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Abstract

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

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1 Introduction

The goal of this paper is to ask 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 re-evaluation of the net benefits from international financial integration. Indeed, the data indicate that developing countries have not required net capital inflows in order to grow (see, amongst others, Prasad et al 2007 and Rodrik and Subramanian 2009). Moreover, financial globalisation 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, our primary aim in this paper is to examine in more detail one mechanism by which international financial integration may raise productivity, which is its potential impact on the level of innovation activity.

The potential connection between financial globalisation and productivity is critically important. While international financial integration may also operate through capital deepening, the most important potential payoff is if financial integration can raise 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.

We focus 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

[1] We review this evidence later in this paper.

case, the adoption of existing technologies is costly, requiring local R&D activity. In addition, the attainment of technological progress typically involves resource reallocation across firms, with higher-productivity firms expanding and laggards 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 roles of investment in knowledge and resource reallocation in driving innovation activity suggest 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 re-direct funding from slower-growing to faster-growing industries. For these reasons, a sizeable literature has developed that emphasises the importance of financial development in determining the level and effectiveness of innovation activity.

In turn, the identified 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 via the role played by financial globalisation 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 globalisation has emphasised that financial globalisation may operate indirectly by tilting the political economy calculus in the direction of improving the general domestic institutional environment (see, amongst 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 has also emphasised that the gains from financial globalisation are typically conditional on the level of development (Kose et al 2009, Bekaert et al 2009, Masten et al 2008). This pattern has been found in myriad studies of the influence of financial globalisation on output growth, productivity growth and volatility measures. The precise conditioning variables differ across these studies but the general theme is common — financial globalisation may not be helpful (and can even have adverse consequences) 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 the level of innovation activity.

A related point is that the gains from international financial integration may be unevenly distributed across the different types of cross-border investment activity. Most obviously, equity-type investments (FDI or portfolio equity) are different in nature to debt-type investments (bank loans and deposits or portfolio debt) along a number of dimensions. Accordingly, the general impact of these 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. Accordingly, we plan to explore these potential differences in this paper.

The structure for the rest of the paper is as follows. We describe the role played by innovation in determining the level of productivity in Section 2. In turn, we examine the potential links between financial globalisation and the levels of productivity and innovation activity in Section 3. In Section 4, we conduct an empirical analysis of the cross-country relation between internatonal financial integration and the levels of innovation activity. Section 5 concludes.

2 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 with the technology frontier.

In either case, research and development costs need to be incurred in order to develop new technologies and/or successfully adopt existing technologies. This point is emphasised by Keller (2004): 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 multi-dimensional 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 et al (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 similar fashion, these authors find that a country's ability to absorb the spillover gains from international R&D efforts is increasing in the levels of these key domestic variables. Focusing on a sample of developing countries, Coe et al (1997) show that productivity growth is significantly influenced by international R&D

[2]he macroeconomics of innovation has been extensively studied 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 Hanushek (2008) and Ciccone and Papaioannou (2009) on human capital and innovation.

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 et al (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.

A related point is made by Aghion et al (2009), who emphasise 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 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, via its contribution to the mobilisation of domestic savings.

In similar fashion, Alfaro et al. (2004) highlight the importance of domestic financial development if a developing country is to maximise the spillovers from inward FDI. In particular, these authors emphasise that domestic firms require financing if they are to re-organise production techniques in order to take advantage of the knowledge acquired through such FDI spilovers. In similar fashion, local entrepreneurs can only imitate the technologies of foreign-owned firms if they have the access to finance that would enable them to set up new operations to exploit the newly-acquired knowledge. Alfaro et al (2004) show robust empirical evidence the connection between FDI and economic growth is enhanced by greater domestic financial development. In subsequent work, Alfaro et al (2009) show that

this connection indeed operates via total factor productivity growth. Further supportive evidence is provided by Chor et al (2008) who show that there is a greater entry response of domestic firms to FDI, the higher is 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 the advanced economies, while it additionally promotes growth through lowering the cost of capital in emerging and developing economies.

There are many mechanisms by which financial development may promote productivity growth and there is an extensive literature that investigates each channel (Demirgüç-Kunt et al 2008 provide a detailed review). For instance, Hartmann et al (2007) emphasise the role of financial development in facilitating the reallocation of capital to faster-growing industries and find evidence in support of that channel. The importance of resource reallocation for productivity growth in developing countries has also been highlighted by Hsieh and Klenow (2009), who show that productivity growth in China and India has been largely driven by the reallocation of labour and capital from low-productivity to high-productivity firms. In similar fashion, Song et al (2008) emphasise 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 a number of significant studies in recent years. Bosch et al (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-a-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 larger 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, government effectiveness and the quality of research institutions.

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

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 exporting status is easier to attain, the greater the level of domestic financial development, since credit constraints act as a barrier to financing the fixed costs of entering export markets.

The connection between financial development and the expansion of the tradables sector is also emphasised by Buera et al (2008). These authors highlight that production in the tradables sector typically requires a larger scale than in the nontraded 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 et al (2008) also conduct a firm-level study, using data on 11,500 firms

in 27 emerging market economies. This study finds that innovation activity is stimulated by several dimensions of globalisation. In particular, firms are more likely to innovate, the greater is the level of foreign competition, the stronger are 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. The finding by these authors 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 other work that has focused on data for advanced economies (see, for example, Aghion et al 2006).

The connection between financial development and the entry and growth of small firms is further highlighted by Aghion et al (2007). These authors study firm-level data for sixteen advanced and emerging economies and show that access to finance promotes the entry of new firms and their post-entry growth. 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, amongst other factors. Accordingly, by promoting financial development, international financial integration has the potential to positively influence the rate of domestic innovation activity and the rate of productivity growth. We turn to the links beween international financial integration and the levels of productivity and innovation activity in the next section.

3 Productivity, Innovation and International Financial Integration

3.1 The Real Effects of Financial Globalisation

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

Levine (2001) reports evidence that supports the hypothesis that financial liberalisation promotes domestic financial development. This study finds that international financial integration improves the liquidity of the domestic stockmarket. 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 contribution of financial openness to financial development is conditional on the general quality of domestic institutions. In particular, these authors find that the domestic equity market expands only if a threshold level of institutional quality is attained. This study also finds capital account liberalisation 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.

The evidence on the contribution of foreign-owned banks to financial development is reviewed by Demirgüç-Kunt et al (2008). 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, multi-country 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 liberalisations increase the value of domestic stocks and enable domestic firms to expand capital expenditures, since a global investor base reduces firm-specific investment risk (Henry 2000a, Henry 2000b, Bekaert et al 2005, Chari and Henry 2008).

Finally, financial globalisation may play a wider role in stimulating domestic institutional reforms that may in turn boost productivity through indirect mechanisms. This point is emphasised by Henry (2003) and Kose, Prasad, Rogoff and Wei (2009). In particular, the latter describe the 'ancillary' gains from financial globalisation as occurring via improvements to the domestic institutional environment and enhanced macroeconomic policy discipline. The political economy calculus that lies behind such ancillary effects has been analysed by Rajan and Zingales (2003, 2004) and Gourinchas and Jeanne (2008), amongst others.

3.2 Empirical Evidence on the Link between International Financial Integration and Productivity

Several recent studies have examined the link between financial globalisation and productivity using cross-country comparative data. Bonfiglioli (2008) studies a sample of 70 countries over 1975-1999 and shows a robust positive effect of international financial integration on total factor productivity. In contrast, she finds 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 globalisation on total factor productivity for a panel of 67 countries over 1966-2005. An important feature of this study is that these authors allow for a differential impact across equity-type liabilities and debt-type liabilities. This distinction turns out to be importance, since 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 et al (2009) study a sample of 96 countries over 1980-2006. These authors also find a positive relation between financial globalisation and total factor productivity. Moreover, these authors also find support for the hypothesis that financial globalisation in part affects productivity via its indirect impact on the level of domestic financial development, institutional quality and macroeconomic policy discipline. Finally, these authors also find the existence of nonlinearities, in that the impact of financial globalisation depends on the initial levels of financial development and institutional quality.

In relaton 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 entrepreneurship indicators can be estimated. These authors find robust evidence that increased international financial integration stimulates the activity of entrepreneurs along dimensions such entry, size, and skewness of the firm-size distribution. Moreover, these authors 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 in vertically-linked industries. Furthermore, Chari et al (2009) find that foreign control of firms in emerging market economies spurs technology transfer and improved governance.

Manova (2008) provides additional evidence by examining sectoral growth dynamics in the wake of international liberalisation of equity markets. She finds that those sectors that grow most quickly are those characterised 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 these finance-dependent sectors. Gupta and Yuan (2009) also study the sectoral impact of stockmarket liberalisations in emerging markets and find that the greatest positive impact was on those industries that are more dependent on external finance and have better growth opportunities. A striking feature of this study is sectoral growth is mainly due to an expansion in the size of existing firms rather than through the entry of financially constrained new firms. However, the role of new firm entry is stronger in those countries that have lower regulatory barriers to firm entry.

Eichengreen et al (2009) also consider industry-level evidence in estimating the impact of capital account liberalisation. These authors find that capital account liberalisation disproportionately boosts the growth of finance-dependent industries. However, these growth gains are only achieved by those 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 the level of productivity. In the next section, we explore whether this relation may be in part attributed to a connection between financial globalisation and the level of innovation activity.

4 Innovation Activity and Financial Integration: An Empirical Analysis

4.1 Determinants of Innovation Activity

In order to investigate the cross-country relation between international financial integration and the levels of innovation activity, we examine the following baseline specification

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

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. Our main innovation indicator is the ratio of R&D expenditure to GDP. However, we also examine measures of corporate dynamism, in view of the role played by firms in driving technological progress.

We include the level of GDP per capita as a general control variable. In addition, we include 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 co-variation pattern between financial globalisation and the 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 plausibly influence at least some of these variables, the estimated coefficients in this speci-

fication only capture the partial impact of financial globalisation while holding fixed these characteristics.

We also consider an alternative specification in which we allow for a difference between equity-type and debt-type international positions. This specification has the form

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

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 international debt category comprises portfolio debt, non-portfolio debt and foreign-exchange reserves. As in equation (1), we include interaction terms in order to allow for threshold effects in the impact of the different dimensions of financial globalisation.

4.2 The Data

Our main indicator of innovation activity is the level of expenditure on R&D, expressed as a percentage of GDP (UNESCO Innovation dataset). 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 versus 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 patent numbers may be too narrow to adequately capture the level of innovation activity. We use the most recent year available, which is typically 2006.

In addition, we follow Djankov et al (2009) in also examining 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.

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

We measure the level of GDP per capita in constant international dollars, taken from the Penn World Tables. We employ two standard measures of domestic financial development (the ratio of liquid liabilities to GDP and the ratio of stockmarket capitalisation to GDP), each taken from the World Bank's Financial Structure Database.[4] In relation to the other control variables, we take the trade openness measure from the World Bank's World Development Indicators database, while we use the educational attainment measure (for the +25 age cohort) constructed by Barro and Lee (2001). We measure institutional quality with the 'government effectiveness' variable from the World Bank's Governance Indicators dataset. Finally, we also include the one-year effective corporate tax rate measure constructed by Djankov et al (2009).

4.3 Innovation Activity and the 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 is clearly increasing in the level of output per capita. Moreover, the relation is convex, with the elastisicity of R&D spending with respect to output per capita relatively small until

[4]See Beck et al (2000) for more details on this database. See also Dorrucci et al (2009) on the measurement of financial development for emerging market economies.

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.

We consider two other indicators of innovation activity in Figures 2 and 3. Figure 2 displays the scatter 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 business entry rate, 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 et al 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.

4.4 Econometric Results

We turn now 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).

We first examine R&D expenditure. Table 1 shows the baseline results. Column (1) shows the positive relation between output per capita and the level of R&D spending. Moreover, it shows a non-linear relation between international financial integration and R&D. In particular, a higher degree of international financial integration only boosts R&D spending 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 turns out to be

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 (the level of stockmarket capitalisation) is marginally significant in column (3). Otherwise, the control variables do not turn out to be individually significant.

We implement equation (2) 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 inernational dollars).

The results for international equity integration broadly hold in the expanded specifications reported in columns (2)-(4). These specifications also deliver 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 are individually significant in columns (2)-(4).

We next turn to the indicators of entrepreneurial activity in Tables 3 through 6. Table 3 shows a very strong pattern of co-variation between GDP per capita and the business density measure. 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 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 are significant in columns (2)-(4).

We distinguish between international equity integration and international debt integration in Table 4. The results show that international equity integration is significantly positively associated with a higher level of business density. Moreover, the 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 output level ($33,400 international dollars). In relation to international debt integration, there is no significant association between cross-border debt holdings and the level of business density. As in Table 3, none of the control variables are individually significant.

Finally, we examine the business entry rate in Tables 5 and 6. 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) do 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 per capita is attained. However, that threshold level is relatively low: it is $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 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 capital 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 must be considered to be 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 globalisation 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. In another direction, this study 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 study 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 et al 2009 for a recent synthesis). Accordingly, a challenge for future research is to establish with a greater level of precision the precise threshold conditions that are required in order for 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 do 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 emphasised that episodes of major financial liberalisation frequently involve a crisis phase in which excess debt levels lead to banking and currency crises. The evidence of Ranciere et al (2008) is that liberalisation 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 favour of financial globalisation. However, this is in itself not sufficient to suggest that a rapid move towards external financial liberalisation 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 is plausibly a complex interplay between financial integration and the level of innovation activity. The pattern that the gains from international equity integration are more attainable for lower-income countries than is the case for international debt integration do suggest that a strategy of opening up to equity-type cross-border flows should precede the liberalisation of debt-type flows. Accordingly, a country that does not have in place the required domestic institutional and policy environment to fully gain from financial integration would be better advised to pursue financial integration in an incrementalist fashion (see also Obstfeld 2009).

That said, it is also possible that financial integration can contribute to the develop a better domestic institutional framework, such that it is not necessarily appropriate to delay all moves towards 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, amongst others, Rajan and Zingales 2003, 2004, Gourinchas and Jeanne 2005 and Mishkin 2006, 2009). Accordingly, the negotiation and modulation of the appropriate pace of financial integration remains a major challenge for policymakers in developing countries.

Moreover, it is also important to emphasise 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 act to reduce the risk profile of international financial flows for emerging market economies (see also Lane 2009a, 2009b). For example, the establishment of the IMF's flexible credit line facility is intended to reduce the risk of a well-behaved emergng 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 liberalisation.

5 Conclusions

The goal of this paper has been to examine the connection between international financial integration and enhanced levels of productivity and innovation activity. At a time when the gains to financial globalisation 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, does suggest that financial globalisation 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 globalisation 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 policymakers in developing countries is to embrace financial globalisation in a phased way that recognises the interplay between domestic institutional development and greater openness to international investment flows. In terms of sequencing, the evidence in this paper and in other recent contributions is that international equity integration offers greater benefits for lower-income countries, whereas the gains from international debt integration are concentrated at higher income levels. Finally, the burden on national policymakers can be alleviated by internationally-coordinated actions to improve the stability of the global financial system. Accordingly, the G20 reform agenda can make it safer for developing countries to obtain the potential benefits from financial globalisation.

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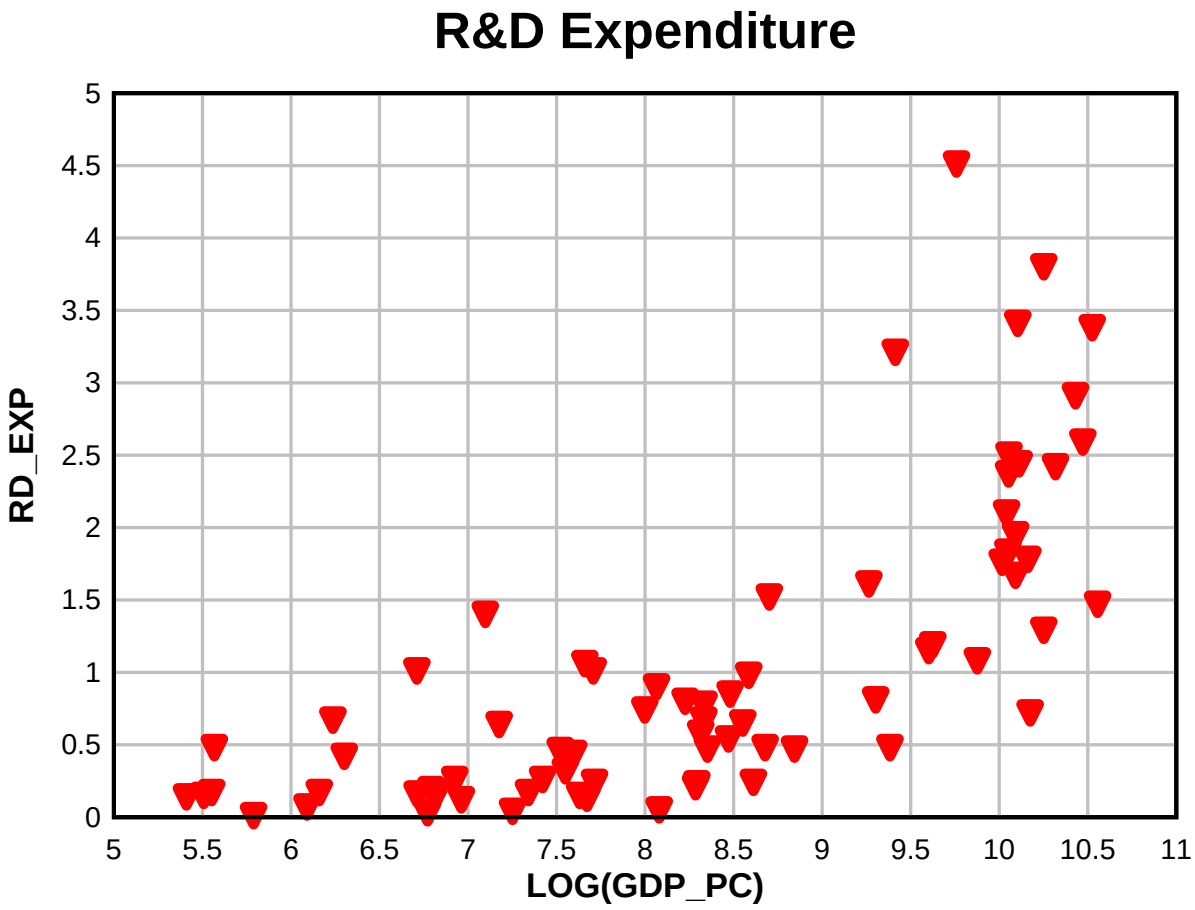

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Figure 1: R&D and Level of Development

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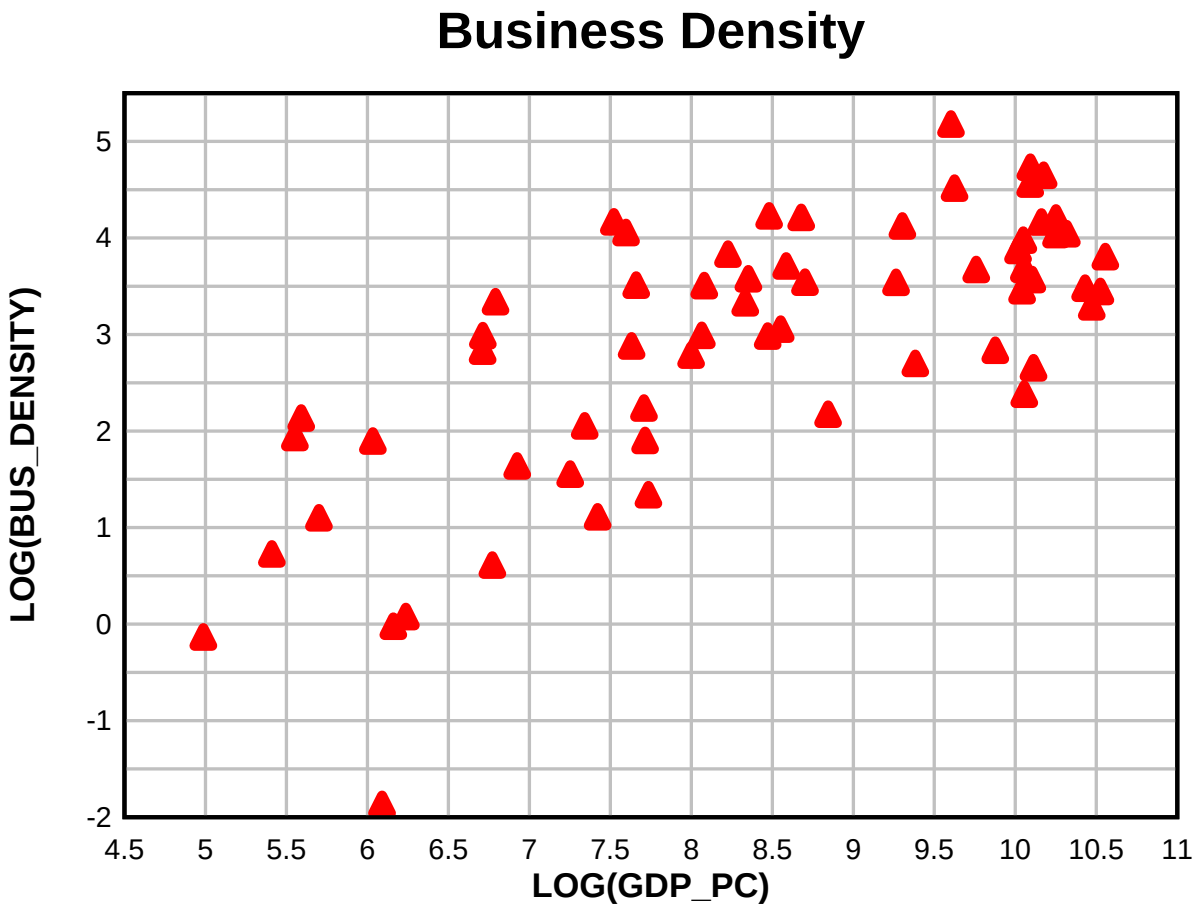

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Figure 2: Business Density and Level of Development

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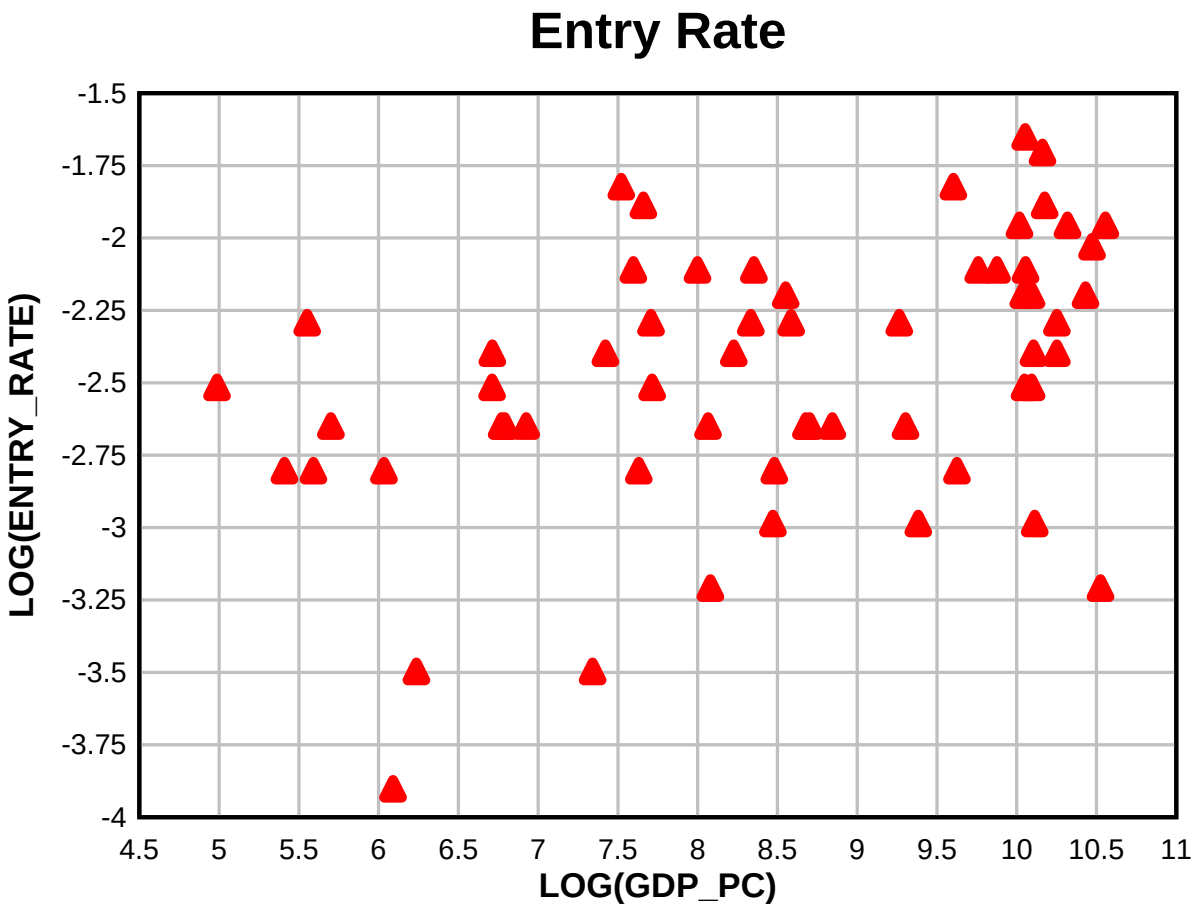

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Figure 3: Entry Rate and Level of Development

Table 1: R&D and International Financial Integration I

	(1)	(2)	(3)	(4)
α	-1.4	-2.3	-3.3	-3.2
	(.53)	(2.1)	(2.2)	(2.4)
Ypc	0.34	0.24	0.21	0.19
	(.07)***	(.1)**	(.12)*	(.13)
IFI	-0.015	-0.023	-0.027	-0.029
	(.004)***	(.007)***	(.008)***	(.008)***
IFI*Ypc	0.0015	0.0022	0.0026	0.0027
	(.0004)	(.0006)***	(.0007)***	(.008)***
IQUAL		8.6	13.9	15.8
		(14.7)	(15.3)	(15.0)
Trade		0.0035	0.0037	0.0037
		(.0017)**	(.0018)**	(.0019)*
EDUC		0.009	0.01	0.009
		(.01)	(.011)	(.01)
LLY			0.24	0.28
			(.34)	(.33)
STKCAP			0.31	0.29
			(.17)*	(.18)
TAX				-0.01
				(.02)
R2	0.58	0.56	0.61	0.6
N	71	53	50	50

Estimation is by OLS, with heteroskedasticity-consistent standard errors. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. Ypc is GDP per capita; IFI is the ratio of foreign assets and liabilities to GDP; IQUAL is government effecitiveness indicator; Trade is ratio of exports plus imports to GDP; EDUC is Barro-Lee educational attainment indicator for +25 age cohort; LLY is ratio of liquid liabilities to GDP; STKCAP is ratio of stockmarket capitalisation to GDP; TAX is one-year effective corporate tax rate.

Table 2: R&D and International Financial Integration II

	(1)	(2)	(3)	(4)
α	-1.3 (.52)**	-2.2 (2.1)	-2.9 (2.2)	-2.8 (2.40
Ypc	0.33 (.07)***	0.24 (.1)**	0.2 (.12)	0.18 (.13)
IEQ	-0.023 (.011)**	-0.02 (.012)	-0.025 (.014)*	-0.026 (.015)*
IEQ*Ypc	0.0028 (.0012)**	0.0024 (.0014)*	0.0028 (.0016)*	0.0029 (.0017)*
IDEBT	-0.013 (.0077)	-0.025 (.01)**	-0.029 (.01)***	-0.03 (.01)***
IDEBT*Ypc	0.0011 (.0008)	0.0022 (.001)**	0.0026 (.001)**	0.0027 (.001)**
IQUAL		8.7 (14.6)	11.9 (14.8)	13.0 (14.3)
Trade		0.0014 (.002)	0.0013 (.002)	0.0013 (.0024)
EDUC		0.008 (.01)	0.011 (.01)	0.011 (.01)
LLY			0.46 (.35)	0.48 (.34)
STKCAP			0.16 (.17)	0.15 (.18)
TAX				-0.006 (.02)
R2	0.59	0.56	0.61	0.6
N	71	53	50	50

Estimation is by OLS, with heteroskedasticity-consistent standard errors. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. Ypc is GDP per capita; IEQ is the ratio of foreign equity-type assets and liabilities to GDP; IDEBT is ratio of foreign debt-type assets and liabilities to GDP; IQUAL is government effecitiveness indicator; Trade is ratio of exports plus imports to GDP; EDUC is Barro-Lee educational attainment indicator for +25 age cohort; LLY is ratio of liquid liabilities to GDP; STKCAP is ratio of stockmarket capitalisation to GDP; TAX is one-year effective corporate tax rate.

Table 3: Business Density and International Financial Integration I

	(1)	(2)	(3)	(4)
α	-4.7 (1.1)***	-5.6 (2.3)**	-5.0 (2.2)**	-4.9 (2.2)**
Ypc	0.84 (.12)***	0.82 (.17)***	0.82 (.19)***	0.81 (.19)***
IFI	0.023 (.007)***	0.018 (.007)**	0.019 (.007)***	0.018 (.007)**
IFI*Ypc	-0.0023 (.0007)***	-0.0018 (.0006)***	-0.0018 (.0006)***	-0.0018 (.007)**
IQUAL		7.2 (11.8)	5.8 (12.1)	7.2 (13.8)
Trade		-0.0004 (.002)	-0.001 (.002)	-0.001 (.002)
EDUC		-0.0018 (.015)	-0.011 (.014)	-0.012 (.014)
LLY			-0.18 (.35)	-0.13 (.39)
STKCAP			0.07 (.43)	0.06 (.17)
TAX				-0.01 (.02)
R2	0.53	0.59	0.61	0.6
N	60	44	43	43

Estimation is by OLS, with heteroskedasticity-consistent standard errors. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. Ypc is GDP per capita; IFI is the ratio of foreign assets and liabilities to GDP; IQUAL is government effecitiveness indicator; Trade is ratio of exports plus imports to GDP; EDUC is Barro-Lee educational attainment indicator for +25 age cohort; LLY is ratio of liquid liabilities to GDP; STKCAP is ratio of stockmarket capitalisation to GDP; TAX is one-year effective corporate tax rate.

Table 4: Business Density and International Financial Integration II

	(1)	(2)	(3)	(4)
α	-4.3 (1.1)***	-5.5 (2.2)**	-4.2 (2.1)*	-4.2 (2.1)*
Ypc	0.8 (.12)***	0.8 (.18)***	0.78 (.19)***	0.78 (.19)
IEQ	0.053 (.03)*	0.073 (.036)*	0.043 (.026)	0.043 (.026)
IEQ*Ypc	-0.005 (.0032)	-0.007 (.0037)*	-0.0038 (.0028)	-0.0038 (.0028)
IDEBT	0.0019 (.019)	-0.024 (.03)	-0.0024 (.02)	-0.0026 (.02)
IDEBT*Ypc	-0.0003 (.002)	-0.0023 (.003)	0.0001 (.002)	0.0002 (.002)
IQUAL		10.1 (11.3)	4.4 (12.0)	4.9 (13.8)
Trade		-0.002 (.003)	-0.0036 (.0027)	-0.0036 (.0028)
EDUC		-0.014 (.014)	-0.015 (.014)	-0.016 (.015)
LLY			0.048 (.38)	0.06 (.42)
STKCAP			-0.14 (.19)	-0.14 (.19)
TAX				-0.003 (.03)
R2	0.54	0.62	0.62	0.61
N	60	44	43	43

Estimation is by OLS, with heteroskedasticity-consistent standard errors. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. Ypc is GDP per capita; IEQ is the ratio of foreign equity-type assets and liabilities to GDP; IDEBT is ratio of foreign debt-type assets and liabilities to GDP; IQUAL is government effecitiveness indicator; Trade is ratio of exports plus imports to GDP; EDUC is Barro-Lee educational attainment indicator for +25 age cohort; LLY is ratio of liquid liabilities to GDP; STKCAP is ratio of stockmarket capitalisation to GDP; TAX is one-year effective corporate tax rate.

Table 5: Entry Rate and International Financial Integration I

	(1)	(2)	(3)	(4)
α	-3.4 (.5)***	-3.6 (1.0)***	-3.8 (1.1)***	-3.8 (1.2)***
Ypc	0.09 (.056)*	0.15 (.062)**	0.23 (.055)***	0.23 (.056)***
IFI	0.002 (.004)	-0.009 (.005)	-0.007 (.004)*	-0.007 (.004)*
IFI*Ypc	-0.0002 (.0004)	0.0008 (.0005)*	0.0008 (.0004)*	0.0008 (.0004)*
IQUAL		1.4 (5.5)	2.3 (6.4)	2.4 (6.7)
Trade		0.0022 (.0012)*	0.0015 (.0013)	0.0015 (.0013)
EDUC		-0.014 (.006)**	-0.021 (.005)***	-0.021 (.005)***
LLY			-0.62 (.15)***	-0.61 (.16)***
STKCAP			0.009 (.1)	0.008 (.1)
TAX				-0.001 (.007)
R2	0.13	0.25	0.42	0.4
N	57	43	42	42

Estimation is by OLS, with heteroskedasticity-consistent standard errors. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. Ypc is GDP per capita; IFI is the ratio of foreign assets and liabilities to GDP; IQUAL is government effecitiveness indicator; Trade is ratio of exports plus imports to GDP; EDUC is Barro-Lee educational attainment indicator for +25 age cohort; LLY is ratio of liquid liabilities to GDP; STKCAP is ratio of stockmarket capitalisation to GDP; TAX is one-year effective corporate tax rate.

Table 6: Entry Rate and International Financial Integration II

	(1)	(2)	(3)	(4)
α	-3.3 (.5)***	-3.5 (1.1)***	-3.9 (1.3)***	-3.9 (1.3)***
Ypc	0.077 (.051)	0.14 (.058)**	0.23 (.05)***	0.23 (.05)***
IEQ	0.019 (.013)	0.036 (.014)**	0.027 (.011)**	0.027 (.011)**
IEQ*Ypc	-0.002 (.0014)	-0.0038 (.0015)**	-0.0029 (.0012)**	-0.0029 (.0012)**
IDEBT	-0.008 (.007)	-0.041 (.012)***	-0.032 (.008)***	-0.032 (.008)***
IDEBT*Ypc	0.001 (.001)	0.0042 (.0012)***	0.0033 (.0008)***	0.0033 (.0008)***
IQUAL		3.3 (6.2)	3.7 (7.1)	4.0 -7.8
Trade		0.0027 (.0014)*	0.0026 (.0008)***	0.0026 (.0008)***
EDUC		-0.021 (.006)***	-0.025 (.005)***	-0.026 (.005)***
LLY			-0.61 (.17)***	-0.61 (.17)***
STKCAP			-0.0033 (.11)	-0.0036 (.11)
TAX				-0.001 (.008)
R2	0.14	0.39	0.51	0.49
N	57	43	42	42

Estimation is by OLS, with heteroskedasticity-consistent standard errors. ***, **, * denote significance at the 1, 5 and 10 percent levels respectively. Ypc is GDP per capita; IEQ is the ratio of foreign equity-type assets and liabilities to GDP; IDEBT is ratio of foreign debt-type assets and liabilities to GDP; IQUAL is government effecitiveness indicator; Trade is ratio of exports plus imports to GDP; EDUC is Barro-Lee educational attainment indicator for +25 age cohort; LLY is ratio of liquid liabilities to GDP; STKCAP is ratio of stockmarket capitalisation to GDP; TAX is one-year effective corporate tax rate.

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