Financial openness and financial integration

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Key to symbols used in tables

- n.a. not applicable
  . .. not available
  - zero
  . insignificant

Abbreviations

GDP gross domestic product
US United States
EU European Union

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Abstract
Until now, the economic literature has used the two terms ‘financial openness’ and ‘financial integration’ interchangeably. As a result, problems relating to the mobility of capital across borders, which is associated with financial openness, have been considered one of the costs of financial integration. Therefore, unlike trade liberalisation, financial integration does not necessarily deliver welfare improvements. This paper, however, argues that financial integration always leads to welfare improvement, provided that financial integration is understood to be a distinctive concept from financial openness. A small modification to the Solow-Swan model for a small open economy is introduced to define the difference between the terms ‘openness’ and ‘integration’ formally. Two empirical tests are also employed using data from fifteen Asia-Pacific economies to verify the assumptions of the model.

Trade and financial liberalisations
While the free movement of physical goods across borders (trade liberalisation) is considered by economists to be welfare improving, the movement of financial assets (capital account liberalisation) consequences which are not so easily defined. On one hand, both microeconomic and macroeconomic theories have pointed out the various benefits of free international capital movement, which in many respects parallel the benefits of international free trade.1 On the other hand, the practical experiences of the East Asia financial crisis raise an array of problems related to quick and easy movement of financial assets to and from a country and may cast a great deal of doubt on the benefits or potential welfare improvements to be derived from financial openness.

Why do the two forms of liberalisation differ so much? Is it because modern financial markets have become far more complex than the traditional goods markets? Or, are the fundamentals of micro and macroeconomics, which are the basis of the ‘old’ economy, no longer relevant to the ‘new’ economy? There have been many studies on the problems associated with capital account liberalisation, but the question stated above still has no clear-cut answer. This paper, however, proposes a short and direct answer—capital account liberalisation must have the same welfare improving effects as trade liberalisation. The reason is that, as long as the two processes of liberalisation can work to their ends, domestic and international markets will integrate with one another in a single market, allowing individuals to optimise freely their behaviours on larger choices. Hence, domestic individuals must all be better off, or, in other words, social welfare must be improved.

While both processes of liberalisation have the final objective of full integration, there is an important difference between trade and financial liberalisations. In goods markets, as soon as trade barriers have been removed and the free movement of goods across borders is guaranteed, the integration is automatically and immediately achieved. In contrast, integration of financial markets in the same conditions would not be immediate—even though capital goods could move freely, it would not yield full integration. Instead, the free movement of capital can be described as financial openness.
Financial openness and financial integration

To date, the economic literature has often used ‘financial integration’ and ‘financial openness’ interchangeably (De Brouwer 1999). Problems associated with capital mobility or financial openness are ascribed as the ‘costs’ of financial integration. If the ‘costs’ are too high, it may be concluded that financial integration induces welfare reduction (Agenor and Aizenman 1998). Thus, the concepts of ‘financial openness’ and ‘financial integration’ should be clearly distinguished.

First, a country pursuing capital account liberalisation is said to be seeking ‘financial integration’ with the international financial markets through ‘financial openness’. That is, ‘financial openness’ is the means, while ‘financial integration’ is the goal. Although financial openness is a necessary condition for financial integration, it is not a sufficient condition.

In practice, ‘financial openness’ is the situation where existing administrative and market-based restrictions on capital movement across borders have been removed. In some countries it also includes the introduction of measures to attract foreign capital and reduce the discrimination against foreign financial institutions operating in domestic markets. When a country implements capital account liberalisation, it should first ensure ‘openness’, then ‘financial integration’ will gradually be achieved. Ideally, that country will eventually have a financial market structure and products similar to those of overseas markets. Domestic financial markets effectively become part of the world market, synchronising interest rate movements, saving and investment activities, and the accumulation of physical capital stocks.

Next, it should be noted that most economic models predicting the benefits of capital account liberalisation in fact imply the benefits of financial integration. That is the models assume that after liberalising its capital account a country will automatically achieve perfect financial integration. As a result, there will be free and frictionless movement of capital across borders whenever interest rate differentials emerge because of the different marginal products of capital or different intertemporal behaviours. If the country in question is relatively small, so that capital flows are relatively large, those models effectively assume real interest rate parity across countries. In those settings, capital account liberalisation will be exactly equivalent to trade liberalisation, in the sense that agents in the economy can freely exercise their optimised decisions, consequently maximising their welfare. Thus, capital account liberalisation guarantees welfare improvement, and countries will definitely benefit from a high degree of financial integration.

Many countries have experienced a lot of problems after liberalising their capital accounts, which have prevented them from achieving the final goal—financial integration. This implies that financial openness does not guarantee immediate financial integration. Since the recent financial crisis in East Asia, the economic literature has sought to explain why financial integration has sometimes caused harm instead of providing the benefits predicted in theory. The question, however, should in fact be restated—what are the costs
of financial openness without, or with only a low level of, financial integration? Or, in other words, as openness is not a sufficient condition for integration, what are the other necessary conditions the absence of which has caused such troubles for those countries which were relatively open in terms of their capital accounts?

Among researchers, the answers to this question range from asymmetric information problems, such as moral hazard and adverse selection (Eichengreen et al. 1998; Roubini 1998), to flawed financial fundamentals (Moreno, Pasadilla, and Remolona 1999; Wibulswasdi 1998). Certainly all these issues are relevant and important, though they overlook the eventual and aggregate cause of these problems for the economy—the low level of financial integration. Instead of trying to identify all the problems inherited in the financial system, it is much simpler to look at the gap between openness and integration to value the costs and benefits of the process of capital account liberalisation.

Furthermore, the issue of sequencing the process of capital account liberalisation has widely been addressed as a policy response to the ostensible costs or risks of financial openness (Eichengreen and Mussa 1999; Johnston 1998). Although financial integration is not directly mentioned, what the sequencing in fact does is harmonise openness and integration in an attempt to prevent the situation when a country completely opens its capital account while its level of financial integration is still very low. There is, however, a shortcoming in sequencing studies—lack of a simple timing index or indicator which would allow policy makers to decide when it is appropriate to move to the next step. For this purpose, a quantitative measure of financial integration could be useful.

Box 1 Malaysia’s capital account restrictions

In September 1998, when Malaysia stepped back from its openness, extensive debates over the appropriateness of that policy took place. Sceptical voices were only cooled several months later when clear signs of a bounce back in the Malaysian economy emerged. This would have been more understandable if the policy had been examined from the point of view of the gap between openness and integration. Essentially, Malaysia was trying to temporarily lower its level of openness in order to eliminate the mismatch with integration. The final consequence of its effort would be exactly equivalent to what Thailand and Korea did. By implementing sweeping reforms of their financial system, cleaning up banking sectors, and strengthening supervision and regulation, Thailand and Korea also effectively closed the gap between openness and integration. Whereas Malaysia decreased its level of openness, the other countries raised their level of integration. Both approaches were ultimately successful in stopping the decline in investor confidence and economic activity, but Thailand and Korea had to take far more bitter medicine.
Outline

It is important not only to distinguish the two concepts of financial openness and financial integration, but also to study the measures of those concepts themselves. If the degrees of financial openness and integration, and hence the gap between them, can be clearly identified and quantified, the costs and risks of having such a gap could also be determined. Policy responses to the existing gap would also be easier to define and justify. The timing issue for sequencing would become more unambiguous. The economic literature, however, continues to use these two concepts interchangeably and, although some studies have sought to measure the financial openness (Whitman 1969; De Brouwer 1999), no attempt has been made so far to identify and quantify the level of financial integration.5

To fill that gap, this paper will develop a model, based on the Solow-Swan model for a small open economy (Benge and Wells 1998), to formulate the two concepts distinctively. As the main purpose of this paper is not to derive a precise indicator for financial integration, the Solow-Swan model will be used to take advantage of its simplicity. A small extension to the original Solow-Swan model will be introduced enabling the distinction between openness and integration. When the model represents the state of less than full integration, it will be used to discuss some of the issues which arise when there is a gap between financial openness and integration. Finally, a quantitative measure of financial integration will be proposed based on the features and implications of the model.

Then, two small empirical tests will be carried out on the data of fifteen Asia-Pacific economies to confirm the underlying assumptions and hypotheses used in the model. It should be noted that, although quantitative indicators of the countries being studied will be estimated, it is not the goal of this paper to quantify exactly the financial integration of those countries, rather it will serve as a confirmation. After the results and fitness of the tests to the theoretical model have been discussed and explained, proposals for further study in this direction will be given, indicating the model may be improved and the integration index refined.

Theoretical model

Baseline model
First we define the openness of a country’s capital account as the situation when capital can move freely across borders. Domestic firms can raise capital in both domestic and international markets, while domestic investors can invest wherever they want. The free movement of capital does not, however, imply parity between domestic and world real interest rates. The difference may be attributed to asymmetric information problems, transaction costs, borrowing constraints, country risks, or government interventions and regulations in financial markets.6
Perfect financial integration, on the other hand, is defined as the situation when the parity of real interest rates is guaranteed. To achieve this condition, the country’s capital account must be open, and other barriers to achieving parity, such as those mentioned above, should not exist. Hence, in a small open economy, where the domestic interest rate is exogenous because of perfect financial integration, households’ choices between consumption/saving and investment will be completely separate (production-consumption separation).

In the real world, no country can achieve perfect financial integration, although most of them have already opened their capital accounts. The reasons vary greatly across countries, but the consequence of less than perfect integration is common to all—domestic interest rates deviate vastly from the world rates. Thus, it is logical to assume that the more endogenous domestic interest rates are, the less integrated is the economy into world markets. In this paper, the degree of endogeneity of domestic interest rates will serve as both theoretical and empirical indicators of the degree of financial integration.

To define perfect financial integration formally, let us look at the basic Solow-Swan model for a small open economy (Benge and Wells 1998). This model assumes constant saving rate, homogenous goods and production technology all over the world, and no transaction and adjustment costs. The fundamental equations underlying the model are

\[ y = g(k) \]  
\[ \frac{dy}{dk} = g_k = r + \delta \]  
\[ \frac{dw}{dt} = s[g(k) - rk] - \delta k - [\mu + n - sr]w \]

where

- \( y \) is the domestic output
- \( g(k) \) is the production function of the economy (\( g_k > 0 \) and \( g_{kk} < 0 \))
- \( w \) is the amount of wealth per effective worker
- \( k \) is the level of capital per effective worker
- \( s \) is the saving rate
- \( r \) is the world interest rate
- \( \delta \) is the rate of depreciation
- \( \mu \) is the rate of technical progress
- \( n \) is the rate of labour force growth, hence \( \mu + n \) is the growth rate of the number of effective workers.
Notice that the model assumes that the domestic interest rate equals the world interest rate, which is exogenous to the model (small open economy). As a result, given the depreciation rate and the world interest rate, domestic output and the level of capital accumulation are determined solely by the conditions that satisfy the Equations 1 and 2, which are independent from saving and consumption behaviours inside the country. Thus, this model represents an economy with perfect financial integration according to our definition above.

Equation 3 determines the total wealth level per effective worker. In the steady state \( \frac{dw}{dt} = 0 \), hence \( s[g(k*) - rk*] - \delta k* = [\mu + n - sr]w* \). If the level of \( w* \) is not adequate to keep the capital level at \( k* \), the country will borrow from abroad and run a current account deficit. Here, we emphasise the notion of perfect financial integration by the fact that the domestic interest rate is equal to the world interest rate and the country can borrow as much capital as it needs to maintain the level of \( k* \) despite the level of \( w* \) (openness is also in place). If this is the case, it is clear that domestic saving and investment would have no correlation, or, in other words, the Feldstein-Horioka paradox should not exist.

Figure 1 describes the model in the case \( w* < k* \). Notice that \( w* \) and \( k* \) are independently determined and the distance between \( w* \) and \( k* \) is net foreign liability. If domestic households change their saving behaviour, only accumulated wealth \( w* \) would change, and hence, the magnitude of foreign liability. Accumulated capital \( k* \) is unchanged provided the world interest rate remains constant.

Figure 1  Solow-Swan model for a small open economy

\[
\begin{align*}
\frac{dy}{dt} &= g(k) \\
\frac{d(k, w)}{dt} &= r + \delta \\
\frac{dw}{dt} &= s[g(k*) - rk*] - \delta k* \\
\frac{d[w*]}{dt} &= [\mu + n - sr]w
\end{align*}
\]
Model extension

Now, let us develop a model for the case where there is capital mobility (openness) but with less than perfect integration. First, it should be noted that according to our definition of financial openness, the domestic interest rate should no longer be equal to the world rate. To represent this we can set \( r = r^* + \pi(k - w) \), where function \( \pi(k-w) \) is a premium (credit spread) function depending on the country’s leverage level—the wider the gap between capital accumulation and wealth level (higher foreign liability), the higher the premium the country has to pay in addition to the world interest rate in order to borrow from overseas. Thus, \( d\pi/d(k-w) > 0 \).

In Figure 2, the new levels of wealth \( w' \) and \( k' \) are determined given the initial gap \( k^*-w^* \). The effect on capital accumulation is unambiguously negative, whereas the effect on the wealth level is ambiguous and depends on the relative changes of the domestic interest rate and capital accumulation. In Figure 2 we assume the effect on wealth is positive. Notice that the gap between \( k' \) and \( w' \) in this case is narrower than in the case of perfect financial integration because \( k' < k^* \) and \( w' > w^* \). But, as capital accumulation is always lower, the country’s output is lower as well despite the new level of wealth. The speed of the adjustment process depends on the characteristics of the functions \( g \) and \( \pi \), as well as the exogenous variables such as the saving rate.

Figure 2  Modified Solow-Swan model
Interestingly, the Feldstein-Horioka paradox can now be explained by this modified Solow-Swan model. It is clear that wealth and capital accumulation are no longer independent under this setting. They are linked through the process of domestic interest rate determination. Indeed, when the saving rate increases, the horizontal line \( s[g(k) - rk] - dk \) rises, resulting in an increase in wealth level, which reduces the gap between \( k \) and \( w \). This reduces the interest rate, causing \( k \), and hence investment, to increase. Thus, in this model saving and investment clearly have positive correlation as shown by Feldstein and Horioka. The stronger the effect of the gap between \( w \) and \( k \) on the domestic interest rate (the bigger \( dp/d(k-w) \)), the higher the correlation between saving and investment.

An immediate application of this finding is that we can simply use the Feldstein-Horioka coefficient as a quantitative measure of the degree of financial integration—the closer the coefficient to 0, the higher the degree of financial integration. The closer the coefficient to 1, the less integrated is the economy into world markets. In the next section we look at the good and the bad sides of the two extreme cases—perfect integration and perfect openness without integration.

**Model implications**

In the first case, it is unambiguous that the country with perfect financial integration (in the original Solow-Swan model) will attain many benefits—higher capital accumulation which results in higher output and higher real wages, and a higher and smoother consumption stream. Although the model does not include any nominal variables, we can infer that price level would be more stable as any adverse effect (for example, natural disasters) on wealth would not influence production and hence the level of supply. Thus, it is always desirable to have financial integration.10

In the second case, although the country can still tap the benefits of higher capital accumulation, there are some negative consequences of openness without perfect integration. First, as the perceived wealth level may vary over time because of changing expectations and fluctuations in nominal variables, the level of physical capital accumulation will also vary over time, hence causing output to fluctuate as well. Second, and more importantly, the function \( \pi \) in reality would not be deterministic as we assumed above. It is likely to include expectation elements, hence causing some problems of asymmetric information.

**Overborrowing.** As the equilibrium level of overseas borrowing is determined by the interest rate equation \( r = r^* + \pi(k-w) \), both foreign lenders and domestic borrowers need to determine the gap \( k-w \). Suppose there is asymmetric information about this gap—overseas lenders think it is \( \Delta_o \) while domestic borrowers, who have better information about the leverage level of domestic corporations, believe it is \( \Delta_d \). In a booming economy, it is reasonable to suggest that \( \Delta_o < \Delta_d \). Substituting these two values into the interest rate equation we obtain \( r_o = r^* + \pi(\Delta_o) \) and \( r_d = r^* + \pi(\Delta_d) \). Since \( \Delta_o < \Delta_d \) and \( d\pi/d(k-w)>0 \),
Finally, lenders and borrowers may agree on a contract rate in the middle of these two rates \( r_o < r_c < r_D \). Hence, domestic borrowers would perceive a lower interest rate they are willing to pay while overseas lenders may perceive a higher interest rate than that at which they are willing to lend. This results in overborrowing (or overlending) in the capital market, because the borrowers have persistent incentives to borrow funds overseas which seem to be ‘cheap’. This overborrowing syndrome will lead to bad debt problems.

In Figure 3, assuming \( r_D = r_c \), the optimal level of capital should be \( k' \). Due to the overborrowing problem, however, suppose that the capital level has reached \( k'' \), which exceeds the optimal level \( k' \). But at that level the return on capital of the whole economy \( g_k(k'') \) must be lower than \( g_k(k') \). Hence, given the gap \( k'' - w \), the total foreign liability, the distance \( bd \) represents the ‘bad debt’ that the lenders will face (the expected return on assets owned by foreigners minus the actual return). As can be seen in Figure 3, the greater the distance between \( k' \) and \( k'' \) (more overborrowing), the larger the ‘bad debt’, \( bd \), in the capital market (note that this figure ignores \( \delta \), that is, \( r = g_k \)).

To solve the ‘bad debt’ problem, the lenders, realising the excessive level of \( k'' \), have to write off non-performing loans and liquidate unproductive assets, effectively reducing the level of \( k'' \). Otherwise, domestic saving must be raised to compensate for the loss of net wealth, which usually cannot be done in a short time. The situation could be even worse if there is herding behaviour among foreign investors and lenders where a speculative attack could trigger a self-fulfilling capital run.

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**Figure 3** Overborrowing and bad debt
Herding behaviour and speculative attack. Recalling that domestic interest rate is calculated by the equation \( r = r^* + \pi(k - w) \), the question arises of how lenders would calculate the gap \( k-w \). Both \( k \) and \( w \) are accumulative levels which are rarely reported in statistical data series. Different accounting practices, different depreciation methods, different references of inflation and exchange rates make the national data of accumulative wealth and capital inaccurate and unreliable. Therefore, foreign lenders often refer to other proxies of that gap such as the sovereign debt rating given by some well-known organisations (Moody, S and P). The problem with this approach is that the rating is not updated quickly enough, especially in the case of sharp declines in the economic environment—namely, in a crisis. To circumvent this foreign investors and lenders could look directly at the most recent credit spread as a guide for evaluation of country risk (a rough proxy for \( k-w \)).

Returning to Figure 3, suppose the country is overborrowing and only some astute speculators are aware of that. To spark an attack, they simply short sell domestic equities and bonds, which drives down the price of those instruments. Strictly speaking, as our model is only a model of real variables, the equivalence of a price fall is a rise in the interest rate (the interest rate and prices of equities and bonds are inversely related). Usually, countries would defend their market’s stability by running down foreign exchange reserves to keep the bad debt level in check and keep interest rates from rising. If reserves become too low, however, and countries give up the fight, interest rates may sharply rise. Thinking that bad days are coming, foreign investors begin to abandon credit rating and start to look at recent levels of credit spread as a proxy for the fair (and safe) level of the interest rate for lending or investing. If this now becomes greater than the expected return on equities, they start to sell their equity holdings, which exacerbates the situation as the interest rate continues to be driven up. The more equity is sold, the quicker the ‘correction’ process from \( k'' \) to \( k' \). This correction may even overshoot the optimal level \( k' \), moving to \( k''' < k' \). If \( k''' \) is too low, an economic recession is guaranteed.

There is a fundamental difference between the case of perfect information and orderly adjustment from \( k'' \) to \( k' \) and the case of quick correction described above. With perfect information, along with falling capital, the accumulative wealth may be rising, because a part of saving which previously had to be paid out as interest is now retained within the country and is added into the national wealth. As a result, the domestic interest rate will fall since the gap \( k-w \) becomes narrower. In the quick correction case, since the correction is so quick and sharp, people assess the gap by the emergency proxy, that is, the recent spread. As the spread was so large, people perceive the wealth level after the correction is too low (to justify the large gap). Hence, unlike the perfect information case, the domestic interest rate is maintained at a high level even after the panic is over. This helps plunge the economy deeper into recession, because it prevents the recovery of capital stock (through new investment).
Empirical tests

Test 1

The crucial point of this paper, which argues for a distinction between the openness of the capital account and financial integration, is the hypothesis that the domestic interest rate follows the rule $r = r^* + \pi(k - w)$, where $\pi$ is an increasing function of the k-w gap. It is impossible, however, to test this hypothesis directly as we do not know the form of the function $\pi$. Therefore we have to find a proxy test at least to confirm the validity of our hypothesis.

First, notice that the condition could be rewritten as $r - r^* = \pi(k - w)$. The left hand side of the equation is the country credit spread over a certain risk free international rate. Linearising the equation around the steady state value we have $r - r^* = c(k - w) + \varepsilon$, where $c$ is a constant and $\varepsilon$ is the non-linear residual.

Second, from Benge and Wells (1998), $k - w = -f = -z / (\mu + n - r^*)$, where $z$ is net exports. Therefore, we can make the approximation $r - r^* = c'(-z) + \varepsilon$, which states that a country credit spread depends inversely on net exports or current account surplus. Thus, we will estimate the following equation

$$r_i - r_i^* = a_0 + a_1 z_i + \varepsilon_i$$

(4)

testing the hypothesis $H_0: a_1 < 0$.

Test 2

Next, since we have proposed using Feldstein-Horioka coefficients as quantitative indicators of financial integration, there should be a direct relationship between these coefficients and the degrees of interest rate endogeneity. The former can be estimated straight from Feldstein-Horioka’s well-known equation

$$I_t = b_0 + b_1 S_t + n_t$$

(5)

where $I$ is investment and $S$ is saving, both as ratios to GDP. But the endogeneity of domestic interest rates again depends on the form of the function $\pi$. The more active the function $\pi$ (the larger $d\pi / d(k - w)$), the more endogenous interest rates are. Let us look again at the equation $r - r^* = \pi(k - w)$. We can logically infer from this equation that the more active the function $\pi$, the more volatile the interest spread. Thus we propose to use the volatility of domestic interest rates as a proxy for the degree of endogeneity of domestic interest rates. To measure the volatility, we simply calculate the standard deviation of a series of interest rates during an investigated period. The final equation of this second test is

$$SDIR_i = c_0 + c_1 FH_i + \xi_i$$

(6)

where $SDIR_i$ are the standard deviations of domestic interest rate, and $FH_i$ are Feldstein-Horioka coefficients. The hypothesis of this second test is $H_0: c_1 > 0$. 
Data

Data of real interest rates, current account balances, domestic saving, and investment are obtained from the World Bank’s World Development Economic Tables. For both tests we use data from 15 Asia-Pacific countries, namely Australia, Bangladesh, China, Hong Kong, Korea, India, Indonesia, Malaysia, Myanmar, Nepal, New Zealand, Philippines, Singapore, Thailand, and Vietnam. For the first test we run two regressions of Equation 4—the first is a cross-country regression at a point in time (early 1990s), the second is a pooled panel data regression for the same 15 countries during the period 1976–96.

For the second test, the estimate is made in two stages. First, 15 independent regressions of Equation 5 are run to estimate Feldstein-Horioka coefficients for the 15 countries during the period 1978–96. The same time span is also used in the calculation of standard deviations of interest rate spreads in the 15 countries. Next, the estimation for Equation 6 is run using estimated data.

Results

Test 1. The estimated equation for the cross-country regression is

\[ r_i - r_i^* = 1.1886 - 0.32357z_i + \varepsilon_i \]

(1.0413) (0.14976)

where the figures in brackets are the standard deviations. As expected, the coefficient on current account balance is negative. At the 95 per cent confidence level, the confidence interval is (-0.5886, -0.0585) which is well below zero. Therefore, there is evidence that the higher a country’s current account deficit, the higher its domestic real interest rate. The estimated R² and F-statistic are, however, very low (0.264 and 4.668 respectively), implying that the relation is not well established. This can also be seen directly from Figure 4.

Although there is a clear tendency towards a negative relationship, the observations are scattered widely, making the fitted line a poor predictor. One explanation is that Equation 4 does not capture enough factors that influence the interest rate spreads. It stems from the simplicity of our model and assumptions, which rely only on one factor (the gap k-w) to explain the endogeneity of domestic interest rates. Another explanation is that we attempted to test the static equations using real data which are dynamic. As countries may be at different stages in their adjustment process, the data may not reflect the real steady state values. This test, however, is not intended to find quantitative relations but to confirm our fundamental assumption that domestic interest rate spread is a function of current account balances. For that purpose, our hypothesis was not rejected with the cross-country test. Let us look at the pooled panel data test.
The estimated equation is

$$r_i - r_i^* = -0.57046 - 0.10661z_i + e_i$$

$$(0.48474) (0.088078)$$

Again, the figures in brackets are standard deviations. The coefficient on the current account is also negative. However, the 95 per cent confidence interval is $(-0.25150, 0.03829)$, an interval which clearly includes zero. Thus, our null hypothesis, $H_0: a_1 < 0$, is rejected at 95 per cent confidence level. Worse still, the $R^2$ and F-statistic are both less than those in the previous case (0.0076 and 1.4649 respectively). The poor relationship of the two variables in this regression is confirmed by Figure 5. There is no longer a clear negative slope and there are a lot of points in the wrong position (that is, points which have negative interest rate spread and negative current account balance).

Besides the reasons given above, we propose two explanations for this rejection and the poor relationship as compared to the simple cross-country test. First, the credit spreads are calculated as the difference between domestic real interest rate and the US real rate of the same year. The former is the country’s nominal interest rate minus the inflation rate. As we extend our data pool to the 1970s and 1980s, we effectively include some periods of hyperinflation in some countries. Consequently, in those countries real interest rates may have become negative at times, and, hence, many observations have a negative spread. This effectively lowers the slope of the regression line, which finally falls to near zero, causing our hypothesis to be rejected. In addition, during this period many significant structural changes took place in some of the countries in our study,\textsuperscript{14} which might have moved the steady state level of endogenous variables in our model significantly.
Second, our model of integration assumes perfect openness. That is, we assume that despite different degrees of financial integration, capital can move freely across borders. In the 1970s and 1980s, and even today, however, the level of openness was not so perfect in most of the countries investigated here. Moreover, not only was the capital account relatively closed in those days, trade barriers were also very high, such that the current account figures do not accurately reflect the true steady state values. Combining all those effects, it is natural to expect a very low relation between interest rate spreads and current account balances when the data cover a long period. Nonetheless, the results of the first test encourage us to accept the formulation of the interest rate premium, which is the crucial extension to the original Solow-Swan model of a small open economy.

**Test 2.** Table 1 describes the results of Feldstein-Horioka coefficient estimation and real interest rate standard deviation. It should be noted that although we expect Feldstein-Horioka coefficients to range from 0 to 1, some estimations deviate from that range. This implies that the Feldstein-Horioka model is also a greatly simplified model of real world saving and investment behaviours. Despite this, the model is still a good representation of those behaviours—countries which have vast amount of foreign investment, must have lower coefficients, and vice versa. The final estimated Equation 6 is

\[
\text{SDIR}_i = 3.2305 + 2.5146F_{H_i} + \epsilon_i \\
(0.81753) (1.0609)
\]

As expected, the Feldstein-Horioka coefficient is positive. Its 95 per cent confidence interval is (0.63575, 4.13031), which is clearly greater than zero. Thus the null hypothesis, \( H_0: c_1 > 0 \), cannot be rejected. The \( R^2 \) and F-statistic are still low (0.30176 and 5.6182 respectively), but are better than in the first test. This can also be seen in Figure 6.
This result confirms the consistency of our two quantitative measures of the financial integration. It also supports the hypothesised interest rate premium which endogenises the domestic interest rate. Thus, the higher the Feldstein-Horioka coefficient is (or the lower the degree of financial integration is), the more volatile the real interest rate spread. According to the model, a more volatile interest rate will make physical capital accumulation and hence output and real wages volatile. The excessive sensitivity of interest rate spread, as shown in the previous section, may well be the reason for various asymmetric information problems and even economic recession.

During the same period over which as we studied the volatility of the 15 countries’ interest rates, the standard deviation of the US real interest rate was 2.23, which is well below the standard deviations of the spread, let alone the interest rates themselves in those 15 countries. The standard deviation of Japan’s real interest rate is even lower at 1.37. Remember that during the period studied (1976–96) both Japan and the United States experienced economic booms and recessions, which means that real interest rates should have moved through the full extent of their cycle. Thus, if a small country takes the US or Japanese real interest rate as an anchor, it is likely that the source of fluctuation is in the country’s financial market structure itself, rather than outside.

Second, in Test 1 a negative relationship between interest rate spread and current account balance was established. In practice, most of the Asian countries which were affected by the crisis have run high and prolonged current account deficits: Thailand had current account deficits in 10 consecutive years, which reached nearly 8 per cent of GDP in 1996. Malaysia had a current account deficit of 8.6 per cent of GDP in 1995. Korea,

<table>
<thead>
<tr>
<th>Country</th>
<th>Feldstein-Horioka coefficient</th>
<th>Real interest rate standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>-0.0552</td>
<td>1.9854</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.3791</td>
<td>2.1906</td>
</tr>
<tr>
<td>China</td>
<td>0.8987</td>
<td>3.1911</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>0.7965</td>
<td>3.0426</td>
</tr>
<tr>
<td>India</td>
<td>0.3672</td>
<td>3.6824</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1.0234</td>
<td>3.2634</td>
</tr>
<tr>
<td>Korea</td>
<td>0.2022</td>
<td>5.0185</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.2107</td>
<td>5.0283</td>
</tr>
<tr>
<td>Myanmar</td>
<td>1.1222</td>
<td>5.6764</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.3719</td>
<td>5.8441</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1.2768</td>
<td>5.5987</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.5149</td>
<td>5.7193</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.8661</td>
<td>6.6698</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.3524</td>
<td>11.1896</td>
</tr>
<tr>
<td>Vietnam</td>
<td>-0.4233</td>
<td>2.7463</td>
</tr>
</tbody>
</table>
Indonesia, and the Philippines also maintained current account deficits over a very long period. In the ten years leading up to the crisis (1987–96), the average current account deficit in those countries was 2.34 per cent of GDP, while the average for all countries in the study was 1.91 per cent. As a result, the magnitude of the premium function must have been high in those periods, which exacerbated the many problems associated with such a premium, especially the overborrowing problem. Hence, it is not surprising that those economies were vulnerable to the crisis contagion.

Final remarks and proposed further study

Final remarks

As the process of globalisation extends into a country, opening up the economy becomes inevitable. While eliminating trade barriers is more or less easy and acceptable, capital account liberalisation must be implemented with greater caution, not only because financial markets and instruments are much more complicated in nature and behaviour than goods markets, but also because the liberalisation does not always guarantee full financial integration. This is the source of the troubles confronting open economies. Thus, in attempting to liberalise capital accounts, countries should pay attention to both openness and integration, the two concepts which are distinctively modelled and quantified in this paper.

As we have seen, for the purpose of modelling integration, only a small change in assumption about world-domestic interest rate spread would make the results deviate greatly from those of the original Solow-Swan model. The assumption that the volatility of the spread determines the degree of integration is very simple, but it is still powerful in
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explaining the differences between openness and integration. Furthermore, even a small assumption about the interest rate spread could have many implications in analysing various problems concerning openness. An important value of our assumption is that if we set the spread equal to zero—that is, the openness implies integration—all sorts of asymmetric information problems, herding behaviours, or speculative attacks would disappear. In other words, in the world of perfect integration (modelled by the original Solow-Swan) it is necessarily welfare improving if the country chooses to open up its economy.

It should be noted that our crucial equation of interest rate spread \( r = r^* + \pi(k - w) \) effectively endogenises the interest rate into the model, an attempt which is not new in the literature. No widely-known previous work, however, has been done in an effort to measure the degree of endogeneity of interest rate, let alone sought to equalise that endogeneity with the concept of financial integration. It is rather surprising that there are abundant indices measuring all sorts of economic activities like stock markets, trade flows, or even the corruption level of a country, but there has been no such measure for the integration of an economy into global markets. Thus, the proposed use of a Feldstein-Horioka coefficient as a quantitative index for the degree of financial integration is the first step to developing a new set of international indices of integration. There are, however, many constraints in using Feldstein-Horioka as a robust index and a more advanced measure should be developed instead.

In the empirical tests undertaken here, the results are clearly in favour of the hypotheses derived from the theoretical model. Indeed, the signs of all estimated coefficients are as expected, although for the larger sample of observations the significance level is not adequate. The first test showed that a country with a high current account deficit must face higher real interest rate premia. This result implicitly confirms the fundamental change to the original Solow-Swan model—the equation \( r = r^* + \pi(k - w) \) and \( d\pi/d(k - w) > 0 \). The second test indicated that the Feldstein-Horioka coefficient and

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Box 2 Asian Crisis contagion and financial integration

One argument against financial integration is that a country which is tightly integrated with international markets may be vulnerable to the economic and financial fluctuations, and sometimes boom and bust, of other countries. But let us have a close look at the Table 1 again. It tells us that countries which were affected by the contagion in the recent financial crisis in Asia have rather high Feldstein-Horioka coefficients, notably Indonesia, -1.023, and Thailand, – 1.352. Countries like Australia, Bangladesh, Nepal, and Vietnam, where the same measures are very low, seem to have been shielded from the crisis. Certainly, the determinant of whether or not a country is affected by the crisis is not simply high or low Feldstein-Horioka coefficients, and the argument above may still hold. As the US real interest rate was used as the world rate, it is worth looking at the US rate itself.
real interest rate spread volatility must have a positive relation. This implicitly endorses the use of the Feldstein-Horioka coefficient as an integration index. Finally, reviewing the estimated Feldstein-Horioka coefficients for countries in the crisis region has revealed interesting implications. Notably, a high Feldstein-Horioka coefficient should be an alarm signal for policy-makers if the country has already opened up its capital account.

Proposed further study
Although this paper has produced some new and interesting results, there are limitations in both its theoretical setting and empirical testing. They are categorised in three issues, and hence, further improvements to this study may be achieved by

(i) using a more complicated model
(ii) using an explicit function form for $\pi$
(iii) using a better data set.

Baseline model. The use of the Solow-Swan model is the simplest approach to the issue and may not adequately cover all important aspects for two reasons. First, the Solow-Swan model is a static model\(^{15}\) and it discards any possibility of endogenous growth, which may be a very important consequence of the economic integration process. It is clearly disadvantageous to use data of today’s fast changing world to estimate parameters of a static model like Solow-Swan. Sometimes the dynamic values are much more important and useful than the steady state values which may not ever be reached. Hence, it will be better to start with some dynamic models like Ramsay’s or Diamond’s\(^{16}\).

In recent years, studies of endogenous growth have shown the importance of spillover effects of imported goods and capital (Romer 1996). These studies implicitly state that the more integrated the economy, the greater the possibility of endogenous growth. If this is the case, Equations 1 and 2 in the original Solow-Swan would have underestimated the effect of capital stock on the production and interest rate determinacy. As a result, our modified model would have underestimated the effect of integration on overall economic performance. Therefore, incorporating the possibility of endogenous growth into our study would strengthen the significance of our tests.\(^{17}\)

Function form of $\pi$. In this paper, knowledge about the function $\pi$, the behaviour of which is crucial to the modified model and the concept of integration, is limited to the condition $d\pi/d(k – w) > 0$. On one hand, this allows the function $\pi$ to be studied in a general setting and does not bind the analysis with any particular functional characteristics. But on the other hand, not defining a certain function form prevents the model from being solved further to derive reduced forms of other endogenous variables of the models. This issue is not so severe here because a static Solow-Swan model is used as a baseline, but if we wanted to study dynamic models it would become necessary to propose a particular function form for $\pi$.
Another issue relating to the function $\pi$ is that it may take more independent variables. In this paper, it has been assumed that $\pi$ depends on only the gap between the level of capital stock and wealth accumulation. This seems reasonable but not adequate in most practical ways. One can expect that the interest rate premium would depend not only on the leverage ratio, but also on other factors such as liquidity constraints, credit risks, and terms and amounts under the lending contracts. If the model incorporated other factors, it would have been better at explaining sources of less than perfect integration, thereby allowing study of the interaction between those factors in an open economy.

A more complicated extension of function $\pi$ is to make it stochastic. This would serve two purposes. First, an explicit inclusion of stochastic elements such as expectations and random disturbances would allow us to study and quantify directly asymmetric information problems inherited in the financial system of the real world. Second, it would be possible to solve analytically for the Feldstein-Horioka coefficient, which would enable more precise tests of this integration index in different environments. This also allows forecasting tasks to be more reliable and verifiable.

Data. Our tests use annual data for the countries in the study. Annual data have the advantage of filtering out small and unimportant fluctuations, but with such sensitive series as interest rate, annual averages may not reflect true movements as the fundamentals change. If we study dynamic processes, quarterly or monthly data are essential for meaningful testing. Another issue is that our data set is not complete. This prevented the use of a more desirable panel data technique for separating different effects across time and countries. A more complete and frequent data set may give more information.
Appendix

Two-good Solow-Swan model for a small open economy

In this model we keep all assumptions and notations of the original model in Benge and Wells (1998). The additional assumption is that there are two goods in the model, one is domestic good and the other is foreign good. Those goods can be either consumed or invested. Then Equations 1 and 2 become

\[ y = g(k_d, k_f) \]  \hspace{1cm} (1')

\[ g_{kd} = r_d + \delta \text{ and } g_{kf} = r_f + \delta = r^* + \delta + \pi \]  \hspace{1cm} (2')

Note that we also assume domestic and foreign capital depreciate at the same rate, \( \delta \).

The profit maximising condition implies \( g_{kd}/g_{kf} = (r_d + \delta)/(r_f + \delta) \)  \hspace{1cm} (7)

We define the real exchange rate, which we assume to be fixed, as

\[ e = k_d / k_f \]  \hspace{1cm} (8)

Hence, accumulated wealth and income per effective worker denominated in domestic goods are

\[ w = k_d + ek_f + ef \]  \hspace{1cm} (9)

\[ x = y + er^*f \]  \hspace{1cm} (10)

We further assume that \( g_{kdf} = g_{kfd} = 0 \) so that we can use the original Equation 3 with only changes in \( k = k_d + ek_f \)

\[ \frac{dw}{dt} = s[(k_d, k_f) - r^*(k_d + ek_f)] - \delta(k_d + ek_f) - (\mu + n - sr^*)w \]  \hspace{1cm} (3')

In the case of perfect financial integration, where \( \pi = 0 \) and \( r_f = r^* \), the model works exactly as the Benge and Wells (1998) model. As domestic firms can freely and unboundedly borrow from overseas, they will borrow or dispose foreign capital to ensure \( g_{kf} = r^* \). Then, profit maximising condition (7) and fixed real exchange rate (8) will determine the level of domestic capital. Finally, at the steady state, Equation 3’ becomes

\[ s[(k_d^*, k_f^*) - r^*(k_d^* + ek_f^*)] - \delta(k_d^* + ek_f^*) = (\mu + n - sr^*)w^* \]  \hspace{1cm} (3’’), hence \( w^* \) will be determined and positive provided \( \mu + n > sr^* \). Since the real exchange rate has entered the steady state wealth level, we can now analyse the effects of exchange rate appreciation/depreciation on the steady state wealth level. Equation 3’’ tells us that, if other variables remain unchanged, a depreciation of the real exchange rate (that is, an increase in \( e \)) will lower the steady state wealth level.
In the case of less than perfect financial integration, function $\pi$ now clearly depends on real exchange rate. Although it is not clear how $k = k_d + ek_t$ will change if the real exchange rate depreciates (this depends on the functional form of the production function), it is certain that the wealth level will decrease. Hence, it is likely that the gap $k-w$ will widen as $e$ increases. Thus foreign investors, who lack information about the gap $k-w$, may look at the real exchange rate as a proxy, especially in a crisis situation.

Notes

1 Hanson (1996) and De Brouwer (1999) summarise the benefits of capital account liberalisation in terms of intertemporal trade, risk reallocation, and taxation benefit.
2 This includes the forms and interactions of financial institutions, laws and regulations, and also market practices and customs.
3 For example, the Mundell-Flemming model (Dornbusch and Fischer 1997) and the Solow-Swan model for a small open economy (Benge and Wells 1998).
4 The studies are rather vague in identifying when the supervision and regulation is strong enough, or when the domestic banking system is robust enough.
5 The measures of financial integration (law and regulation, saving/investment correlation, and consumption patterns) which are summarised from previous literatures by De Brouwer (1999), are actually measures for openness since those literatures in fact did not distinguish openness and integration.
6 For more complicated models, which include several goods and exchange rate, heterogeneity of financial assets and instruments, inflation and currency depreciation/appreciation expectations may also be the reasons.
7 As a single good model is used, and hence exchange rate issue is not relevant in this paper, simple parity, covered, and uncovered interest parities are not distinguished.
8 The EU countries may be an exception to this general statement.
9 It is not easy to define the world interest rates for empirical purposes. In this paper, however, we use the US rates as the world rates on the grounds that the US economy is so big and influential in small open economies around the world.
10 There are also some arguments against perfect integration, such as vulnerability to overseas recession (through the interest rate link), or the loss of monetary policy power. In the long run, however, these fluctuations would be relatively small compared to other aggregate values.
11 The exchange rate may be an alternative indicator for the $k-w$ gap in the crisis situation. Inclusion of the exchange rate in the Solow model requires an extension of the model itself—the model has to distinguish domestic and foreign capitals, and the exchange rate is the rate at which domestic and foreign capital can be exchanged. Due to the complexity of this extension, the two-asset Solow model is investigated in an Appendix.
12 STARS system in the IEDB database at the Australian National University
13 Ideally a separate effect panel data regression should be run in order to estimate cross-country and time-series effects simultaneously; but this is prevented by limited availability of data.
14 For example, the change in exchange rate regime in Australia and New Zealand in 1980s.
15 This is not absolutely correct. In fact, the Solow-Swan model is built from dynamic settings, but all final equations we use in this paper are at steady state, which could be considered static in nature.
16 See Romer (1996) for those models.
17 It would, however, make the modified model very complicated.
References


