Free Flows, Limited Diversification: Openness and the Fall and Rise of Stock Market Correlations, 1890—2001

Author(s): Dennis Quinn and Hans-Joachim Voth

Source: *NBER International Seminar on Macroeconomics*, Vol. 6, No. 1 (2009), pp. 7-39

Published by: The University of Chicago Press on behalf of the The National Bureau of Economic Research

Stable URL: https://www.jstor.org/stable/10.1086/648693

1

Free Flows, Limited Diversification: Openness and the Fall and Rise of Stock Market Correlations, 1890–2001

Dennis Quinn, *Georgetown University*
Hans-Joachim Voth, *Universitat Pompeu Fabra, ICREA, and CEPR*

That international diversification is good for stock market investors is a key result of modern portfolio theory. As early as 1909, Henry Lowenfeld, in his *Investment, an Exact Science*, 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* ("Dancing in Step," March 24, 2001) highlighted that stock market correlations grew sharply in the 1990s. Goetzmann, Li, and Rouwenhorst (2005) were among the first to examine return correlations over the long run. They find major changes during the period 1860–2000. According to their paper, the risk reduction achievable by sending funds abroad has fallen from 90% in the 1950s to 65% at the end of the twentieth century. Benefits can still be substantial, but they are much smaller than analysts writing in the 1960s believed. 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. Our data set spans the whole period from the nineteenth-century heyday of global capital flows, across the period of turmoil during the interwar period, to the recent, gradual return to growing cross-border flows (Bordo, Eichengreen, and Kim 1998; Bordo, Eichengreen, and Irwin 1999; Obstfeld and Taylor 2002). Independent of the measure

978-0-226-70749-5/2010/2009-0010$10.00

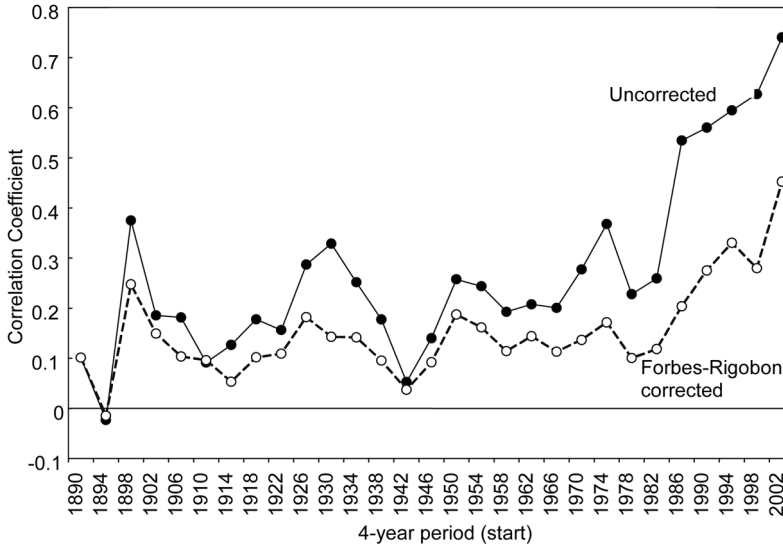

Fig. 1. Two measures of equity market correlations. Each observation represents the average equity market correlation coefficient in a group of 16 countries, for 4-year panels, 1890–2001. The 16 countries in our data set are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the United States. "Uncorrected" is the equity market correlation of a pair of countries and is taken from Global Financial Data. The Forbes-Rigobon volatility adjusted equity correlation is proposed in Forbes and Rigobon (2002) and used here.

we use, equity market correlations were modestly 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 increasing contagion in financial markets, driven by changes in investor composition. There is a common view that liberalized markets show a higher degree of comovement with world indices (Bekaert and Harvey 2000). In an increasingly connected world, real variables could start to move in unison as a result of greater trade, coordinated policies, and so forth. Alternatively, growing specialization could lead to growing divergence of economic cycles.

This paper argues that the liberalization of capital accounts was a major causal factor behind growing return correlations, exploiting a new extension of a long-run data set on policy-induced openness. We undertake a comprehensive analysis of the fall and rise of return correlations over the last century, using the first consistent, detailed data set

on capital account openness since 1890. Such long-run data, we argue, are crucial for determining the effects of policy for two reasons. First, many papers in the liberalization literature focus on regulatory changes at the frequency of months or, at most, years. Implementation lags can be and often are long and variable. This may in turn obscure the true consequences of new rules and regulations. Second, we have detailed information on changes in openness. 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 postwar period—share prices began to comove.

Our findings have important implications for sustainable risk-return trade-offs in international equity portfolios. First, the set of feasible diversification opportunities was always much smaller than simple analysis of correlations from the immediate postwar period suggests. Much of the investment advice derived from the early studies on diversification benefits could not have been followed in practice. 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 key investors switch from national to foreign, global factors start to drive national returns. While some benefits remain, optimal 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 not easily move their investments abroad; when they did, returns started to move in lockstep.

Papers closest in scope to ours are Goetzmann et al. (2005) and Bekaert and Harvey (2000). Goetzmann et al. assemble a comprehensive data set 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.[1] Bekaert and Harvey show that correlations and betas increase

after liberalization of capital markets, using a number of case studies from emerging countries in the recent past.[2]

Other papers also touch on the question of equity correlations and financial openness. Dellas and Hess (2005) show that stock market synchronization increases with the liquidity of equity markets and greater financial depth. Bekaert, Hodrick, and Zhang (2005) examine correlations over the period 1980–2003, finding no evidence of an upward trend in correlations. 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, Errunza, and Hogan (2007) 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 U.K. exchange control liberalization had no immediate impact on stock market correlations but led to long-run shifts.[3] Hunter (2005) examines Argentine, Mexican, and Chilean American depositary receipts. 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 U.S. investors have not declined over the last two decades (DeSantis and Gerard 1997; Lewis 2006). Ang and Bekaert (2002) argue that while correlation patterns 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 they 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, among others, Henry (2000).[4] Coeurdacier and Guibaud (2004) argue that shocks to wealth and portfolio

rebalancing are responsible for growing comovements of stock market indices.

Another closely related body of literature analyzes the extent of international capital market integration over the long run. Obstfeld and Taylor (2003) argue that the period since the late nineteenth 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 twentieth century. Obstfeld and Taylor (2002) examined equity market correlations over the long run, but without an explicit link with policy variables. Volosovych (2007) focuses on international bond markets during the period 1875–2002. He employs principal components analysis to conclude that integration in the last period of globalization during the late nineteenth century was markedly lower than in the last 20 years. Similar data and methods were employed by Mauro, Sussman, and Yafeh (2002), who argue that contagion in modern-day bond markets has become much greater than it was historically. Bordo and Murshid (2006) find the opposite, on the basis of their measure of currency crises.

We proceed as follows. In Section I, we describe the data sets 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. The equity return data are from a range of standard sources. The results section (Sec. II) examines to what extent we can find a systematic link between openness and returns correlations in our panel. Then, in Section III, we subject the data to a range of robustness tests and extensions. Finally, in Section IV, we discuss the implications of our findings. Section V presents conclusions.

I. Data

We use a single, consistently defined measure of de jure capital account openness—CAPITAL—for the period 1890–2001. Quinn (1997) and Quinn and Toyoda (2007) derive measures of capital and current account openness for the postwar period from the International Monetary Fund's *Annual Report on Exchange Restrictions*, based on a coding of the legal provisions governing international financial transactions.[5] To create a measure of capital account openness over the long term (1890–1938), Quinn (2003) used the coding rules described in Quinn (1997) and as data sources League of Nations (1923, 1922). The information in these sources is supplemented by Einzig (1934), Ellis (1939, 1940), IMF (1949), and Palyi (1972). We employ data for 16 of the countries in the sample.[6] The

Quinn-Toyoda measures of capital account and current financial account openness are widely used in empirical studies in finance and economics.[7]

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 therefore a composite of de jure and de facto restrictions on capital flows. It is a more finely graded measure of openness than the dichotomous variables compiled by the IMF itself (which requires an all-or-nothing decision about when a country should be counted as "closed"). Openness on this measure varies from 0 (completely closed) to 100 (no restrictions). Values below 50 generally indicate that international capital transactions are highly restricted.

To fix ideas, we briefly describe how the data were coded with respect to securities in two prominent cases. We take Britain and France in 1965 as illustrative. British controls on potential capital flows in the 1960s were extensive. The IMF (1965) noted the web of British regulations and restrictions on direct and portfolio investments. In particular, the rules governing transfers of securities between U.K. residents and nonresidents were extensive and were targeted at (*a*) inward portfolio flows especially and (*b*) forcing settlements in currencies other than sterling:

> [While] transactions in securities of all types may be carried out freely between residents of the United Kingdom … permission is required for all transfers of securities in the United Kingdom in which a nonresident is involved as either transferor or transferee, but most transferors are covered by a general authority.
>
> Nonresidents … may buy any securities on a recognized stock exchange in the United Kingdom [but only] against payment from an External Account; against payment from a Blocked Account, they may buy most sterling securities. Securities so purchased may be exported from the United Kingdom. Foreign currency securities may be sold by nonresidents on a stock exchange in the United Kingdom for settlement only in foreign currency. In no circumstances may settlement be in sterling. (IMF 1965, 549)

Nonresident access to the U.K. securities markets for capital raising was also controlled through a permit system:

> 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.

Similarly, residents faced significant (but fewer) restrictions on the sources of funds for outward portfolio purchases:

> Residents of the United Kingdom may make capital transfers without restriction to other Sterling Area countries, except Hong Kong (see section on Exchange Control Territory, above). All capital transfers by residents to countries outside the Sterling Area require approval.… The purchase of foreign currency securities outside the Sterling Area must also be financed with investment currency or, in some cases, by long-term borrowing outside the Sterling Area. (548)

The permission requirements for nonresident securities purchases, the restrictions on uses and sources of funds by nonresidents, and the general restrictions on the currency used in settlements for nonresident transactions amount to extensive inward restrictions. Outward flows, while still restricted, were affected less by onerous restrictions. Britain in 1965 receives a CAPITAL score of 37.5 (out of 100), which implies extensive controls of the form of investments and the way they can be paid for.

> France in 1965 was, in contrast, much less restrictive. The IMF noted that Securities may be imported and exported freely through authorized banks as follows: imported on behalf of residents or nonresidents, exported on behalf of nonresidents …, or exported on behalf of residents for the purpose of selling the securities in accordance with the regulations mentioned in the preceding paragraph. Dealings in securities on a spot or forward basis may be made in France by all nonresidents. Residents may carry out spot forward transactions in securities on foreign stock exchanges. (199)

Nonresidents, in particular, had fewer restrictions on securities and other investments in France compared to Britain:

> Issues of securities in France by nonresidents require the approval of the Ministry of Finance.… [But] within the limits described below, nonresidents may freely make investments in France and deal in securities in France. They are permitted to repatriate the proceeds accruing from the liquidation of approved investments and from the sale of their securities in France. (197)

In general, "nonresidents may freely make direct investments in France and deal in securities in France" (198). France, in 1965, received a score of 75 (out of 100), which implies moderate controls.

Figure 2 shows the development of average openness and the distribution within the sample. At the end of the nineteenth century, openness is high, approaching the maximum of 100 in many cases. Over the twentieth century, it follows the U shape identified by Obstfeld and Taylor (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 World War II.[8]

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

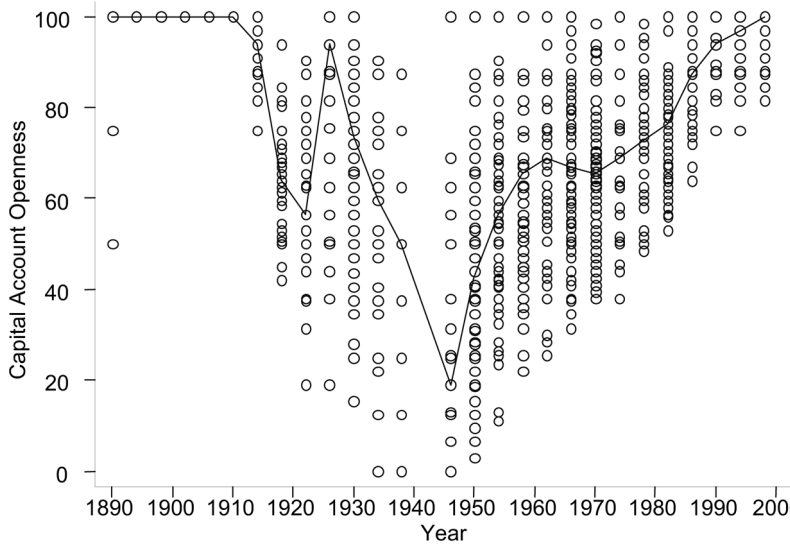

Fig. 2. Average capital account openness, 1890–2001 (line), with dots indicating the pairwise capital account openness for each country pair in the sample. The line connects median capital account openness in our sample of 16 countries. Each circle represents openness for a country in our sample during nonoverlapping 4-year periods, 1890–2001. The 16 countries are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the United States. Capital account openness measures the intensity of regulatory restrictions on capital movements between a pair of countries and is from Quinn (2003) and is extended here. The measure is scaled 0–100, with larger values indicating greater openness.

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.

In principle, there are two strategies available to researchers interested in equity return correlations over the long term: using all available markets, with shifting sample composition over time, or focusing on a (much smaller) subset of indices in continuous observation over the very long run. Goetzmann et al. (2005) mainly use a stable set of markets for which data for the past century are available. We follow a similar approach, favoring consistency and ease of interpretation over breadth of coverage, and focus on our set of 16 countries for which we have almost uninterrupted data series spanning the period 1890–2001.

We calculate the returns as monthly log differences of the main country return indices, taken from Global Financial Data (https://www.globalfinancialdata.com/).[9] Correlations are derived for 29 nonoverlapping 4-year periods from 1890 to 2006. 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 data set contains a total of 2,263 observations. Table 1 summarizes the main statistics. Real return correlations in our data set range from −0.48 to 0.905, with an average of 0.31. Corrected for the Forbes-Rigobon bias, the mean falls to 0.16, and the maximum correlation is 0.78.

To control for changes in the comovements of fundamentals, we use data on GDP growth, interest rates, and trade. From Maddison's (2002) GDP figures, we derive growth correlations. The accuracy and reliability of his figures have been questioned. Discussion mainly centers on Maddison's 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. In the spirit of Bracker, Docking, and Koch (1999), to examine other real linkages, we employ the Barbieri (2002) data set on trade volumes to derive 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 World War I (fig. 3). They appear to have more of a "J shape," similar to the pattern identified by Volosovych (2007). 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

Table 1
Descriptive Statistics

	Mean	Median	Standard Deviation	*N*
Capital account openness (CAPITAL)	69.328	72	23.323	2,263
Return correlation[a] (return)	31.023	29.602	23.784	2,263
FR corrected return correlation[a] (returnfr)	16.257	13.253	15.415	2,263
Growth correlation[a] (growth)	.188	.291	.577	2,263
Interest rate correlations (interest)	.393	.532	.482	2,263
Income differences (IncDif)	.642	.565	.456	2,263
Bilateral trade/gdp (bitrade)	.019	.009	.029	2,165
Trade volume/GDP (trade)	.004	.001	.008	1,061

Note: These data are descriptive statistics for 120 country pairs, observed for nonoverlapping 4-year periods, during 1890–2001. The 16 countries are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the United States. Capital account openness measures the intensity of regulatory restrictions on capital movements between a pair of countries and is from Quinn (2003) and extended here. The measure is scaled 0–100, with larger values indicating greater openness. "Return correlation" is the equity market correlation of a pair of countries and is taken from Global Financial Data. The Forbes-Rigobon volatility-adjusted equity correlation is proposed in Forbes and Rigobon (2002) and used here. We use Maddison's (2002) GDP figures to compute pair growth correlations and national income differences. The Barbieri (2002) data set on trade volumes is used to derive bilateral trade intensity and average total trade volumes. Interest rate correlations are the pair's correlation on 10-year government bond yields, taken from Global Financial Data.
[a]Indicates that the variable was multiplied by 100.

Great Depression. During the 1930s, they fell to low levels, bottoming out in the period 1942–45. The postwar period saw a recovery and a first peak after 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 and Rigobon (2002) demonstrate, measured correlations are affected by the volatility of returns. For the volatility suffered by investors in their portfolio, the uncorrected measure matters. We use the correction to examine if changes in volatility drive our results, using the correction

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

where ρ_{it} is the corrected correlation coefficient for country pair i at time t, ρ_{it}^{u} is the uncorrected correlation, and δ_{it} is the increase in the variance of the returns in any 4-year interval relative to the period with the minimum variance. In effect, ρ_{it} is a scaled-down version of ρ_{it}^{u}, with the magnitude of the adjustment depending on the relative increase in the variance of

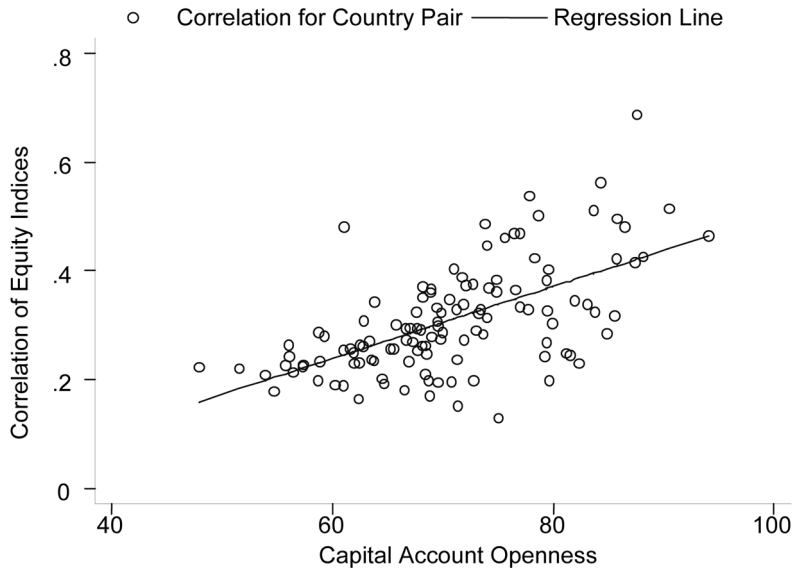

Fig. 3. Average capital account openness and equity market correlations, 1890–2001, by country pair. These data are the averages for capital account openness and equity market correlations for dyads in our sample, 1890–2001. The 16 countries are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the United States. The pairing of these 16 countries yields 120 unique country pairs. Capital account openness measures the intensity of regulatory restrictions on capital movements between a pair of countries and is from Quinn (2003) and is extended here. The measure is scaled 0–100, with larger values indicating greater openness. "Return correlation" is the equity market correlation of a pair of countries and is taken from Global Financial Data.

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 1920s 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 4-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.

Table 1 provides descriptive statistics of the main variables in our data set. Table 2 gives pairwise correlation coefficients. Most variables are highly correlated with each other. In particular, capital account openness is highly and positively correlated with return correlations, corrected and uncorrected. The correlation coefficient of growth rates is also significantly higher where capital accounts are more open, but the coefficient is not large (0.09). This suggests that fundamentals may be more synchronized in country pairs that allow for free capital flows—an issue to which we will return later. Greater openness to trade, and more bilateral trade, also seem to go hand in hand with a more open capital account and with higher return correlations.

II. Results

What explains the fall and rise 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 the one hand and by fundamentals on the other. Results suggest that both factors play a role but that the impact of regulation-induced financial openness is stronger. Before analyzing our data for the last century as a whole, we first return to our earlier case study of France and the United Kingdom to examine in more detail these countries' regulatory regime in the postwar era.

A. Case Study

During the period 1958–61, equity return correlations between the United Kingdom and France were a mere 0.2 (uncorrected, and 0.17

Table 2
Pairwise Correlations

	CAPITAL	Return	Returnfr	Growth	Interest	IncDif	Bitrade	Trade
CAPITAL	1							
Return	.492*	1						
Returnfr	.332*	.81*	1					
Growth	.093*	.1*	.082*	1				
Interest	.213*	.239*	.214*	.064*	1			
IncDif	.112*	−.066*	−.084*	−.078*	−.036	1		
Bitrade	.228*	.251*	.200*	.124*	.152*	.167*	1	
Trade	.270*	.338*	.209*	.049*	.170*	−.141*	.569*	1

Note: The pairwise correlations of the variables listed in table 1 are reported here. See table 1 for definitions and descriptive statistics.
*Significant at the .05 level or beyond.

Forbes-Rigobon corrected). This should have made it highly attractive for U.K. investors to buy French equities, and vice versa. Yet, average capital account openness was low. In 1965, for example, for CAPITAL, the scores are 75 for France and 37.5 for Britain, for an average of 56.25. A detailed look at the regulation in place in 1965 suggests that British investors could not have easily purchased French shares, and French investors could not have easily invested in Britain. The potential portfolio diversification that beckoned on the 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 transactions: openness in France declined in 1966–69 to 62.5. Combined with a score of 44 for the United Kingdom, the average decreased to 53. Outcome measures such as the spread between domestic and external interest rates suggest that tightening regulations led to increasing market segmentation. The gap between internal and Euromarket interest rates for instruments denominated in pounds and francs became substantial and persisted during this period of tightening capital controls. Between December 1971 and May 1979 (the date of Margaret Thatcher's election), the correlation between monthly external and internal sterling interest rate instruments was only 0.3. For France after Bretton Woods, the correlation between domestic and external interest rates was even lower: 0.09 (Quinn and Jacobson 1989). As we would expect if policy-driven openness was a key determinant of equity market correlations, correlations between the two markets fell to a mere 0.12.[11]

It was not until 1979, when Britain under Thatcher abolished many regulations restricting the free market, that the capital account was fully liberalized (achieving a perfect score of 100). The Conservatives came to power after the May 3 election: by July 18, the Thatcher government had abolished all controls on direct investment and eased or eliminated most restrictions on portfolio investment, including the onerous "115 percent cover … for overseas portfolios financed by foreign currency" (IMF 1980, 422). On October 23, 1979, "the Government announced the removal of all remaining exchange controls. … Portfolio investments were wholly freed, as was dealing in gold. The requirement that foreign currency securities be deposited with authorized institutions was abolished" (422). After 1979, the correlation between domestic and Eurosterling interest rate changes rose to 0.96. This suggests that British capital markets were much more integrated with global capital markets than they had been. At the same time, following the Thatcher reforms, equity market

correlations for the CAC-40 and the FTSE-100 also jumped—but only to 0.4 in the period 1982–85, in part because of tightened capital account restrictions by the Socialist government of President Francois Mitterrand. France, in this instance, changed relative position from leader to laggard in financial openness. It was only during the run-up to Economic and Monetary Union (EMU) that the French capital account was opened comprehensively. By 1990, France had a score of 87.5, indicating a low degree of restriction overall. Return correlations between the British and French indices reached 0.71 (and 0.59 Forbes-Rigobon corrected).

B. Main Results

As a first pass through the argument, we use the mean correlation coefficient and capital account openness over the longest period for each country pair. If the argument that policy-induced openness systematically leads to higher correlations is right, we should find that country pairs that maintained relatively open capital accounts should show much greater comovement of equity returns. Figure 3 suggests that our hypothesis receives qualified support from the data. At values below 60, return correlations are around 0.2 or so. As capital flows become easier, correlations increase. Above 80, they generally exceed 0.4.

Capital account openness did not just differ between country pairs; it also changed dramatically over time. To obtain our main results, we use both sources of variation. We estimate models of the type

$$\rho_{i,t} = a_i + \beta Q_{i,t} + \gamma X'_{i,t} + \varepsilon, \tag{2}$$

where $\rho_{i,t}$ is the correlation coefficient (corrected or uncorrected) for country pair i at time t, a is a pair-specific intercept, Q is the capital-account-related measure of openness, and X' is a vector of controls. Estimating with fixed effects ensures that confounding factors that may simultaneously produce high values for openness and for return correlations in a particular country pair are not responsible for our results. As part of our robustness checks, we also estimate with period dummies.

Table 3, model 1, presents the results with uncorrected correlations as the dependent variable, using no time or country dummies. A 1% increase in capital account openness raises correlations of equity markets by 0.5%; a 25-point change in this 0–100 variable predicts an increase in equity market correlations of 12.5%, or 0.125 points in equity correlations on the original scale. As we add pair fixed effects (model 2), the coefficient on Q falls slightly but remains highly significant. When we

Table 3
Financial Openness and Stock Market Correlations (Dependent Variable: Standard and Forbes-Rigobon Correlation Coefficients)

	Dependent Variable: Return			Dependent Variable: Return-FR		
	(1)	(2)	(3)	(4)	(5)	(6)
CAPITAL account	**.502****	**.477****	**.144****	**.22****	**.192****	**.071****
openness	(27.13)	(25.21)	(4.933)	(16.9)	(15.97)	(3.354)
Constant	–3.389	.173	50.369**	1.032	.915	19.833**
	(–2.816)	(.035)	(511.29)	(1.107)	(.302)	(6.129)
Pair fixed effects	N	Y	N	N	Y	N
Country dummies	N	N	Y	N	N	Y
Period dummies	N	N	Y	N	N	Y
Adjusted R^2	.24	.32	.51	.11	.33	.35

Note: We estimate ordinary least squares (OLS) regressions of capital account openness's effect on the correlation of equity market returns for a pair of countries. The dependent variable is either the correlation of the returns between a pair of countries' equity markets (return) or the correlations adjusted for volatility using the Forbes-Rigobon correction (return-FR). *t*-statistics computed from panel-corrected standard errors are in parentheses below the coefficients (see Beck and Katz 1995). Sixteen countries in 120 country pairs totaling 2,263 observations constitute the sample. The observations are nonoverlapping 4-year averages of the data, 1890–2001. Models 1 and 4 are random effects models; models 2, 3, 5, and 6 contain pair, period, or country unit effects. The coefficient estimates of the pair, period, and country dummies are not reported to save space but are available from the authors. Hausman tests (not reported here) strongly reject the use of random effects in favor of pair fixed effects.
*p-value < .05.
**p-value < .01.

use country and period dummies, the coefficient declines markedly, to a third or less of the size estimated in models 1 and 2. Yet even if a large share of the variation over time and in the cross section is absorbed by fixed effects, capital account openness emerges as an important and large predictor of changes in equity market correlations.

In models 4–6, we use the Forbes-Rigobon (FR) corrected returns as the dependent variable. Capital account openness is also a significant predictor of correlations. As the FR corrected correlations vary less, the coefficient on Q declines in magnitude. A 25-point increase in openness predicts an increase of FR correlations by 1.75 to a 5.5% increase in FR correction correlations. An obvious concern is that we may be simply picking up the effect of other, more important variables that changed in the same way over time and in the dyads in our sample. In table 4, we control for these factors. We add growth rate correlations in models 1–7 to take the most basic of fundamentals into account. Growth rate correlations are close to standard levels of significance when included on their own (model 1). Combined with other proxies for correlated fundamentals, they do not emerge as consistently significant. Bilateral trade, on the

Table 4
Financial Openness and Stock Market Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	A. Dependent Variable: Return						
CAPITAL account openness	**.474****	**.293****	**.502****	**.300****	**.486****	**.105***	**.145****
	(25.21)	(9.841)	(25.1)	(9.976)	(24.17)	(2.389)	(4.896)
Growth rate correlation	1.263	.609	1.053	.492	.887	1.474	1.334*
	(1.727)	(.617)	(1.44)	(.497)	(1.209)	(.928)	(2.097)
Bilateral trade			74.655**		68.837**		91.661**
			(3.389)		(3.227)		(4.866)
Trade		564.26**		522.34**		102.26	
		(6.744)		(5.961)		(1.157)	
Interest rate correlation				−.038	4.105**	2.028	3.088**
				(−.031)	(4.66)	(1.277)	(3.402)
National income differences				−12.735	−12.336**	−2.188	−4.333**
				(−1.803)	(−2.73)	(−1.447)	(−4.213)
Constant	−3.389	11.319*	−4.641	17.707**	2.369	48.632**	51.362**
	(−2.816)	(2.007)	(−.902)	(2.662)	(.407)	(6.916)	(10.47)
Pair fixed effects	Y	Y	Y	Y	Y	N	N
Country dummies	N	N	N	N	N	Y	Y
Period dummies	N	N	N	N	N	Y	Y
Observations/pairs	2,263/120	1,061/73	2,165/120	1,061/73	2,165/120	1,061/73	2,165/120
Adjusted R^2	.32	.31	.35	.31	.36	.43	.53

	B. Dependent Variable: Return-FR						
CAPITAL account openness	**.187****	**.098****	**.202****	**.101****	**.202****	**.061***	**.075****
	(15.48)	(5.147)	(15.33)	(5.528)	(15.46)	(1.996)	(3.441)
Growth rate correlation	3.65	.089	3.212**	.183	3.121**	2.437	2.259
	(2.96)	(.046)	(2.639)	(.094)	(2.579)	(1.244)	(1.878)
Bilateral trade			49.193**		49.71**		69.53**
			(2.752)		(2.789)		(4.394)
Trade		94.704		66.353		126.47	
		(1.696)		(1.164)		(1.958)	
Interest rate correlation				5.463*	10.105**	5.564*	8.817**
				(2.035)	(4.655)	(2.824)	(4.011)
National income differences				−9.45*	−4.442	−.07	−1.645*
				(−2.185)	(−1.573)	(−.069)	(−2.161)
Constant	.957	7.642*	−2.084	11.948**	.005	14.625**	17.538**
	(.314)	(2.097)	(−.674)	(2.902)	(.002)	(3.119)	(4.957)
Pair fixed effects	Y	Y	Y	Y	Y	N	N
Country dummies	N	N	N	N	N	Y	Y
Period dummies	N	N	N	N	N	Y	Y
Observations/pairs	2,263/120	1,061/73	2,165/120	1,061/73	2,263/120	1,061/73	2,165/120
Adjusted R^2	.33	.26	34	.29	.35	.30	.38

Note: We estimate OLS regressions with controls for capital account openness's effect on the correlation of equity market returns for a pair of countries. The description of the control variables is found in table 1. In panel A, the dependent variable is the correlation of the returns between a pair of countries' equity markets (return). In panel B, the dependent variable is the correlation of the returns between a pair of countries' equity markets adjusted for volatility using the Forbes-Rigobon correction. These OLS models are panel fixed-effects models with either pair fixed effects or period and country fixed effects. *t*-statistics using panel-corrected standard errors are in parentheses below the coefficients (see Beck and Katz 1995). Sixteen countries in 120 country pairs constitute the sample for models 1, 3, 5, and 7, and 16 countries in 73 country pairs constitute the sample for models 2, 4, and 6. The observations are nonoverlapping 4-year averages of the data, 1890–2001. The coefficient estimates of the pair, period, and country dummies are not reported to save space but are available from the authors.
*p-value < .05.
**p-value < .01.

other hand, emerges as an important and statistically significant predictor of correlations. 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. Trade exposure overall is also a good predictor of correlations, but it is not significant in all specifications. When we use country and period dummies and use the full vector of controls, we do not obtain a statistically significant coefficient for the trade variables. The same is true of interest rate correlations. National income differences in general predict lower correlations between equity indices, but again, the effect is not significant in all specifications. In contrast, what emerges as consistently significant is Q—capital account openness. The estimated effects range between 0.11 and 0.5 and are highly statistically significant in all specifications.

In panel B of table 4, we use FR corrected correlations. Again, the estimated effects of our capital account measure are always highly statistically significant and substantive. As in the specification using uncorrected correlations, neither the size nor the magnitude of the coefficients on Q in table 4 is reduced by adding control variables (compared to matching models in table 3). Higher correlations of output growth rates predict higher equity market correlations, but the effect is not significant in all models. Interest rate correlations are consistently significant, as is bilateral trade.

Our results in tables 3 and 4 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 postwar period, for example, the IMF's standard measure (which indicates only 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 liberalized only recently and whose equity markets do not have a long history. A data set that included them would arguably contain even more identifying variance and could show larger effects.

III. Robustness

In this section, we examine the robustness of our main result. We test if a handful of countries drive our result. Next, we turn to the stability of effects by subperiod. Did the strength of the openness-correlation nexus increase over time? Finally, we examine if serial correlation in

our explanatory variable produces an upward bias in the estimated significance level.

The United States and the United Kingdom were the two dominant financial markets during the last century and a half. They appear numerous times in our country pairs. If they drove an important part of our results, this could be cause for concern. How does omitting either or both countries from the analysis influence the results? In table 5, we examine the robustness of our findings to dropping the United States and the United Kingdom from the sample.

Overall, we find that our results are highly robust to the omission of the United States and the United Kingdom. The coefficient estimates for average capital account openness are always positive and statistically significant at the 0.01 level. The only exception is for the corrected correlation coefficient in table 5, panel B, model 6, in which more than half the sample is lost because of data limitations, and where the coefficient is significant at the 0.05 level. The magnitude of the coefficients does not change markedly. We find a range of 0.12–0.47 for the simple return correlations and of 0.06–0.2 for the Forbes-Rigobon corrected ones.

How stable are our results in different subperiods since 1890? Table 6 gives the results if we subdivide our data set into three broad periods: 1890–1917 to examine correlations in the last age of globalization, 1918–53 for the long interwar period from World War I to the end of immediate reconstruction, and 1954–2001, which covers the Bretton Woods period and the second period of globalization.

For the period before 1918, we have to estimate without fixed effects, since there is not enough variation over time to use a difference-in-difference approach. For both the uncorrected and the FR corrected coefficients, we find a positive effect of greater openness. The coefficient is large, but since Q is not cardinal in nature, there is no meaningful way to compare the coefficient on Q across periods. Growth rate correlations once again emerge as significant, and trade, interest rate correlations, and national income differences have the predicted sign even if only growth rates emerge as significant when we use the uncorrected specifications.

For the period of turmoil during the interwar period and immediately following World War II, we find a statistically significant effect of Q on both dependent variables. Bilateral trade surprisingly appears negatively correlated with equity market comovements. Since the interwar period saw the collapse of the global trading system, we surmise that the effects of the Great Depression are indirectly responsible for this result.

Table 5
Pooled, Cross-Section, Time-Series Regressions without United States or United Kingdom: Financial Openness and Stock Market Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	A. Dependent Variable: Return						
CAPITAL account openness	**.455****	**.256****	**.473****	**.26****	**.453****	**.117***	**.148****
	(21.52)	(6.851)	(21.04)	(6.616)	(19.64)	(2.075)	(4.383)
Growth rate correlation	.409	−.408	.166	−.395	−.081	.73	1.058
	(.478)	(−.301)	(.192)	(−.292)	(−.095)	(.6)	(1.416)
Bilateral trade			81.166**		74.793**		47.006*
			(3.139)		(3.014)		(2.014)
Trade		467.05**		460.84**		−101.32	
		(4.333)		(4.175)		(−.957)	
Interest rate correlation				−.232	4.568**	1.229	3.365**
				(−.15)	(4.509)	(.776)	(3.239)
National income differences				−3.441	−5.967	−2.442	−3.792**
				(−.295)	(−1.022)	(−.664)	(−2.747)
Constant	7.107	19.33**	5.069	19.231**	4.894	54.662**	54.453**
	(1.832)	(4.528)	(−.902)	(4.459)	(1.272)	(6.93)	(11.29)
Pair fixed effects	Y	Y	Y	Y	Y	N	N
Country dummies	N	N	N	N	N	Y	Y
Period dummies	N	N	N	N	N	Y	Y
Observations/pairs	1,683/91	616/45	1,604/91	616/45	1,604/91	616/45	1,604/91
Adjusted R^2	.30	.31	32	.31	.33	.43	.52

	B. Dependent Variable: Return-FR						
CAPITAL account openness	**.178****	**.058***	**.192****	**.063****	**.189****	**.08***	**.079****
	(13.14)	(2.498)	(12.873)	(2.601)	(12.64)	(2.108)	(3.129)
Growth rate correlation	3.578**	−.201	3.253**	−.185	3.157*	3.118	2.455
	(2.551)	(.079)	(2.639)	(.073)	(2.291)	(1.256)	(1.849)
Bilateral trade			35.078		35.299		24.845
			(1.716)		(1.728)		(1.226)
Trade		14.969		5.64		126.47	
		(.236)		(.086)		(1.958)	
Interest rate correlation				1.544	10.095**	5.564*	8.041**
				(.434)	(3.837)	(2.824)	(2.577)
National income differences				−4.619	−.999	−.07	−3.298**
				(−.691)	(−.0274)	(−.069)	(−2.935)
Constant	11.29**	20.187**	9.912**	19.839**	9.18	14.625**	25.821**
	(3.6)	(6.021)	(3.101)	(5.908)	(3.002)	(3.119)	(3.821)
Pair fixed effects	Y	Y	Y	Y	Y	N	N
Country dummies	N	N	N	N	N	Y	Y
Period dummies	N	N	N	N	N	Y	Y
Observations/pairs	1,683/91	616/45	1,604/91	616/45	1,604/91	616/45	1,604/91
Adjusted R^2	.31	.16	31	.16	.32	.22	.36

Note: In panel A, the dependent variable is the correlation of the returns between a pair of countries' equity markets. In panel B, the dependent variable is the correlation of the returns between a pair of countries' equity markets adjusted for volatility using the Forbes-Rigobon correction. All observations containing data for either the United States or the United Kingdom are omitted. The description of the control variables is found in table 1. These OLS models are panel fixed-effects models with either pair fixed effects or period and country fixed effects. *t*-statistics using panel-corrected standard errors in parentheses are reported below the coefficient estimates (see Beck and Katz 1995). Fourteen countries in 91 country pairs constitute the sample. The observations are nonoverlapping 4-year averages of the data, 1890–2001. The coefficient estimates of the pair, period, and country dummies are not reported to save space but are available from the authors.

*p-value < .05.

**p-value < .01.

Table 6
Panel Regressions by Historical Subperiods: Financial Openness and Stock Market Correlations

	Dependent Variable: Return			Dependent Variable: Return-FR		
	1890–1917	1918–53	1954–2001	1890–1917	1918–53	1954–2001
	(1)	(2)	(3)	(4)	(5)	(6)
CAPITAL account	**23.706***	**.243****	**.849****	**20.08***	**.118****	**.323****
openness	(2.588)	(8.291)	(28.0)	(2.843)	(5.546)	(18.52)
Growth rate correlation	24.891*	.921	.271	54.409	3.311	2.189
	(2.006)	(.813)	(.323)	(1.805)	(1292)	(1.732)
Bilateral trade	244.20	−36.675*	154.02**	111.27	−13.529	55.631*
	(.623)	(−2.267)	(4.463)	(.401)	(−.822)	(2.101)
Interest rate correlation	.185	−1.216	1.593	1.606	2.28	12.847**
	(.015)	(−.857)	(1.627)	(.099)	(.582)	(4.905)
National income	−11.711	−49.218**	5.687	−12.679	−22.677**	5.101
differences	(−.638)	(4.958)	(.719)	(−1.043)	(−3.366)	(1.096)
Constant	−2340.9*	11.319*	−20.63**	−1977.6*	13.652*	−22.177**
	(−2.547)	(2.007)	(−4.241)	(−2.798)	(2.469)	(−5.556)
Observations/pairs	15/6	709/19	1,440/120	15/6	709/19	1,440/120
Adjusted R^2	.28	.24	.50	.33	.22	.52

Note: We estimate OLS regressions with controls of capital account openness's effect on the correlation of equity market returns for a pair of countries. The dependent variable is either the correlation of the returns between a pair of countries' equity markets (models 1–3) or the correlation adjusted for volatility using the Forbes-Rigobon correction (models 4–6). The description of the control variables is found in table 1. OLS models 2, 3, 5, and 6 use pair fixed effects, which are not reported to save space. Data are missing for the World War II years in models 2 and 5. OLS models 1 and 4 have insufficient degrees of freedom to use pair fixed effects. Results using trade instead of bilateral trade are substantively identical but are not reported to save space. *t*-statistics using panel-corrected standard errors in parentheses are reported below the coefficient estimates (see Beck and Katz 1995). The observations are nonoverlapping 4-year averages of the data for a given period.
*p-value < .05.
**p-value < .01.

After 1955, we find large positive and statistically significant coefficients of capital account openness on both the corrected and uncorrected correlations.[12] Trade appears important in the post–World War II period and, in the FR corrected estimation, interest rate correlations. Overall, we find a high degree of consistency in our subperiods: independent of the part of the twentieth century that we analyze, country pairs with more open capital accounts saw their stock markets fluctuate in parallel to a much higher extent.

Bertrand, Duflo, and Mullainathan (2004) highlight the potential pitfalls of difference-in-difference estimators. 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, and (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 is 0.76 (standard error 0.019), there is obvious scope for concern (although the general method of moments system estimators do not suffer from this deficiency). Among other remedies, Bertrand et al. suggest collapsing the data to a time-averaged cross section (i.e., abstracting from time variation). This strategy 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.

Hence, we regress

$$\rho_i = C + \beta Q_i + \gamma X_i' + \varepsilon, \tag{3}$$

where ρ_i is the average correlation coefficient (corrected or uncorrected) for each country pair i, Q is the Quinn-Toyoda measure of capital account openness, and X' is a vector of control. Independent of specification, we find a large and significant effect of openness on return correlations.

In the baseline specification 1 in panels A and B of table 7, the coefficient on capital account openness is large and significant. So is the correlation of growth rates. The controls for trade volume are in general significant where we use the uncorrected correlations as the dependent variable. Including them causes the growth rate correlations to decline in magnitude or even to change sign (specification 5, panel A). Interest rate correlations always exhibit positive covariance with equity market returns, and the coefficients are statistically significant in three of four specifications. National income differences appear to reduce correlations in equity markets, but the result is not stable across specifications.

Even in the specification that yields the smallest coefficient on Q in panel A, increasing openness by 40 points (equivalent to the observed increase in mean openness in our sample between 1954 and 1998) raises the correlation coefficient of stock markets by 0.2. Overall, according to the results from the time-averaged cross section, we can account for one-third of the variation in correlation coefficients with openness.

Panel B uses the FR corrected correlations as a dependent variable. Coefficients on openness are generally smaller, as we would expect: the dependent variable has a more limited range, by construction. The significance of our findings is generally not affected, even if the t-statistic in one of our final specifications drops to 3.2. The effect of trade is not as apparent in the FR corrected specification, and growth correlations appear to have

Table 7
Cross-Section Regressions: Financial Openness and Stock Market Correlations

	(1)	(2)	(3)	(4)	(5)
	A. Dependent Variable: Return				
CAPITAL account openness	**.572****	**.501****	**.51****	**.541****	**.542****
	(7.658)	(6.622)	(9.946)	(7.335)	(8.304)
Growth rate correlation	11.795**	1.888	6.261	1.57	−5.1
	(2.832)	(.299)	(1.464)	(.257)	(−1.29)
Bilateral trade			120.73**		136.34**
			(3.521)		(4.186)
Trade		1010.9**		781.25**	
		(3.44)		(2.647)	
Interest rate correlation				30.407	19.536**
				(1.33)	(3.768)
National income differences				−4.648	−7.364**
				(−2.885)	(−4.846)
Constant	−10.974*	−9.085	−7.878	−9.097	−11.142**
	(−2.144)	(−1.807)	(−1.587)	(−1.83)	(−2.625)
Observations	120	73	120	73	120
Adjusted R^2	.40	.52	.45	.56	.62
	B. Dependent Variable: Return-FR				
CAPITAL account openness	**.3****	**.256****	**.28****	**.237****	**.281****
	(4.377)	(3.586)	(3.959)	(3.192)	(4.210)
Growth rate correlation	23.716	24.522	20.29*	24.129	8.832
	(2.763)	(1.817)	(2.498)	(1.770)	(.911)
Bilateral trade			41.268		59.795
			(1.223)		(1.557)
Trade		369.74		112.26	
		(1.404)		(.442)	
Interest rate correlation				53.561**	51.43**
				(26295)	(3.64)
National income differences				−2.345	−4.459**
				(−1.649)	(−2.835)
Constant	−5.928	−5.418	−5.091	−4.022**	−4.606
	(−1.338)	(−1.198)	(−1.139)	(−.926)	(−1.148)
Observations	120	73	120	73	120
Adjusted R^2	.20	.23	.21	.29	.33

Note: In this table, we estimate the cross-sectional determinants of equity market correlations between a pair of countries. The dependent variable is either the correlation of the returns between a pair of countries' equity markets (panel A) or the correlations adjusted for volatility using the Forbes-Rigobon correction (panel B). These OLS models are cross-sectional models with heteroskedasticity-consistent matrices. *t*-statistics are in parentheses below the coefficient estimates. Sixteen countries in 120 country pairs are represented in models 1, 3, and 5. Because of data limitations, models 2 and 4 contain data for 16 countries and 73 country pairs. The data are averaged across all periods.
*p-value < .05.
**p-value < .01.

a similar effect. Overall, there is little evidence that understated standard errors in the standard difference-in-difference setup are responsible for the significant coefficients we obtained in the panel estimation.

IV. Discussion

In this section, we discuss two issues that arise—causality and the magnitude of effects. Causality is a crucial issue not because of reverse causation. It is unlikely that higher equity market comovement may have directly lowered barriers to free capital movement. Omitted variables are a more serious concern. What if a third factor is simultaneously driving up correlations and equity market comovement? We have tried to control for some factors that come to mind, such as bilateral trade and the comovement of interest rates. Yet controlling for these factors will succeed only if we capture the transmission mechanism perfectly. This is not likely.

Instead, we emphasize two aspects. First, the main driver of changes in capital account openness was politics. In the tale of two countries that we mentioned before, the key steps in Britain's road to an open capital account are easy to describe. After Margaret Thatcher's election in 1979, opening the capital account became a priority for the new Conservative government. Restrictions on foreign exchange and foreign asset holdings were dismantled almost overnight. The rise in openness caused by such a sudden change in policy is unlikely to reflect other, unmeasured factors, whose influence could at best influence correlations slowly.

One of the key steps along the path to greater openness came in the run-up to EMU. Countries such as France and Italy, which had retained numerous capital controls, opened up their accounts. On average, countries joining EMU saw their openness rise by 28 points on the Quinn-Toyoda scale between 1993 and 2000. If we use EMU membership as an instrument for capital account openness, we should be able to sidestep some of the concerns about endogeneity.[13] We estimate for the postwar sample, including data from 1945 onward. The simple coefficient (t-statistic) on the CAPITAL variable is 0.59 (27.1) in a fixed-effects model. Using EMU for the first stage, we obtain an R^2 of 0.37 and an F of 7.5. EMU enters positively and significantly. The Stock-Yogo (2002) test unambiguously rejects the possibility of weak identification. In the instrumental variables equation, the coefficient on openness reaches 1.1 (19.6), which is large and highly significant. To the extent that we can solve endogeneity problems by instrumenting with EMU membership, our argument that the relationship uncovered is causal receives additional support.

Our results in tables 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 postwar period, for example, the IMF's standard measure (which indicates only 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 induces attrition bias. Also, we miss some of the countries that liberalized only recently and whose equity markets do not have a long history. A data set 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. The attainable level of diversification with fully open capital accounts will be larger than our study implies. We focus on a stable set of countries for the last century. However, Goetzmann et al. (2005) 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.

One important limitation of our analysis is the fact that we cannot address the country versus industry factor debate. Roll (1992) found a large role for industry composition in explaining comovements between country indices. Cavaglia, Brightman, and Aked (2000) called into question Heston and Rouwenhorst's (1994) result that country factors are decisive. In recent work, Bekaert, Hodrick, and Zhang (2005) conclude that industry factors mattered only for a relatively short period and that country factors overall remain crucial.[14]

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 has collected data on bilateral asset position including equity investments, but it covers only the period 1997–2003. We use the information for 2002 since this is the last year in which 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 8 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 (specifications 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).

V. Conclusions

During much of the postwar period, capital flows between advanced capitalist countries were anything but free. Correlations were low, but this did not indicate unexploited investment opportunities. Few investors were allowed to move funds from one jurisdiction to another. Our analysis

Table 8
Bilateral Holdings, Correlations and Openness

	Dependent Variable: ΔCorrelation	Dependent Variable: Bilateral Holdings	
	(1)	(2)	(3)
Bilateral holdings/total holdings (two countries)	1.41**		
	(4.1)		
Average openness		.0017**	.003**
		(4.03)	(3.6)
Initial correlation			−.025
			(.7)
Change in openness			.0007*
			(2.25)
Constant	.31**	−.08*	−.19**
	(14.4)	(2.7)	(3.1)
Observations	120	120	120
Adjusted R^2	.12	.11	.14
Effect of moving from the 25th to the 75th percentile of the exogenous variable (relative to the mean of the dependent variable)	.06 (+16%)	.02 (+98.5%)	

Note: Absolute values of t-statistics are in parentheses.
+Significant at 10%.
*Significant at 5%.
**Significant at 1%.

suggests that capital controls did not just stand in the way of exploiting diversification opportunities. To a large extent, they created an illusion that they were large in the first place. The mean (uncorrected) correlation during the period 1950–54 in our data set was 0.26. By 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.[15] 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. This means that the world described in the seminal papers by Grubel (1968) and Levy and Sarnat (1970) looked promising for international investors precisely because it was de facto and de jure nearly impossible to invest across borders.[16] Thus, many 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.[17]

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 actual equity return correlations has been the result of higher volatility. Diversification benefits are much less today than they were in the more distant past because of high volatility. Yet even after correcting for the upward bias along the lines of Forbes and Rigobon (2002), we find that equity return correlations today are substantially higher than they were a century ago. Interdependence has therefore also grown, but to a smaller extent.

The nineteenth century is widely viewed as a golden age of globalized capital markets. In many dimensions, capital flows across borders and the degree of market integration was as high 100 years ago as it is today (Obstfeld and Taylor 2003). Our findings suggest that global capital markets before 1914 were superior to the present-day equivalents in one regard in particular. 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 nineteenth century combined remarkable levels of capital mobility with only modestly high correlations, whereas the most recent era of globalization has brought about a large, rapid, and sustained reduction in diversification opportunities.

The waning of international diversification opportunities is probably driven by a number of factors. Greater openness, the factor we highlighted here, was the result of policy changes following the collapse of Bretton Woods. In addition, the organizational structure of financial intermediaries

has changed, as has the median investor in many markets. John Maynard Keynes described investors in the first wave of globalization as "inhabitant(s) of London (who) could … by telephone, sipping … morning tea in bed, adventure his wealth in the natural resources and new enterprises of any quarter of the world, and share, without exertion or even trouble, in their prospective fruits and advantages" (1922, 11–12). By the late twentieth century, they have given way to professionals who are managing portfolios on behalf of others; many of these firms operate worldwide and are advised by global investment banks that also use a single trading book for their proprietary desks. Shocks to net worth, and the resulting changes in risk appetite, now simultaneously drive changes in equity values from Toyko to Johannesburg. They may account for a large share of the biggest price moves (Morris and Shin 2004). As the influence of local factors has declined, global ones play an increasing role in the pricing of shares. The next stage of our project will examine if greater openness to global flows has systematically increased the variability of stock returns.

Endnotes

We would like to thank Claudio Bordio, Fernando Broner, Luis Catao, Nicolas Coeurdacier, Giancarlo Corsetti, Allan Eberhart, Ana Fernandes, Marc Flandreau, Andrew Filardo, Jeff Frankel, John Freeman, Keith Ord, Hew Pill, Diego Puga, Michael Reiter, Alan Taylor, Christian Upper, Jaume Ventura, and John Williams for comments and suggestions. We owe a special debt of gratitude to Barry Eichengreen, our discussant at the 2008 Allied Social Science Associations meetings. Seminar audiences at the Bank for International Settlements, at Universitat Pompeu Fabra, the University of Bern, the 2007 International Political Economy Society conference, and the Centre for Economic Policy Research–Centre de Recerca en Economia Internacional Conference on Financial Markets offered helpful advice. We are grateful to the CREI, Georgetown University McDonough School of Business, and the National Science Foundation for their support (SBR-9729766, SBR-9810410). Rebecca Anderson, Naphat Kissamrej, Laura McCann, and Ravi Tayal helped prepare the manuscript, and we thank them. Research assistance by Bernhard Silli and Roland Umlauf is gratefully acknowledged.

1. For a survey of research on the effects of capital account liberalization, see Eichengreen (2002).

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

3. In a similar vein, Dickinson (2000) examines the relative contributions of macroeconomic factors and of financial globalization on the cointegration of stock markets.

4. Lewis (2006) also documents that for U.S. investors, the benefits from holding foreign stocks cross-listed in the United States have declined sharply.

5. After 1979, the name of the annual report changed to *Annual Report on Exchange Arrangements and Exchange Restrictions*, and after 1989, to *Exchange Arrangements and Exchange Restrictions*.

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

7. See Eichengreen (2002) and Kose et al. (2006) for reviews. Recent studies in finance and economics using the Quinn-Toyoda measure have examined whether capital account openness influences corporate tax rates (Schwarz 2007; Devereux, Lockwood, and Redoano

2008), currency risk premia (Lustig and Verdelhan 2007), currency crises (Ranciere, Tornell, and Westerman 2008), economic growth (Bekaert, Harvey, and Lundblad 2005; Quinn and Toyoda 2008), financial integration (Imbs 2006), growth opportunities and market integration (Bekaert et al. 2007), and industry growth (Vlachos and Waldenstrom 2005).

8. It is not possible to measure capital account openness from 1940 to 1945 since the main data sources used to construct it either cease to function (League of Nations after December 1939) or have not yet formed (IMF). Information about financial openness for many countries from 1946 onward is found in IMF (1949).

9. Variable codes for the equity indices used are available from the authors on request.

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 are used to adjust data from, e.g., 1890–93, 1958–61, 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. Corsetti, Pericoli, and Sbracia (2002) 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.

11. The British case is examined in Taylor and Tonks (1989).

12. Since we cannot be certain that a rise by 10 points on the Quinn-Toyoda scale should be expected to have the same impact on correlations, independent of starting levels, comparing magnitudes directly is not sensible.

13. We thank Philip Lane for this suggestion. During the run-up to EMU, some investment firms introduced pan-European trading desks. Some observers expected that a continent-wide equity market would soon come into existence. To the extent that financial market participants changed their behavior because of EMU, our instrument will not be valid.

14. 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.

15. 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.

16. Levy and Sarnat (1970) conclude that, since the optimum country portfolio does not contain all countries in the world, there must be substantial barriers to free capital movement.

17. We focus on a stable set of countries for the last century. As Goetzmann et al. (2005) show, 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 may be too pessimistic compared to the full range of investment choices available.

References

Ang, Andrew, and Geert Bekaert. 2002. "International Asset Allocation with Regime Shifts." *Review of Financial Studies* 15:1137–87.

Barbieri, Katherine. 2002. *The Liberal Illusion: Does Trade Promote Peace?* Ann Arbor: University of Michigan Press.

Beck, Nathaniel, and Jonathan N. Katz. 1995. "What to Do (and Not to Do) with Time-Series–Cross-Section Data in Comparative Politics." *American Political Science Review* 89:634–47.

Bekaert, Geert, and Campbell R. Harvey. 1995. "Time-Varying World Market Integration." *Journal of Finance* 50:403–44.

———. 2000. "Foreign Speculators and Emerging Equity Markets." *Journal of Finance* 55:565–613.

Bekaert, Geert, Campbell R. Harvey, and Robin Lumsdaine. 2002. "Dating the Integration of World Equity Markets." *Journal of Financial Economics* 65:203–47.

Bekaert, Geert, Campbell R. Harvey, and Christian Lundblad. 2004. "Growth Volatility and Financial Liberalization." Working Paper no. 10560, NBER, Cambridge, MA.

———. 2005. "Does Financial Liberalization Spur Growth?" *Journal of Financial Economics* 77:3–55.

Bekaert, Geert, Campbell R. Harvey, Christian Lundblad, and Stephan Siegel. 2007. "Global Growth Opportunities and Market Integration." *Journal of Finance* 62:1081–1137.

Bekaert, Geert, Robert Hodrick, and Xiaoyan Zhang. 2005. "International Stock Return Comovements." Working paper, Columbia University.

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Difference-in-Difference Estimators?" *Quarterly Journal of Economics* 119:249–75.

Bordo, Michael D., Barry Eichengreen, and Douglas Irwin. 1999. "Is Globalization Today Really Different than Globalization a Hundred Years Ago?" Working Paper no. W7195, NBER, Cambridge, MA.

Bordo, Michael D., Barry Eichengreen, and Jongwoo Kim. 1998. "Was There Really an Earlier Period of International Financial Integration Comparable to Today?" Working Paper no.W6738, NBER, Cambridge, MA.

Bordo, Michael D., and Antu Panini Murshid. 2006. "Globalization and Changing Patterns in the International Transmission of Shocks in Financial Markets." *Journal of International Money and Finance* 25, no. 4:655–74.

Bracker, Kevin, Diane Scott Docking, and Paul D. Koch. 1999. "Economic Determinants of Evolution in International Stock Market Integration." *Journal of Empirical Finance* 6:1–27.

Brooks, Robin, and Marco Del Negro. 2004. "The Rise in Comovement across National Stock Markets: Market Integration or IT Bubble?" *Journal of Empirical Finance* 11:643–73.

Carrieri, Francesca, Vihang R. Errunza, and Kedreth Hogan. 2007. "Characterizing World Market Integration through Time." *Journal of Financial and Quantitative Analysis* 42:915–40.

Cavaglia, Stefano, Christopher Brightman, and Michael Aked. 2000. "The Increasing Importance of Industry Factors." *Financial Analysts Journal* 56:41–54.

Coeurdacier, Nicolas, and Stéphane Guibaud. 2004. "International Equity Holdings and Stock Returns Correlations: A Paradox and Its Resolution." Working paper, DELTA-ENS-EHESS, Paris.

Corsetti, Giancarlo, Marcello Pericoli, and Massimo Sbracia. 2002. "Some Contagion, Some Interdependence: More Pitfalls in Tests of Financial Contagion." *Journal of International Money and Finance* 24:1177–99.

De Jong, Frank, and Frans de Roon. 2005. "Time-Varying Market Integration and Expected Returns in Emerging Markets." *Journal of Financial Economics* 78:583–613.

Dellas, Harris, and Martin Hess. 2005. "Financial Development and Stock Returns: A Cross-Country Analysis." Working paper, University of Bern.

DeSantis, Giorgio, and Bruno Gerard. 1997. "International Asset Pricing and Portfolio Diversification with Time-Varying Risk." *Journal of Finance* 52: 1881–1912.

Devereux, Michael P., Ben Lockwood, and Michela Redoano. 2008. "Do Countries Compete over Corporate Tax Rates?" *Journal of Public Economics* 92: 1210–35.

Dickinson, David G. 2000. "Stock Market Integration and Macroeconomic Fundamentals: An Empirical Analysis, 1980–95." *Applied Financial Economics* 10, no. 3:261–76.

Eichengreen, Barry. 2002. "Capital Account Liberalization: What Do the Cross Country Studies Show Us?" *World Bank Economic Review* 15:341–66.

Einzig, Paul. 1934. *Exchange Control*. London: Macmillan.

Ellis, Howard S. 1939. "Exchange Control in Austria and Hungary." *Quarterly Journal of Economics* 54, no. 1, pt. 2:1–185.
———. 1940. "German Exchange Control, 1931–1939: From an Emergency Measure to a Totalitarian Institution." *Quarterly Journal of Economics* 54, no. 4, pt. 2:1–158.
Forbes, Kristin J., and Roberto Rigobon. 2002. "No Contagion, Only Interdependence: Measuring Stock Market Comovements." *Journal of Finance* 43:2223–61.
Goetzmann, William, Lingfeng Li, and Geert Rouwenhorst. 2005. "Long-Term Global Market Correlations." *Journal of Business* 78:1–38.
Grubel, Herbert. 1968. "Internationally Diversified Portfolios: Welfare Gains and Flows." *American Economic Review* 58:1299–1314.
Henry, Peter Blair. 2000. "Do Stock Market Liberalizations Cause Investment Booms?" *Journal of Financial Economics* 58:301–34.
Heston, Steven L., and K. Geert Rouwenhorst. 1994. "Does Industrial Structure Explain the Benefits of International Diversification?" *Journal of Financial Economics* 36:3–27.
Hunter, Delroy. 2005. "What Drives Time Variation in Emerging Market Segmentation?" *Journal of Financial Research* 28:261–80.
Imbs, Jean. 2006. "The Real Effects of Financial Integration." *Journal of International Economics* 68, no. 2:296–324.
IMF (International Monetary Fund). Various years. *Annual Report on Exchange Restrictions*. Washington, DC: International Monetary Fund.
Keynes, John Maynard. 1922. *The Economic Consequences of the Peace*. London: Macmillan.
Kose, M. Ayhan., Eswar Prasad, Kenneth Rogoff, and Shang-Jin Wei. 2006. "Financial Globalization: A Reappraisal." Working Paper no. 12484, NBER, Cambridge, MA.
Lane, Philip R., and Gian Maria Milesi-Ferretti. 2004. "International Investment Patterns." Working Paper no. 134, International Monetary Fund, Washington, DC.
League of Nations. 1922. *Memorandum on Currency, 1913–1921*. Geneva: Kundig.
———. 1923. *International Financial Conference, Brussels, 1920*. Geneva: Kundig.
Levy, Haim, and Marshall Sarnat. 1970. "International Diversification of Investment Portfolios." *American Economic Review* 60:668–75.
Lewis, Karen. 2006. "Is the International Diversification Potential Diminishing? Foreign Equity Inside and Outside the US." Working Paper no. 12697, NBER, Cambridge, MA.
Lowenfeld, Henry. 1909. *Investment, an Exact Science*. London: Financial Review of Reviews.
Lustig, Hanno, and Adrien Verdelhan. 2007. "The Cross Section of Foreign Currency Risk Premia and Consumption Growth Risk." *American Economic Review* 97, no. 1:89–117.
Maddison, Angus. 2002. *The World Economy*. Paris: OECD Publishing.
Mauro, Paolo, Nathan Sussman, and Yishay Yafeh. 2002. "Emerging Market Spreads: Then versus Now." *Quarterly Journal of Economics* 117:695–733.
Morris, Stephen, and Hyun Shin. 2004. "Liquidity Black Holes." *Review of Finance* 8, no. 1:1–18.
Obstfeld, Maurice, and Alan M. Taylor. 2002. "Globalization and Capital Markets." Working Paper no. W8846, NBER, Cambridge, MA.
———. 2003. "Global Capital Markets." In *Globalization in Historical Perspective*, ed. M. D. Bordo, A. M. Taylor, and J. G. Williamson. Chicago: University of Chicago Press.

Palyi, Melchior. 1972. *The Twilight of Gold, 1914–1936: Myths and Realities*. Chicago: Regnery.

Prados de la Escosura, Leandro. 2000. "International Comparisons of Real Product, 1820–1990: An Alternative Data Set." *Explorations in Economic History* 37, no. 1:1–41.

Quinn, Dennis P. 1997. "The Correlates of Change in International Financial Regulation." *American Political Science Review* 91:531–51.

———. 2003. "Capital Account Liberalization and Financial Globalization, 1890–1999: A Synoptic View." *International Journal of Finance and Economics* 8:189–204.

Quinn, Dennis P., and Robert Jacobson. 1989. "Industrial Policy through the Restriction of Capital." *American Journal of Political Science* 33:700–736.

Quinn, Dennis P., and A. Maria Toyoda. 2007. "Ideology and Voter Preferences as Determinants of Financial Globalization." *American Journal of Political Science* 51:344–63.

———. 2008. "Does Capital Account Liberalization Lead to Growth?" *Review of Financial Studies* 21:1403–49.

Ranciere, Romain, Aaron Tornell, and Frank Westerman. 2008. "Systemic Crises and Growth." *Quarterly Journal of Economics* 123:359–406.

Roll, Richard. 1992. "Industrial Structure and the Comparative Behavior of International Stock Market Indices." *Journal of Finance* 47:3–41.

Schwarz, Peter. 2007. "Does Capital Mobility Reduce the Corporate-Labor Tax Ratio?" *Public Choice* 130:363–80.

Stock, James H., and Motohiro Yogo. 2002. "Testing for Weak Instruments in Linear IV Regression." Technical Working Paper no. 0284, NBER, Cambridge, MA.

Taylor, Mark P., and Ian Tonks. 1989. "The Internationalization of Stock Markets and the Abolition of U.K. Exchange Control." *Review of Economics and Statistics* 71:332–36.

Vlachos, Jonas, and Daniel Waldenstrom. 2005. "International Financial Liberalization and Industry Growth." *International Journal of Finance and Economics* 10:263–84.

Volosovych, Vadym. 2007. "Measuring Financial Market Integration over the Long Run: Is There a U-Shape?" Working paper, Social Science Research Network, http://ssrn.com/abstract=961846.