Free Flows, Limited Diversification: Explaining the Fall and Rise of Stock Market Correlations, 1890-2001*

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ABSTRACT: Using a new dataset on capital account openness, we investigate why equity return correlations changed over the last century. Using equity returns from 16 countries for the period 1890-2001, we show that correlations increase as financial markets are liberalized. In addition, countries with similar regulatory regimes show higher correlations. These findings are robust to controlling for both the Forbes-Rigobon bias and global averages in equity return correlations. We show that greater synchronization of fundamentals is not the main cause of increasing correlations. These results imply that the home bias puzzle may be smaller than traditionally claimed. (97 words)

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That international diversification is good for stock market investor is a key result of modern portfolio theory. As early as 1909, Henry Lowenfeld, in his *The Geographical Distribution of Capital*, argued along similar lines. A long lineage of papers demonstrates that international equity market correlations are lower than industry correlations within one country. Consequently, investors should be able to improve the risk/return profile of their portfolio significantly if they put part of it into foreign equities (Grubel (1968), Levy and Sarnat (1970)).

At the same time, a growing body of literature shows that international equity market correlations are not constant over time. The *Economist* (Economics Focus, "Dancing in Step," March 24, 2001) highlighted that stock market correlations grew sharply in the 1990s. Goetzman et al. (2005) were among the first to examine return correlations over the long run. They find major changes during the period 1860-2000. The risk reduction achievable by sending funds abroad has fallen from 90 percent in the 1950s to 65 percent at the end of the twentieth century (Goetzman et al. 2005). They are still substantial, but much smaller than analysts writing in the 1960s had argued. Vanishing opportunities for diversification have obvious implications for the "home bias" literature.

Why are equity market correlations changing over time? And why do equity market correlations drop precipitously during the interwar years, only to increase slowly during the postwar period? Figure 1 shows our *explanandum.* We plot both standard correlations and volatility-corrected correlations (using the Forbes-Rigobon method) for a set of 16 developed countries. Independent of the measure we use, equity market correlations were high in the period before World War I, fall to relatively low levels during the world wars and interwar years (with a rebound during the Great Depression), and then gradually increase until they reach unprecedented levels in the postwar period.

A variety of interpretations have been suggested for this pattern, from increased trade linkages to contagion in financial markets. Yet so far, there has been no systematic, quantitative analysis of the determinants of equity market correlations over the long run. This paper offers a comprehensive analysis of the fall and rise of return correlations over the last century, using the first consistent, detailed dataset on capital account openness

since 1890. Such long-run data may be crucial for determining the effects of policy. Many papers in the liberalization literature focus on changes at the frequency of months or at most, years.[1] Implementation lags can and often are long and variable. This may in turn obscure the true consequences of new rules and regulations.

We argue that government regulation was a key determinant of equity market correlations. Over the last century, capital controls often obstructed portfolio diversification. Policy-induced segmentation produced artificially low correlations of equity market returns. As constraints on investors declined and as regulatory rules governing capital accounts converged – especially in the post-war period – share prices began to co-move. We focus on two aspects of the regulatory regime. One is the average level of capital account openness between a pair of countries. The more open the average, the greater the correlations. The second is the difference in levels of capital account openness; the more similar the capital account openness is in the pair, the higher correlations will be.

Our findings have important implications for sustainable risk-return tradeoffs in international equity portfolios. First, the set of feasible diversification opportunities was always much smaller than simple analysis of correlations from the immediate post-war period suggested. Much of the investment advice derived from the early studies on diversification benefits could not have been followed in a practical sense. Capital accounts in Europe, for example, were largely closed to current and capital account transactions before 1959, and did not become fully open until the 1990s. Second, if greater openness itself is responsible for driving up correlations, investors may be chasing a chimera of greater stability by putting their money into overseas markets. While the benefits for early investors may have been large, the benefits of international diversification have declined rapidly as more and more capital moved overseas. When the marginal investors switch from national to foreign, global factors start to drive national returns. While some benefits remain, optimum international investment diversification in a new equilibrium characterized by massive international capital flows may be less than what the artificially low correlations of the 1950s and 1960s implied. The home bias puzzle may therefore be less puzzling than many authors believe. Investors often could

[1] Cf. For example the meticulous study by Bekaert, Hodrick and Zhang (2005).

not easily move their investment money abroad; when they did, returns started to move in lockstep.

However, capital account openness cannot explain all of the fall and rise of correlations over the last century. Correlations have increased sharply, but interdependence in an economic sense has risen much more modestly. Volatility is higher in recent years in our dataset than it was for most of the past century. Our dataset does not allow us to draw firm conclusions about the causes behind this increase.[2]

I. Prior Literature

The papers closest in scope to ours are Goetzmann et al. (2003), and Bekaert and Harvey (2000). Goetzmann et al. (2003) assemble a comprehensive dataset on equity return correlations over the last 150 years, and analyze the extent to which they have changed over time. The authors underline the extent to which correlations are time-varying. They also show how the opening up of additional markets has expanded the set of investment choices. Dellas and Hess (2005) show that stock market synchronization increases with the liquidity of stock markets and greater financial depth. Bekaert, Hodrick and Zhang (2005) examine correlations over the period 1980-2003, finding no evidence of an upward trend. Bekaert and Harvey (2000) show that correlations and betas increase after liberalization of capital markets, using a number of case studies from emerging countries.[3] De Jong and de Roon (2005) document that integration into world capital markets increases local market betas relative to the world index. At the same time, they find that the cost of capital and expected returns fall by 4.5%, which suggests that diversification opportunities exceeded the increasing influence of the world beta. Carrieri et al (2005) study eight emerging markets and argue that correlations are an imperfect measure of international market integration. They also conclude that liberalization played a big role in furthering integration for the period 1977-2000. Taylor and Tonks (1989) use cointegration analysis to conclude that the UK exchange control liberalization had no immediate impact on stockmarket correlations, but led to long-run shifts.[4] Hunter (2005)

[2] There is only limited evidence that greater openness itself is driving higher volatility. We will explore the origins of equity market correlation volatility in future work.

[3] In related work that examines the effects of capital account liberalization on macroeconomic stability, Bekaert, Harvey and Lundblad (2004) document a reduction in volatility.

[4] In a similar vein, Dickinson (2000) examines the relative contributions of macroeconomic factors and of financial globalization on the cointegration of stockmarkets.

examines Argentine, Mexican and Chilean ADRs. He demonstrates that, following liberalization of capital markets in these countries, integration did not necessarily increase; in some cases, it actually declined. If the increase in integration immediately after liberalization does not necessarily last, we need studies over the long term to determine how changes in policy are related to equity market correlations.

Other related literature contains several important contributions. Time-varying market integration was analyzed by Bekaert and Harvey (1995). Some recent studies find that international diversification benefits for US investors have not declined over the last two decades (DeSantis and Gerard 1997, Lewis 2006). Ang and Bekaert (2002) argue that while correlation patterns may shift, diversification benefits are still substantial. Bekaert, Harvey and Lumsdaine (2002) find that increases in market integration take substantial amounts of time after an official change in policy, and that different financial series imply different speeds of transition. Brooks and Del Negro (2004) show that higher correlations in the 1990s were largely driven by the effects of the tech bubble, and conclude that benefits of cross-country diversification should still be substantial after the bubble's demise. The effects of liberalized capital flows on economic performance are analyzed by, inter alia, Henry (2000).[5]

Another closely related body of literature analyzes the extent of international capital market integration over the long run. Obstfeld and Taylor (2005) argue that the period since the late 19th century saw a broadly "U-shaped" pattern, with a trough in the interwar period and broadly similar degrees of integration at the beginning and end of the 20th century. Obstfeld and Taylor (2002) examined equity market correlations over the long run, but without an explicit link with policy variables. Volosovych (2005) focuses on international bond markets during the period 1875 to 2002. He employs principal components analysis to conclude that integration in the last period of globalization during the late 19th century was markedly lower than in the last 20 years. Similar data and methods were employed by Mauro et al. (2002), who argue that contagion in modern-day bond markets has become much greater than it was historically. Bordo and Murshid (2002) find the opposite, based on their measure of currency crises.

[5] Lewis (2006) also documents that for US investors, the benefits from holding foreign stocks cross-listed in the US have declined sharply.

We proceed as follows. In section II, we describe the datasets on openness and on equity return correlations, as well as for the various controls. We employ a new version of the widely-used Quinn-Toyoda measure of openness, based on a detailed coding of legal provisions, that now extends back to 1890 (earlier versions only covered the period from 1947-1999). The equity return data is from a range of standard sources. The results section examines to what extent we can find a systematic link between openness and returns correlations in our panel, and subject the data to a range of robustness tests and extensions. We then take one step further, and analyze the IMF database on bilateral equity positions. In country-pairs where portfolio holdings are largest today, return correlations have declined the fastest since the 1950s. This offers additional support for the hypothesis that higher flows drive up equity return correlations. Section IV concludes.

II. **Data**

We use a single, consistently defined measure of de jure capital account openness – called *CAPITAL* - for the period 1890-2001. Quinn (1997) and Quinn and Toyoda (2007) derived measures of capital and current account openness for the post-war period from the IMF's *Annual Report on Exchange Restrictions*, based on a coding of the legal provisions governing international financial transactions. Quinn (2003) extends this series back to 1890. [6] We employ data for 16 of the countries in the sample.[7]

Many recent studies in international macroeconomics and international finance have used *CAPITAL*.[8] Openness on this measure varies from 0 (completely closed) to 100 (no restrictions). *CAPITAL* measures if capital payments can be received from abroad or sent abroad without restrictions, how likely permissions are to be granted, and if direct and portfolio investment is curtailed. It is a more finely graded measure of openness than, say, the dichotomous variables compiled by the IMF itself (which requires an arbitrary decision about when a country should be counted as "closed"). Sweden in 1980, for example, required Riksbank approval for the receipt of capital payments from abroad (with an exemption for life insurance). Issuance of securities by non-residents required

[6] To create a measure of capital account openness, 1890-1938, Quinn 2003 used the coding rules described in Quinn 1997. The data sources included Einzig, 1934; Ellis, 1939, 1940; IMF, 1949, League of Nations, 1923, 1922; and Palyi, 1972

[7] These are: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the United States.

[8] See Eichengreen (2001) and Kose, Prasad, Rogoff, and Wei (2006) for reviews.

approval. The Annual Report also states that "the purchase of both listed and unlisted securities by residents from nonresidents requires authorization. As a rule, such authorization is not granted" (Quinn 1997). There were no restrictions on sales. The combination of these rules and regulations led to a score of half of the possible points for Sweden in 1980. Values below 50 generally indicate that international capital transactions are highly restricted from a legal perspective.

Figure 2 shows the development of average openness and the distribution within the sample. At the end of the 19th century, openness is high, approaching the maximum of 100 in many cases. Over the 20th century, it follows the "U-shape" identified by Taylor and Obstfeld (2003) for the globalization of capital markets overall. World War I sees a sharp decline, followed by a recovery in the interwar period prior to the Great Depression. After 1929, capital openness declines rapidly, and falls to low levels just after WW II.[9]

The postwar period shows two periods of liberalization – one immediately after the end of hostilities, with average openness recovering to approximately 75 by the early 1960s. The second liberalization wave started after the collapse of the Bretton Woods System, and continued more or less unchecked until the end of our sample period. By the end of the twentieth century, openness was as high as it had been at the end of the nineteenth.

Differences in regulatory regimes between and among countries are initially minimal. During the inter- and post-war period, however, the regulatory regimes among countries differed greatly. In recent years, the differences have diminished. (The average level of capital openness and the capital differences series are correlated at -0.33.)

In principle, there are two strategies available to researchers interested in equity return correlations over the long term – using all available markets, with shifting compositions over time, or using a (much smaller) subset of indices in continuous observation over the very long run. Goetzman et al. (2005) mainly use a stable set of markets for which data for the past century is available. We follow a similar approach, favoring consistency and ease of interpretation over breadth of coverage, and focus on

[9] It is not possible to measure *CAPITAL* from 1939 to 1945 as the main data sources used to construct it either dissolve (League of Nations) or have not yet formed (IMF).

our set of sixteen countries for which we have almost uninterrupted data series spanning the period 1890 to 2001.

We calculate the returns as monthly log differences of the main country return indices, taken from Global Financial Data. Correlations are derived for 28 non-overlapping 4-year periods from 1890 to 2001, containing (a maximum of) 48 returns for each country. With 16 countries, we can draw on 120 country-pairs for each time period. This gives us a theoretical maximum of 3,480 observations. Because of missing observations, our dataset contains a total of 2,787 observations on return correlations. Table 1 summarizes the main statistics. To facilitate interpretation, we multiply correlation coefficients used as a dependent variable by 100 throughout. Real returns in our dataset range from -0.48 to 0.905, with an average of 0.27. Corrected for the Forbes-Rigobon effect of higher variance, the mean falls to 0.1, and the maximum correlation is 0.78.

We use Maddison's (2002) GDP figures to control for fundamentals such as growth correlations. There are some questions about the accuracy and reliability of these figures. Questions mainly center on the use of price indices (Prados de la Escosura 2000). Given that no comprehensive alternative data series are available and the majority of researchers accept the Maddison figures as a starting point, we use them for our analysis. To examine other real linkages, we employ the Barbieri (2002) dataset on trade volumes, deriving bilateral trade intensity. To control for other financial shocks that might drive equity return correlations, we include data on 10-year government bond yields, taken from Global Financial Data. Interest rates are highly correlated – with an average coefficient of 0.4. The range extends from -0.99 to 0.99.

Equity market correlations were initially modest, but rose from around 0.1 to 0.2 by the outbreak of WW I (Figure 3). They appear to have more of a "J-shape", similar to the pattern identified by Volosovych (2005). Together with the resumption of free capital flows in the interwar period, they rose in the second half of the 1920s, and peaked during the Great Depression. During the 1930s, they fell to very low levels, bottoming out in the period 1942-45. The postwar period saw a recovery and a first peak during the turmoil following the end of Bretton Woods. From the late 1980s, correlations jumped up, reaching levels of 0.5 and above for the past two decades.

As Forbes-Rigobon (2002) demonstrate, measured correlations are affected by the volatility of returns. We use their correction:

$$\rho_{it} = \frac{\rho_{it}^{u}}{\sqrt{1+\delta_{it}\left[1-(\rho_{it}^{u})^{2}\right]}} \qquad (1)$$

where $_{it}$ is the corrected correlation coefficient for country-pair i at time t, $^{u}_{it}$ is the uncorrected correlation, and $_{it}$ is the increase in the variance of the returns in any four-year interval relative to the period with the minimum variance. In effect, $_{it}$ is a scaled-down version of $^{u}_{it}$, with the magnitude of the adjustment depending on the relative increase in the variance of returns relative to a base period. Since the correction is not without difficulties, we will examine both the corrected and uncorrected measures.[10]

Figure 1 contrasts the simple and Forbes-Rigobon corrected series of correlations. The key finding is that, once corrected, equity market correlations in our set of 55 country pairs do not increase much between the early 1900s and the late 1980s. With the exceptions of two dips during the 1920 and the 1940s, share price correlations are broadly stable over almost a century. Higher correlations during the Great Depression are largely driven by the rise in volatility. Much of the increase in simple correlations after the 1970s is also the result of higher volatility, and does not signal an increase in equity market interdependence. The rise in the late 1980s, however, is obvious in both series. The final four four-year periods contain the highest average observed levels of equity market correlations during the entire period, for both the Forbes-Rigobon corrected and uncorrected series.

One important limitation of our analysis is the fact that we cannot address the country vs. industry factor debate. Cavaglia, Brightman and Aked (2000) called into

[10] A problem with the Forbes-Rigobon correction is that it may use data from the future to correct the past data, and does so across differing regimes. For example, the modal year for the minimum variance among the 120 country pairs is 1962-65: 33 pairs experience their lowest variance then. For these 33 pairs, data from 1962-65 is used to adjust data from, e.g. 1958-61 and 1890-93 and 1998-2001, which represent very different regimes. Moreover, economic actors presumably adjusted current behavior in light of past values of variance, leaving the question of whether the adjustment is exogenous. See also Corsetti et al. (2002), who argue that the Forbes-Rigobon method overstates the upward bias. To the extent that we still find significant effects even with the large correction of the Forbes-Rigobon method, we are establishing a lower bound on the true effect.

question Heston and Rouwenhorst's (1994) result that country factors are decisive. Bekaert, Hodrick and Zhang (2005) argue that industry factors mattered only for a relatively short period, and that country factors overall remain crucial.[11]

III. Results

What explains the rise and fall of equity market correlations over the last century? Using uncorrected as well as Forbes-Rigobon corrected correlations as indicators of interdependence between markets, we examine if changes can be explained by policy-driven openness on one hand, and by fundamentals on the other. Our results suggest that both factors play a role, but that the impact of regulation-induced financial openness is stronger. Before turning to the dataset for the last century as a whole, we first examine one illustrative case in more detail – France and the UK in the postwar era.

Case study

During the period 1958-61, equity return correlations between the UK and France were a mere 0.2 (uncorrected, and 0.17 Forbes-Rigobon corrected). This should have made it highly attractive for UK investors to buy French equities, and vice versa. GDP growth rates were highly correlated, indicating a substantial degree of real linkages (0.72). Yet capital account openness was low. In 1964, for example, for *CAPITAL*, the scores are 75 for France and 37.5 for Britain, for an average of 56.25.

Would-be British investors in France faced high hurdles in leaving Britain. For example, British regulations of would-be investors in France were biting:

> All capital transfers by residents to countries outside the Sterling Area require approval... For direct investments outside the Sterling Area, official exchange is made available only where the project is designed to bring a substantial continuing return to the United Kingdom's balance of payments, e.g., in additional export earnings, and where there are good prospects that the over-all

[11] If we could correct for the internet effect identified by Brooks and Del Negro (2004), we would observe less of a rise in the corrected correlations.

> return to the balance of payments will within two to three years equal or exceed the capital outflow.[12] [IMF 1965, p. 548.]:

British restrictions on inflows put even greater hurdles in the way of foreign investors wishing to put their money in British assets. The IMF noted:

> The participation of foreign capital as a direct investment in the United Kingdom is subject to individual authorization, which is normally granted provided that adequate capital for the project is supplied in an approved manner of payment (see section on Prescription of Currency, above) or by the import of goods and services; the foreign exchange received must be surrendered at rates ruling in the official market. With respect to new investment (as opposed to take-overs or participation in an existing business), the authorities must be satisfied that an acceptable proportion of the capital subscription will be made by foreign remittance. ….
>
> Foreign-owned firms and foreign individuals must obtain Treasury permission in order to raise capital in the United Kingdom, and U.K. resident subsidiaries of foreign companies are required to obtain consent from the Treasury before borrowing in the United Kingdom or before issuing shares or other securities to nonresidents. Such permission is freely given for borrowing for the purpose of financing the company's day-to-day business, but is not normally given for any expansion of manufacturing capacity except for companies whose activities are regarded as bringing special advantages to the U.K. economy. [IMF 1965, p. 549]

France was much less restrictive. The IMF noted that

> "Most outward transfers by residents for the purpose of making investments abroad require approval; these include direct investments in foreign enterprises as well as the establishment of branches by French firms. Requests for the authorization of direct investments abroad are approved liberally." [IMF 1965, p. 197.]

Inbound investment was also relatively easy. The IMF observed that "nonresidents may freely make direct investments in France and deal in securities in France…". [IMF 1965, p. 198]

A detailed look at the regulation in place in 1964 suggests that British investors could not easily have purchased French shares, and French investors could not have easily invested in Britain. The potential portfolio diversification that beckoned on the

[12] Note that the term "direct investment" is not only used in the modern sense of FDI, i.e. acquiring operating control over a foreign firm. It also denotes the transfer of funds with the purpose of purchasing foreign securities.

other side of the channel was real enough – but tight rules on permissible transactions provided a very effective barrier to actual flows for the British side.

By the late 1960s, with the Bretton-Woods system under increasing strain, France tightened its rules on capital account transaction: openness in France declined in 1966-1969 to 62.5. Joined to a score of 44 for the UK, the average decreased to 53. As our story would predict, correlations between the two markets fell to a mere 0.12. The gap between internal domestic and external (Euromarket) interest rates for instruments denominated in pounds and francs was substantial and persisted during this period of tightening capital controls.[13] This demonstrates the extent to which capital markets had become separated. It was not before 1979, when Britain under Margaret Thatcher abolished many regulations restricting the free market, that the capital account was fully liberalized (achieving a perfect score of 100). Following the reforms, correlations jumped – to 0.4 in the period 1982-85. France changed relative position from leader to laggard, and liberalized only gradually in the run-up to EMU. By 1990, it had a score of 87.5, indicating quite a low degree of restriction overall. Return correlations reached 0.71 (0.59 Forbes-Rigobon corrected).

Panel Evidence

Next, we examine the link between openness and equity return correlations more systematically. Figure 4 shows kernel density functions of correlations coefficients for the dyads, conditional on openness being limited (*CAPITAL* median) or high (above the median), for the period after 1950. The modal (uncorrected) correlation is 0.2 for relatively closed markets, and 0.62 for open markets. Negative correlations are rare for countries with fully open capital markets.

To test the effect of openness econometrically, we estimate models of the type:

$$\rho_{i,t} = a_i + \beta Q_{a,i,t} + \gamma X'_{i,t} + \varepsilon \qquad (2)$$

where $_{it}$ is the correlation coefficient (corrected or uncorrected) for country-pair i at time t, *a* is a pair-specific intercept (in the fixed effect models), Q_a is the capital-account related measure of openness from the *CAPITAL* index, and X' is a vector of controls.

[13] Between December of 1971 and May of 1977 (the date of Thatcher's election), the correlation between monthly external and internal sterling interest rate instruments was only 0.3. Post-Thatcher, the correlation rose to 0.96. For France post-Bretton Woods, the correlation between domestic and external interest rates was even lower: 0.09. See Quinn and Jacobson 1989, p. 723.

We estimate using both OLS and the Generalized Method of Moments system estimator proposed in Arellano and Bover 1995 and Blundell and Bond 1998. (See Eichengreen and Leblang 2003 and Quinn and Toyoda 2007 for applications.) The system GMM jointly estimates the equation in levels and differences, with the levels equation estimated with the first difference of the regressors and the differences equation estimated with lags of the regressors and dependent variable. Wawro 2002 shows the superior consistency of GMM-system methods in panel studies in political economy compared to estimators based on OLS (provided $t \geq 3$). The GMM-system estimator shows less bias in dynamic models than other GMM approaches (Hayakawa 2007).[14]

Table 2 presents the results with uncorrected correlations as the dependent variable. In the baseline specification, our estimates suggest that a rise by 40 points in *CAPITAL* (equivalent to the observed increase in our sample between 1954 and 1998) would translate into a rise in correlations by 0.21. We experiment with a number of specifications, using pooled estimation, fixed effects based on each dyad, and country fixed effects. We also use period dummies to take account of unobserved, time-varying patterns. In all specifications, the coefficient on openness is strongly positive. Its size varies by specification. In particular, including period dummies reduces the size of the capital account variable by a substantial margin. However, the impact of a rise in openness remains substantial throughout. In the simple pooled regression, we find that correlations (sample average 0.31) almost double (+0.215) if openness rises from the 25th to 75th percentile. In the equation with the smallest coefficient (3), we find a rise by 11% (+0.034). According to our estimates from eq. 1, had it not been for the liberalization in the period post-45, equity return correlations would be only two-thirds as high today as they actually are (0.42 instead of 0.63 for the period 1998-2001). The results are significant at the 1% level throughout. The basic results so far suggest that financial liberalizations have been an important factor driving up correlations between stock markets.

The Hausman test suggests that we need to use fixed effects (compared to random effects). The models with and without pair-wise fixed effects, however, show persistent

[14] Hayakawa (2007) finds that the GMM levels estimator has an upward bias, the GMM difference estimator has a downward bias, and that, in GMM-system estimators, the biases cancel in cases where $t \geq 4$.

evidence of serially correlated errors. Models with a lagged endogenous variable, country dummy variables, and period dummies produce estimates that are free of this problem: see model 5. We also estimate models with system GMM to obtain efficient, consistent estimates. The GMY-system results are similar to the OLS results in terms of sign, size, and levels of statistical significance (models 1 and 2; models 5 and 6).

In table 3, we use Forbes-Rigobon corrected correlation coefficients as the dependent variable. This cleans the data of the effect of changes in volatility over time. We find that capital account openness increases correlations in all specifications. The coefficient estimates are smaller for capital account openness, compared to those in Table 2. This is unsurprising. Since the Forbes-Rigobon correction scales down the dependent variable, there is less variability that can be explained. The effects remain large throughout – with correlations rising by between 14% and 57% (+0.02 and 0.098) relative to the sample mean if openness increases from the 25th to the 75th percentile. We again find that with lagged dependent variables, we can obtain estimates free of serial correlation under both OLS and GMM-sys estimations (models 5 and 6).

In Tables 4 and 5, we enrich the specification by investigating the effect of differences in levels of capital account openness between the pairs (Q_d) as well as the influence of economic fundamentals. Higher stock market correlations could reflect increasingly parallel changes in basic economic variables. We investigate the effect of correlated economic fundamentals (growth rates and interest rates), similarities in economic structure (differences in per capita income), and trade integration (bilateral trade flows).

$$\rho_{i,t} = \beta_0 + \beta_1 \rho_{i,t-1} + \beta_2 Q_{a,i,t} + \beta_3 Q_{d,i,t} + \beta_4 \text{Growth\_corr}_{i,t} + \beta_5 \text{IRate\_corr}_{i,t} + \beta_6 \text{Income\_diff}_{i,t} + \beta_7 \text{Bilateral\_trade}_{i,t} + \beta_{8\ldots46}(\text{Country Dummies, Period Dummies}) + \varepsilon_{i,t} \qquad (3)$$

Recent research has stressed the importance of investigating and controlling for unobserved cross-sectional or spatial correlation in time-series panel studies. (See Franzese and Hays 2007.) Of particular concern in this investigation is whether the observation of a given correlation for a country pair is fully independent of the

observations of other pairs at the same time. To capture the spatial correlations and unobserved global influences, we estimate some models with the contemporaneous global average of equity market correlations as an independent variable.[15] We also allow for the possibility that geography (here, time differences between national markets) influences correlations. We also add a time trend. The inclusion of the global averages of correlations, the geography indicator and the time trend require omitting the country dummies and the year fixed effects, producing equation 4 (below).

$$\rho_{i,t} = \beta_0 + \beta_1 \rho_{i,t-1} + \beta_2 Q_{a,i,t} + \beta_3 Q_{d,i,t} + \beta_4 \text{Growth\_corr}_{i,t} + \beta_5 \text{IRate\_corr}_{i,t} + \beta_6 \text{Income\_diff}_{i,t} + \beta_7 \text{Bilateral\_trade}_{i,t} + \beta_8 \text{Global\_corr}_{j,t} + \beta_9 \text{Time\_Distance}_i + \beta_{10} \text{Time} + \varepsilon_{i,t}$$

Table 4 reports OLS estimations, and Table 5 reports companion GMM-system estimates. The models are well behaved from a statistical perspective. We find that the effect of capital account openness on either Corr or FR-corr remains strong and statistically significant, independent of the additional controls we include, and regardless of the method employed.

Differences in capital account openness, conditional on any given average openness score, reduce correlations: the estimated coefficient is negative and statistically significant at beyond the .01 level in all models in which it is included. A similar regulatory regime between a pair of countries is associated with higher correlations. Greater regulatory divergence, in contrast, is associated with decreasing correlations.

The other variables are controls, and we limit our discussions of them. Models 4.2 and 5.2 show that, when GDP growth rates are highly correlated, stock markets are also more likely to fluctuate in parallel. The variable has the expected sign and is significant at the 5% level. It also has a considerable impact (with a rise from the 25th to the 75th percentile raising equity market correlations by 0.14). In models with additional variables, however, we cannot confirm the significance of GDP growth at standard levels of statistical significance.

Interest rate correlations and bilateral trade volume are associated with higher return correlations. The coefficient estimates of these variables are positive and

[15] We remove the contribution of the value of each dependent variable pair from the global average.

statistically significant in most models. Differences in per capita income between a pair of countries, in contrast, robustly reduce correlations. Its coefficient estimate is negative at beyond at least the .05 level in all models. These findings are in line with the results by Lane and Milesi-Ferretti (2004), who show that cross-border capital flows are higher between countries that trade more with each other, have higher per capita incomes, and are closer to each other.

The influence of global equity correlations is assessed in models 4.7 and 5.7. Global average correlations have a positive and highly statistically significant positive coefficient. A one percent change in the global average correlation is associated with a roughly two thirds to three quarters percentage change in the pairwise equity correlation. The inclusion of global average correlations increases the explanatory power of the equations (the adjusted r-square) by 8 points. The capital openness and capital difference indicators are unaffected by the inclusion of the global average indicators. The geography indicator's coefficient estimates are statistically significant and negative in three models, suggesting that greater distances are associated with lower correlations.

Models 4.8 and 5.8 substitute the Forbes Rigobon corrected correlation coefficient for the uncorrected correlation in equation 4. The results are substantively identical to the results using the uncorrected coefficients. The estimated coefficients for average capital account openness are statistically significantly associated with increasing equity correlations at beyond the .01 level. The estimated coefficients for differences in capital account regulatory regimes are statistically significantly associated with decreasing equity correlations at beyond the .01 level.

Robustness – Omitting Leading Countries and Parameter Estimates over Time

The U.S and the U.K. were dominant financial markets during this period of study. How does omitting either or both countries from the analysis influence the results? In Appendix Table 1, we omit the data for the U.S. from models 2.5, 3.5, 4.1-4.8, and compare the coefficients for average capital and difference in regulatory regimes to those for the full sample. We repeat this by omitting data for the U.K. We next omit data for both countries.

The results are highly robust to the omission of the U.S, the U.K., and both. The coefficient estimates for average capital account openness are always positive and statistically significant at beyond the .01 level. In the models with country and year dummies (2.5, 3.5, 4.1-4.6), the coefficient estimates of openness are double or triple the size of the estimate of the full sample. This finding is consistent with the reality that the U.S. especially, but also the U.K., was far more open than most countries in the sample, so their contribution to the variance in the independent variable is small. The coefficient estimates in the models that include global averages (4.7 and 4.8) but which omit either the U.S. or the U.K. or both are nearly identical to those in the baseline models. The global average of equity returns includes information for the U.S. and the U.K already, so the estimates with and without their data are consistent.

The results for differences in regulatory regime are also highly robust to the omission of the data for either or both. The coefficient estimates omitting the U.S., the U.K, or both are generally smaller than the original estimates, though statistically significant and negative at the .05 level or beyond in all models. Because the U.S. and the U.K were, as noted above, more open, there is more identifying variance in the models with them than without them (as their regulatory regimes differed from those of other countries more than other countries in the sample).

Models 4.7 and 4.8 (equation 4 using Corr and FR_Corr respectively) based on equation 4 offer consistent estimates, given the evidence above. We therefore use them to assess whether the parameter estimates for the capital openness and capital differences variables differ by time. Table 5 divides the last 110 years into a number of subperiods – the volatile interwar years, the period of immediate postwar reconstruction, the heyday of the Bretton-Woods system, and the period of the free float after 1973. In the last age of financial globalization, openness of capital accounts was very high. Before 1914, there appears to be a puzzling coincidence of high capital account openness on the one hand, and low correlations on the other. However, the number of equity return correlations is actually quite low. Before 1900, we only have one country pair in observation, rising to 10 by 1910.

In table 6, we add dummy variables to models 4.7 and 4.8 that correspond to dates for the differing currency regimes in the sample: the gold standard period, the interwar

years, Bretton Woods, and the modern period.[16] To assess directly whether *CAPITAL*'s effects on equity correlations differ by time, we use the procedures outlined in Friedrich 1982. For example, we add the terms, $(\text{Interwar})_t$ and $CAPITAL_{t,i}$ *(Interwar_t) to equation 4, and repeat that for Bretton Woods and the modern period.

The key question is if the interaction term is statistically significant. We use the parameter estimate and proper period standard error from Friedrich (1982).[17]

For the gold standard era, there are no observations on equity return correlations for countries where *CAPITAL* is less than 100.[18] With only 25 observations for the period before 1914, we can infer little from the data about the late 19th century per se. The period dummy is positive, but is not statistically significant at conventional levels.

The baseline coefficients for *CAPITAL* in Table 6 are always positive and statistically significant at beyond the .01 level. The interaction terms for the Interwar period**CAPITAL* are not statistically significant, and neither is the interaction term for the modern period using FR_corr as the dependent variable. The interaction term for Modern period**CAPITAL* using Corr is positive and statistically significant, which provides some evidence that the influence of *CAPITAL* is stronger in the modern period.

For robustness, we report in Appendix Table 2 estimates where the interwar, Bretton Woods, and modern periods are examined separately. The results are consistent with *CAPITAL* having a statistically significant and positive influence throughout.

Robustness - Outliers and Standard Errors of Difference-in-Difference Estimates

Since outliers might be driving some of our results, we examine if they are robust to a range of alternative estimators. Model 1 in Table 7 uses the Huber-Biweight robust estimator to reduce the influence of observations with high leverage. This leaves the size

[16] The Gold standard error is 1890-1914; the interwar years are 1919-1937; the Bretton Woods era is 1946 to 1973; and the modern era is 1974 to the present. The results are not sensitive to minor adjustments in dates, except for the Bretton Woods era. The inclusion or exclusion of 1946-1949 influences the results, and this is discussed in the text.

[17] The base coefficient and the interaction coefficient are added together to produce the period effect. The computation of the standard errors requires extracting the covariance of the base term and the interaction term. The formula is given by taking the square root of (standard error of X1 + standard error of $X2^2$ + 2*X2*covarX1X2).

[18] A few countries maintained some restrictions, but we do no have enough data to calculate return correlations for them.

of the coefficients unchanged compared to the standard OLS estimation. Median regression analysis, where we minimize the absolute deviation instead of its square, also yields nearly identical results. Outliers are not responsible for our finding that capital account openness drives up stock market correlations.

Duflo et al. (2004) highlight the potential pitfalls of difference-in-difference estimators as used in Tables 2 and 4. If an exogenous variable exhibits serial correlation, the standard errors in typical fixed-effects estimations will be too small, leading us to reject the null of no effect too easily. The problem will be more acute (i) the longer the time span covered (ii) the greater the serial correlation in the dependent variable (iii) the greater the serial correlation of the exogenous variable. Since the autocorrelation coefficient of the Forbes-Rigobon corrected correlation variable is 0.37 (standard error 0.03), and of *CAPITAL* 0.76 (with a standard error of 0.019), there is obvious scope for concern (although the GMM-system estimators do not suffer from this deficiency). Duflo et al. suggest a number of remedies, two of which they recommend – collapsing the data (i.e. abstracting from time-variation) and using randomization inference to derive test statistics based on simulation results. The former is particularly powerful in our case since all countries vary their capital market openness over time, and because the number of country pairs is large, giving the test a high degree of power.

Table 8 reports the results from collapsing the data and estimating a single cross-section. Models 1, 2, and 3 report the results for the full sample as available (1890-2001 at the outer limit). Model 1 matches model 4.1, model 2 matches model 4.7 (Corr), and model 3 matches model 4.8 (FR_Corr). The coefficient estimates for both *CAPITAL* and differences in *CAPITAL* are highly statistically significant and positive/negative (respectively). The coefficient estimates jump to between three and a half to five and a quarter times the size of the original coefficients. As a robustness check, we re-estimate the models using median data for 1954-2001 (models 4, 5, and 6). The coefficient estimates are again larger than the original estimates, and five of the six are highly statistically significant and in the expected direction. (The sixth is the *CAPITAL* coefficient for FR-Corr, and its t-stat is 1.58.)

The second method proposed by Duflo et al. involves simulating the distribution of the exogenous variable using "placebo" changes in labor laws (in their case, with a

dummy variable to capture it). This is harder to implement in our case, since there is not a single law that is either in force or not. All countries reverse policy a few times, and change in the dyads is often gradual. To deal with these issues, we generate "placebo openness" that replicates the time-series characteristics of our data. Two variations are employed. In the first variation, we use a randomly chosen initial value for the first observation in each country pair drawn from the interval [0, 100].[19] In the second, we use the historically observed starting value. In both cases, the evolution of placebo openness over time is then simulated by the observed autocorrelation coefficient and random shocks with a variance equal to that in the observed distribution. We generate 10,000 replications of the randomly generated placebo laws, and compare the distribution of coefficients for artificial openness to the one from actual data. In the basic fixed-effects regression with the Forbes-Rigobon corrected correlation coefficients as the dependent variable, we obtained a coefficient of 0.2 (t-statistic 15.2). In the Monte Carlo generated distribution of coefficients with random starting values, the largest coefficient observed is 0.147, indicating significance at more than the 99.99% level. With historical starting values, the maximum coefficient is a little below 0.001, again indicating a very high degree of significance. Serial correlation is unlikely to have affected the significance of the coefficient on openness.

Limitations

Our results in Table 4 and 5 probably understate the extent to which correlations have increased because of greater capital account openness. Measuring capital account openness is not without problems, even with the best indicators available. In the post-war period, for example, the IMF's standard measure (which only indicates if markets are open or closed) is positively correlated with our measure. Where the more finely graded *CAPITAL* measure adds some noise in the explanatory variable, this would induce attrition bias. Also, we miss some of the countries that only liberalized recently, and whose equity markets do not have a long history. A dataset that included them would arguably contain even more identifying variance, and could show larger effects.

There is, however, one factor that tends in the opposite direction. We may have understated the extent to which capital account liberalizations drive up correlations. The

[19] The authors would like to thank Fabio Canova for his advice on this issue.

attainable level of diversification with fully open capital accounts will, however, be larger than our study implies. We focus on a stable set of countries for the last century. However, Goetzman et al. (2002) show that the additional reduction in risk from adding a large number of smaller markets can be substantial. As the number of countries (and stock markets) has surged in the last 100 years, our results will be too pessimistic compared to the full range of investment choices available.

Channels

What reason is there to believe that capital chasing diversification opportunities is responsible for the positive relationship between openness and correlations? We controlled for changes in economic fundamentals, interest rate correlations and the like, but the argument so far has worked by process of elimination. A more direct test should examine how flows react to past correlations, and how correlations in turn react to flows. Data limitations make such a direct test impossible. The IMF's Coordinated Portfolio Investment Survey (CPIS) has collected data on bilateral asset position including equity investments, but it only covers the period 1997-2003. We use the information for 2002 since this is the last year when final estimates are available, and the coverage is broad. Since stocks at the beginning are known to have been very low overall, existing stocks in 2002 must largely be the result of flows (and appreciation) over the postwar period.

If our argument is correct, then the greater bilateral holdings are today, the higher correlations should be as well. Also, greater openness on average, and large increases in openness, should have resulted in increasing bilateral holdings. Both predictions are borne out by the data. Table 9 examines the empirical regularities. Countries with greater bilateral holdings saw a marked and statistically significant rise in correlations. Also, greater average openness is strongly correlated with higher bilateral holdings (eq. 2 and 3). Correlations in 1953 are negatively related to the value of bilateral equity holdings, but at -0.025, the effect is weak and insignificant. Correlations in 1997 vary positively with the log of bilateral holdings (0.57, significant at the 1% level).

IV. Conclusions

Feasible diversification has often been much less than the examination of

correlation structures suggests. During much of the post-war period, capital flows between advanced capitalist countries were anything but free. Low correlations did not indicate unexploited investment opportunities because few investors could have moved funds across borders. Yet much of the initial literature on diversification benefits focused precisely on these periods – 1951 to 1967 in the seminal paper by Levy and Sarnat (1970), 1959 to 1966 in Grubel (1968).[20] Academic studies and practitioners' beliefs about the benefits of international investing may have been too sanguine – and the home bias inferred from investors' portfolios much too large.

Our analysis suggests that capital controls did not just stand in the way of exploiting diversification opportunities. To a large extent, they created the illusion that they were large in the first place. The mean (uncorrected) correlation during the period 1950-54 in our dataset was 0.26. In 1998-2001, it had risen to 0.63. We conclude that policy changes, and not only greater trade or interest rate linkages per se, played a decisive role in driving them up.[21] Using a set of 120 country pairs over the last century shows that liberalization has tended to increase the covariance of stock market returns. We also report robust evidence that divergent capital account regulatory regimes between a pair of countries decrease correlations.

These results are robust to corrections for the upward biases during periods of higher volatility established by Forbes and Rigobon. We also show that real linkages are not to blame for the increase in correlations. Our central finding is also robust to including the average global correlation for the other 119 pairs in the data. Examination of IMF portfolio data shows that where bilateral capital holdings have increased in the postwar period, correlations of returns have risen rapidly.

Our paper also contributes to the debate about the nature of financial globalization over the last century. Since corrected and uncorrected correlations diverge strongly, we demonstrate that an important part of the increase in equity return correlations has been the result of higher volatility, not of greater interdependence. Yet even after correcting for the upward bias along the lines of Forbes and Rigobon (2002), we find that equity return

[20] Levy and Sarnat (1970) conclude that, since the optimum country portfolio doesn't contain all countries in the world, there must be substantial barriers to free capital movement.
[21] Our conclusions differ in part from those in, say, Lewis (2006) because we examine a much longer time period than the last 20 years, and a wider set of countries.

correlations today are substantially higher than they were a century ago. Our evidence therefore suggests that the Ostfeld-Taylor view of 19th century financial integration may be too optimistic, and that recent degrees of financial globalization are unprecedented. This suggests a different metric for analyzing the benefits of international diversification. When assessing opportunities for risk reduction because of low return correlations, actual levels of capital account openness have to be taken into account. In this regard, the 19th century combined remarkable levels of capital mobility with relatively low correlations, while the most recent era of globalization has brought about a large and rapid fall in diversification opportunities.

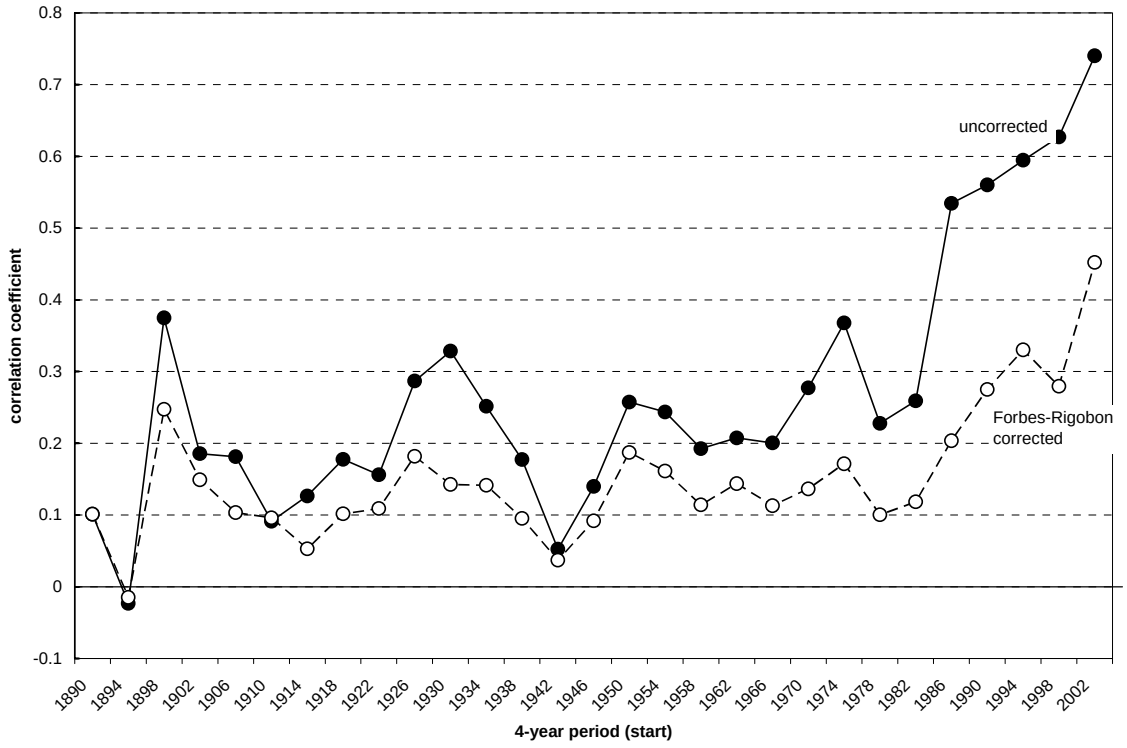

Figure 1: Two measures of equity market correlations

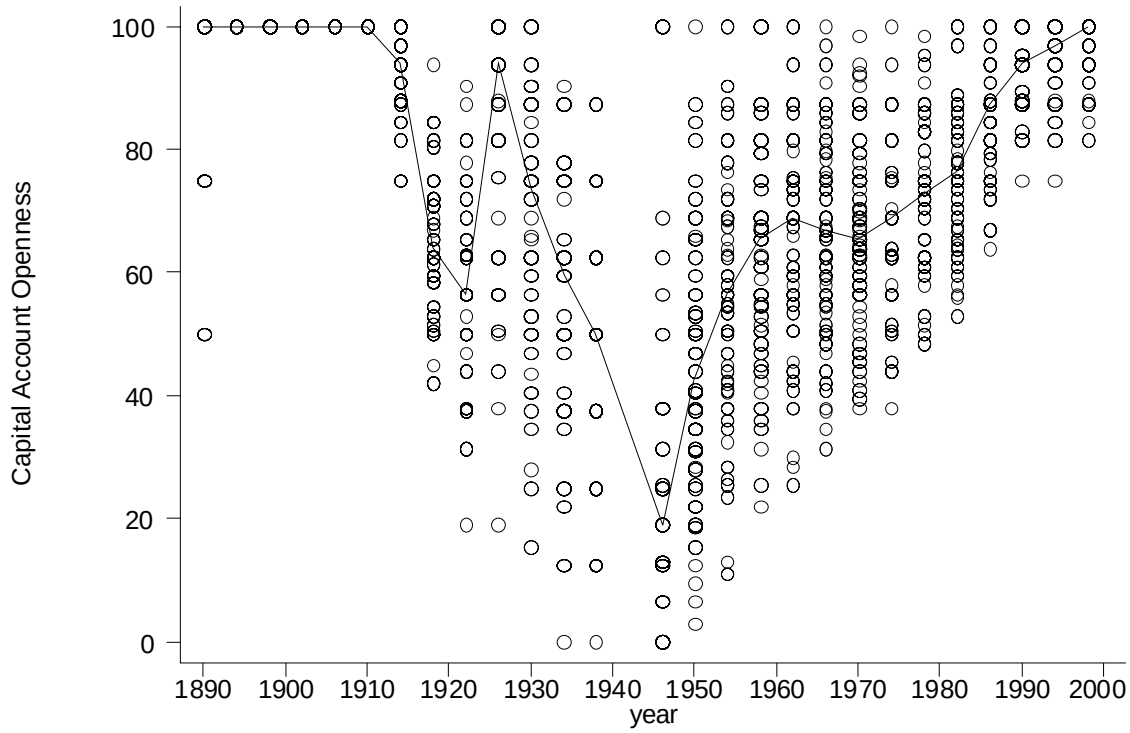

Figure 2: Capital account openness, 1890-1900

Note: line connects the median values. Dots indicate openness in each country pair in our sample.

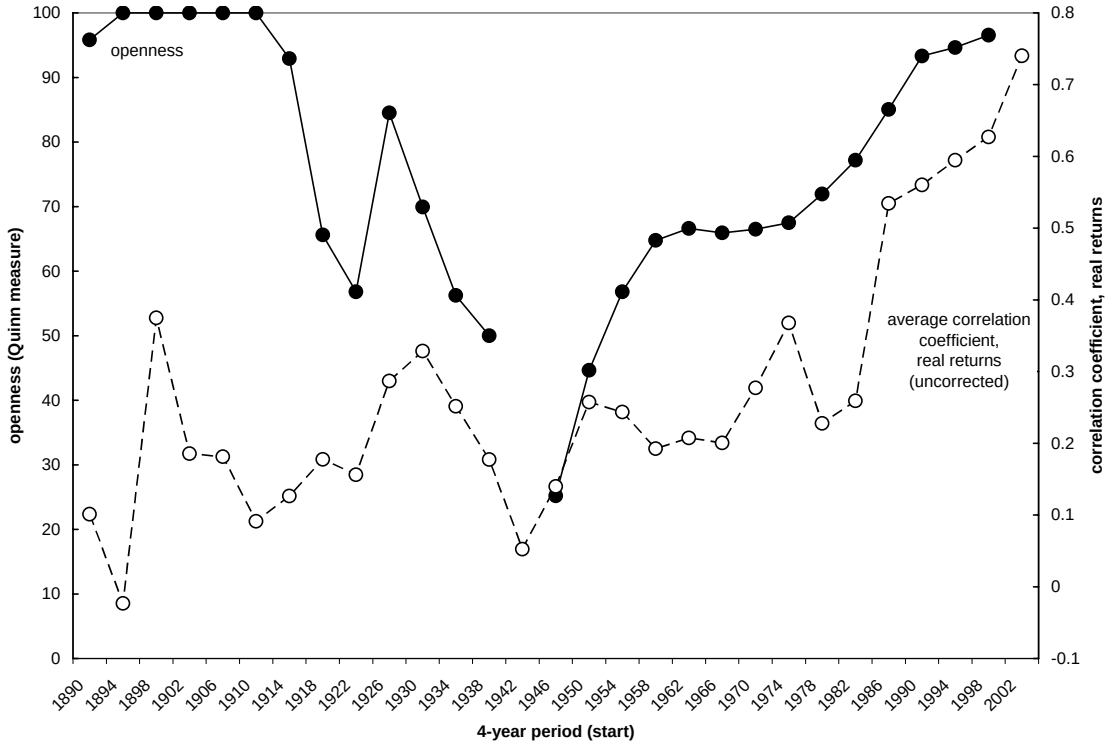

Figure 3: Capital account openness and equity market correlations, 1890-2005

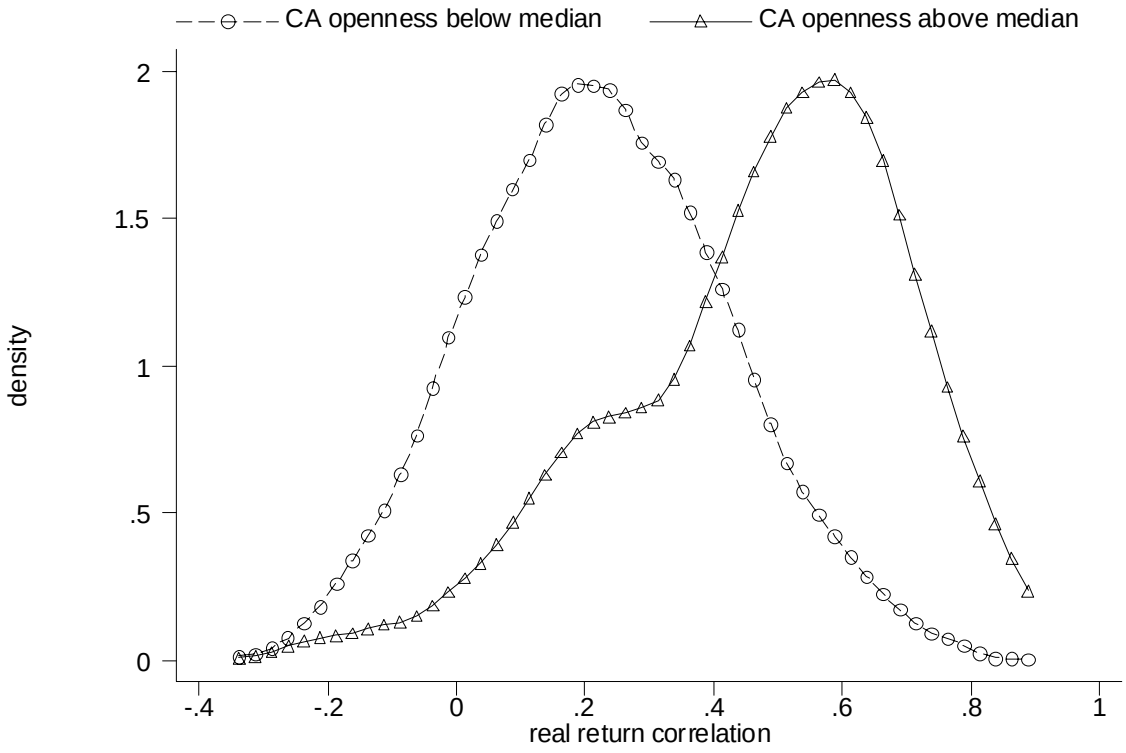

Figure 4: Uncorrected correlations, conditional on capital account openness.

Tables

Table 1: Descriptive statistics and Pairwise Correlations

Variable	N	MEAN	ST. DEV	VARIANCE	MINIMUM	MAXIMUM
Return	2073	32.52	23.64	558.96	-33.77	88.8
Return_FR	2073	17.07	15.43	238.11	-33.77	75.47
CAPITAL	2073	69.73	22.98	527.9	0	100
CAPITAL_Dif	2073	23.91	22.01	484.46	0	100
Growth_Cor	2073	0.19	0.57	0.33	-1	1
Inter_Cor	2073	0.41	0.48	0.23	-0.94	1
Income_Dif	2073	0.64	0.46	0.21	0	2.11
Bi_Trade	2073	0.02	0.03	0	-0.52	0.22
World_Return	2073	32	15.23	231.79	1.52	63

Return	1								
Return_FR	0.801	1							
CAPITAL	0.53	0.353	1						
CAPITAL_Dif	-0.341	-0.263	-0.346	1					
Growth_cor	0.099	0.079	0.091	-0.119	1				
Interest_cor	0.227	0.205	0.224	-0.186	0.076	1			
Income_Dif	-0.072	-0.085	0.108	0.103	-0.087	-0.031	1		
Bi_Trade	0.252	0.199	0.226	-0.169	0.133	0.154	0.168	1	
World_Return	0.619	0.371	0.588	-0.342	0.037	0.217	-0.003	0.143	1
	Return	Return_FR	*CAPITAL*	*CAPITAL_Dif*	Growth_cor	Interest_cor	Income_Dif	Bi_Trade	World_Return

Table 2: Financial openness and stock market correlations – OLS and GMM-SYS estimations (dependent variable: standard (corr) correlation coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	GMM-SYS	OLS	OLS	OLS	GMM-SYS
Y_{s-1}					0.202*** (0.022)	-0.095 (0.059)
***CAPITAL* account openness**	**0.495*** (0.019)**	**0.534*** (0.034)**	**0.132*** (0.027)**	**0.130*** (0.029)**	**0.124*** (0.029)**	**0.186*** (0.067)**
Constant	-3.358** (1.352)	-6.077*** (2.431)	65.909*** (5.922)	51.818*** (4.465)	38.275*** (4.53)	-29.3*** (8.560)
Observations	2263	2263	2263	2263	2141	2141
Number of countries	16	160	16	16	16	16
Number of pairs	120	120	120	120	120	120
Pair Fixed effects	N	N	Y	N	N	N
Country dummies	N	N	N	Y	Y	Y
Period dummies	N	N	Y	Y	Y	Y
R^2	0.24	0.23	0.552	0.513	0.540	.50
P	0.375***		0.089***	0.211***	0.058	
AR1		-9.082***				-4.556***
AR2		-2.797**				-0.925
Sargan Test p-value		1.00				1.00
Serial correlation	YES	YES	YES	YES	**No**	**No**

Notes: Panel corrected standard errors in parentheses below coefficient: see Beck and Katz 1995. * p-value < .1; ** p-value < .05; *** p-value < .01. **ρ** is estimated as the coefficient of the lag of residuals run on the residuals. A statistically significant coefficient indicates the presence of serially correlated residuals. A lagged endogenous variable cannot be validly entered in the equations with pair-fixed effects (models 2 and 5). The observations are non-overlapping four year averages of the data, 1890-2001. The results for the pair, period, and country dummies are not reported to save space, but are available from the authors. In GMM-SYS, the R2 is defined as 1-RSS/TSS. No serial correlation is indicated in GMM-SYS models when, in second stage analysis, the Arellano-Bond test for second-order serial correlation is not significant, and the AR1 test shows evidence of significant negative serial correlation in the differenced residuals. For a discussion, see Doornik and Hendry (2001, 69). For the transformed equations, the internal instruments are lags 2 through 5. The transformations used are first differences. For the levels equation, the internal instruments are lag 1 on the variables. Country dummies are also used as instruments as well as exogenous regressors.

Table 3: Financial openness and stock market correlations – OLS and GMM-SYS estimations (dependent variable: Forbes-Rigobon corrected correlation coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	GMM-SYS	OLS	OLS	OLS	GMM-SYS
$\mathbf{Y_{s-1}}$					0.324***	-0.019
					(0.023)	(0.059)
***CAPITAL* account openness**	**0.216*** (0.013)**	**0.241*** (0.027)**	**0.063*** (0.019)**	**0.063*** (0.021)**	**0.047** (0.020)**	**0.113** (0.053)**
Constant	1.250	-0.469 1.779	23.847***	20.752***	10.581***	-16.278*** (5.016)
	(0.934)		(4.039)	(3.234)	(3.088)	
Observations	2263	2263	2263	2263	2141	2141
Number of countries	16	16	16	16	16	16
Number of pairs	120	120	120	120	120	120
Pair Fixed effects	N	N	Y	N	N	N
Country dummies	N	N	N	Y	Y	Y
Period dummies	Y	N	Y	Y	Y	Y
R^2	0.11	.11	0.45	0.35	0.44	.27
P	0.465***		0.179*	0.334***	-0.020	
AR1		-8.542***				-4.472***
AR2		-2.130**				-0.952
Sargan Test p-value	1.00	1.00	1.00	1.00	1.00	1.00
Serial correlation?	YES	YES	YES	YES	**No**	**No**

Notes: * p-value < .1; ** p-value < .05; *** p-value < .01. Panel corrected standard errors in parentheses below coefficient in OLS estimations: see Beck and Katz 1995. To assess serial correlation in the OLS estimations, **ρ** is estimated as the coefficient of the lag of residuals run on the residuals. A statistically significant coefficient indicates the presence of serially correlated residuals. The observations are non-overlapping four year averages of the data, 1890-2001. The results for the pair, period, and country dummies are not reported to save space, but are available from the authors. In GMM-SYS, the R2 is defined as 1-RSS/TSS. No serial correlation is indicated in GMM-SYS models when, in second stage analysis, the Arellano-Bond test for second-order serial correlation is not significant, and the AR1 test shows evidence of significant negative serial correlation in the differenced residuals. For a discussion, see Doornik and Hendry (2001, 69). For the transformed equations, the internal instruments are lags 2 through 5. The transformations used are first differences. For the levels equation, the internal instruments are lag 1 on the variables. Country dummies are also used as instruments as well as exogenous regressors.

Table 4: Financial openness and stock market correlations - OLS (dependent variable: standard (corr) and Forbes-Rigobon corrected (FR-corr) correlation coefficients)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Corr	Corr	Corr	Corr	Corr	Corr	Corr	FR-corr
$\mathbf{Y_{s-1}}$	0.197*** (0.022)	0.201*** (0.022)	0.198*** (0.022)	0.198*** (0.022)	0.192*** (0.023)	0.180*** (0.023)	0.218*** (0.021)	0.374*** (0.022)
***CAPITAL* account openness**	**0.108*** (0.029)**	**0.120*** (0.029)**	**0.120*** (0.029)**	**0.125*** (0.029)**	**0.123*** (0.029)**	**0.105*** (0.030)**	**0.171*** (0.021)**	**0.059*** (0.015)**
***CAPITAL* account differences**	**-0.092*** (0.018)**					**-0.086*** (0.019)**	**-0.088*** (0.018)**	**-0.066*** (0.013)**
Growth rate correlation		1.964*** (0.630)				1.339** (0.640)	0.927 (0.66)	1.076 (1.176)
Interest Rate Correlation			2.956*** (0.899)			2.327** (0.907)	1.053 (0.812)	7.434*** (2.198)
National Income differences				-2.577** (1.040)		-2.513** (1.068)	-4.095*** (0.868)	-1.884*** (0.627)
Bi-lateral Trade					64.622*** (17.25)	60.087*** (17.17)	78.916*** (16.18)	30.862*** (11.67)
Global Stock Market Correlations							0.695*** (0.038)	0.631*** (0.053)
Time-Dif Between Pairs							-0.158* (0.092)	-0.249*** (0.063)
Time-Trend							-0.115*** (0.024)	-0.078*** (0.016)
Constant	42.422*** (4.561)	38.125*** (4.504)	36.485*** (4.523)	43.756*** (5.070)	34.822*** (4.554)	42.398*** (5.162)	221.48*** (46.11)	153.28*** (29.95)
Observations	2141	2141	2141	2141	2075	2075	2073	2073
Adj. R^2	0.55	0.54	0.55	0.54	0.55	0.55	.5	.37
ρ	0.002	0.004	0.006	0.011	-0.002	-0.011	0.04*	0.009

Notes: Panel corrected standard errors in parentheses below coefficient: see Beck and Katz 1995. * p-value < .1; ** p-value < .05; *** p-value < .01. **ρ** is estimated as the coefficient of the lag of residuals run on the residuals. A statistically significant coefficient indicates the presence of serially correlated residuals. The observations are non-overlapping four year averages of the data, 1890-2001, for 16 countries comprising 120 country pairs. Models 1-6 are estimated with period and countries dummies, which are not reported to save space, but are available from the authors. Models 7 and 8, which include the indicators of time-distance and global averages of stock market correlations, cannot include period and country fixed effects.

Table 5: Financial openness and stock market correlations – GMM-sys

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Corr	Corr	Corr	Corr	Corr	Corr	Corr	FR-corr
Y_{s-1}	0.021	0.018	0.029	-0.083**	-0.018	0.094*	0.111**	0.146***
	(0.043)	(0.044)	(0.045)	(0.04)	(0.049)	(0.050)	(0.047)	(0.053)
Y_{s-2}						-0.061	-0.005	0.004
						(0.046)	(0.042)	(0.04)
***CAPITAL* account openness**	**0.115****	**0.108****	**0.194****	**0.158****	**0.236*****	**0.151****	**0.207*****	**0.083*****
	(0.054)	**(0.055)**	**(0.077)**	**(0.061)**	**(0.069)**	**(0.07)**	**(0.044)**	**(0.033)**
***CAPITAL* account differences**	**-0.073*****					**-0.147*****	**-0.115*****	**-0.124*****
	(0.023)					**(0.036)**	**(0.043)**	**(0.03)**
Growth rate correlation		1.827**				1.012	0.476	-0.308
		(0.8)				(1.347)	(1.325)	(1.078)
Interest Rate Correlation			2.223**			3.823*	3.297**	1.346
			(0.927)			(2.041)	(1.697)	(1.163)
National Income differences				-10.98***		-4.921**	-7.048***	-2.39
				(2.478)		(2.222)	(2.553)	(2.019)
Bi-lateral Trade					39.579	55.624	71.744*	51.209*
					(32.42)	(41.68)	(41.54)	(28.44)
Global Stock Market Correlations							0.728***	0.745***
							(0.079)	(0.136)
Time-Dif Between Pairs							-0.265	-0.135
							(0.174)	(0.151)
Time-Trend							-0.175***	-0.126***
							(0.038)	(0.03)
Constant	-21.227***	-19.619***	-32.451***	13.423***	-36.451***	25.384***	340.397***	246.485***
	(7.249)	(7.395)	(9.928)	(8.667)	(8.443)	(7.321)	(74.16)	(59.37)
Observations	2141	2141	2141	2141	2075	1969	1968	1968
R^2	.54	.53	.53	.50	.53	.56	0.52	0.34
AR1	-3.821***	-5.169***	-3.82***	-4.27***	-4.763**^	-2.217**	-5.708***	-5.306***
AR2	-0.631	-0.008	0.2112	-0.871	0.13	0.982	0.921	0.652
Sargan test, p-value	106.0	106.2	108.9	109.6	97.92	84.66	106.1	106.3
	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]	[1.00]

(dependent variable: standard (corr) and FR corrected (FR-corr) correlation coefficients)

Notes: * p-value < .1; ** p-value < .05; *** p-value < .01. The results for the pair, period, and country dummies are not reported to save space, but are available from the authors. The R2 is defined as 1-RSS/TSS. No serial correlation is indicated in GMM-SYS models when, in second stage analysis, the Arellano-Bond test for second-order serial correlation is not significant, and the AR1 test shows evidence of significant negative serial correlation in the differenced residuals. For a discussion, see Doornik and Hendry (2001, 69). For the transformed equations, the internal instruments are lags 2 through 5 in models 1-5, and lag 2 in models 6, 7, and 8. The transformations used are first differences. For the levels equation, the internal instruments are lag 1 on the variables. Country dummies are also used as instruments as well as exogenous regressors.

Table 6: Financial openness and stock market correlations – Interactions by Time (Based on Model 4.7 (models 1-4) and 4.8 (models 5-8)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Var/period	Corr Gold era	Corr Interwar	Corr BW	Corr Modern	FR-corr Gold era	FR-corr Interwar	FR-corr BW	FR-corr Modern
Yt-1	0.217*** (0.021)	0.233*** (0.021)	0.226*** (0.021)	0.213*** (0.021)	0.373*** (0.022)	0.377*** (0.022)	0.374*** (0.022)	0.373*** (0.022)
***CAPITAL* account openness**	**0.168*** (0.022)**	**0.189*** (0.027)**	**0.241*** (0.032)**	**0.164*** (0.022)**	**0.057*** (0.015)**	**0.08*** (0.019)**	**0.111*** (0.023)**	**0.058*** (0.016)**
***CAPITAL** * Interwar**		-0.002 (0.048)				0.007 (0.034)		
***CAPITAL** * BWoods**			**-0.099** (0.041)**				**-0.069** (0.03)**	
***CAPITAL** * Modern**				**0.096* (0.058)**				0.013 (0.041)
Period Dummy	6.024 (7.049)	-9.350*** (3.032)	9.522*** (2.735)	-8.265** (4.184)	6.301 (4.222)	-6.052*** (2.106)	6.05*** (2.027)	-1.015 (3.039)
***CAPITAL* account differences**	**-0.087*** (0.018)**	**-0.091*** (0.019)**	**-0.079*** (0.019)**	**-0.088*** (0.018)**	**-0.065*** (0.013)**	**-0.069*** (0.013)**	**-0.06*** (0.014)**	**-0.066*** (0.013)**
Growth rate correlation	0.937 (0.660)	0.91 (0.657)	0.963 (0.658)	0.903 (0.659)	1.098 (1.175)	0.897 (1.170)	1.066 (1.177)	1.069 (1.177)
Interest Rate Correlation	1.036 (0.812)	0.819 (0.81)	0.788 (0.811)	0.869 (0.816)	7.232*** (2.206)	6.239*** (2.197)	6.559*** (2.202)	7.377*** (2.211)
National Income differences	-4.081*** (0.868)	-3.918*** (0.865)	-4.12*** (0.866)	-4.232*** (0.87)	-1.866*** (0.628)	-1.82*** (0.624)	-1.929*** (0.626)	-1.900*** (0.629)
Bi-lateral Trade	78.749*** (16.20)	74.795*** (16.02)	78.851*** (16.16)	78.686*** (16.33)	30.619*** (11.67)	28.676** (11.56)	30.572*** (11.66)	30.652*** (11.74)
Global Stock Market Correlations	0.697*** (0.038)	0.812*** (0.044)	0.726*** (0.045)	0.671*** (0.046)	0.637*** (0.054)	0.711*** (0.056)	0.615 *** (0.058)	0.622*** (0.062)
Time-Dif Between Pairs	-0.159* (0.092)	-0.173* (0.093)	-0.157* (0.092)	-0.148 (0.092)	-0.252*** (0.063)	-0.267*** (0.063)	-0.253*** (0.063)	-0.248*** (0.063)
Time-Trend	-0.112*** (0.024)	-0.314*** (0.049)	-0.139*** (0.025)	-0.101*** (0.031)	-0.075*** (0.012)	-0.18*** (0.029)	-0.085*** (0.016)	-0.079*** (0.022)
Constant	215.45*** (46.48)	608.25*** (94.50)	261.39*** (48.18)	194.51*** (60.35)	146.66*** (30.39)	350.40*** (55.34)	161.44*** (30.08)	153.84*** (43.01)
Observations	2073	2073	2073	2073	2073	2073	2073	2073
Adj. R^2	0.499	0.506	0.503	0.5	0.372	0.379	0.375	0.371
ρ	0.041*	0.022	0.027	0.04*	.009	0.003	0.004	0.009

Notes: Panel corrected standard errors in parentheses below coefficient: see Beck and Katz 1995. * p-value < .1; ** p-value < .05; *** p-value < .01. **ρ** is estimated as the coefficient of the lag of residuals run on the residuals. A statistically significant coefficient indicates the presence of serially correlated residuals. The observations are non-overlapping four year averages of the data, 1890-2001, for 16 countries comprising 120 country pairs. Models 1-6 are estimated with period and countries dummies, which are not reported to save space, but are available from the authors. Models 7 and 8, which include the indicators of time-distance and global averages of stock market correlations, cannot include period and country fixed effects.

Table 7: Robustness checks (dependent variable: Forbes-Rigobon corrected correlations)

	(1)	(2)
	Huber-Biweight robust	Median regression
***CAPITAL* account openness**	0.19	0.17
	(14.9)**	(100)**
Constant	-2.9	17.6
	(0.9)	(100)**
Observations	2198	2198
R-squared		
Fixed effects	Y	Y

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%
Note: M_ denotes the mean of a series from 1890-2005, with one value for each country-pair

Table 8

(dependent variable: Corr (8.1, 8.2, 8.4, & 8.5) and FR_Corr (8.3 and 8.6)

	(1)	(2)	(3)	(4)	(5)	(6)
Base Model	1890-2001	1890-2001	1890-2001	1954-2001	1954-2001	1954-2001
Dep. Variable	corr	corr	FR_corr	corr	corr	FR_corr
***CAPITAL* account openness**	**0.591*** (0.076)**	**0.584*** (0.064)**	**0.288*** (0.063)**	**0.585*** (0.079)**	**0.423*** (0.077)**	0.153 (0.097)
***CAPITAL* account differences**	**-0.391*** (0.069)**	**-0.230*** (0.065)**	**-0.323*** (0.059)**	**-0.354*** (0.065)**	**-0.126* (0.071)**	**-0.226*** (0.063)**
Growth rate correlation		-8.289** (3.955)	9.867 (8.481)		-3.271 (4.259)	13.623 (8.891)
Interest Rate Correlation		13.332** (5.124)	47.243*** (12.67)		24.407*** (5.932)	42.139** (17.88)
National Income differences		-5.94*** (1.476)	-1.377 (1.521)		-3.780** (1.765)	-0.837 (1.955)
Bi-lateral Trade		107.07*** (31.71)	-4.623 (39.90)		120.32*** (31.88)	47.078 (41.09)
Time-Dif Between Pairs		-0.372** (0.143)	-0.358*** (0.129)		0.074 (0.170)	-0.245* (0.140)
Constant	-0.777 (5.480)	-4.502 (4.436)	3.369 (4.092)	-1.088 (5.583)	-4.907 (5.504)	8.179 (6.030)
Observations	120	120	120	120	120	120
Adj. R^2	0.49	0.66	0.45	0.44	0.6	0.31

Notes: * p-value < .1; ** p-value < .05; *** p-value < .01. The variables are the mean of a series, with one value for each country-pair. Models 1-3 contain the full set of averaged data, though some data pairs have a shorter time period than others. Models 4-6 contain data that have been truncated to 1954-1999. All country pair data are of the same duration in models 4-6.

Table 9: Bilateral holdings, correlations and openness

	(1)	(2)	(3)
Dependent variable	correlation	Bilateral holdings	
Bilateral holdings/total holdings (2 countries)	1.41** (4.1)		
CAPITAL		0.0017** (4.03)	0.003** (3.6)
Initial correlation			-0.025 (0.7)
Change in *CAPITAL*			0.0007* (2.25)
Constant	0.31** (14.4)	-0.08* (2.7)	-0.19** (3.1)
N	120	120	120
Adj. R^2	0.12	0.11	0.14
Effect of moving from the 25th to the 75th percentile of the exogenous variable (relative to the mean of the dependent variable)	0.06 (+16%)	0.02 (+98.5%)	

Absolute value of t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

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Appendix Table 1

		Original β	**No U.S.**		
	Variable		Beta	St. error	t-stat
Model 2.5	Capital	0.124**	0.313***	0.025	12.48
Model 3.5	Capital	0.047**	0.131***	0.013	9.895
Model 4.1	Capital	0.108***	0.304***	0.024	12.61
	DIF	-0.092***	-0.047**	0.021	-2.287
Model 4.2	Capital	0.12***	0.308***	0.024	12.92
Model 4.3	Capital	0.12***	0.303***	0.024	12.66
Model 4.4	Capital	0.125***	0.314***	0.024	13.23
Model 4.5	Capital	0.123***	0.297***	0.025	12.03
Model 4.6	Capital	0.105***	0.277***	0.025	11.05
	DIF	-0.86***	-0.050**	0.021	-2.366
Model 4.7	Capital	0.171***	0.150***	0.023	6.573
	DIF	-0.088***	-0.082***	0.020	-4.064
Model 4.8	Capital	0.059***	0.047***	0.016	2.929
	DIF	-0.066***	-0.066***	0.015	-4.510
			No U.K		
	Variable	***Original β***	Beta	St. error	T-stat
Model 2.5	Capital	0.124**	0.285***	0.026	10.86
Model 3.5	Capital	0.047**	0.126***	0.013	9.469
Model 4.1	Capital	0.108***	0.262***	0.025	10.55
	DIF	-0.092***	-0.11***	0.02	-5.615
Model 4.2	Capital	0.12***	0.279***	0.025	11.27
Model 4.3	Capital	0.12***	0.267***	0.025	10.68
Model 4.4	Capital	0.125***	0.287***	0.025	11.61
Model 4.5	Capital	0.123***	0.274***	0.026	10.69
Model 4.6	Capital	0.105***	0.235***	0.026	9.020
	DIF	-0.86***	-0.106***	0.02	-5.314
Model 4.7	Capital	0.171***	0.160***	0.023	6.933
	DIF	-0.088***	-0.094***	0.02	-4.824
Model 4.8	Capital	0.059***	0.056***	0.016	3.422
	DIF	-0.066***	-0.065***	0.014	-4.686
			No US, UK		
	Variable	***Original β***	Beta	St. error	t-stat
Model 2.5	Capital	0.124**	0.307***	0.025	12.03
Model 3.5	Capital	0.047**	0.09***	0.0174	5.188
Model 4.1	Capital	0.108***	0.294***	0.026	11.43
	DIF	-0.092***	-0.064***	0.022	-2.864
Model 4.2	Capital	0.12***	0.302***	0.026	11.84
Model 4.3	Capital	0.12***	0.289***	0.026	11.19
Model 4.4	Capital	0.125***	0.308***	0.026	12.09
Model 4.5	Capital	0.123***	0.29***	0.027	10.94
Model 4.6	Capital	0.105***	0.262***	0.027	9.662
	DIF	-0.86***	-0.067***	0.023	-2.948
Model 4.7	Capital	0.171***	0.149***	0.025	6.043
	DIF	-0.088***	-0.087***	0.022	-3.972
Model 4.8	Capital	0.059***	0.049***	0.017	2.783
	DIF	-0.066***	-0.065***	0.016	-4.132

Appendix Table 2: Financial openness and stock market correlations – by Time

(dependent variable: standard (corr) and Forbes-Rigobon corrected (FR-corr) correlation coefficients) based on Models 4.7 (corr) and 4.8 (FR_corr)

	(1)	(2)	(3)	(4)	(5)	(6)
Base Model	Interwar corr	Interwar FR_corr	BWoods Corr	BWoods FR_corr	Modern corr	Modern FR_corr
$\mathbf{Y_{s-1}}$	0.284*** (0.049)	0.254*** (0.056)	0.156*** (0.381E-01)	0.237*** (0.391E-01)	0.247*** (0.033)	0.612*** (0.035)
Average Capital account openness	**0.257*** (0.058)**	**0.137*** (0.037)**	**0.209*** (0.036)**	**0.101*** (0.026)**	**0.314*** (0.056)**	**0.110*** (0.039)**
Capital account **differences**	**-0.073* (0.042)**	**-0.067*** (0.026)**	**-0.106*** (0.03)**	**-0.078*** (0.021)**	-0.035 (0.041)	-0.015 (0.027)
Growth rate correlation	0.603 (1.567)	0.898 (3.802)	-1.202 (1.171)	1.25 (2.169)	3.347*** (0.886)	-0.270 (1.378)
Interest Rate Correlation	4.807** (2.085)	13.229** (5.397)	2.044 (1.348)	7.32** (2.952)	-2.869** (1.282)	-9.794* (5.919)
National Income differences	-3.594* (1.992)	-1.473 (1.357)	-5.485*** (1.580)	-2.489** (1.185)	-4.443*** (1.156)	-1.791** (0.777)
Bi-lateral Trade	-30.924 (26.02)	-33.444* (20.12)	164.83*** (37.78)	81.531*** (29.03)	102.0*** (16.38)	24.232* (13.61)
Global Stock Market Correlations	0.482*** (0.174)	0.205 (0.254)	0.667 *** (0.168)	0.647*** (0.168)	0.890*** (0.063)	0.752*** (0.078)
Time-Dif Between Pairs	-0.315 (0.254)	-0.284* (0.159)	-0.251* (0.150)	-0.303*** (0.107)	0.125 (0.122)	-0.189** (0.079)
Time-Trend	-0.286 (0.191)	-0.332** (0.131)	-0.422*** (0.101)	-0.317*** (0.717E-01)	-0.553*** (0.141)	-0.389*** (0.096)
Constant	548.09 (370.2)	643.55** (255.0)	823.35*** (195.7)	619.91*** (140.2)	1068.8*** (276.7)	759.18*** (187.8)
Observations	418	418	795	795	840	840
Country Pairs	112	112	120	120	120	120
Adj. R^2	0.253	0.226	0.207	0.21	0.609	0.587
ρ	0.005	0.042			0.006	-0.063

Notes: * p-value < .1; ** p-value < .05; *** p-value < .01. Panel corrected standard errors in parentheses below coefficient: see Beck and Katz 1995. Because panel corrected standard errors cannot be computed for observations where the panel is t=1, a number of pairs are omitted from analysis. **ρ** is estimated as the coefficient of the lag of residuals run on the residuals. A statistically significant coefficient indicates the presence of serially correlated residuals.