are therefore assumed to be constant across the given period for each country, but allowed to vary across countries.

The model in equation (1) is assumed to hold for each of the smaller countries  $i$  in the world, with  $i=1,2,\dots,I$ . The  $C$  countries that are defined as the cross-country factors are large countries in which shocks are expected to have the greatest spillover effects in countries around the world. These  $C$  larger countries are then excluded from the set of countries included as  $i$ . For example, Chile and the Philippines could be two countries included as countries  $i$ , and the U.S. and Japan could be two countries included as countries  $c$  but not included as  $i$ . Estimates of  $\beta_i^c$  should therefore capture the effect of movements in the U.S. and Japanese markets on the Chilean and Philippine markets, with minimal feedback effect from  $R_{it}$  to  $f_t^c$ .<sup>9</sup> The model focuses on the effect of shocks to larger countries on smaller countries, rather than estimating simultaneous equations between all countries in the world, due to limited data availability for bilateral linkages between most smaller countries in the world.

One potential problem with equation (1), however, is that the global, sectoral, and cross-country factors can be highly correlated, making it difficult to isolate the individual impact of each set of factors. More specifically, if a large country  $c$  that is a major producer (or purchaser) in a given industrial sector

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<sup>9</sup> There are, however, unusual occasions when shocks to smaller countries affect larger countries—such as when the 1998 Russian crisis affected bond spreads in the U.S. In these cases, estimates of  $\beta_i^c$  should be interpreted as correlations between two countries  $c$  and  $i$ , instead of direct effects of country  $c$  on country  $i$ .

experiences a significant shock, the country-specific shock could not only affect other countries through cross-country linkages, but also simultaneously affect certain sectors on a global basis. For example, the U.S. produces a major share of global production and is a major consumer in the electronics industry. The impact of a shock to the U.S. economy on other countries could therefore be largely captured in the sectoral factor for electronics, reducing estimates of any direct cross-country effects of the U.S. on other economies. Similarly, if a shock to a major economy (such as the U.S.) spreads to most other countries in the world, this could appear to be a “global” shock, even though it is technically just a country-specific shock in a major economy. In order to control for this potential multicollinearity when estimating the factor loadings, we examine the correlation structure between each of the factors, as well as estimate equation (1) without the sectoral and/or global factors.

After obtaining estimates of the cross-country loadings  $\beta_i^c$  (either with or without controls for the full set of global and sectoral factors) for each pair of small countries  $i$  and large countries  $c$  (an  $I \times C$  matrix of  $\beta$ s), we decompose these cross-country loadings into different types of bilateral linkages. We focus on four different channels through which shocks to a large country  $c$  could affect a smaller country  $i$ . First, shocks to country  $c$  could affect country  $c$ 's demand for imports from country  $i$ . Second, shocks to country  $c$ , and especially shocks to country  $c$  that affect country  $c$ 's exchange rate, could affect the relative price of country  $c$ 's exports and therefore affect country  $i$  through trade competition in third markets. Third, shocks to country  $c$  could affect bank lending from country  $c$  into smaller countries  $i$ . Finally, shocks to country  $c$  could affect flows of foreign investment from country  $c$  into country  $i$ . There are obviously other channels that could link large and small countries, such as portfolio investment, trade credit, or multinational exposure. We focus on these four channels, however, not only because they have been highlighted in previous literature (as discussed in Section II), but also because these are bilateral linkages for which data is available.<sup>10</sup>

In order to estimate the importance of these four different bilateral linkages in explaining the cross-country factor loadings, we use the following model:

$$\beta_i^c = \alpha_0 + \alpha_1 \text{Import Demand}_i^c + \alpha_2 \text{Trade Competition}_i^c + \alpha_3 \text{Bank Lending}_i^c + \alpha_4 \text{Foreign Investment}_i^c + \alpha_5 \mathbf{X}_i^c + \eta_{ic} \quad (2)$$

where  $\beta_i^c$  are the cross-country factor loadings (estimated in equation (1)) that measure the effect of asset returns in country  $c$  on country  $i$  after controlling for global and/or sectoral shocks;  $\alpha_0$  is a constant

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<sup>10</sup> To the best of our knowledge, bilateral data on variables such as portfolio investment, trade credit, and multinational exposure is not available for the majority of countries in our dataset.

term; *Import Demand*<sup>c</sup><sub>i</sub> measures the importance to country *i* of imports from country *i* into country *c*; *Trade Competition*<sup>c</sup><sub>i</sub> measure the importance to country *i* of export competition in 3<sup>rd</sup> markets between country *i* and country *c*; *Bank Lending*<sup>c</sup><sub>i</sub> measures the importance to country *i* of bank loans from country *c*; *Foreign Investment*<sup>c</sup><sub>i</sub> measures the importance to country *i* of total investment from country *c*;  $\mathbf{X}_i^c$  is a matrix including any country-specific factors in countries *i* and/or *c* that could affect linkages with other countries (such as capital controls); and  $\eta_{ic}$  is a normally-distributed error term.

This model developed in equations (1) and (2) can easily be extended to measure not only the average role of different global linkages over the full period, but also how their importance has changed over time. More specifically, the model can be estimated for different time periods to see if there is a significant change in coefficient estimates across periods. Or, instead of focusing on average values for each of the variables over a given period of time, it is possible to use annual data over the same period to estimate a panel model. More specifically, assume that equation (1) is estimated using annual data, yielding annual estimates of the  $\beta_{iz}^c$ 's for each pair of countries *i* and *c* in each year *z*. Then equation (2) can be estimated as an annual panel:

$$\begin{aligned} \beta_{iz}^c = & \alpha_0 + \alpha_1 \text{Import Demand}_{iz}^c + \alpha_2 \text{Trade Competition}_{iz}^c + \alpha_3 \text{Bank Lending}_{iz}^c \\ & + \alpha_4 \text{Foreign Investment}_{iz}^c + \alpha_5 \mathbf{X}_{iz}^c + \alpha_6 \mathbf{T}_z + \eta_{icz} \end{aligned} \quad (2')$$

where  $\mathbf{T}_z$  is a vector of annual dummy variables and all other variables are defined above, except each now represents the relevant variable over the year *z* instead of averaged over the full period. Both equations (2) and (2') will be estimated for each of the model variations below.

Although, at first glance, one might expect that positive (negative) movements in large countries' asset markets would have positive (negative) effects on other countries' asset markets through each of the four bilateral linkage variables (so that  $\alpha_1, \alpha_2, \alpha_3, \alpha_4 > 0$ ), theory suggests that the signs of these coefficients are *a priori* indeterminate and can only be ascertained empirically. For example, negative news about a large economy's growth prospects could cause negative returns in the large country's asset market. This could generate a contraction in lending and investment by banks and firms based in the large country as they strengthen balance sheets and build reserves for the expected slowdown.<sup>11</sup> The resulting contraction in lending and investment in other countries would be expected to have a negative affect on asset returns in other countries, so that  $\alpha_3, \alpha_4 > 0$ . On the other hand, if the negative economic news on the large country caused banks and investors to keep their total volume of

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<sup>11</sup> Peek and Rosengreen (1997) provide evidence of this and show that after the 1990 Japanese stock market crash, Japanese banks reduced lending in the U.S. Goldfajn and Valdés (1997) develop a formal model of how a shock to one country can cause financial intermediaries to liquidate loans to other countries.

lending/investment fairly constant, but shift exposure away from the large economy to other countries, then they could increase lending/investment in other markets so that  $\alpha_3, \alpha_4 < 0$ .

The sign of the coefficient on *Trade Competition* is also difficult to predict. If negative economic news in the large country corresponded to a depreciation of its exchange rate, this could give its exports a competitive advantage, and therefore have a negative effect on expected asset returns in countries that are important trade competitors (so that  $\alpha_2 > 0$ ). If the exchange rate movement is only partially passed through into export prices or the exchange-rate movement is only expected to be short lived, however, any effect on competitors could be minimal. Moreover, if the negative news in the large economy is any factor potentially hurting firm competitiveness—such as disappointing productivity growth, legislation increasing labor market rigidities, higher corporate taxes, or higher interest rates—this could improve the relative competitiveness of other countries' exports and generate a positive shock to other countries' asset markets, so that  $\alpha_2 < 0$ .

Even the sign of the coefficient on *Import Demand* is not clear-cut. In many cases, negative asset market returns in the large country reflect negative news about earnings prospects for domestic firms and reduced expectations for economic growth. This could indicate decreased demand for imports and therefore cause negative returns in other countries that export to the large country, so that  $\alpha_1 > 0$ . Some news, however, could generate negative market movements in the large country, but not signify any changes in expectations about real variables such as growth or import demand. Other types of news could cause negative returns in the large economy, but simultaneously increase the country's demand for imports. For example, tariff reductions in the large economy might hurt earnings prospects of domestic firms (causing negative asset market returns), but increase the ability of other countries to import into the large economy (causing positive returns in other countries), so that  $\alpha_1 < 0$ . Therefore, the signs of each of the coefficient estimates for the bilateral linkage variables in equations (2) and (2') are *a priori* indeterminate, and only empirical analysis will be able to establish the importance and direction of these bilateral linkages in the international transmission of asset market movements.

A final issue with the estimates of equations (1) and (2) or (2') is that when coefficients are compared across different periods, changes in market volatility across periods will bias estimates of cross-country comovement.<sup>12</sup> To test if this is a problem, we calculate the average volatility in each market over each period. Volatility fluctuates significantly across individual years, especially in stock markets, but is fairly constant over longer periods. For example, the average variance in local currency stock market returns from 1991-1995 is 0.12, and from 1996-2000 is 0.14. The average variance in local currency bond market returns is 0.01 between 1994-97 as well in 1998-2000. Therefore, in the following

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<sup>12</sup> See Forbes and Rigobon (2002) for a more detailed discussion of this issue.

analysis when we compare coefficient estimates across periods, we focus on comparisons across longer periods of 3-5 years instead of individual years, although we continue to estimate both sets of results.

#### IV. Data

In order to estimate the role of different global and bilateral linkages, we compile data from a number of sources. The data used to estimate the factor model of returns in equation (1) was compiled from DataStream, although many of the individual data series were based on different original sources that are incorporated into DataStream. Asset returns ( $R_{it}$ ) are measured by weekly stock returns or weekly bond returns, both measured in either U.S. dollars or local currency. Stock returns are based on stock indices compiled by DataStream, which are weighted to be representative of all major markets in the given country. The bond data for developed countries is based on the total country return indices compiled by Morgan Stanley Capital International (MSCI) for 7-10 year bonds. The bond data for emerging markets is based on the EMBI Global total country return indices compiled by JPMorgan.<sup>13</sup>

The global, sectoral, and cross-country factors in the factor model of returns are also based on data series reported in DataStream.<sup>14</sup> In our base estimates, we include four global factors: global interest rates, oil prices, gold prices, and commodity prices. All factors are calculated as changes or returns for the relevant price. Global interest rates are calculated as the principal component from overnight discount rates in the U.S., U.K., and Japan.<sup>15</sup> Oil prices are the current dollar prices per barrel for Brent oil, calculated as freight-on-board. Gold prices are the prices of gold bullion in \$/oz on the London Bullion Market. Gold prices are included as a global factor in order to capture any changes in global risk aversion. Commodity prices are an index calculated by the *Economist* based on U.S. dollar prices of a large basket of commodities. The sectoral factors are weekly returns based on the Morgan Stanley Capital International (MSCI) Industrial Sector Indices. These indices are calculated based on U.S. dollar stock returns in 45 countries, with weights based on country production in the given sector. We use the 36 MSCI indices available for the relevant period to create 14 sectoral factors: automobiles, chemicals, consumer goods, electronics, energy, forest products and paper, industrial components, financial, leisure and tourism, merchandising, metals, telecommunications, textiles and apparel, and transportation.<sup>16</sup>

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<sup>13</sup> To the best of our knowledge, identical data for bond returns in emerging markets and developed countries is not available. The sample of emerging market bonds is: Argentina, Brazil, Chile, China, Colombia, Hungary, Korea, Malaysia, Mexico, Morocco, Philippines, Poland, Turkey, and Venezuela.

<sup>14</sup> Certain factors, such as oil or gold prices, could be included as either global or sectoral factors. The sensitivity analysis examines using different definitions and finds that it has no impact on the key results.

<sup>15</sup> Overnight rates for other large European countries, such as Germany or France, are not included to calculate the principal component due to the break in their series in 1999 with the adoption of the euro.

<sup>16</sup> See Appendix A of Forbes and Chinn (2003) for further details on the creation of these 14 indices. As discussed in the sensitivity analysis, we also include each of the 36 MSCI sectoral indices as independent sectoral factors.

The final set of factors, the cross-country factors, is returns for the large countries  $c$  in the asset market corresponding to the left-hand side variable. In other words, if  $R_{it}$  is U.S. dollar stock returns for country  $i$ , then  $f_t^c$  is U.S. dollar stock returns for country  $c$ . For the countries indexed by  $c$ , we include the five largest countries in the world as ranked by GDP measured in U.S. dollars at either the start or end of the sample period (1985 or 2000).<sup>17</sup> These 5 large countries  $c$  are: France, Germany, Japan, the U.K., and U.S.

For the second-stage regressions, when we estimate the cross-country factor loadings as a function of specific bilateral linkages in equations (2) or (2'), we construct a dataset from several sources. The GDP data used as a denominator for many of these statistics is taken from the World Bank's *World Development Indicators* (and reported in U.S. dollars). The trade data used to calculate *Import Demand* $_i^c$  and *Trade Competition* $_i^c$  is from the *Statistics' Canada* database, accessed through the *Worldview Trade Analyzer* service. This database reports bilateral trade flows between most countries in the world by 4-digit SITC codes.<sup>18</sup> More specifically, *Import Demand* $_i^c$  is measured as imports into country  $c$  from country  $i$  as a share of country  $i$  GDP:

$$\text{Import Demand}_i^c = \frac{\text{Imp}_i^c}{\text{GDP}_i}, \quad (3)$$

where  $\text{Imp}_i^c$  is total imports into large-country  $c$  from country  $i$ , and  $\text{GDP}_i$  is GDP for country  $i$ . All variables are measured in U.S. dollars.

The second cross-country linkage variable included in equations (2) and (2'), *Trade Competition* $_i^c$ , is a weighted product of two terms. The first term is exports from country  $c$  in a given industry as a share of world exports in that industry. This term captures how important exports from country  $c$  are to the industry, and therefore the potential impact of shocks to country  $c$  on the industry as a whole. The second term is total exports from country  $i$  in the same industry, as a share of country  $i$ 's GDP. This term captures the importance of each industry to country  $i$ . Finally, the products of these two terms are summed across all four-digit industries for each pair of countries  $i$  and  $c$ , and then weighted by the maximum calculated value (and multiplied by 100). This creates an index that can take values from 0 to 100. In other words, *Trade Competition* $_i^c$  is calculated as:

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Including such a large number of factors, however, severely limits the degrees of freedom for the analysis. Moreover, some of these more disaggregated factors are even more highly correlated with the global factors and/or individual country factors.

<sup>17</sup> We only include 5 countries due to data limitations. More specifically, the direct investment data is not available for other large economies, such as Spain or Italy (after 1994).

$$Trade\ Competition_i^c = \frac{100}{Max_{TradeCompetition}} \sum_k \left( \frac{Exp_{W,k}^c}{Exp_{W,k}^W} * \frac{Exp_{W,k}^i}{GDP_i} \right) \quad (4)$$

where  $Exp_{W,k}^c$  is exports from large-country  $c$  to every other country in the world ( $W$ ) in industry  $k$ ;  $Exp_{W,k}^W$  is exports from every country in the world to every other country in the world (i.e. total global exports) in industry  $k$ ;  $Exp_{W,k}^i$  is exports from country  $i$  to every other country in the world in industry  $k$ ;  $GDP_i$  is GDP for country  $i$ ; and  $Max_{TradeCompetition}$  is the maximum value of the product in parentheses for every country pair in the sample. All variables continue to be measured in U.S. dollars. The  $k$  industries are about 1000 4-digit SITC groups.

It is worth noting that this trade competition variable in equation (4) is a substantial improvement from that used in earlier work.<sup>19</sup> Previous studies generally attempted to measure trade competition by examining aggregate trade flows to common markets. This measure often misclassified countries as direct competitors if the two countries were highly dependent on a common market, even if the two countries did not directly compete in any specific industries. For example, if a high proportion of Saudi Arabia's oil and of Brazil's coffee goes to the same third market, Saudi Arabia and Brazil would have been classified as direct competitors. By focusing on trade in specific industries, instead of aggregate trade flows to common countries, this paper's statistics should provide more accurate measures of trade competition.

The data used to calculate the third cross-country linkage variable included in equations (2) and (2'),  $Bank\ Lending_i^c$  is based on lending data reported by the Bank of International Settlements (BIS).  $Bank\ Lending_i^c$  is measured as the total stock of bank lending from country  $c$  in country  $i$  as a share of country  $i$  GDP.<sup>20</sup> The data used to calculate the final global linkage variable,  $Foreign\ Investment_i^c$  is based on the OECD's *International Direct Investment Statistics Yearbook*.<sup>21</sup>  $Foreign\ Investment_i^c$  is measured as the total stock of foreign investment from country  $c$  in country  $i$  as a share of country  $i$  GDP. These two global linkage variables can be written as:

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<sup>18</sup> The *Worldview* online database has the advantage of reporting more up-to-date information and longer time series. See <http://www.trademeasures.com/MSIEIndex.html> for more information.

<sup>19</sup> Forbes (2002) is the only other paper (to the best of our knowledge) to calculate a trade competition variable based on 4-digit SITC information.

<sup>20</sup> More specifically, the total stock of bank lending is the consolidated international claims of BIS reporting banks within country  $c$  into country  $i$ .

<sup>21</sup> More specifically, we use the 2001 CD-ROM. The data series is the total outward direct investment position reported by each OECD country into other countries in the world.

$$\text{Bank Lending}_i^c = \frac{\text{Lending}_i^c}{\text{GDP}_i}, \quad (5)$$

$$\text{Foreign Investment}_i^c = \frac{\text{Investment}_i^c}{\text{GDP}_i}, \quad (6)$$

where  $\text{Lending}_i^c$  is total bank lending from large-country  $c$  to country  $i$ ;  $\text{Investment}_i^c$  is total foreign direct investment from large-country  $c$  to country  $i$ ; and  $\text{GDP}_i$  is GDP for country  $i$ . All variables are measured in U.S. dollars.<sup>22</sup> It is worth noting that *Foreign Investment* does not include “portfolio investment” and smaller investment flows across countries.<sup>23</sup>

Combining the information for these four bilateral linkage variables defined in equations (3) through (6) with the weekly stock and bond return information yields a data set with information for 38 countries  $i$  and 5 large countries  $c$  from 1985 through 2000. Information is not available for the full period for many countries—often because stock or bond markets did not exist at the start of the period. Appendix A reports the full sample of countries, by region, as well as the years for which data is available for the factor model regressions for different asset markets. The correlation matrix for each of the 23 factors shows that, as expected, there is a high correlation between several of the sectoral indices and the Japanese and U.S. cross-country factors.<sup>24</sup> As a result, it may be difficult to isolate the direct impact of shocks to the U.S. and Japan on other countries from the impact of shocks to the U.S. and Japan working through these sectors. On a more positive note, the correlations between the 4 global factors and the cross-country factors are extremely low, suggesting that multicollinearity between the global and cross-country factors should not affect estimates of the cross-country factor loadings.

As discussed in Sections I and II, many of the bilateral linkage variables used in the second-stage regressions and defined in equations (3) through (6) have not been widely used (and never used simultaneously) in previous work. Therefore, Tables 1 through 3 provide additional information on these four variables. Table 1 reports means and standard deviations for the full period of time, as well as for several different sub-periods. Most of the trade and foreign investment linkages increased over the three periods from 1986 through 2000. Bank lending, however, fell substantially between 1986-90 and

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<sup>22</sup> Direct investment data is reported in local currency values, which are then converted to U.S. dollar values using end-of-period U.S. dollar exchange rates, as also reported in the *International Direct Investment Statistics Yearbook* CD-ROM.

<sup>23</sup> More specifically, direct investment is the “lasting interest of a resident entity in one economy (direct investor) in an entity resident in another economy (direct investment enterprise).” Direct investment is generally defined as when a direct investor, who is resident in another economy, owns 10 percent or more of the ordinary shares, voting power, or equivalent, of a direct investment enterprise. Bank lending is generally classified as portfolio investment and not as direct investment. Also, the foreign investment data is based on statistics reported by each national government. Therefore, although the OECD attempts to ensure the same definitions and standards across countries, different reporting standards persist.

<sup>24</sup> The full correlation matrix is available as Appendix B in Forbes and Chinn (2003).

1991-95. This undoubtedly reflects the decreased bank lending to emerging markets after the 1980's debt crisis. Despite this decline, average bank lending from the 5 larger countries to smaller countries (as a share of smaller country GDP) is still greater than direct investment between the same sets of countries, although this gap has been closing over time. Table 2 reports correlations between the 4 bilateral linkage variables for the full period. The two trade variables (*Import Demand* and *Trade Competition*) are the most highly correlated—with an average correlation of 66% over the full period from 1986-2000. *Foreign Investment* also tends to be highly correlated with the trade variables. *Bank Lending* tends to be the least correlated with the other variables.

To better understand how these bilateral linkages fluctuate across different countries and periods, Table 3 reports a selection of values for the U.S. and Japan (two of the larger countries indexed by *c*) and a selection of 10 smaller countries indexed by *i* in 1985 and 2000. Most of the patterns are not surprising. For example, all four of the bilateral linkage variables are substantially lower for economies traditionally considered to be less integrated with the global economy, such as China and India. *Import Demand* for the U.S. and Mexico and Canada is very large and increased substantially between 1985 and 2000. *Import Demand* for many smaller Asian countries is fairly large for both Japan and the U.S. For some of these economies, such as Malaysia and Thailand, reliance on imports into the U.S. increased substantially between 1985 and 2000, so that the U.S. is currently a more important export market than nearby Japan. Countries that produce more high-tech goods, such as Korea and Malaysia, tend to have higher values of *Trade Competition* with the U.S. and Japan. *Bank Lending* from both Japan and the U.S. has decreased between 1985 and 2000, as has *Foreign Investment* from Japan. In sharp contrast, many countries' reliance on *Foreign Investment* from the U.S. has increased over time.

## V. Estimation Results: Average Stock Market Linkages from 1986-2000

### A. Factor Model of Stock Returns

To estimate the relative importance of different global linkages, we begin by using the data set described in Section IV to estimate equation (1) over the entire sample period for stock markets (1986-2000) with the full set of 4 global factors, 14 sectoral factors, and 5 cross-country factors.<sup>25</sup> Figure 1 shows results from F-tests of the joint significance of the global, sectoral, and cross-country factors when the model is estimated using local currency stock returns. Results for U.S. dollar stock returns are similar. Colored bars indicate that the relevant group of factors are jointly significant for each country *i*. Table 4 reports the corresponding R<sup>2</sup>'s for the full regressions, and the coefficient estimates and standard errors for each of the 5 cross-country factor loadings (the  $\beta_i^c$ 's).

<sup>25</sup> We focus on the period 1986-2000 instead of 1985-2000 since some of the explanatory variables in the second-stage regressions are lagged by 1 period and are only available starting in 1985.

The results in Figure 1 and Table 4 show a number of patterns. First, the global, sectoral and cross-country factors are each often jointly significant, although the global factors are less often significant than the other two sets of factors. For example, out of the 37 regressions, the global factors are jointly significant at the 10 percent level in 16 cases, and the sectoral and cross-country factors are each significant in 30 cases. Second, the relative importance of the three different sets of factors fluctuates across regions. For example, the global factors are more often significant in the Americas, but rarely in Asia. Third, estimates of the individual cross-country factor loadings also tend to vary by region, with the major economy (or economies) in each region usually the most important for nearby markets. For example, the U.S. factor is most often positive and significant in the Americas, and the French, German and U.K. factors are most often positive and significant in Europe. Fourth, many of the cross-country factors follow intuitive patterns based on cultural similarities or colonial origin. For example, the U.K. factor is large and significant in Australia, Hong Kong, Singapore, and South Africa, and the U.S. factor is large and significant in Israel.

Fifth, the magnitude of the estimates suggests that the impact of stock market movements in large economies on small economies can be large. For example, the 0.87 coefficient on the U.S. factor for Argentina suggests that a 10% return in the U.S. stock market is correlated with an 8.7% return in the Argentine market. A final pattern is the relative unimportance of the U.S. and Japanese factors for many countries. More specifically, the U.S. factor is never positive and significant (even at the 10% level) in the Asian markets, and only occasionally significant outside of the Americas. The Japanese factor is also rarely significant, even in Asia. These counterintuitive results support the concerns raised in Sections III and IV about multicollinearity. The high correlation between the Japanese/U.S. factors and the sectoral factors could cause imprecise estimates of the cross-country factor loadings. In other words, the sectoral factors may be capturing much of the direct cross-country effect of shocks to the Japanese and U.S. markets on other countries.

In order to test for this effect, we reestimate equation (1) but exclude the sectoral factors (while continuing to include the global factors). Resulting estimates of the cross-country factor loadings (continuing to focus on local currency returns) are reported in Table 5. Although many of the estimates and patterns are similar to those in Table 4, the estimated factor loadings for Japan and the U.S. change as predicted. More specifically, the estimated Japanese and U.S. factor loadings are now not only consistently positive, but often highly significant. For example, the Japanese factor loading is now significant (at the 10% level) for 9 of the 11 Asian countries (versus only 1 country in Table 4). This change is even more striking for the estimates based on U.S. dollars (not reported), in which the U.S. factor is now significant for 7 of the 11 Asian countries. In fact, the cross-country factor loadings for all

five large countries are now jointly significant (at the 10% level) for all of the countries in the sample except China and Colombia.

This comparison between Tables 4 and 5 suggest that there are advantages and disadvantages to including the sectoral factors when estimating cross-country linkages in equation (1). On one hand, theory suggests that in order to obtain unbiased estimates of cross-country factor loadings, it is necessary to control for both global and sectoral shocks. On the other hand, the high correlation between the sectoral factors and cross-country factors could cause much of the direct impact of shocks to large countries on other countries to be captured in estimates of the sectoral loadings. Therefore, in the remainder of this paper, we estimate the factor model both with and without the sectoral factors. We have also estimated each of the specifications with and without the global factors, but since this has no significant impact on the key results, we leave these results for the sensitivity tests.

As an extension to Tables 4 and 5 we re-estimate the factor model (both with and without the sectoral factors), but instead of estimating a cross-section for the full period, we estimate the model separately for each year between 1986-2000 for each country  $i$ . The estimated global, sectoral, and cross-country factor loadings fluctuate across individual years, although they follow the general patterns discussed above. These extensive estimates are not reported due to space constraints, but are used at the end of Section B to estimate the panel variation of the cross-country linkage model in equation (2').

## **B. Decomposition of Cross-country Linkages**

Before decomposing the estimated cross-country factor loadings into specific bilateral linkages, we examine the time-series characteristics of the variables to test for nonstationarity. There is a strong likelihood that some of the variables may drift upwards over time as global integration has increased. The short time series and wide panel nature of the dataset described in Section IV, however, complicate the standard unit root tests. Therefore, we use two different approaches to examine the time-series characteristics of the data: conduct unit root tests series-by-series using the univariate test of Elliott et al. (1996), and use the panel unit root test of Breitung and Meyer (1994), which can easily be applied to panels with a large cross-section and short time dimension.

These tests and their outcomes are discussed in detail in Appendix B. The results suggest that all of the variables are stationary except *Foreign Investment*. The evidence of nonstationarity in *Foreign Investment* is not surprising given the increase in foreign direct investment documented in Table 1. Consequently, the subsequent analysis uses the first difference (instead of the level) of foreign direct

investment in order to estimate equations (2) and (2').<sup>26</sup> This series of results also suggests that inference based on OLS estimates is accurate and it is not necessary to use panel-cointegration methods.<sup>27</sup>

Next, we use the estimated cross-country factor loadings to estimate equation (2) and decompose these cross-country linkages into specific bilateral linkages. Panels A and B in Table 6 report coefficient estimates when the dependent variables are the factor loadings from equation (1) based on local currency and U.S. dollar stock returns, respectively.<sup>28</sup> The left side of each table shows results when the factor model is estimated with the sectoral factors (as in Table 4), while the right side of the table excludes the sectoral factors (as in Table 5). As discussed in Section II, however, there is an extensive literature examining how integration with the global economy and capital controls can affect stock market returns and cross-market comovement. Therefore, we also estimate each specification including the Chinn and Ito (2002) measure of capital account openness in each country  $i$ .<sup>29</sup> This statistic is calculated as a standardized principal component of four IMF dummy variables measuring different types of external account restrictions, with an adjustment for the length of time that the capital controls were in place.<sup>30</sup> A higher value indicates greater capital account openness.

Although the results at the top of Table 6 vary across specifications, the most consistent finding is that the coefficient on *Import Demand* is positive and highly significant (at the 5% level) in 6 of the 8 models. This suggests that on average between 1986 and 2000, direct trade may have been the most important bilateral linkage determining how shocks to the world's largest economies affected other stock markets. The estimated coefficients on *Trade Competition* are negative, with fluctuating significance, and on *Bank Lending* are positive, although usually insignificant. The coefficients on *Foreign Investment* fluctuate in sign and are never significant at the 5% level. The explanatory power of these regressions is fairly low, with only 3-7% of the variance explained in the models including the sectoral factors, and a slightly better 10-14% of the variance explained in the models excluding the sectoral factors.<sup>31</sup>

As an extension to these results, instead of using variables averaged over the entire 15-year period from 1986-2000, we use the estimated annual cross-country factor loadings (discussed at the end

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<sup>26</sup> The sensitivity analysis also examines the impact of using levels instead of first differences for *Foreign Investment*. The key results do not change.

<sup>27</sup> All estimates are also adjusted for heteroscedasticity and serial correlation.

<sup>28</sup> All variables are averages based on annual values for each year available from 1986 to 2000. Stock variables are measured at the start of each year (or end of the previous year).

<sup>29</sup> We assume that financial markets in each of the large countries  $c$  have limited capital account restrictions and are fairly well integrated with global financial markets.

<sup>30</sup> The creation of this statistic is described in more detail in Appendix D of Forbes and Chinn (2003). The sensitivity analysis also reports results using other measures of capital controls. These other measures, however, are only available for a much more limited selection of countries.

<sup>31</sup> Many models attempting to explain stock market movements have a low degree of explanatory power since financial market prices are affected by a wide variety of hard-to-measure influences.

of Section IV.A) to estimate the panel regression in equation (2'). We also include period dummy variables for each year (excluding the year 2000). Estimates are reported in Panels C and D of Table 6. Despite the substantial increase in the number of observations, the regressions have an even lower explanatory power than those based on the period-averaged data. Estimates are even more inconsistent across specifications, with not only fluctuating significance, but also fluctuating signs.

## **VI. Estimation Results: Changes in Global Linkages in Stock Markets Over Time**

One problem with the results reported in Section V, and which could explain the low explanatory power of the models, is that the specification imposes the constraint that each of the coefficients and their underlying relationships are constant between 1986 and 2000. Global linkages and the determinants of stock market returns, however, may have changed over this sample period. As discussed in Section II, trends in the TMT sector could have changed the importance of sectoral factors relative to other factors in the late 1990's. Or, as also discussed in Section II, many emerging markets have only recently become integrated with global financial markets, causing significant changes in their relationships with other countries. Therefore, this section examines if the average results for the full sample period reported above mask important changes over time.

### **A. Factor Model of Stock Returns**

To test if the importance of the global, sectoral, and cross-country factors has changed between 1986 and 2000, we divide the full sample period into 3 sub-periods of equal length: 1986-1990, 1991-1995, and 1996-2000. Then we estimate equation (1), for each five-year period. Figure 2 summarizes the key results by reporting the percent of countries within each region and for the full sample for which the relevant factor(s) are significant (at the 5% level). More specifically, the left of the figure reports the percent of countries for which the full set of global, sectoral, or cross-country factors are jointly significant, and the right side of the figure reports the percent of countries for which the 5 cross-country betas are individually significant.<sup>32</sup>

Figure 2 shows a number of results. First, the cross-country factors continue to be highly significant. Moreover, their importance appears to have fallen from 1986-1990 to 1991-95, and then increased substantially from 1991-1995 to 1996-2000.<sup>33</sup> This pattern is especially strong in the Americas. Second, the sectoral factors appear to be more important in the later period from 1996-2000 than in early periods, especially in Asia. This could partially reflect the technology, media and

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<sup>32</sup> Results when the model is estimated without sectoral factors, or using U.S. dollar stock returns (instead of local currency returns), are similar.

<sup>33</sup> This agrees with Brooks and Del Negro (2002, 2003), which find that the importance of global effects (which include our cross-country effects) falls from the late 1980's to early 1990's, and then increases in the late 1990's.

telecommunications bubble discussed in Section II. Third, the relative importance of the individual cross-country factors has changed across time. For example, the U.S. factor is significant more than twice as often in the latest period from 1996-2000 than in the earliest period from 1986-1990. In sharp contrast, the cases in which the Japanese factor is significant fell by more than half in the same period, with a particularly dramatic decline for Europe and the Americas. The importance of the U.K. factor also fell between 1986-1990 and 1996-2000 in most regions. These changes in the relative importance of the largest economies, and especially the U.S. versus Japan, undoubtedly reflect the stronger growth in the U.S. economy over the later half of the 1990's and its increased importance as an export market for countries around the world.

### **B. Decomposition of Cross-Country Linkages**

Next, we use the estimated cross-country factor loadings from Section A to estimate the importance of the four real and financial linkage variables during the different five-year periods between 1986 and 2000. Table 7 reports results for local currency and U.S. dollar estimates based on period-averaged variables.<sup>34</sup> The coefficient estimates indicate that there were substantial changes in the importance of the bilateral linkage variables in the different sub-periods. In the earlier two periods (from 1986-90 and 1991-95), most of the coefficient estimates are insignificant, and of the few that are significant, none are robust across alternate specifications. Not only does the coefficient significance vary across specifications, but even the estimated signs show a remarkable lack of stability. Not surprisingly, the proportion of the variance explained by the models in both of these periods is very low.

Estimates during the later period from 1996-2000, however, reflect very different patterns. There is a dramatic increase in the model's explanatory power, with the proportion of the variance explained by the model increasing to 14-21%. There is also a substantial increase in the consistency of most estimates across the different specifications. The most noteworthy change is that the coefficient on *Import Demand* is always positive and significant (at the 5% level). The coefficients on *Bank Lending* are also positive and significant, and the coefficients on *Trade Competition* are negative and significant, although both of these results are less robust in the annual-panel estimates. Moreover, the sensitivity analysis in Section VIII shows that these estimates are also not as robust to alternate samples, definitions, and specifications as those for *Import Demand*. The estimates for *Foreign Investment* are the only ones that continue to be generally insignificant with fluctuating signs.

These results indicate that in the later half of the 1990's bilateral linkages became more important determinants of how shocks to large financial markets are transmitted to smaller countries

around the world. In particular, direct trade appears to be the most consistently significant bilateral linkage. One surprising result is that foreign investment, despite its rapid growth in recent years, does not appear to be a significant determinant of bilateral linkages in financial markets. This could partially be caused by noise in the bilateral data on foreign investment (as discussed in Section IV).

The coefficient estimates also suggest that not only are bilateral linkages other than foreign direct investment significant determinants of stock market comovements, but that the magnitude of this impact can be large. For example, consider Chile, which is in the process of finalizing a free-trade agreement with the U.S. From 1996-2000, *Import Demand* for Chile with the U.S. was 4.0%, and the estimated U.S. cross-country factor loading was 0.26.<sup>35</sup> Then assume that Chile's *Import Demand* variable increased to 25.1%, which is the value for Mexico with the U.S. from 1996-2000. Holding everything else constant, the U.S. factor loading for Chile would be predicted to increase to 0.62.<sup>36</sup> A 10% return in the U.S. stock market, which previously would have been correlated with a 2.6% return in the Chilean market, would now be correlated with a 6.2% return in the Chilean market. These calculations are obviously only a rough approximation, but they do suggest that changes in bilateral linkages, and especially bilateral trade flows, can have large effects on how asset market movements are transmitted internationally.

## VII. Estimation Results: Global Linkages in Bond Markets

Next, we repeat the analysis performed in Sections V and VI, except focus on global linkages in bond markets instead of stock markets. As shown in Appendix A, data availability for bond markets is much more limited. Therefore, in this section we focus on estimates from 1994-2000 (the full period available).<sup>37</sup> The global factors and sectoral factors are the same as used above, but the dependent variable ( $R_{it}$ ) and each of the five cross-country factors are measured as returns for the relevant bond index (instead of stock index) as discussed in Section IV. Summary results for estimates of the factor model of returns in equation (1), based on U.S. dollars, are reported in Figure 3.<sup>38</sup> Results are similar when the sectoral factors are excluded from the model.

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<sup>34</sup> Panel estimates based on annual data, as well as estimates without controls for capital account restrictions, are not reported due to space constraints. Both sets of results are available in Tables 6 and 7 of Forbes and Chinn (2003). The central results are identical to those discussed above.

<sup>35</sup> Based on local currency stock market returns when equation (1) controls for global and cross-country factors, but not sectoral factors.

<sup>36</sup> This uses the estimated coefficient of 1.699 in Panel A of Table 7. As shown in the sensitivity analysis, this is close to the average coefficient estimate for this variable, using a wide variety of model specifications.

<sup>37</sup> Forbes and Chinn (2003) also report results for bond markets during sub-periods from 1994-97 and 1998-2000.

<sup>38</sup> In this section, we focus on results based on U.S. dollar returns, instead of local currency, since information for local currency bond prices is unavailable for many emerging markets. This also provides a contrast to the focus on local currency estimates in Sections V and VI.

The patterns in Figure 3 are similar to those for the factor model of stock returns in Figure 2, especially for the most comparable time period from 1996-2000. Sectoral factors and cross-country factors continue to be highly significant and more important than global factors in determining market returns. There is also some evidence that the cross-country factors may be even more important than the sectoral factors for the whole sample. Of the individual cross-country factors, the U.S. factor is most often significant, for most of the individual regions as well as the entire sample. The largest economy (or economies) in each region also continues to be important to neighboring economies, although in most specifications the U.S. factor is more often significant in Asia than the Japanese factor. One difference between the results for bond returns and the corresponding estimates for stock returns is that excluding the sectoral factors does not have as large an impact on the estimated cross-country factor loadings, especially for the U.S. and Japan. This difference undoubtedly reflects that fact that the sectoral factors are stock indices, and therefore more highly correlated with stock returns than bond returns in the major economies.

Next, we decompose these estimated cross-country factor loadings into the four different bilateral linkages as specified in equations (2) and (2'). Table 8 reports results for U.S. dollar and local currency bond returns, based on period averages and annual data as well as with and without controls for capital account restrictions. Many coefficient estimates continue to fluctuate across specifications and are often insignificant. The coefficient on *Foreign Investment* is never significant. The one fairly robust finding, however, is the importance of *Import Demand* in explaining cross-country linkages in bond markets. The estimated coefficient on *Import Demand* is positive in all 16 of the specifications, and is significant (at the 10% level) in 14 of these specifications. Estimates are particularly large and significant for the regressions based on the period-averaged data and/or the larger sample of U.S. dollar bond returns. This supports one of the key results from the decomposition of bilateral linkages in stock markets: that one of the primary mechanisms by which movements in large financial markets are transmitted to other markets is through direct trade flows.

### **VIII. Sensitivity Analysis**

This section summarizes an extensive series of sensitivity tests examining if the key conclusions reported above are robust to variable definitions, model specification, control variables, and sample selection. It focuses on results from bilateral linkage regressions in equation (2), since these results are the key focus of the paper. (The results from the first-stage regressions are also highly robust.) Since most of the bilateral-linkage estimates for the full sample period and earlier periods for stock markets continue to fluctuate across specifications, we also focus on the robustness of the key results during the later period for stock markets (1996-2000) and full period for bond markets (1994-2000). Table 9

reports a selection of these results (discussed in detail below) for our preferred specification –stock markets using period-averaged values based on the model without sectoral factors.<sup>39</sup>

As an initial series of sensitivity tests, we examine the impact of modifying variable definitions. First, we use two different measures of capital controls: a statistic developed in Edison and Warnock (2002), which is based on restrictions on the foreign ownership of equities, and a statistic developed in Kaminsky and Schmukler (2002), which focuses on capital account regulations.<sup>40</sup> Results are reported in columns (2) and (3) of Table 9. In each case, the sample size shrinks substantially. Second, we use moving-average two-week returns, instead of weekly returns, to partially adjust for differences in market hours in different countries. Results are virtually unchanged. Third, we redefine the sectoral factors in equation (1) using different sets of sectors, such as the larger set of 36 MSCI sectoral indices. We also include some of the global factors, such as gold and oil, as sectoral factors. Some of these changes affect the relative importance of sets of factors for different countries, and the global factors become even less consistently significant, but the key results discussed above are unchanged.

As a next series of sensitivity tests, we estimate a variety of different model specifications. First, we exclude the global factors from equation (1). Column 4 in Table 9 reports the resulting estimates for the second-stage regressions. Second, we focus on a smaller set of cross-country factors and only include one major market from each region. More specifically, we continue to include the U.S., Japan, and France as cross-country factors, but exclude the U.K. and Germany.<sup>41</sup> Results are reported in column 5. Third, we include *Foreign Investment* in levels (instead of differences), as reported in column 6. We also estimate specifications with the other bilateral linkage variables in differences.

Next, we add a number of additional control variables. First, we include squared and/or cubed terms for each of the bilateral linkage variables as a rough test for any non-linearities. These additional terms are generally insignificant, and most of the other coefficient estimates become even more fragile (which is not surprising given the increased multicollinearity in the regressors). Column 7 reports results when the model includes squared terms for each of the 4 bilateral linkage variables. Second, we add a number of variables typically included in gravity-equation models (which tend to be highly correlated

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<sup>39</sup> Results for the same set of sensitivity tests for bond markets are equally robust and are reported in Table 10 in Forbes and Chin (2003). Complete results for any of these sensitivity tests are available from the authors. We prefer estimates based on a model without sectoral factors, due to the multicollinearity between the sectoral and cross-country factors (as discussed in Sections III and V). We prefer estimates based on period averages, instead of the annual cross-sections, due to changes in market volatility across shorter periods that could bias estimates (as discussed in Section III).

<sup>40</sup> This measure evaluates regulations on offshore borrowing by domestic financial institutions, offshore borrowing by non-financial corporations, multiple exchange rate markets, and controls on capital outflows.

<sup>41</sup> We include France instead of Germany for the European cross-country factor since German reunification during the sample period could affect estimates.

with bilateral trade).<sup>42</sup> Many of these variables are individually significant, and including them often reduces the magnitude of the estimated coefficient on *Import Demand*. As shown in column 8, however, which reports results when 5 gravity variables are added to the model, the coefficient on *Import Demand* still remains positive and highly significant. Finally, Column 9 adds regional dummy variables.

As a final series of sensitivity tests, we examine the impact of sample selection and outliers. First, we exclude countries that had a banking and/or currency crisis. Banking crises are defined based on the Caprio and Klingebiel (2001) classification of countries with “systemic banking crises”. Currency crises are defined as countries experiencing a 25% or greater depreciation of their U.S. dollar exchange rate within any 4-week period. Column 10 of Table 9 reports results when countries with either type of crisis are excluded from the sample.<sup>43</sup> The *Bank Lending* variable is usually insignificant when countries with a banking crisis are excluded from the sample. Second, we exclude oil exporters from the sample, with oil exporters defined as having a ratio of oil and gas exports to GDP of over 5% in the given year.<sup>44</sup> Third, we only include high-income countries or low/middle income countries, with income groups based on the definition in World Bank (2001). Finally, we use a number of different measures to exclude outliers. For example, we define outliers as having a value for any of the four bilateral linkage variables greater or less than the mean plus/minus three or five standard deviations.

This series of sensitivity tests (including those not reported in Table 9) confirms the central results discussed in Sections V through VII. In the bilateral linkage regressions for stock markets in the earlier periods from 1985-90 or 1991-95, the signs and significance of coefficient estimates fluctuate across specifications. For stock markets in the later period from 1996-2000, and bond markets from 1994-2000, however, the coefficient on *Import Demand* is consistently positive and highly significant. The coefficient on *Bank Lending* is positive and significant in about half of the specifications, and is more often significant for stock markets than bond markets. The coefficient on *Trade Competition* is negative and significant in about half the specifications, and is more often significant in bond markets than in stock markets. The coefficient on *Foreign Investment* is rarely significant. Therefore, in the later half of the 1990’s, direct trade between countries appears to be the most important determinant of how movements in large financial markets affected stock and bond markets around the globe.

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<sup>42</sup> More specifically, we add combinations of the following 5 variables: whether the 2 countries share a common border; whether the 2 countries have a common language; whether 1 of the countries was ever colonized by the other country; the natural log of distance between the 2 countries; and the natural log of the product of the two countries real GDPs. The geography data is taken from Rose (2002) and is available on Rose’s website at: <http://faculty/haas.berkeley.edu/arose/>. The GDP data is taken from the World Bank’s *World Development Indicators*. See Rose (2002) for further information on gravity-equation models.

<sup>43</sup> A country is excluded if it had either type of crisis in any 1 year in the given period.

<sup>44</sup> More specifically, oil and gas exports are defined as SITC codes 33 (petroleum, petroleum products, and related materials) and 34 (gas-natural and manufactured).

## **IX. Conclusions**

In an effort to better understand why shocks to the world's largest financial markets often spread to some markets, while other countries remain relatively isolated, this paper attempts to answer four questions.

First, how important are cross-country linkages with large financial markets, as compared to global and sectoral factors, in explaining financial market returns in countries around the world? To answer this question, we estimated a factor model in which a country's market returns are a function of: global factors (global interest rates, oil prices, gold prices, and commodity prices), sectoral factors (stock returns for 14 sectoral indices), cross-country factors (market returns in France, Germany, Japan, the U.K. and U.S.), and country-specific effects. We find that both cross-country and sectoral factors are important determinants of stock returns in countries around the world (although it is often difficult to differentiate between these two sets of factors). Not surprisingly, movements in the largest regional economy tend to be the most important cross-country factor for nearby countries, although movements in the U.S. market are also important for most regions. During 1996-2000, the U.S. factor and sectoral factors gained importance in most regions, while the Japanese and U.K. factors lost importance.

Second, how important are bilateral trade flows, trade competition in third markets, bank lending, and investment exposure in explaining these cross-country linkages? To answer this question, we decomposed the cross-country linkages estimated in the factor models into these four specific real and financial linkages. Estimates for the full period from 1986-2000 had a low degree of explanatory power and most coefficient estimates were not robust, even after controlling for capital account openness and using several different model specifications. One of the relatively stronger results was that direct trade (measured by a country's reliance on imports into the largest economies) appears to be one of the most important determinants of cross-country linkages between large economies and markets around the world.

Third, how has the relative importance of these various global linkages changed over time? In order to answer this question, we repeated the above series of estimates for different time periods. In the earlier periods, from 1986-90 and from 1991-95, bilateral linkages continue to have a low degree of explanatory power and estimates are highly sensitive to model specification. From 1996-2000, however, bilateral linkages through trade and finance become substantially more important determinants of how shocks are transmitted from large economies to markets around the world. More specifically, direct trade flows appear to be the strongest and most important determinant of cross-country linkages. Rough estimates suggest that the magnitude of these effects can be large. Bilateral bank lending and trade competition in third markets can also be significant, although these results fluctuate across

specifications. Bilateral foreign investment, however, does not appear to be a significant determinant of cross-country linkages in any period.

Fourth and finally, how does the relative importance of these global linkages vary across stock markets and bond markets? In order to answer this question, we repeat the same series of estimates discussed above, except focus on linkages in bond markets instead of stock markets. We find that most of the key results are unchanged. For example sectoral and cross-country factors continue to be highly significant and more important than global factors in determining market returns. There is some evidence that the cross-country factors may be even more important than the sectoral factors in bond markets. Of the individual cross-country factors, the U.S. factor is most often significant for the sample as a whole, as well as for most of the individual regions. When the cross-country linkages are decomposed into real and financial linkages, foreign direct investment continues to be insignificant. Bank lending is sometimes significant, but this result is even less robust than in the stock market regressions. Trade competition in third markets is more often significant than in stock markets, but its importance still fluctuates across model specifications. Bilateral trade flows, however, continue to be consistently positive and significant, and appear to be the most important determinant of cross-country linkages in bond markets as well as stock markets.

Although this paper has addressed a range of questions, this analysis is only a start. Many of these questions could be extended in a number of different directions. For example, does the importance of different types of global linkages vary between crisis periods and the longer time periods investigated in this paper? Does the importance of different global linkages vary based on the type of shocks affecting large economies? Do these results on the relationships between large and small economies also apply to pairs of smaller economies (such as Argentina and Brazil)? And last, but certainly not least, what is the importance of other types of bilateral linkages (such as portfolio investment, trade credit, and multinational exposure) that are not included in this paper's analysis?

Despite these remaining questions, the paper has documented a number of factors determining why movements in large financial markets can have substantial effects on countries around the world. The decomposition of bilateral linkages in both stock and bond markets reach the same conclusion: that the primary mechanism by which shocks to the largest financial markets were transmitted internationally in the later part of the 1990's was through direct trade flows. These results suggest that despite the recent growth in capital flows across countries, direct trade linkages are still more important than financial linkages in determining how shocks to the world's largest economies affect a variety of markets around the globe. Finally, these results document that real linkages between countries, even when measured at an annual frequency, can be large and important determinants of higher frequency movements in financial markets.

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## Appendix A: Sample Coverage<sup>1</sup>

Region	Country <i>i</i>	Stock Market Regressions <sup>2</sup>	Bond Market Regressions (U.S. Dollars)	Bond Market Regressions (Local Currency)
<i>Americas</i>	Argentina	1989-2000	1994-2000	---
	Brazil	1995-2000	1994-2000	---
	Canada	1985-2000	1994-2000	1994-2000
	Chile	1990-2000	1999-2000	---
	Colombia	1993-2000	1997-2000	---
	Mexico	1989-2000	1994-2000	---
	Venezuela	1991-2000	1994-2000	---
<i>Asia</i>	Australia	1985-2000	1994-2000	1994-2000
	China	1994-2000	1994-2000	---
	Hong Kong	1985-2000	--	--
	India	1991-2000	--	--
	Indonesia	1991-2000	--	--
	Korea (South)	1988-2000	1994-2000	---
	Malaysia	1987-2000	1996-2000	---
	New Zealand	1989-2000	1994-2000	1994-2000
	Philippines	1988-2000	1994-2000	---
	Singapore	1985-2000	--	--
Thailand	1988-2000	1997-2000	---	
<i>Europe</i>	Austria	1985-2000	1994-2000	1994-2000
	Belgium	1985-2000	1994-2000	1994-2000
	Denmark	1985-2000	1994-2000	1994-2000
	Finland	1989-2000	1994-2000	1994-2000
	Greece	1989-2000	1997-2000	1997-2000
	Hungary	1992-2000	1999-2000	---
	Iceland	1994-2000	--	--
	Ireland	1985-2000	1994-2000	1994-2000
	Italy	1985-2000	1994-2000	1994-2000
	Netherlands	1985-2000	1994-2000	1994-2000
	Norway	1985-2000	1994-2000	1994-2000
	Poland	1995-2000	1994-2000	---
	Portugal	1991-2000	1994-2000	1994-2000
	Spain	1988-2000	1994-2000	1994-2000
	Sweden	1985-2000	1994-2000	1994-2000
Switzerland	1985-2000	1994-2000	1994-2000	
<i>Middle East &amp; Africa</i>	Israel	1994-2000	--	--
	Morocco	--	1994-2000	---
	South Africa	1985-2000	1995-2000	1995-2000
	Turkey	1989-2000	1996-2000	---

*Notes:* (1) France, Germany, Japan, U.K. and U.S. are included as “large countries” indexed by *c* and therefore excluded from the list of smaller countries indexed by *i*.

(2) Includes stock returns expressed in both local currency and U.S. dollars.

## Appendix B: Unit Root Testing

There are two standard approaches to determine if variables are stationary: conduct unit root tests series-by-series, or employ recently developed panel unit-root tests. Each of these approaches encounters difficulties when applied to our dataset. The series-by-series approach is hampered by the extremely short time span of the data (16 observations at most). The panel approach is complicated by the fact that the panels are much wider than long (i.e., the number of observations,  $N$ , is much larger than the number of periods,  $T$ ). Hence, we examine results from both sets of tests.<sup>45</sup>

### The Series-by-Series Analysis

First, we use a modified Dickey-Fuller test known as the ADF-GLS test to test for stationarity.<sup>46</sup> While the standard Dickey-Fuller procedure is notorious for its low power, the ADF-GLS test has been shown to be approximately uniformly most powerful invariant.<sup>47</sup> We use a variant of the tests that allows for a linear time trend. The unit root hypothesis is rejected when the ADF-GLS test statistic is significant.

Using this test, we find that the cross-country factor loadings reject the unit root null with the greatest frequency. For instance, 50% of the factor loadings (i.e., the  $\beta$ s) estimated using sectoral indices and US dollar stock returns reject the null hypothesis (using a 10% significance threshold). In other words, the unit root null is rejected at rates much higher than would be expected to occur randomly. Turning to the bilateral linkage variables, 34% and 30% of the *Import Demand* and *Trade Competition* series reject the unit root null. The *Bank Lending* and *Foreign Investment* series exhibit lower rejection rates of 26% and 27%, respectively. These tests suggest that all of the variables are stationary, although the results for the financial variables are weakest.

### The Panel Unit Root Test

We use a likelihood ratio test advanced by Breitung and Meyer (1994), mainly because this is the most appropriate test for panel data sets where the time dimension ( $T$ ) is much smaller than the cross-sectional dimension ( $N$ ). The results are reported in table A1 and include tests for estimates both with and without the sectoral effects and for different combinations of financial markets and currencies. Overall, there is strong evidence of reversion for almost all of the cross-country factor loadings. Only one of these cases is unable to reject nonstationarity, but the number of observations for this test is substantially smaller, reducing the test's power.

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<sup>45</sup> See Appendix C of Forbes and Chinn (2003) for equations and additional details on these testing methodologies.

<sup>46</sup> See Elliott et al. (1996) for a more detailed description of this testing procedure.

<sup>47</sup> For example, see Pantula et al. (1994) and Stock (1994).

For the bilateral linkage variables, test results clearly indicate that the *Trade Competition* and *Bank Lending* series are stationary. Although the evidence for the *Import Demand* series is somewhat weaker (and the test statistic is insignificant), the reversion coefficient is still negative. Moreover, results from the series-by-series tests rejected the unit root null for this series, so we treat *Import Demand* as stationary in the base regressions. In stark contrast, the positive and statistically significant coefficient on the *Foreign Investment* series indicates that this series is nonstationary. *Foreign Investment* also had one of the lowest rejection rates of stationarity in the series-by-series tests. We also examine the first difference of *Foreign Investment*, and this test strongly rejects the presence of a unit root. Therefore, in the main regression analysis, we treat all of the variables as stationary except *Foreign Investment*.

**Appendix Table A1: Panel Unit Root Tests**

Variable	$\alpha_0$	N	Adj.-R2
<b><i>Betas - With Sectoral Factors</i></b>			
Stock returns in US\$	-0.059** (0.013)	2057	0.28
Stock returns in local currency	-0.014* (0.008)	2057	0.13
Bond returns in US\$	-0.317** (0.040)	675	0.30
Bond returns in local currency	-0.010 (0.028)	405	0.21
<b><i>Betas - Without Sectoral Factors</i></b>			
Stock returns in US\$	-0.213** (0.018)	2060	0.36
Stock returns in local currency	-0.233** (0.018)	2060	0.30
Bond returns in US\$	-0.395** (0.044)	680	0.39
Bond returns in local currency	-0.407** (0.063)	405	0.23
<b><i>Bilateral Linkage Variables</i></b>			
Import Demand	-0.007 (0.005)	10,644	0.01
Trade Competition	-0.021** (0.005)	10,644	0.03
Bank Lending	-0.041** (0.005)	5657	0.07
Foreign Investment	0.047** (0.007)	4361	0.05
Differenced Foreign Investment	-0.185** (0.016)	3804	0.32

*Notes:* Reversion coefficient from panel regressions using all available data. Standard errors in parentheses. \*\* and \* denote significance at the 5% and 10% levels, respectively.

**Table 1**  
**Means and Standard Deviations for Bilateral Linkage Variables<sup>1</sup>**

	<b>Full Period</b>	<b>Sub-periods</b>		
	<b>1986-2000</b>	<b>1986-1990</b>	<b>1991-1995</b>	<b>1996-2000</b>
Import demand	2.88 (4.35)	2.78 (4.18)	2.69 (4.00)	3.17 (4.82)
Trade competition	13.15 (13.12)	12.38 (13.52)	12.85 (12.91)	14.19 (12.89)
Bank lending	5.12 (15.98)	7.03 (22.99)	4.76 (15.79)	3.91 (6.49)
Foreign investment	2.36 (3.78)	1.96 (3.04)	2.18 (3.33)	2.93 (4.68)

*Note:* (1) Means are listed with corresponding standard deviations in parentheses.

**Table 2**  
**Correlations Between Bilateral Linkage Variables: 1986-2000**

	<b>Import demand</b>	<b>Trade competition</b>	<b>Bank lending</b>	<b>Foreign investment</b>
Import demand	1.00			
Trade competition	0.66	1.00		
Bank lending	0.22	0.51	1.00	
Foreign investment	0.62	0.59	0.41	1.00

**Table 3**  
**Selection of Bilateral Linkage Variables with Japan or the U.S.**

Country <i>i</i>	1985				2000			
	Import Demand <sup>1</sup>	Trade Comp. <sup>2</sup>	Bank Lending <sup>3</sup>	Foreign Invest. <sup>4</sup>	Import Demand <sup>1</sup>	Trade Comp. <sup>2</sup>	Bank Lending <sup>3</sup>	Foreign Invest. <sup>4</sup>
<b><i>Bilateral Linkages with Japan</i></b>								
Australia	3.8	1.8	4.8	2.1	3.0	3.9	2.4	2.0
Brazil	0.7	4.5	4.8	2.1	0.5	3.1	0.5	0.7
Canada	1.3	21.9	.	0.5	1.0	23.7	1.8	0.9
China	1.9	1.4	1.0	0.1	4.1	8.9	1.0	0.8
India	0.5	0.8	0.4	0.0	0.6	1.7	0.5	0.3
Indonesia	11.1	1.4	5.9	9.5	10.5	8.0	6.7	3.1
Korea	5.0	18.1	10.4	1.8	4.6	17.3	2.2	0.9
Malaysia	12.0	6.3	15.4	3.5	14.7	36.4	6.2	4.5
Mexico	1.0	3.8	7.0	0.7	0.2	17.0	0.4	0.4
Thailand	2.6	5.7	7.8	2.0	8.3	20.2	8.0	3.9
<b><i>Bilateral Linkages with U.S.</i></b>								
Australia	1.3	14.3	3.0	5.1	1.5	13.5	1.7	9.1
Brazil	3.5	8.2	9.6	4.0	2.5	6.4	2.4	6.0
Canada	21.2	21.0	.	13.4	37.2	30.4	2.0	18.4
China	0.8	3.3	0.2	0.1	5.5	14.7	0.1	0.9
India	0.9	2.1	0.4	0.2	2.5	5.7	0.5	0.3
Indonesia	5.5	3.5	3.0	5.1	6.1	16.9	2.1	7.6
Korea	12.4	11.0	8.8	0.8	8.8	20.0	1.3	2.0
Malaysia	7.0	11.1	3.3	3.6	24.4	59.5	1.2	6.7
Mexico	9.0	5.0	12.8	2.8	26.4	21.0	2.6	6.1
Thailand	3.9	16.8	4.3	2.8	12.9	36.6	0.8	5.8

**Notes:** See Section IV for additional information on variable definitions. All variables expressed as percents.

- 1) *Import Demand* is the ratio of imports from country *i* to country *c* as a share of country *i* GDP. See equation (3).
- 2) *Trade Competition* is an index from 1 to 100 capturing the importance of trade competition between country *i* and *c* relative to country *i*'s GDP, based on 4-digit SITC information. See equation (4).
- 3) *Bank Lending* is the total stock of bank lending from country *c* in country *i* as a share of country *i* GDP. See equation (5).
- 4) *Foreign Investment* is the total stock of foreign investment from country *c* in country *i* as a share of country *i* GDP. See equation (6).

**Table 4**  
**Estimated Cross-Country Factor Loadings:**  
**Local Currency Stock Returns Using Full Set of Factors**

Country <i>i</i>	R <sup>2</sup>	France	Germany	Japan	U.K	U.S.
<b>Americas</b>						
Argentina	0.12	0.31	0.01	0.39*	-0.05	0.87**
Brazil	0.38	0.35**	0.15	0.29**	0.11	1.02**
Canada	0.66	0.06**	0.01	-0.01	0.10**	0.43**
Chile	0.14	0.11	0.00	0.00	0.13	0.22*
Colombia	0.05	0.08	0.01	0.01	-0.02	0.05
Mexico	0.20	0.04	0.24	0.08	0.13	0.48**
Venezuela	0.07	0.05	-0.05	0.08	0.03	0.00
<b>Asia</b>						
Australia	0.37	-0.04	0.16**	-0.03	0.34**	-0.02
China	0.20	-0.40**	0.27	-0.24	0.06	-0.38
Hong Kong	0.23	0.09	0.26**	-0.07	0.28**	-0.28**
India	0.08	0.09	0.29**	-0.07	-0.06	-0.19
Indonesia	0.13	0.00	0.32*	0.00	-0.04	-0.38
Korea	0.15	0.07	-0.02	0.17	-0.09	-0.40**
Malaysia	0.21	-0.12*	0.25**	0.00	0.30**	-0.03
New Zealand	0.21	-0.05	0.07	-0.03	0.23**	0.10
Philippines	0.16	0.07	0.29**	-0.04	0.10	0.07
Singapore	0.33	-0.05	0.08	0.12**	0.37**	-0.20
Thailand	0.20	0.05	0.30**	0.02	0.17	-0.30
<b>Europe</b>						
Austria	0.30	0.12**	0.42**	0.03	-0.04	-0.21**
Belgium	0.41	0.20**	0.24**	-0.01	0.16**	0.04
Denmark	0.26	0.03	0.28**	-0.01	0.11**	0.14*
Finland	0.49	0.16*	0.25**	0.05	0.31**	-0.11
Greece	0.14	0.21*	0.28*	0.08	0.00	-0.08
Hungary	0.27	0.22*	0.18	-0.07	0.19	0.07
Iceland	0.14	-0.01	0.09	0.12**	-0.02	0.21**
Ireland	0.42	0.04	0.11**	0.09*	0.62**	0.19**
Italy	0.33	0.27**	0.23**	-0.07	0.17**	-0.08
Netherlands	0.69	0.12**	0.31**	0.08**	0.31**	0.23**
Norway	0.35	0.00	0.31**	0.03	0.38**	0.05
Poland	0.16	0.06	0.51**	0.26	0.11	-0.04
Portugal	0.36	0.23**	0.22**	-0.12**	-0.01	-0.12
Spain	0.50	0.25**	0.25**	0.08*	0.23**	0.02
Sweden	0.44	0.18**	0.34**	0.08	0.22**	-0.07
Switzerland	0.61	0.14**	0.35**	-0.02	0.24**	0.02
<b>Middle East &amp; Africa</b>						
Israel	0.20	0.31**	-0.02	-0.06	-0.05	0.36**
South Africa	0.36	0.15**	0.20**	-0.07	0.24**	0.03
Turkey	0.10	-0.20	0.25	-0.01	0.30	-0.27

*Notes:* Estimates of cross-country betas from equation (1) with control variables for full set of global, sectoral and cross-country factors. R<sup>2</sup>'s are for the full model. \*\* and \* is significant at the 5% and 10% level, respectively. Standard errors are not reported due to space constraints but are available in Table 4 of Forbes and Chinn (2003).

**Table 5**  
**Estimated Cross-Country Factor Loadings:**  
**Local Currency Stock Returns with No Sectoral Factors**

Country <i>i</i>	R <sup>2</sup>	France	Germany	Japan	U.K.	U.S.
<i>Americas</i>						
Argentina	0.08	0.30	-0.06	0.11	0.01	0.54**
Brazil	0.30	0.21	0.20	0.27**	0.10	0.41**
Canada	0.61	0.07**	0.01	0.02	0.12**	0.59**
Chile	0.11	0.09	0.03	0.01	0.16*	0.20**
Colombia	0.03	0.05	0.05	-0.01	-0.02	0.09
Mexico	0.18	0.03	0.25	0.15**	0.18	0.44**
Venezuela	0.05	-0.01	0.08	0.12	0.14	0.12
<i>Asia</i>						
Australia	0.31	-0.04	0.15**	0.11**	0.41**	0.10**
China	0.07	-0.41**	0.38*	0.18*	0.31	0.22
Hong Kong	0.21	0.09	0.31**	0.10**	0.40**	0.08
India	0.03	0.14	0.25**	-0.02	-0.07	-0.12
Indonesia	0.08	0.02	0.47**	0.20**	0.07	-0.13
Korea	0.10	0.10	0.08	0.29**	0.06	0.21**
Malaysia	0.18	-0.11	0.29**	0.19**	0.39**	0.10
New Zealand	0.17	-0.05	0.11*	0.14**	0.27**	0.15**
Philippines	0.13	0.04	0.33**	0.08	0.16	0.11
Singapore	0.28	-0.05	0.15**	0.23**	0.48**	0.13*
Thailand	0.16	0.04	0.42**	0.21**	0.31**	0.04
<i>Europe</i>						
Austria	0.26	0.12**	0.43**	0.13**	0.02	-0.06
Belgium	0.38	0.20**	0.24**	0.04*	0.16**	-0.01
Denmark	0.21	0.04	0.26**	0.07**	0.11**	0.04
Finland	0.35	0.22**	0.35**	0.01	0.31**	0.37**
Greece	0.11	0.22**	0.32**	0.22**	-0.00	0.04
Hungary	0.21	0.20*	0.36**	-0.01	0.29**	0.21*
Iceland	0.04	-0.03	0.10*	0.05	-0.08	0.05
Ireland	0.40	0.04	0.13**	0.12**	0.61**	0.05
Italy	0.28	0.29**	0.31**	0.04	0.19**	0.02
Netherlands	0.65	0.11**	0.29**	0.04**	0.30**	0.13**
Norway	0.29	0.01	0.31**	0.07	0.40**	0.08
Poland	0.14	0.05	0.60**	0.18	0.09	0.21
Portugal	0.32	0.26**	0.24**	0.01	0.04	0.06
Spain	0.48	0.24**	0.29**	0.11**	0.25**	0.10*
Sweden	0.39	0.19**	0.38**	0.08*	0.24**	0.16**
Switzerland	0.58	0.13**	0.37**	0.07**	0.26**	0.03
<i>Middle East &amp; Africa</i>						
Israel	0.18	0.33**	-0.03	0.01	-0.00	0.42**
South Africa	0.31	0.15**	0.24**	0.05	0.28**	0.09
Turkey	0.04	-0.19	0.45**	0.14	0.32	0.04

*Notes:* Estimates of cross-country betas from equation (1) with control variables for global and cross-country factors, but not sectoral factors. R<sup>2</sup>s are for the full model. \*\* and \* is significant at the 5% and 10% level, respectively. Standard errors are not reported due to space constraints but are available in Table 5 of Forbes and Chinn (2003).

**Table 6: Bilateral Linkage Regressions for Stock Returns: Full Period (1986-2000)**

Factor Model Includes Sectoral Factors							Factor Model Excludes Sectoral Factors						
N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lending	Foreign Invest.	Capital Controls	N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lending	Foreign Invest.	Capital Controls
<i>Panel A: Local Currency Returns, Period Averages</i>													
181	0.03	0.390 (0.561)	-0.221 (0.160)	0.137 (0.105)	8.905* (4.986)		181	0.10	1.282** (0.395)	-0.189 (0.123)	0.090 (0.071)	0.030 (4.332)	
161	0.04	0.729 (0.561)	-0.251 (0.188)	0.174 (0.128)	6.548 (5.122)	-0.003 (0.013)	161	0.14	1.555** (0.367)	-0.271** (0.133)	0.121 (0.082)	-2.467 (4.527)	0.007 (0.009)
<i>Panel B: U.S. Dollar Returns, Period Averages</i>													
181	0.05	1.370** (0.528)	-0.439** (0.170)	0.245* (0.148)	3.993 (4.510)		181	0.12	1.705** (0.418)	-0.235* (0.138)	0.059 (0.075)	0.566 (3.549)	
161	0.07	1.715** (0.492)	-0.439** (0.209)	0.282 (0.207)	-0.064 (4.074)	-0.001 (0.017)	161	0.14	1.878** (0.446)	-0.234 (0.166)	0.084 (0.099)	-2.620 (3.720)	-0.001 (0.010)
<i>Panel C: Local Currency Returns, Annual Data</i>													
1259	0.01	-0.005 (0.725)	-0.629** (0.218)	0.208** (0.086)	2.452 (1.689)		1260	0.02	0.408 (0.352)	0.083 (0.109)	-0.047 (0.039)	0.644 (1.000)	
943	0.03	-0.021 (1.146)	-0.575 (0.385)	0.273** (0.102)	5.989* (3.532)	-0.033* (0.019)	942	0.02	0.374 (0.561)	0.010 (0.176)	-0.015 (0.045)	1.342 (1.807)	0.005 (0.010)
<i>Panel D: U.S. Dollar Returns, Annual Data</i>													
1257	0.03	-0.036 (1.039)	-0.826** (0.327)	0.105 (0.143)	4.960 (5.387)		1260	0.03	0.951** (0.384)	0.030 (0.117)	-0.100** (0.045)	-1.537 (1.171)	
941	0.03	0.507 (1.716)	-0.786 (0.557)	0.213 (0.180)	10.119 (12.962)	-0.037 (0.043)	942	0.03	0.790 (0.631)	0.051 (0.209)	-0.089 (0.054)	-3.338 (2.738)	0.002 (0.013)

**Notes:** Panels A and B report estimates of equation (2). Panels C and D report estimates of equation (2') and include annual dummy variables. Standard errors in parentheses. \*\* and \* is significant at the 5% & 10% level, respectively.

**Table 7: Bilateral Linkage Regressions for Stock Returns: Different Sub-periods**

Years	Factor Model Includes Sectoral Factors							Factor Model Excludes Sectoral Factors						
	N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lend.	Foreign Invest.	Capital Controls	N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lend.	Foreign Invest.	Capital Controls
<i>Panel A: Local Currency Returns, Period Averages</i>														
<b>1986 to 1990</b>	60	0.01	0.117 (0.829)	-0.316 (0.432)	0.283 (0.249)	-11.640 (19.224)	-0.001 (0.031)	60	0.05	-0.294 (0.603)	-0.043 (0.286)	0.169 (0.144)	-9.193 (13.880)	0.034 (0.022)
<b>1991 to 1995</b>	104	0.04	-1.156 (1.333)	-0.043 (0.322)	0.075 (0.157)	-4.561 (11.020)	0.001 (0.022)	104	0.01	0.160 (0.862)	0.065 (0.198)	-0.092 (0.100)	-1.601 (8.345)	0.008 (0.016)
<b>1996 to 2000</b>	149	0.14	1.498** (0.677)	-0.968** (0.234)	0.799** (0.335)	7.294** (3.045)	0.007 (0.015)	149	0.18	1.699** (0.226)	-0.383** (0.121)	0.358** (0.203)	-0.597 (1.331)	0.002 (0.010)
<i>Panel B: U.S. Dollar Returns, Period Averages</i>														
<b>1986 to 1990</b>	60	0.06	-2.074* (1.193)	0.754 (0.564)	-0.075 (0.390)	2.342 (36.788)	-0.102** (0.047)	60	0.02	-0.163 (0.524)	0.195 (0.257)	-0.016 (0.121)	-4.251 (10.330)	0.019 (0.023)
<b>1991 to 1995</b>	104	0.03	-2.909 (2.070)	0.413 (0.672)	0.120 (0.216)	8.314 (17.143)	-0.036 (0.066)	104	0.01	0.070 (1.143)	0.071 (0.283)	-0.197 (0.152)	-8.282 (12.566)	0.011 (0.026)
<b>1996 to 2000</b>	149	0.18	1.932** (0.677)	-1.065** (0.232)	1.418** (0.372)	0.088 (2.656)	0.022 (0.017)	149	0.21	2.036** (0.311)	-0.458** (0.154)	0.585** (0.269)	-2.700* (1.634)	-0.003 (0.011)

*Notes:* Estimates of equation (2). Standard errors in parentheses. \*\* and \* is significant at the 5% & 10% level, respectively.

**Table 8: Bilateral Linkage Regressions for Bond Returns: Full Period (1994-2000)**

Factor Model Includes Sectoral Factors							Factor Model Excludes Sectoral Factors						
N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lending	Foreign Invest.	Capital Controls	N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lending	Foreign Invest.	Capital Controls
<i>Panel A: U.S. Dollar Returns Period Averages</i>													
157	0.09	2.398** (0.476)	-0.540* (0.300)	1.440* (0.826)	6.104 (4.590)		157	0.13	2.839** (0.436)	-0.522* (0.274)	1.291 (0.833)	5.376 (4.556)	
142	0.11	2.646** (0.516)	-0.959** (0.392)	1.468* (0.809)	6.800 (5.214)	0.054* (0.031)	142	0.16	3.082** (0.471)	-0.905** (0.331)	1.364 (0.828)	6.428 (5.255)	0.046* (0.027)
<i>Panel B: Local Currency Returns, Period Averages</i>													
85	0.13	2.847** (0.506)	-0.457 (0.340)	0.678 (0.814)	-1.382 (2.968)		85	0.16	2.902** (0.513)	-0.466* (0.277)	0.795 (0.809)	-1.242 (2.990)	
85	0.15	2.811** (0.509)	-0.595** (0.282)	0.669 (0.802)	-1.563 (3.121)	0.055 (0.064)	85	0.18	2.868** (0.515)	-0.595** (0.255)	0.786 (0.797)	-1.410 (3.115)	0.052 (0.065)
<i>Panel C: U.S. Dollar Returns, Annual Data</i>													
550	0.01	4.688** (1.466)	-1.901** (0.866)	-1.985 (4.863)	3.615 (4.334)		554	0.01	4.787** (1.498)	-1.493 (0.923)	-0.854 (4.608)	2.337 (4.073)	
350	0.02	5.068** (2.155)	-4.104** (1.962)	5.550 (5.636)	12.222 (16.331)	0.057 (0.078)	354	0.02	5.647** (2.379)	-3.193 (2.109)	5.545 (6.254)	4.974 (18.427)	0.040 (0.086)
<i>Panel D: Local Currency Returns, Annual Data</i>													
191	0.01	1.627* (0.949)	-0.034 (0.725)	0.987 (2.072)	1.726 (1.486)		191	0.02	1.965** (0.803)	-0.155 (0.373)	0.445 (1.671)	1.551 (1.565)	
113	0.03	0.596 (11.563)	4.760 (3.395)	11.937 (11.482)	5.308 (17.585)	-0.026 (0.101)	113	0.06	1.219 (5.837)	2.058 (1.503)	6.772 (4.854)	7.375 (9.839)	0.045 (0.069)

**Notes:** Panels A and B report estimates of equation (2). Panels C and D report estimates of equation (2') and include annual dummy variables. Standard errors in parentheses. \*\* and \* is significant at the 5% & 10% level, respectively.

**Table 9**  
**Sensitivity Analysis: Bilateral Linkage Regressions – Local Currency Stock Returns**

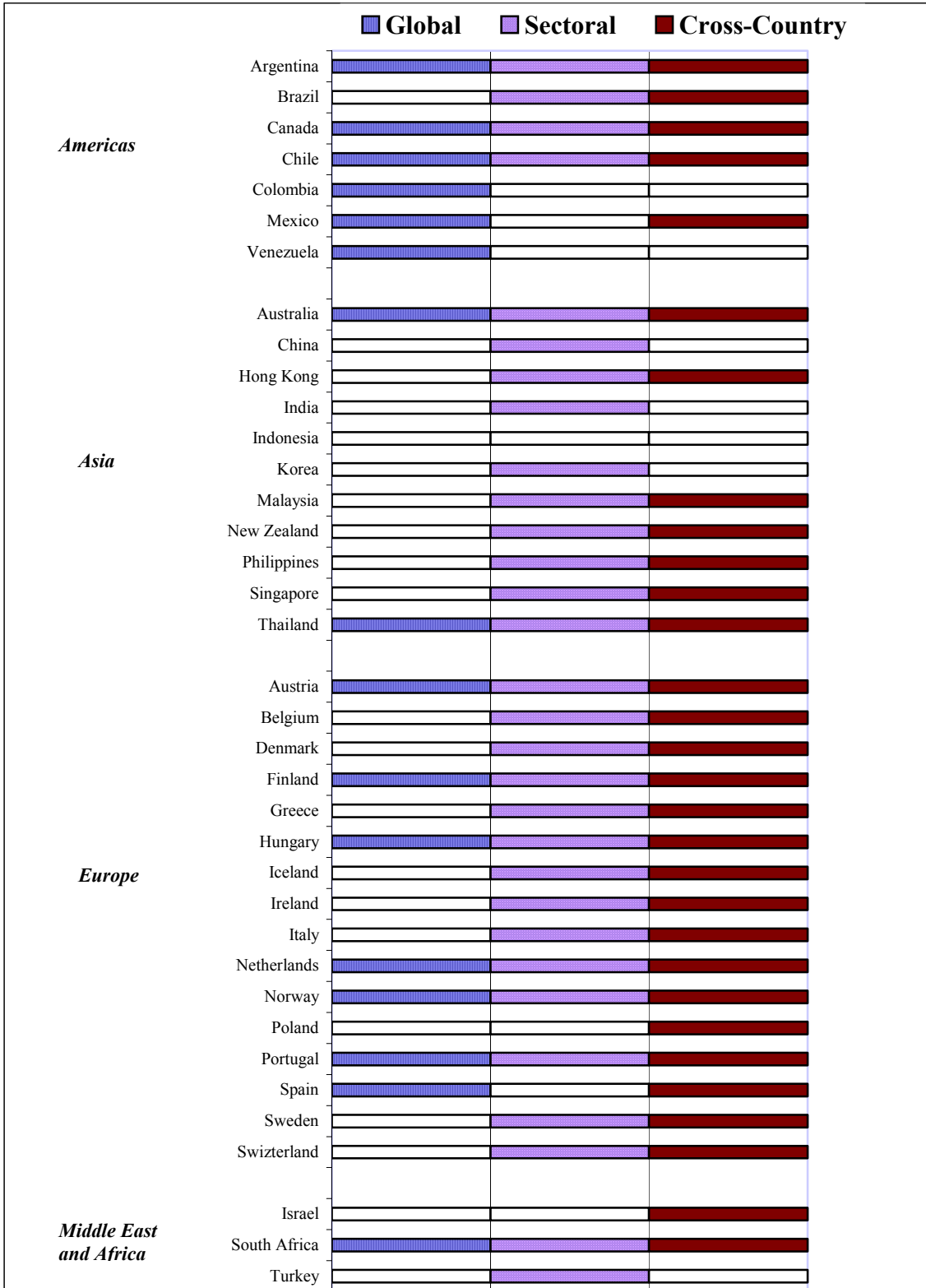
	<b>Base Case</b>	<b>E-W Capital Controls<sup>1</sup></b>	<b>K-S Capital Controls<sup>2</sup></b>	<b>No global factors<sup>3</sup></b>	<b>Exclude Germ. &amp; UK<sup>4</sup></b>	<b>Foreign Inv. in levels<sup>5</sup></b>	<b>Include squared terms<sup>6</sup></b>	<b>Add gravity vars.<sup>7</sup></b>	<b>Add regional dummies<sup>8</sup></b>	<b>Exclude crises<sup>9</sup></b>	<b>High Income<sup>10</sup></b>	<b>Low &amp; Middle Income<sup>10</sup></b>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Import Demand	1.699** (0.226)	1.206** (0.488)	1.353** (0.308)	1.649** (0.223)	1.619** (0.267)	1.665** (0.260)	1.499** (0.720)	1.192** (0.234)	1.753** (0.221)	1.910** (0.239)	1.936** (0.234)	1.128** (0.512)
Trade Comp.	-0.383** (0.121)	-0.197 (0.200)	-0.393 (0.225)	-0.380** (0.121)	-0.612** (0.186)	-0.337** (0.128)	-0.025 (0.300)	-0.309** (0.131)	-0.380** (0.114)	-0.423** (0.131)	-0.425** (0.133)	-0.298 (0.284)
Bank Lending	0.358* (0.203)	1.407** (0.523)	0.683 (0.448)	0.424** (0.198)	0.244 (0.217)	0.394** (0.190)	1.184** (0.566)	0.272 (0.185)	0.368** (0.185)	0.342 (0.219)	0.304 (0.209)	1.961** (0.923)
Foreign Invest.	-0.597 (1.331)	7.307* (4.320)	2.612 (3.380)	-0.912 (1.276)	2.201 (2.519)	-0.095 (0.336)	-0.036 (2.023)	-1.942 (1.430)	-1.246 (1.408)	-0.993 (1.393)	-1.430 (1.412)	10.819 (7.359)
Capital Controls	0.002 (0.010)	-0.093 (0.092)	-0.026 (0.036)	0.000 (0.009)	0.013 (0.016)	0.000 (0.010)	-0.005 (0.010)	-0.009 (0.010)	-0.004 (0.012)	0.010 (0.011)	0.004 (0.032)	0.004 (0.020)
<i>N</i>	<b>149</b>	<b>86</b>	<b>91</b>	<b>149</b>	<b>84</b>	<b>151</b>	<b>149</b>	<b>149</b>	<b>149</b>	<b>110</b>	<b>84</b>	<b>65</b>
<i>R</i> <sup>2</sup>	<b>0.18</b>	<b>0.17</b>	<b>0.16</b>	<b>0.19</b>	<b>0.17</b>	<b>0.17</b>	<b>0.21</b>	<b>0.26</b>	<b>0.20</b>	<b>0.22</b>	<b>0.27</b>	<b>0.13</b>

**Notes:** Based on estimates of equation (1) with global factors and cross-country factors, but no sectoral factors. Standard errors in parentheses.

\*\* and \* is significant at the 5% & 10% level, respectively.

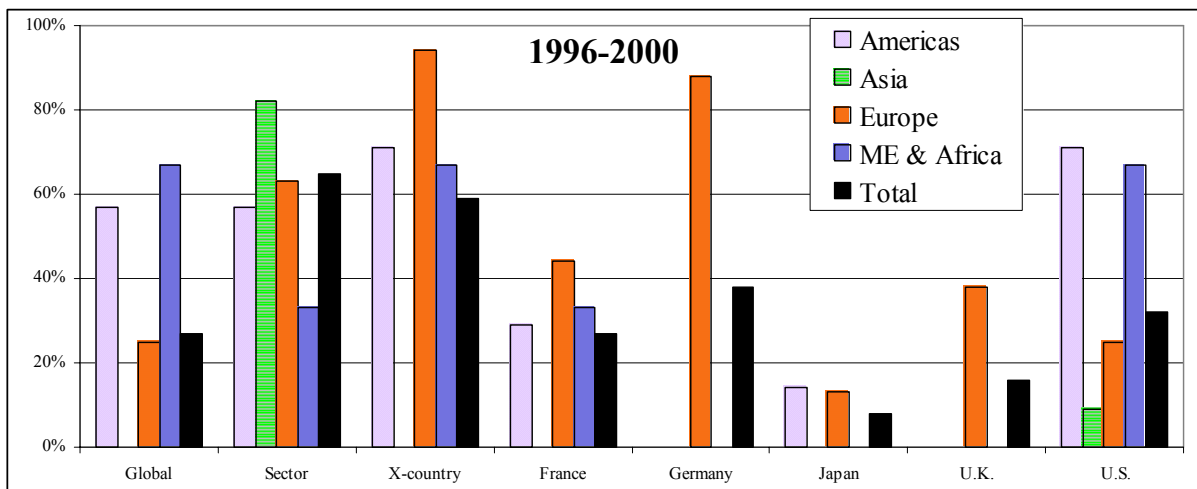
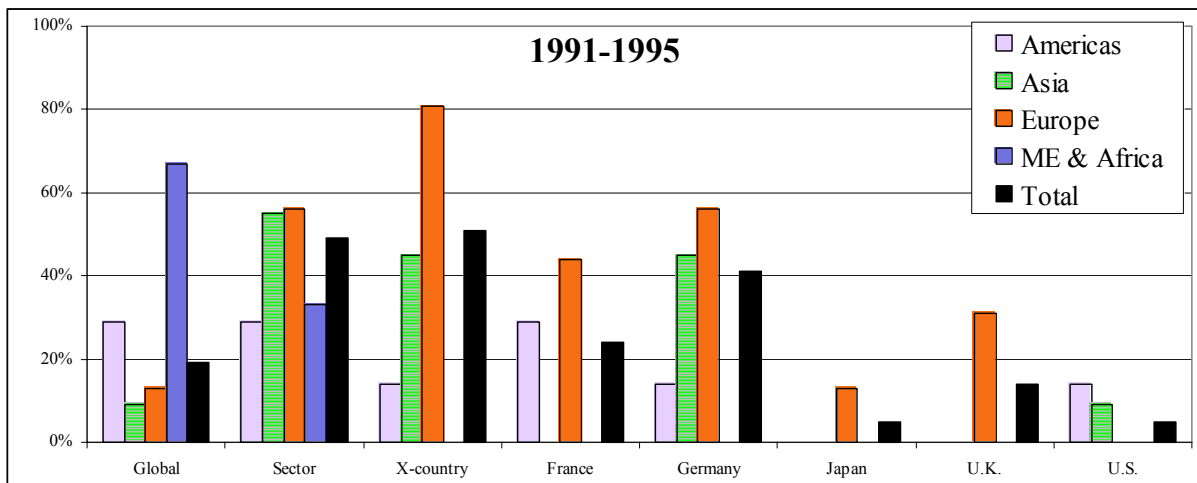
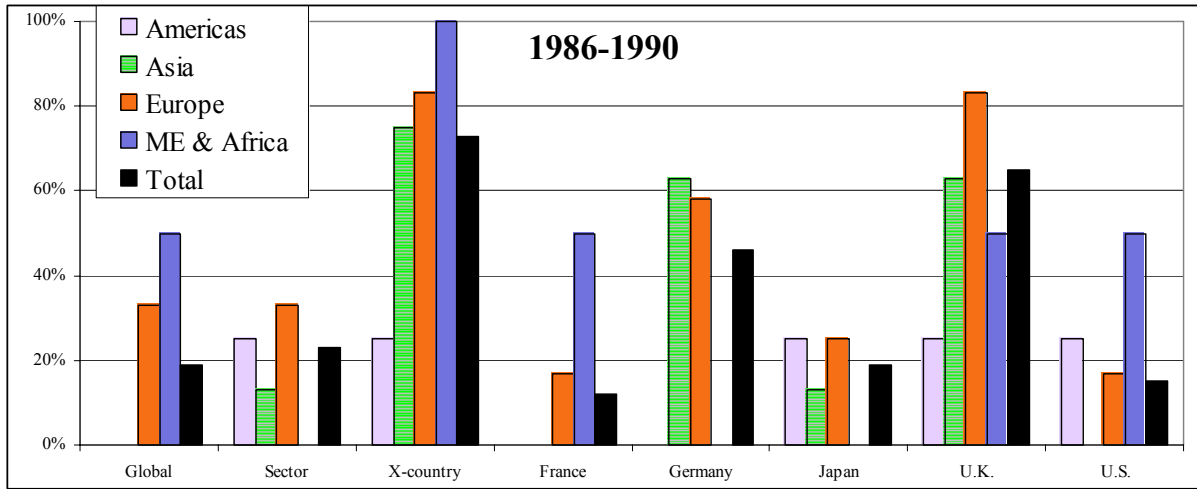
- (1) Capital controls measured by Edison and Warnock (2002) unsmoothed measure of capital controls
- (2) Capital controls measured by Kaminsky and Schmukler (2002) measure of capital account liberalization.
- (3) Underlying factor model estimates from equation (1) exclude the set of global factors.
- (4) Underlying factor model estimates from equation (1) exclude the cross-country factors for Germany and the U.K.
- (5) Foreign investment measured in levels instead of first-differences.
- (6) Include squared terms for each of the 4 bilateral linkage variables.
- (7) Includes 5 gravity equation variables: common borders, common language, former colony, log of distance between countries, and log of the product of real GDPs.
- (8) Includes regional dummy variables for each region as specified in Appendix A.
- (9) Exclude countries defined as having a banking crisis or currency crisis in the given year. See text for definitions.
- (10) Includes only high income or low/middle income countries. Definitions based on World Bank (2001).

**Figure 1: Joint Significance of Different Factor Groups**



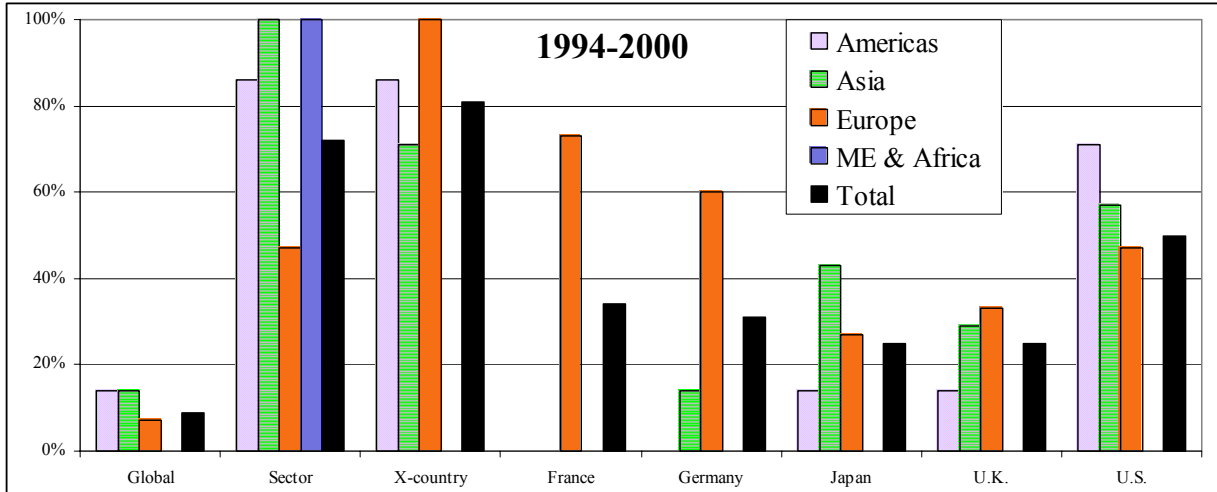
*Note:* Colored bars show that an F-test indicates that the relevant set of factors is jointly significant at the 10% level. White bars indicate jointly insignificant.

**Figure 2: Summary Results for Factor Model in Different Periods – Stock Markets**



**Notes:** Reports percent of coefficient estimates that are significant at the 5% level. Results based on estimates of equation (1) for local currency stock returns with sectoral factors. Results for global, sectoral and cross-country factors are F-tests of the joint significance of factors. Results for France, Germany, Japan, the U.K. and U.S. are from a t-test of the significance of the estimated cross-country beta. Regional divisions listed in Appendix A. “Total” is for the full sample of countries.

**Figure 3: Summary Results for Factor Model – Bond Markets**



**Notes:** Reports percent of coefficient estimates that are significant at the 5% level. Results based on estimates of equation (1) for U.S. dollar bond returns with sectoral factors. Results for global, sectoral and cross-country factors are F-tests of the joint significance of factors. Results for France, Germany, Japan, the U.K. and U.S. are from a t-test of the significance of the estimated cross-country beta. Regional divisions listed in Appendix A. “Total” is for the full sample of countries.