



Innovation and Competition



Innovation and Financial Globalization

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This paper examines the links between international financial integration and the level of innovation activity. If financial globalization boosts innovation, this helps to explain the empirical evidence indicating that increased financial integration conditionally raises the level of productivity and long-run living standards. The paper finds that conditional on the level of development, more integrated economies do exhibit higher levels of innovation activity, but the impact differs across equity-type and debt-type dimensions of international financial integration. Moreover, the gains from equity-type integration kick in for countries at relatively low income levels, whereas the gains from debt-type integration are only found for high-income countries.

This paper asks how international financial integration affects the levels of productivity and innovation activity. This is a timely question, since the current global financial crisis is leading to a reevaluation of the net benefits from international financial integration. Indeed, the data indicate that developing countries have been able to grow without net capital inflows (see, among others, Prasad, Rajan, and Subramanian 2007; Rodrik and Subramanian 2009). Moreover, financial globalization has not generally delivered a more stable path for consumption or output for developing countries (Kose, Prasad, Rogoff, and Wei 2009). However, there is a recent accumulation of evidence that under certain conditions, international financial integration can help to deliver a higher level of productivity, which is the driving force for long-term living standards.¹ Accordingly, this paper examines in more detail one mechanism by which international financial integration may raise productivity, which is its potential impact on the level of innovation activity.

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The potential connection between financial globalization and productivity is critically important. While international financial integration may also operate through capital deepening, the most important potential payoff occurs when financial integration raises total factor productivity. In particular, Gourinchas and Jeanne (2006) show that international financial integration can only offer a limited welfare gain if the level of productivity is unaffected, since the capital deepening effect only serves to bring forward convergence to a country's conditional steady-state level of output. In contrast, an increase in productivity improves the steady-state level of output, offering a long-term welfare gain.

The paper focuses on innovation activity, since technological progress depends on purposeful efforts to develop new technologies or, especially in developing countries, to move closer to the frontier by adopting existing technologies developed elsewhere. Even in the latter case, the adoption of existing technologies is costly, requiring local research and development (R&D) activity. In addition, the attainment of technological progress typically involves resource reallocation across firms, with higher-productivity firms expanding and laggards being driven out of business. For this reason, economic environments that facilitate such firm-level dynamism may be more conducive to higher rates of effective innovation activity.

The role of investment in knowledge and resource reallocation in driving innovation activity suggests that the financial system has an important part to play in promoting innovation. For instance, the costs incurred in R&D may require external-to-the-firm funding. Similarly, if technological advances are embodied in new firms, this requires a financial system that is able to support the early-stage growth of *de novo* enterprises. At an industry level, if productivity growth is higher in some sectors than in others, the financial system must have the capability to redirect funding from slower-growing to faster-growing industries. For these reasons, a sizable literature emphasizes the importance of financial development in determining the level and effectiveness of innovation activity.

In turn, the positive contribution of financial development begs the question of whether international financial integration has the potential to boost the level of innovation activity. First, international financial integration may be helpful as a result of the role played by financial globalization in accelerating the development of domestic financial systems in developing countries. Second, the specific characteristics of innovation activity may be especially supported by the entry of foreign investors, in view of the risk profile of the innovation process. Third, one line in the recent literature on financial globalization emphasizes that financial globalization may operate indirectly by tilting the political economy calculus in the direction of improving the general domestic institutional environment (see, among others, Kose, Prasad, Rogoff, and Wei 2009). Through this indirect channel, international financial integration may further boost innovation activity, through the positive impact of institutional reform on the investment climate.

However, the recent literature also finds that the gains from financial globalization are typically conditional on the country's level of development (Kose, Prasad, Rogoff, and Wei 2009; Bekaert, Harvey, and Lundblad 2009; Masten, Coricelli, and Masten 2008). This pattern has been found in myriad studies of the influence of

financial globalization on output growth, productivity growth, and volatility measures. The precise conditioning variables differ across these studies, but the general theme is common: financial globalization may not be helpful (and can even be harmful) if the domestic economy is not sufficiently developed to marshal the potential gains. Accordingly, it is important to investigate whether such threshold effects are also present in determining the relation between international financial integration and level of innovation activity.

A related point is that the gains from international financial integration may be distributed unevenly across the different types of cross-border investment activity. Most obviously, equity-type investments (foreign direct investment or portfolio equity) are different in nature to debt-type investments (bank loans and deposits or portfolio debt) along several dimensions. Accordingly, the general impact of different types of financial integration on the level of innovation activity may not coincide. Moreover, the threshold level of economic development required to gain from international equity integration may not be the same as that for international debt integration. This paper explores these potential differences.

The paper is structured as follows. It describes the role played by innovation in determining the level of productivity, examines the potential links between financial globalization and the levels of productivity and innovation activity, and conducts an empirical analysis of the cross-country relation between international financial integration and the levels of innovation activity. A final section concludes.

Innovation and Productivity

There are two sources of productivity growth.² First, the global technology frontier is advanced through the development of new or better types of products, plus efficiency gains in the methods of producing the existing range of products. Second, for most countries, the existing level of technology is some distance away from the frontier. For these countries, productivity growth can be achieved through the adoption of superior forms of technology that have already been introduced in leading-edge economies. For developing countries, it is natural that the primary focus has been on understanding how to close the gap between the existing technology and the technology frontier.

In either case, R&D costs need to be incurred in order to develop new technologies or adopt existing technologies. Keller (2004) emphasizes this point: international technology diffusion does not occur in a passive fashion but rather requires purposeful investments in order to acquire and exploit the technological advances made elsewhere. Clearly, this is a multidimensional challenge, and the successful adoption of new technologies is facilitated by factors such as improvements in the stock of human capital, high-quality domestic institutions, and integration into the global trading system.³

Moreover, Coe, Helpman, and Hoffmaister (2008) find evidence that these factors interact with each other. For instance, R&D expenditures are more effective the higher is the quality of domestic institutions and the level of human capital. In a similar fashion, a country's ability to absorb the spillover gains from international R&D efforts

increases as the level of these key domestic variables increases. Focusing on a sample of developing countries, Coe, Helpman, and Hoffmaister (1997) show that productivity growth is significantly influenced by international R&D spillovers, where a country's level of trade with leading-edge countries helps to determine the international transmission of R&D efforts.

For our purposes, a key contribution is provided by Aghion, Howitt, and Mayer-Foulkes (2005), who highlight the critical role played by financial development in enabling technological catch-up. These authors show that a threshold level of financial development is required if a country is to converge to the technological frontier. The underlying explanation is that domestic innovation is required in order to absorb leading-edge technologies. Such innovation is costly, and its financing requires a sufficiently developed domestic financial system. Accordingly, productivity growth is constrained if a country is not sufficiently financially developed.

Aghion and others (2009) make a related point, emphasizing the complementarity between domestic savings and foreign investment in promoting innovation. In their model, convergence to the technological frontier requires collaboration between a foreign investor and a domestic entrepreneur. The greater is the equity that the domestic agent can invest in the cooperative project, the less problematic are agency problems in operating the joint venture. In support of this hypothesis, these authors provide empirical evidence that productivity growth is positively associated with lagged savings in low-income countries. In turn, financial development is important for innovation as a result of its contribution to the mobilization of domestic savings.

In a similar fashion, Alfaro and Kalemli-Ozcan (2004) highlight the importance of domestic financial development if a developing country is to maximize the spillovers from inward foreign direct investment (FDI). In particular, these authors emphasize that domestic firms require financing if they are to reorganize production techniques in order to take advantage of the knowledge acquired through such FDI spillovers. In a similar fashion, local entrepreneurs can only imitate the technologies of foreign-owned firms if they have access to finance that would enable them to set up new operations to exploit the newly acquired knowledge. Alfaro and Kalemli-Ozcan (2004) show robust empirical evidence that the connection between FDI and economic growth is enhanced by greater domestic financial development. In subsequent work, Alfaro, Kalemli-Ozcan, and Sayek (2009) show that this connection indeed operates via total factor productivity growth. Chor, Foley, and Manova (2008) provide further evidence, showing that as the entry response of domestic firms to FDI grows higher, so also does the level of domestic financial development.

More generally, the empirical literature has established that domestic financial development is a robust correlate of faster economic growth and higher income levels (see Levine 2005 for an extensive survey). In particular, the evidence from aggregate and micro-level studies is that financial development boosts total factor productivity among advanced economies, while it also promotes growth by lowering the cost of capital in emerging and developing economies.

There are many mechanisms by which financial development may promote productivity growth, and an extensive literature investigates each channel (Demirgüç-Kunt,

Beck, and Honohan 2008 provide a detailed review). For instance, Hartmann and others (2007) emphasize the role of financial development in facilitating the reallocation of capital to faster-growing industries and find evidence in support of that channel. Hsieh and Klenow (2009) highlight the importance of resource reallocation for productivity growth in developing countries, showing that productivity growth in China and India has been driven largely by the reallocation of labor and capital from low-productivity to high-productivity firms. In a similar fashion, Song, Storesletten, and Zilibotti (2008) emphasize reallocation dynamics as a driver of Chinese productivity growth. The role of financial frictions in delaying the reallocation process is also highlighted in the quantitative model of Buera and Shin (2008).

In relation to the empirical literature on the determinants of innovation in developing countries, the World Bank has produced several significant studies in recent years. Bosch, Lederman, and Maloney (2005) examine the relation between R&D and the number of patents granted. These authors find that the effectiveness of R&D is lower in developing countries in terms of generating patentable discoveries. In turn, lower effectiveness can be related to lower levels of education and lower-quality institutional environments.

Lederman and Maloney (2003) take a broader view of the role of R&D and show that the elasticity of output growth vis-à-vis R&D is greater for developing countries, such that the social rate of return to R&D is higher for this group. However, the scale of R&D spending is much higher in higher-income countries, suggesting that there are significant barriers to R&D activity in the developing world. Their analysis identifies a low level of financial development as an important constraint on R&D activity. In addition, other country characteristics are also important, such as the protection of intellectual property rights, effectiveness of government, and quality of research institutions.

A causal connection between innovation and level of output per capita is also established in the empirical work reported by Lederman and Saenz (2005), even controlling for factors such as the quality of institutions and the level of trade openness. Accordingly, in view of the contribution of innovation activity to living standards, these authors advocate the importance of establishing the determinants of innovation activity.

Turning to firm-level evidence, Lederman (2009) studies a panel of 25,000 manufacturing firms across 68 developing and advanced economies. He finds that exporting status and the licensing of foreign technologies are good predictors of the rate of firm-level innovation. In turn, such correlates may lend further support for the hypothesis that domestic financial development is important for innovation. For instance, Manova (2008) provides extensive evidence that as exporting status is easier to attain, domestic financial development increases, since credit constraints act as a barrier to financing the fixed costs of entering export markets.

Buera, Kaboski, and Shin (2008) emphasize the connection between financial development and the expansion of the tradables sector. These authors show that production typically requires a larger scale in the tradables sector than in the non-traded sector. In the absence of financial development, the growth of the tradables sector will be constrained by the small feasible size of firms. In turn, this negatively

affects aggregate productivity growth, in view of the greater scope for high-productivity operations in the tradables sector.

Gorodnichenko, Svejnar, and Terrell (2008) also conduct a firm-level study, using data on 11,500 firms in 27 emerging-market economies. This study finds that several dimensions of globalization stimulate innovation activity. In particular, as firms are more likely to innovate, the greater is the level of foreign competition, the stronger are the vertical linkages with foreign firms, and the higher is the level of international trade. Moreover, these authors find that the gains are similar across the manufacturing and service sectors. Their finding that greater product market competition (via the entry of foreign firms) stimulates innovation activities is especially important, in view of the ambiguous effects that have been found in work focused on data for advanced economies (see, for example, Aghion and others 2006).

Aghion, Fally, and Scarpetta (2007) study the connection between financial development and the entry and growth of small firms. These authors study firm-level data for 16 advanced and emerging economies and show that access to finance promotes the entry of new firms and their growth after entry. These effects are strongest for those industrial sectors that are most dependent on external finance. Accordingly, financial development promotes the “creative destruction” process by which new technologies are disseminated through the entry of new firms.

The message from this body of work is that domestic innovation activity is required in order for a developing country to improve its level of productivity. In turn, a country’s capacity to innovate is a function of its domestic financial development, among other factors. Accordingly, by promoting financial development, international financial integration has the potential to influence positively the rate of domestic innovation activity and the rate of productivity growth.

Productivity, Innovation, and International Financial Integration

This section turns to the links between international financial integration and the levels of productivity and innovation activity.

The Real Effects of Financial Globalization

In principle, financial globalization may affect the level of productivity through several channels. Most directly, international financial integration may stimulate domestic financial development. One reason pertains to the network characteristic of financial markets: the deeper and more liquid are financial markets, the more attractive is participation in these markets because of the increasing returns to scale. Martin and Rey (2000, 2004) model this process: an increase in the scale of the financial system boosts liquidity and reduces transaction costs, which in turn increases the gains from creating new financial assets.

Levine (2001) reports evidence supporting the hypothesis that financial liberalization promotes domestic financial development. He finds that international financial integration improves the liquidity of the domestic stock market. In addition, the

efficiency of the domestic banking sector is improved by the entry of foreign-owned banks. In a more recent study, Chinn and Ito (2006) show that the contribution of financial openness to financial development is conditional on the general quality of domestic institutions. In particular, they find that the domestic equity market expands only if a threshold level of institutional quality is attained. They also find that capital account liberalization promotes financial development only if trade openness has been achieved. Finally, their empirical work underlines the complementarity between the development of the domestic banking sector and the development of equity markets.

Demirgüç-Kunt, Beck, and Honohan (2008) review the evidence on the contribution of foreign-owned banks to financial development. While the empirical literature finds quite nuanced results, these authors conclude that the balance of the evidence indicates that opening to foreign banks has the potential to increase efficiency and the level of competition. However, the gains from the entry of foreign-owned banks will be greater for those developing countries that possess the domestic institutional structures that enable foreign-owned banks to implement the higher-technology style of banking that is the comparative advantage of large, multinational banks.

In addition, international financial integration expands the scope of financial possibilities for domestic investors by virtue of the potential gains from international risk sharing. In particular, international financial integration fundamentally alters the scope for risk diversification and thereby improves access to finance for riskier projects. In turn, this may raise the trend growth rate of an economy since firms will be better able to obtain financing for higher-return, higher-risk projects. Through this mechanism, the profile for output will change to higher average growth, albeit with greater volatility (Obstfeld 1994). In relation to this mechanism, the evidence is that equity market liberalization increases the value of domestic stocks and enables domestic firms to expand capital expenditures, since a base of global investors reduces firm-specific investment risk (Henry 2000a, 2000b; Bekaert, Harvey, and Lundblad 2005; Chari and Henry 2008).

Finally, financial globalization may play a wider role in stimulating domestic institutional reforms that may in turn boost productivity through indirect mechanisms. This point is emphasized by Henry (2007) and Kose, Prasad, Rogoff, and Wei (2009). In particular, the latter describe the “ancillary” gains from financial globalization as occurring via improvements in the domestic institutional environment and enhancement of macroeconomic policy discipline. The political economy calculus that lies behind such ancillary effects has been analyzed by Rajan and Zingales (2003, 2004), among others.

Empirical Evidence on the Link between International Financial Integration and Productivity

Several recent studies have examined the link between financial globalization and productivity using cross-country comparative data. Bonfiglioli (2008) studies a sample of 70 countries over 1975–99 and finds that international financial integration has a robust positive effect on total factor productivity. In contrast, she finds that it has little

impact on the rate of capital accumulation, such that international financial integration primarily affects overall growth performance through the productivity channel.

Kose, Prasad, and Terrones (2009) estimate the impact of financial globalization on total factor productivity for a panel of 67 countries over 1966–2005. An important feature of this study is that it allows for a differential impact across equity-type liabilities and debt-type liabilities. This distinction turns out to be important, because the authors find that a higher level of equity-type liabilities is associated with a gain in total factor productivity. In contrast, an increase in debt-type liabilities is associated with lower total factor productivity, although that effect is attenuated in countries with better institutions and a higher level of domestic financial development.

Bekaert, Harvey, and Lundblad (2009) study a sample of 96 countries over 1980–2006. They also find a positive relation between financial globalization and total factor productivity. Moreover, they find support for the hypothesis that financial globalization affects productivity in part via its indirect impact on the level of domestic financial development, institutional quality, and macroeconomic policy discipline. Finally, they find the existence of nonlinearities, in that the impact of financial globalization depends on the initial levels of financial development and institutional quality.

In relation to firm-level evidence, Alfaro and Charlton (2006) explore the relation between international financial integration and the level of entrepreneurial activity in a country. These authors exploit a firm-level data set of approximately 24 million firms in nearly 100 countries in 1999 and 2004, such that the impact of country-level and industry-level influences on indicators of entrepreneurship can be estimated. They find robust evidence that increased international financial integration stimulates the activity of entrepreneurs along dimensions such as entry, size, and skewness of the firm-size distribution. Moreover, they find that the positive impact of international financial integration is greater in those industries that are more reliant on external finance and that entrepreneurial activity is higher in industries that have a larger share of foreign firms or that are vertically linked. Furthermore, Chari, Chen, and Dominguez (2009) find that foreign control of firms in emerging-market economies spurs technology transfer and improved governance.

Manova (2008) provides additional evidence by examining the dynamics of sectoral growth in the wake of international liberalization of equity markets. She finds that the sectors that grow most quickly are characterized by a high dependence on external-to-the-firm finance. The interpretation is that the international integration of equity markets improves the funding capacity of firms in finance-dependent sectors. Gupta and Yuan (2009) also study the sectoral impact of stock market liberalization in emerging markets and find that the greatest positive impact is on industries that are more dependent on external finance and have better opportunities for growth. A striking feature of this study is that sectoral growth is mainly due to an expansion in the size of existing firms rather than the entry of financially constrained new firms. However, the role of new-firm entry is stronger in countries that have lower regulatory barriers to entry.

Eichengreen, Gullapalli, and Panizza (2009) also consider industry-level evidence in estimating the impact of capital account liberalization. They find that capital

account liberalization disproportionately boosts the growth of finance-dependent industries. However, these gains in growth are only achieved by countries that have attained a threshold level of economic development.

In summary, the main message from the country-level, firm-level, and sectoral-level studies is that there appears to be a conditionally positive relation between international financial integration and level of productivity.

Innovation Activity and Financial Integration: An Empirical Analysis

This section explores whether the relation between international financial integration and level of productivity may be attributed in part to a connection between financial globalization and level of innovation activity.

Determinants of Innovation Activity

In order to investigate the cross-country relation between international financial integration and level of innovation activity, this paper examines the following baseline specification:

$$\begin{aligned}
 INNOV_i = & \alpha + \beta * \log YPC_i + \gamma * IFI_i + \sigma * \log YPC_i * \\
 & IFI_i + \chi * Z_i + \varepsilon_i,
 \end{aligned} \tag{1}$$

where *INNOV* is an indicator of innovation activity, *YPC* is GDP per capita, *IFI* is the sum of foreign assets and foreign liabilities (expressed as a ratio to GDP), and *Z* is a set of general control variables. The main indicator of innovation is the ratio of R&D expenditure to GDP. However, measures of corporate dynamism are also examined, in view of the role played by firms in driving technological progress.

The level of GDP per capita is included as a general control variable. Also included is an interaction term between the *IFI* variable and the level of GDP per capita, in order to establish whether a threshold effect operates, by which the pattern of co-variation between financial globalization and level of innovation activity is sensitive to the level of development. The list of general control variables includes measures of general institutional quality, trade openness, educational attainment, indicators of domestic financial development, and the corporate tax rate. Since international financial integration may influence at least some of these variables, the estimated coefficients in this specification only capture the partial impact of financial globalization, while holding these characteristics fixed.

Also considered is an alternative specification allowing for a difference between equity-type and debt-type international positions. This specification has the following form:

$$\begin{aligned}
 INNOV_i = & \alpha + \beta * \log YPC_i + \gamma_E * IEQ_i + \sigma_E * \log YPC_i * IEQ_i + \\
 & \gamma_D * IDEBT_i + \sigma_D * \log YPC_i * IDEBT_i + \chi * Z_i + \varepsilon_i,
 \end{aligned} \tag{2}$$

where *IEQ* is the sum of FDI and foreign portfolio equity assets and liabilities (expressed as a ratio to GDP) and *IDEBT* is the sum of international debt assets and

liabilities (expressed as a ratio to GDP). The category of international debt comprises portfolio debt, non-portfolio debt, and foreign exchange reserves. As in equation 1, interaction terms are included to allow for threshold effects in the impact of different dimensions of financial globalization.

The Data

The main indicator of innovation activity is the level of expenditure on R&D, expressed as a percentage of GDP (UNESCO Innovation data set). The R&D expenditure variable captures aggregate spending on research and development but does not differentiate across different types of activity, such as the distinction between the creation of new technologies and the imitation or adaptation of existing technologies. While R&D expenditure is an “input” measure, the heterogeneity in innovation outputs (especially for developing countries) means that indicators such as number of patents may be too narrow to capture the level of innovation activity. The most recent year available is used, which is typically 2006.

In addition, Djankov and others (2009) examine a measure of business density and the business entry rate, where these variables are taken from the World Bank’s entrepreneurship survey. Alfaro and Charlton (2006) also examine firm dynamics in order to capture the role played by new enterprises and reallocation in the innovation process. The analysis here follows their lead.

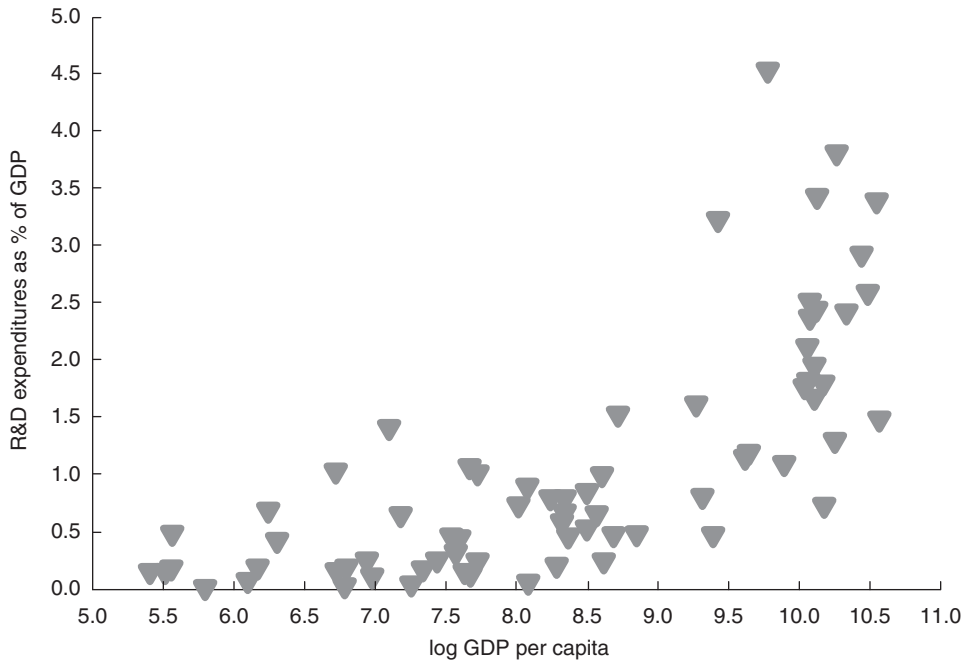
The levels of foreign asset and foreign liability positions are employed in order to measure the de facto scale of international financial integration, where these data are drawn from an updated version of the data set constructed by Lane and Milesi-Ferretti (2007). The rationale for using such volume-based measures is analogous to employing the volume of exports and imports to measure the degree of effective trade openness. In particular, the impact of financial globalization on an economy should increase as the gross scale of cross-border financial positions increases.

The level of GDP per capita is measured in constant international dollars, taken from the Penn World Tables. Two standard measures of domestic financial development (the ratio of liquid liabilities to GDP and the ratio of stock market capitalization to GDP) are employed, each taken from the World Bank’s Financial Structure database.⁴ In relation to the other control variables, the measure of trade openness is taken from the World Bank’s World Development Indicators database, while the educational attainment measure (for the +25 age cohort) is taken from Barro and Lee (2001). Institutional quality is measured with the “government effectiveness” variable from the World Bank’s Governance Indicators data set. Finally, the measure of one-year effective corporate tax rate is constructed by Djankov and others (2009).

Innovation Activity and Level of Development

Figure 1 shows the cross-country relation between the level of GDP per capita and the scale of R&D expenditures (expressed as a ratio to GDP). The level of R&D spending clearly increases with the level of output per capita. Moreover, the relation is convex: the elasticity of R&D spending with respect to output per capita is

FIGURE 1.
Relation between R&D Expenditures and Level of Development



Sources: UNESCO Innovations data set; Penn World Tables.

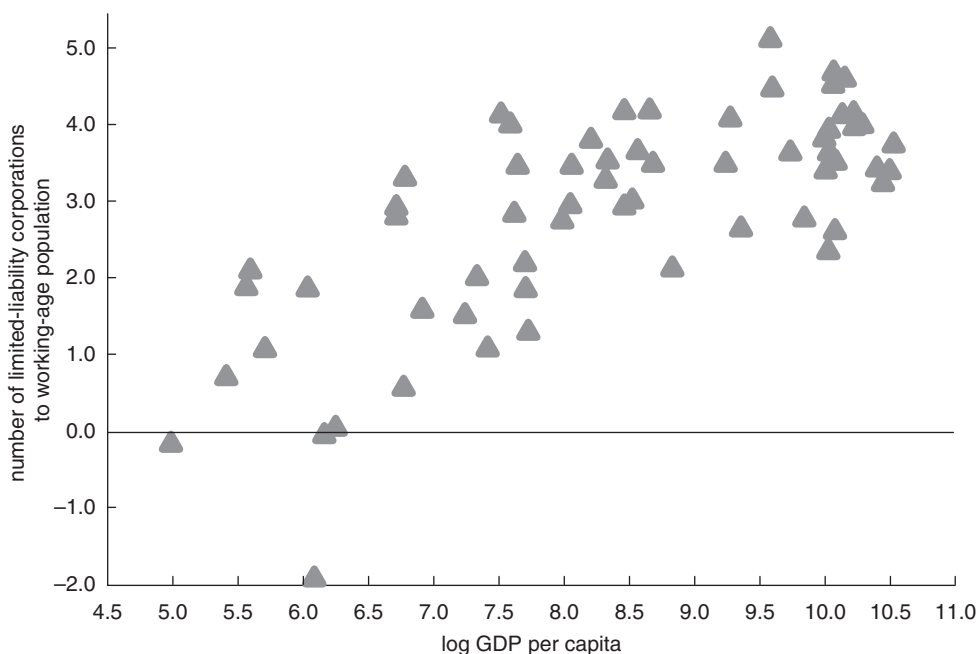
relatively small until a threshold value of output per capita is attained. After that threshold, the elasticity of R&D spending with respect to output per capita becomes substantially larger.

Two other indicators of innovation activity are considered in figures 2 and 3. Figure 2 displays the scatter plot of business density against GDP per capita, where business density is measured as the number of limited-liability corporations relative to the working-age population. Figure 3 shows the rate of business entry, which measures the number of newly registered limited-liability corporations as a ratio to the existing stock of corporations. A high level of business density and a high entry rate indicate an economic environment that is conducive to entrepreneurial activity (see also the discussion in Djankov and others 2009). Both figures show a positive connection between the level of development and the level of entrepreneurial activity, although the degree of co-variation is stronger for the business density measure than for the entry rate measure.

Econometric Results

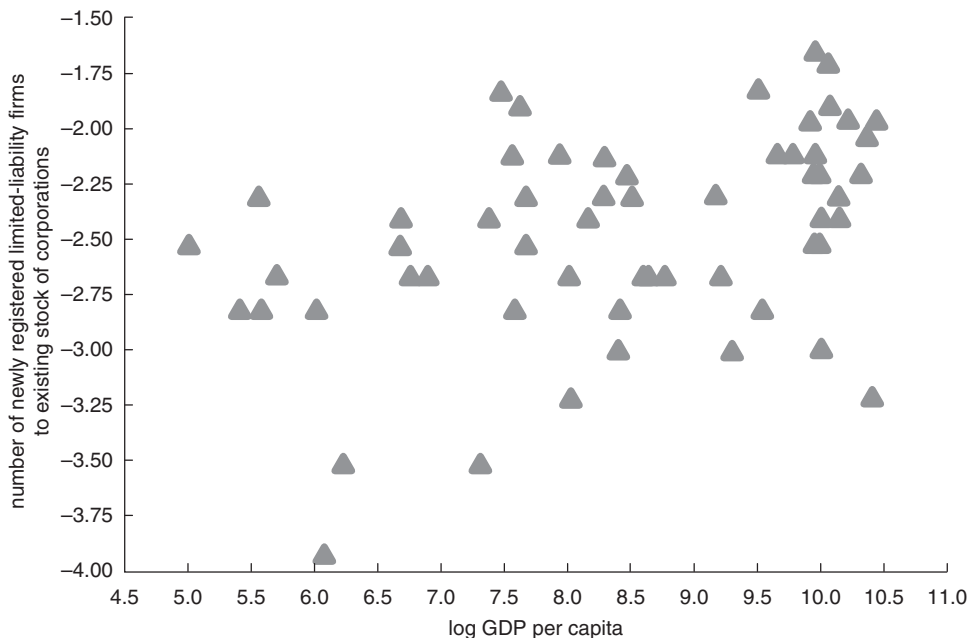
The discussion now turns to an econometric analysis of the cross-country variation in levels of innovation activity, with a particular focus on the relation between international financial integration and innovation activity. Our approach is based on the specifications described in equations 1 and 2.

FIGURE 2.
Relation between Business Density and Level of Development



Sources: Djankov and others 2009; Penn World Tables.

FIGURE 3.
Relation between Entry Rate and Level of Development



Sources: Alfaro and Charlton 2006; Penn World Tables.

Table 1 shows the baseline results for R&D expenditure. Column 1 shows the positive relation between output per capita and level of R&D spending. Moreover, it shows a nonlinear relation between international financial integration and R&D. In particular, a higher degree of international financial integration boosts R&D spending only if a threshold level of output per capita has been attained. In fact, the estimated threshold is quite high, at 22,000 international dollars (2000 constant prices).

The basic pattern of results is very similar even when additional control variables are included in columns 2–4. In relation to these controls, trade openness is individually significant in columns 2–4: a higher level of engagement in international trade is associated with a greater level of R&D expenditure. In addition, one of the financial development variables (level of stock market capitalization) is marginally significant in column 3. Otherwise, the control variables are not individually significant.

TABLE 1. R&D and International Financial Integration I

| Variable | (1) | (2) | (3) | (4) |
|----------|----------------------|-----------------------|-----------------------|----------------------|
| α | -1.4 (0.53) | -2.3 (2.1) | -3.3 (2.2) | -3.2 (2.4) |
| YPC | 0.34 (0.07)*** | 0.24 (0.1)** | 0.21 (0.12)* | 0.19 (0.13) |
| IFI | -0.015 (0.004)*** | -0.023 (0.007)*** | -0.027 (0.008)*** | -0.029 (0.008)*** |
| IFI*YPC | 0.0015 (0.0004) | 0.0022 (0.0006)*** | 0.0026 (0.0007)*** | 0.0027 (0.008)*** |
| IQUAL | | 8.6 (14.7) | 13.9 (15.3) | 15.8 (15.0) |
| Trade | | 0.0035 (0.0017)** | 0.0037 (0.0018)** | 0.0037 (0.0019)* |
| EDUC | | 0.009 (0.01) | 0.01 (0.011) | 0.009 (0.01) |
| LLY | | | 0.24 (0.34) | 0.28 (0.33) |
| STKCAP | | | 0.31 (0.17)* | 0.29 (0.18) |
| TAX | | | | -0.01 (0.02) |
| R^2 | 0.58 | 0.56 | 0.61 | 0.6 |
| N | 71 | 53 | 50 | 50 |

Source: Author's calculations.

Note: Estimation is by ordinary least squares, with heteroskedasticity-consistent standard errors. YPC is GDP per capita; IFI is the ratio of foreign assets and liabilities to GDP; IQUAL is an indicator of government effectiveness; Trade is the ratio of exports plus imports to GDP; EDUC is the Barro-Lee indicator of educational attainment for the +25 age cohort; LLY is the ratio of liquid liabilities to GDP; STKCAP is the ratio of stock market capitalization to GDP; TAX is the one-year effective corporate tax rate.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Equation 2 is implemented in table 2 by differentiating between cross-border equity holdings and cross-border debt holdings. Column 1 shows a striking result: there is a significant relation between international equity integration and R&D expenditure, but no such relation applies for international debt integration. Moreover, the positive impact of international equity integration kicks in at a relatively low level of output per capita (3,700 international dollars).

TABLE 2. R&D and International Financial Integration II

| Variable | (1) | (2) | (3) | (4) |
|-----------|----------------------|---------------------|---------------------|---------------------|
| α | -1.3 (0.52)** | -2.2 (2.1) | -2.9 (2.2) | -2.8 (2.40) |
| YPC | 0.33 (0.07)*** | 0.24 (0.1)** | 0.2 (0.12) | 0.18 (0.13) |
| IEQ | -0.023 (0.011)** | -0.02 (0.012) | -0.025 (0.014)* | -0.026 (0.015)* |
| IEQ*YPC | 0.0028 (0.0012)** | 0.0024 (0.0014)* | 0.0028 (0.0016)* | 0.0029 (0.0017)* |
| IDEBT | -0.013 (0.00277) | -0.025 (0.01)** | -0.029 (0.01)*** | -0.03 (0.01)*** |
| IDEBT*YPC | 0.0011 (0.0008) | 0.0022 (0.001)** | 0.0026 (0.001)** | 0.0027 (0.001)** |
| IQUAL | | 8.7 (14.6) | 11.9 (14.8) | 13.0 (14.3) |
| Trade | | 0.0014 (0.002) | 0.0013 (0.002) | 0.0013 (0.0024) |
| EDUC | | 0.008 (0.01) | 0.011 (0.01) | 0.011 (0.01) |
| LLY | | | 0.46 (0.35) | 0.48 (0.34) |
| STKCAP | | | 0.16 (0.17) | 0.15 (0.18) |
| TAX | | | | -0.006 (0.02) |
| R^2 | 0.59 | 0.56 | 0.61 | 0.6 |
| N | 71 | 53 | 50 | 50 |

Source: Author's calculations.

Note: Estimation is by ordinary least squares, with heteroskedasticity-consistent standard errors. YPC is GDP per capita; IEQ is the ratio of foreign equity-type assets and liabilities to GDP; IDEBT is the ratio of foreign debt-type assets and liabilities to GDP; IQUAL is an indicator of government effectiveness; Trade is the ratio of exports plus imports to GDP; EDUC is the Barro-Lee indicator of educational attainment for the +25 age cohort; LLY is the ratio of liquid liabilities to GDP; STKCAP is the ratio of stock market capitalization to GDP; TAX is the one-year effective corporate tax rate.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

The results for international equity integration broadly hold in the expanded specifications reported in columns 2–4. These specifications show a significant role for international debt integration. However, the overall association between international debt integration and R&D spending remains negative for all countries in the sample, even if it less negative for higher-output countries. Finally, none of the control variables is individually significant in columns 2–4.

Tables 3 through 6 present the results for indicators of entrepreneurial activity. Table 3 shows a very strong pattern of co-variation between GDP per capita and business density. However, columns 1–4 also show a systematic pattern in the relation between international financial integration and business density. In contrast to the R&D variable, the locus of this relation is quite different in that the positive

TABLE 3. Business Density and International Financial Integration I

| Variable | (1) | (2) | (3) | (4) |
|----------|------------------------|------------------------|------------------------|----------------------|
| α | -4.7 (1.1)*** | -5.6 (2.3)** | -5.0 (2.2)** | -4.9 (2.2)** |
| YPC | 0.84 (0.12)*** | 0.82 (0.17)*** | 0.82 (0.19)*** | 0.81 (0.19)*** |
| IFI | 0.023 (0.007)*** | 0.018 (0.007)** | 0.019 (0.007)*** | 0.018 (0.007)** |
| IFI*YPC | -0.0023 (0.0007)*** | -0.0018 (0.0006)*** | -0.0018 (0.0006)*** | -0.0018 (0.007)** |
| IQUAL | | 7.2 (11.8) | 5.8 (12.1) | 7.2 (13.8) |
| Trade | | -0.0004 (0.002) | -0.001 (0.002) | -0.001 (0.002) |
| EDUC | | -0.0018 (0.015) | -0.011 (0.014) | -0.012 (0.014) |
| LLY | | | -0.18 (0.35) | -0.13 (0.39) |
| STKCAP | | | 0.07 (0.43) | 0.06 (0.17) |
| TAX | | | | -0.01 (0.02) |
| R^2 | 0.53 | 0.59 | 0.61 | 0.6 |
| N | 60 | 44 | 43 | 43 |

Source: Author's calculations.

Note: Estimation is by ordinary least squares, with heteroskedasticity-consistent standard errors. YPC is GDP per capita; IFI is the ratio of foreign assets and liabilities to GDP; IQUAL is an indicator of government effectiveness; Trade is the ratio of exports plus imports to GDP; EDUC is the Barro-Lee indicator of educational attainment for the +25 age cohort; LLY is the ratio of liquid liabilities to GDP; STKCAP is the ratio of stock market capitalization to GDP; TAX is the one-year effective corporate tax rate.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

association between international financial integration and business density is stronger at lower levels of output per capita. Indeed, it turns negative at higher levels of output per capita (beyond 22,000 international dollars). None of the control variables is significant in columns 2–4.

Table 4 distinguishes between international equity integration and international debt integration. The results show that international equity integration is significantly positively associated with a higher level of business density. Moreover, the

TABLE 4. Business Density and International Financial Integration II

| Variable | (1) | (2) | (3) | (4) |
|-----------|--------------------|---------------------|---------------------|---------------------|
| α | -4.3 (1.1)*** | -5.5 (2.2)** | -4.2 (2.1)* | -4.2 (2.1)* |
| YPC | 0.8 (0.12)*** | 0.8 (0.18)*** | 0.78 (0.19)*** | 0.78 (0.19) |
| IEQ | 0.053 (0.03)* | 0.073 (0.036)* | 0.043 (0.026) | 0.043 (0.026) |
| IEQ*YPC | -0.005 (0.0032) | -0.007 (0.0037)* | -0.0038 (0.0028) | -0.0038 (0.0028) |
| IDEBT | 0.0019 (0.019) | -0.024 (0.03) | -0.0024 (0.02) | -0.0026 (0.02) |
| IDEBT*YPC | -0.0003 (0.002) | -0.0023 (0.003) | 0.0001 (0.002) | 0.0002 (0.002) |
| IQUAL | | 10.1 (11.3) | 4.4 (12.0) | 4.9 (13.8) |
| Trade | | -0.002 (0.003) | -0.0036 (0.0027) | -0.0036 (0.0028) |
| EDUC | | -0.014 | -0.015 | -0.016 |
| LLY | | | 0.048 (0.38) | 0.06 (0.42) |
| STKCAP | | | -0.14 (0.19) | -0.14 (0.19) |
| TAX | | | | -0.003 (0.03) |
| R^2 | 0.54 | 0.62 | 0.62 | 0.61 |
| N | 60 | 44 | 43 | 43 |

Source: Author's calculations.

Note: Estimation is by ordinary least squares, with heteroskedasticity-consistent standard errors. YPC is GDP per capita; IEQ is the ratio of foreign equity-type assets and liabilities to GDP; IDEBT is the ratio of foreign debt-type assets and liabilities to GDP; IQUAL is an indicator of government effectiveness; Trade is the ratio of exports plus imports to GDP; EDUC is the Barro-Lee indicator of educational attainment for the +25 age cohort; LLY is the ratio of liquid liabilities to GDP; STKCAP is the ratio of stock market capitalization to GDP; TAX is the one-year effective corporate tax rate.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

interaction term is only marginally significant in column 2 and, even then, the overall association between international equity integration and business density only turns negative at a very high level of output (33,400 international dollars). In relation to international debt integration, there is no significant association between cross-border debt holdings and level of business density. As in table 3, none of the control variables is individually significant.

Finally, tables 5 and 6 present the findings for rate of business entry. Consistent with the scatter plot in figure 3, there is a positive but mild relation between GDP per capita and the business entry rate. Columns 2–4 provide some evidence of co-variation between international financial integration and the business entry rate. As with the R&D measure, the pattern is negative until a threshold level of output

TABLE 5. Entry Rate and International Financial Integration I

| Variable | (1) | (2) | (3) | (4) |
|----------|---------------------|---------------------|----------------------|----------------------|
| α | -3.4 (0.5)*** | -3.6 (1.0)*** | -3.8 (1.1)*** | -3.8 (1.2)*** |
| YPC | 0.09 (0.056)* | 0.15 (0.062)** | 0.23 (0.055)*** | 0.23 (0.056)*** |
| IFI | 0.002 (0.004) | -0.009 (0.005) | -0.007 (0.004)* | -0.007 (0.004)* |
| IFI*YPC | -0.0002 (0.0004) | 0.0008 (0.0005)* | 0.0008 (0.0004)* | 0.0008 (0.0004)* |
| IQUAL | | 1.4 (5.5) | 2.3 (6.4) | 2.4 (6.7) |
| Trade | | 0.0022 (0.0012)* | 0.0015 (0.0013) | 0.0015 (0.0013) |
| EDUC | | -0.014 (0.006)** | -0.021 (0.005)*** | -0.021 (0.005)*** |
| LLY | | | -0.62 (0.15)*** | -0.61 (0.16)*** |
| STKCAP | | | 0.009 (0.1) | 0.008 (0.1) |
| TAX | | | | -0.001 (0.007) |
| R^2 | 0.13 | 0.25 | 0.42 | 0.4 |
| N | 57 | 43 | 42 | 42 |

Source: Author's calculations.

Note: Estimation is by ordinary least squares, with heteroskedasticity-consistent standard errors. YPC is GDP per capita; IFI is the ratio of foreign assets and liabilities to GDP; IQUAL is an indicator of government effectiveness; Trade is the ratio of exports plus imports to GDP; EDUC is the Barro-Lee indicator of educational attainment for the +25 age cohort; LLY is the ratio of liquid liabilities to GDP; STKCAP is the ratio of stock market capitalization to GDP; TAX is the one-year effective corporate tax rate.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

per capita is attained. However, that threshold level is relatively low: \$6,300 in the specification reported in column 3.

In terms of the control variables, the educational attainment variable enters with a significantly negative sign across columns 2–4. One of the financial development measures (the ratio of liquid liabilities to GDP) is also significantly negative in columns 3–4. However, the trade variable is positive and marginally significant in column 2.

Table 6 shows that international equity integration and international debt integration are both significant across columns 2–4. Indeed, the pattern is quite striking. As

TABLE 6. Entry Rate and International Financial Integration II

| Variable | (1) | (2) | (3) | (4) |
|----------------|--------------------|-----------------------|-----------------------|-----------------------|
| α | -3.3 (0.5)*** | -3.5 (1.1)*** | -3.9 (1.3)*** | -3.9 (1.3)*** |
| YPC | 0.077 (0.051) | 0.14 (0.058)** | 0.23 (0.05)*** | 0.23 (0.05)*** |
| IEQ | 0.019 (0.013) | 0.036 (0.014)** | 0.027 (0.011)** | 0.027 (0.011)** |
| IEQ*YPC | -0.002 (0.0014) | -0.0038 (0.0015)** | -0.0029 (0.0012)** | -0.0029 (0.0012)** |
| IDEBT | -0.008 (0.007) | -0.041 (0.012)*** | -0.032 (0.008)*** | -0.032 (0.008)*** |
| IDEBT*YPC | 0.001 (0.001) | 0.0042 (0.0012)*** | 0.0033 (0.0008)*** | 0.0033 (0.0008)*** |
| IQUAL | | 3.3 (6.2) | 3.7 (7.1) | 4.0 -7.8 |
| Trade | | 0.0027 (0.0014)* | 0.0026 (0.0008)*** | 0.0026 (0.0008)*** |
| EDUC | | -0.021 (0.006)*** | -0.025 (0.005)*** | -0.026 (0.005)*** |
| LLY | | | -0.61 (0.17)*** | -0.61 (0.17)*** |
| STKCAP | | | -0.0033 (0.11) | -0.0036 (0.11) |
| TAX | | | | -0.001 (0.008) |
| R ² | 0.14 | 0.39 | 0.51 | 0.49 |
| N | 57 | 43 | 42 | 42 |

Source: Author's calculations.

Note: Estimation is by ordinary least squares, with heteroskedasticity-consistent standard errors. YPC is GDP per capita; IEQ is the ratio of foreign equity-type assets and liabilities to GDP; IDEBT is the ratio of foreign debt-type assets and liabilities to GDP; IQUAL is an indicator of government effectiveness; Trade is the ratio of exports plus imports to GDP; EDUC is the Barro-Lee indicator of educational attainment for the +25 age cohort; LLY is the ratio of liquid liabilities to GDP; STKCAP is the ratio of stock market capitalization to GDP; TAX is the one-year effective corporate tax rate.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

was the case for the business density variable, international equity integration is associated with a higher entry rate at lower levels of GDP per capita, but the relation turns negative beyond a threshold level. In fact, the threshold level is lower than was the case for business density, kicking in at \$13,000.

In contrast, international debt integration has a negative association with the entry rate at lower levels of output per capita. However, the relation turns positive once output per capita exceeds \$17,300. Taken together, these results suggest that international equity integration is especially useful at lower levels of development, whereas international debt integration can be helpful, but only at higher levels of development. The results for the control variables are quite similar to those for the business density variable. The main exception is that the trade variable is now significant across columns 2–4 and is highly significant in columns 3 and 4.

Of course, these empirical results are highly provisional. While the partial correlations uncovered by the regression analysis are intriguing, much more extensive research is required in order to probe the links between financial globalization and innovation activity in a more complete manner. In one direction, it is well understood that results in cross-country cross-sectional regression studies can be sensitive to the choice of control variables. Accordingly, it will be important in future research to investigate alternative sets of control variables.

This paper has not attempted to establish whether the links between international financial integration and innovation activity are causal in nature. If a good set of instruments for international financial integration could be identified, it would be useful to explore endogeneity issues.

In relation to the role of threshold effects, this paper has opted to focus on the level of GDP per capita as the variable that influences the relation between international financial integration and innovation activity. This has the virtue of being a fairly general indicator of the level of development. However, other authors have sought to examine threshold effects where specific institutional variables or other structural characteristics (such as the level of domestic financial development) intermediate the relation between international financial integration and various macroeconomic outcomes (see Kose, Ayhan, Prasad, and Taylor 2009 for a recent synthesis). Accordingly, a challenge for future research is to establish with a greater level of precision the exact threshold conditions that are required in order to reap the gains from international financial integration. Moreover, it seems clear that there are multiple thresholds, with the threshold conditions for international equity integration less demanding than those for international debt integration.

Further research should include time-series analysis, in order to establish under what circumstances countries that increase the level of international financial integration also experience an increase in innovation activity. However, such time-series analysis is hampered by relatively short time series for some of the key variables. Moreover, establishing the line of causation in time-series studies can be especially difficult in view of the timing issues involved. Finally, the literature on financial development in emerging-market economies and developing countries has found that episodes of major financial liberalization frequently involve a crisis phase in

which excess debt levels lead to banking and currency crises. Ranci re, Tornell, and Westermann (2008) present evidence that liberalization still raises long-term growth, even accounting for such “bumpiness.” Since innovation activity varies over the business cycle, a further task for future research is to establish the impact of financial crises on the level of innovation activity.

The evidence that greater financial integration is associated with higher levels of innovation activity (conditional on threshold levels of development) helps to support the long-term case in favor of financial globalization. However, this is not sufficient to suggest that a rapid move toward external financial liberalization is desirable for all countries. Rather, in line with the cumulative evidence on associated topics in the recent empirical literature, the existence of threshold effects means that there may be a complex interplay between financial integration and level of innovation activity. The gains from international equity integration seem to be more attainable for lower-income countries than is the case for international debt integration, which suggests that a strategy of opening up to equity-type cross-border flows should precede the liberalization of debt-type flows. Accordingly, a country that does not have in place the required domestic institutional and policy environment to gain fully from financial integration would be better advised to pursue financial integration in an incremental fashion (see also Obstfeld 2009).

That said, it is also possible that financial integration can contribute to a better domestic institutional framework, such that it is not necessarily appropriate to delay all moves toward financial openness until the domestic institutional framework is fully in place. This is in line with the research that attempts to link the political economy of reform with the degree of financial openness (see, among others, Rajan and Zingales 2003, 2004; Gourinchas and Jeanne 2005; Mishkin 2006, 2009). Accordingly, the negotiation and modulation of the appropriate pace of financial integration remains a major challenge for policy makers in developing countries.

Moreover, it is important to emphasize that the relation between international financial integration and national economic performance also depends on the nature of the global governance of the international financial system. In particular, the recent reforms of the International Monetary Fund and the expanded role for the Financial Stability Board should help to reduce the risk profile of international financial flows for emerging-market economies (see also Lane 2009a, 2009b). For example, the establishment of the International Monetary Fund’s flexible credit line facility is intended to reduce the risk of a well-behaved emerging-market economy encountering liquidity problems due to external dysfunction in international financial markets. Further governance reforms along these lines may alter the calculus for developing countries in determining the pace of international financial liberalization.

Conclusions

This paper has examined the connection between international financial integration and enhanced levels of productivity and innovation activity. At a time when the

gains to financial globalization are being called into question, it is important to examine the potential long-term gains from financial integration. The evidence in this paper, together with the findings in the related recent literature, suggests that financial globalization can conditionally raise the level of innovation activity, which in turn boosts long-term productivity.

However, more research is required in order to establish whether this finding is robust and involves a causal mechanism running from financial globalization to more intense levels of innovation activity. In addition, the cross-sectional econometrics deployed in this paper should be supplemented by alternative empirical approaches, including detailed country studies that record how financial integration has affected innovation activity in specific settings. A further avenue for future research is to establish why different types of financial integration (equity positions versus debt positions) have different patterns of co-variation with innovation activity.

The challenge for policy makers in developing countries is to embrace financial globalization in a phased way that recognizes the interplay between domestic institutional development and greater openness to international investment flows. In terms of sequencing, this paper and other recent contributions find evidence that international equity integration offers greater benefits for lower-income countries than international debt integration, where the gains are concentrated at higher income levels. Finally, the burden on national policy makers can be alleviated by internationally coordinated actions to improve the stability of the global financial system. Accordingly, the G-20 reform agenda can make it safer for developing countries to obtain the potential benefits from financial globalization.

Notes

1. This evidence is reviewed later in the paper.
2. The macroeconomics of innovation has been studied extensively over the last two decades, with major overviews provided by Grossman and Helpman (1991), Aghion and Howitt (1998, 2009), and Acemoglu (2008).
3. See also Ciccone and Papaioannou (2009) on human capital and innovation.
4. See Beck, Demirgüç-Kunt, and Levine (2000) for more details on this database. See also Dorrucci, Meyer-Cirkel, and Santabarbara (2009) on the measurement of financial development for emerging-market economies.

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