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Capital Mobility in Developing Countries: Some Measurement Issues and Empirical Estimates

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A fundamental determinant of the macroeconomic properties of an economy is its degree of financial integration with the outside world. Yet very little is known about this characteristic of many developing economies. An important stumbling block in the empirical assessment of financial integration is the multiplicity of approaches to measurement. This article describes and evaluates alternative tests of capital mobility and applies four such tests to assess the degree of integration with external financial markets exhibited by a large group of developing countries in recent years. The evidence suggests that a substantial number of developing countries can be considered financially open.

An economy is financially open when its residents are able to trade financial assets with residents of another country. The degree of financial openness, however, is a somewhat amorphous concept, not clearly defined in many applications and difficult to measure. This is unfortunate because analytical models suggest that the nature of the relationship between domestic and world financial markets (also referred to as the degree of capital mobility) is one of the key characteristics of any economy, serving as a fundamental determinant of many of its most basic macroeconomic properties.

Residents of different political jurisdictions may issue financial assets of many types. As in the case of goods, such assets may be traded or nontraded and, if traded, may or may not be close substitutes for foreign assets of the corresponding type. Assets may become nontraded for a variety of reasons, including the existence of transaction costs in trading assets across political jurisdictions, as well as the presence of information costs, coupled with asymmetric information between domestic and foreign agents. In addition, and particularly in the case of developing countries, legal barriers to trading assets (capital controls), both those already in place and (separately) prospective future barriers, play roles similar to quotas in goods markets. Asymmetric political risks or taxes borne by domestic and foreign investors may also inhibit arbitrage.

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Intuitively, a high degree of financial integration exists when traded assets are close substitutes in private portfolios for their foreign counterparts and when either a large proportion of domestic financial assets are traded, or traded assets are close substitutes for assets that are not traded. In such cases, prices of domestic assets are closely linked with prices of world assets and, at least for small countries, domestic asset prices would not be affected by domestic excess demands or supplies of specific types of financial assets.

Most of the existing literature on financial integration—both for industrial and for developing countries—fails to address explicitly the scope of traded assets in particular economies or the strength of domestic arbitrage links between traded and nontraded assets. Instead, the focus has been on assessing the nature of arbitrage between domestic and foreign assets of the same type. Even in this partial context, however, it may be useful to distinguish between weak and strong financial integration.

The former refers to a situation in which the law of one price holds for individual financial assets—that is, domestic and foreign residents trade identical assets at the same price. This situation implies the absence or relative unimportance of the barriers listed above. However, it leaves room for assets issued in one political jurisdiction to be imperfect substitutes in all private portfolios with otherwise identical assets issued in a different one, as well as for differences in preferences between domestic and foreign agents as to the composition of their portfolios. Strong financial integration, by contrast, would prevail when identically defined assets (for example, a six-month Treasury bill) issued in different political jurisdictions and denominated in different currencies are perfect substitutes in all private portfolios. This would imply that the relative rates of return on such assets would be unaffected by their relative supplies. Under these circumstances, of course, any scope for differences in preferences between domestic and foreign portfolio managers is eliminated.

Economies that exhibit strong financial integration have very different macroeconomic properties from those that exist in financial autarky. The macroeconomic consequences of strong financial integration are typically derived on the usual assumption that all domestic interest-bearing assets are perfect substitutes (so the distinction between traded and nontraded assets can be ignored). Five macroeconomic implications of strong financial integration are especially important.

First, changes in excess supplies and demands of assets in a small economy have no influence on the world prices of the assets. Thus, shocks to domestic saving and investment schedules, which affect the domestic flow of excess supply and demand for financial assets, leave unchanged the rates of return on assets confronting domestic agents. In particular, changes in domestic investment do not affect the rates of return on assets available to domestic savers, and changes in domestic saving do not affect the cost of capital for domestic firms.[1]

1. This statement needs to be interpreted with care. I mean it to imply only that domestic nominal interest rates are unaffected by such changes. As further discussion will show, real rates may well be affected.

Instead, increases in domestic investment are financed voluntarily by foreign private agents. Similarly, reductions in domestic saving simply decrease the country's rate of accumulation of foreign assets. The implication is that economic growth is not limited by a scarcity of domestic saving. It follows that policy measures to promote saving do not increase domestic investment but merely reduce the current account deficit.

Second, as is well known, the effects of domestic fiscal and monetary policies on aggregate demand also depend on the extent to which the economy is financially integrated with the rest of the world. Under the fixed (or predetermined) exchange rate regime that characterizes most developing countries, strong financial integration implies that in a small economy neither fiscal nor monetary policy can influence the terms for domestic borrowing and lending.

Third, the economy's steady-state inflation rate may be affected by the extent of its integration with world capital markets. The revenue that a government can collect from the inflation tax depends on the stock of base money and on the elasticity of base money demand with respect to the rate of inflation. Given the revenue to be raised through the inflation tax, the smaller the stock of base money and the higher its elasticity with respect to the rate of inflation, the higher the steady-state inflation rate. Even under weak financial integration, domestic agents have more means at their disposal to escape an inflation tax (for example, by taking capital abroad) than when the economy is financially closed. This is likely to increase the elasticity of base money demand, implying that the inflationary consequences of a given fiscal deficit are magnified.

Fourth, taxes on capital more generally become problematic under a situation of high capital mobility because the taxes can be evaded by taking funds out of the country. With high capital mobility, the taxation of capital would leave the domestic economy with a suboptimal capital stock because owners of capital would require an after-tax rate of return in the domestic economy equal to the pre-tax return available externally.

Fifth, interest rate policy in repressed economies, in which domestic interest rates are subject to binding legal restrictions, is affected by the implications of financial openness. The pursuit of positive real interest rates in a closed economy in which the domestic marginal product of capital is the relevant opportunity cost of funds may easily be frustrated by capital inflows if the economy is sufficiently open.

These macroeconomic implications of strong financial integration are well known, but not much has been done to assess where developing countries may lie along the spectrum from effective financial autarky to strong financial integration. Although the vast majority of developing countries maintain controls on capital movements (see IMF 1991), the effectiveness of the controls is often questioned, and the view is widespread that the mere existence of these controls does not justify treating these economies as financially closed.

The issue addressed here is whether existing empirical approaches to the measurement of capital mobility can be applied to developing countries. Section I

briefly discusses some conceptual issues associated with alternative approaches to the measurement of financial integration and summarizes the evidence from existing empirical studies of financial integration in developing countries. Section II presents the results of applying the empirical techniques to a large developing-country sample. Section III offers conclusions.

I. The Measurement of Capital Mobility

Perhaps one reason for the ambiguity that surrounds the empirical degree of financial integration that characterizes developing economies is that no single approach to its measurement has become widely accepted. Several empirical methods have been applied, either formally or informally, to measure capital mobility. These include measures of the magnitude of gross capital flows, the degree to which a variety of arbitrage conditions are satisfied, the scope for sterilization of the effects of reserve movements on the domestic money supply, saving-investment correlations, and, more recently, tests based on the Euler equation for the path of optimal consumption. This section describes these measures, treats some conceptual issues that arise in their application, and summarizes the evidence on financial integration in developing countries.

The Magnitude of Capital Flows

Many economists have a strongly held belief that industrial countries are, or at least have recently become, highly integrated financially. This belief is at least partly based on the observation that gross financial flows among industrial countries are very substantial. Golub (1990) cites the examples of Feldstein (1983: 150), Caprio and Howard (1984: 4), Obstfeld (1986a: 70), and Penati and Dooley (1984: 7). But the size of gross flows is often taken to be an imperfect indicator of the degree of financial integration. The reason is that although capital flows would indeed be zero under financial autarky, they need not necessarily occur between strongly integrated financial markets. Continuous equalization of the prices of financial assets would remove the incentives for capital movements.

Nevertheless, there are at least two reasons to expect that a country enjoying a high degree of financial integration with the rest of the world should, on average, experience large gross capital flows. First, in markets that are strongly integrated, the geographic locations of the parties on the two sides of a financial transaction are indeterminate. Thus, borrowing and lending by domestic residents should frequently cross international boundaries.[2] Second, although changes in international rates of return should quickly be reflected in domestic rates under such conditions, preservation of portfolio equilibrium for domestic

2. This insight formed the basis for an empirical test (Golub 1990) for capital mobility among industrial countries.

residents in response to such changes will typically require net capital flows. For example, in response to a change in world interest rates, the preservation of domestic monetary equilibrium under fixed exchange rates would be achieved through capital flows unless effects on the demand for money were accommodated by the domestic monetary authority.

The gross-flow evidence, which unfortunately is available only for the indebted major developing countries, indicates that these countries have exhibited a substantial amount of at least de facto financial openness. (See Calvo, Leiderman, and Reinhart 1992; Rojas-Suarez 1990; Montiel 1993; Cuddington 1986; and Dooley 1988.)

Interest Parity Conditions

The degree of financial integration has typically been assessed not in terms of the size of either gross or net capital flows between jurisdictions but by the extent to which expected returns are equalized between domestic and foreign assets of the same type. The equalization of returns can be measured by simple interest arbitrage (for assets of the same type, denominated in different currencies but issued in the same political jurisdiction), covered interest parity (for assets of the same type, issued in different political jurisdictions but with forward cover for exchange risk), uncovered interest parity (for assets of the same type, issued in different jurisdictions without forward cover), and real interest parity (for testing the equalization of expected real returns across similar assets issued in different jurisdictions). For present purposes, comparisons of simple and real interest parity are not of direct relevance. Because the former is restricted to the same political jurisdiction, it has nothing to say about capital mobility per se, whereas the latter confounds financial with goods market integration. Covered interest parity, by contrast, is of limited empirical relevance for most developing countries because forward markets exist for very few developing-country currencies.

Uncovered interest parity (UIP) is thus the most relevant interest parity measure for the majority of developing countries.[3] It consists of the assertion that arbitrage equalizes expected returns on domestic and foreign assets of the same type:

$$(1) \qquad (1 + i_t) = E_t[(1 + i_t^*)\, s_{t+1}/s_t]$$

where i_t and i_t^* are the domestic and foreign interest rates respectively, s_t is the domestic-currency price of foreign exchange (equal to s_{t+1} next period), and E_t is the expectations operator. The asset in question in this example is taken to be

3. For applications, see Lizondo (1983) and Khor and Rojas-Suarez (1991) for Mexico; Phylaktis (1988) and Dooley and Isard (1980) for Argentina; Edwards and Khan (1985) for Colombia and Singapore; Reisen and Yeches (1991) for the Republic of Korea and Taiwan (China); Robinson, Byeon, and Teja (1991) for Thailand; Faruqee (1991) for several Pacific Basin countries; and Haque and Montiel (1991) for several developing countries.

a nominally safe asset. Yet, because of political and currency risk, i_t^* and s_{t+1} are both random.

In equation 1, the expected value of $(1 + i_t^*)s_{t+1}/s_t$ is not observable. Testing UIP thus requires making an ancillary assumption about how the unobservable subjective expectations of future returns on foreign-currency assets are formed. With rational expectations, $E_t[(1 + i_t^*)s_{t+1}/s_t]$ becomes the expectation of the true distribution of $(1 + i_t^*)s_{t+1}/s_t$, conditioned on the available information. Under these circumstances, $(1 + i_t^*)s_{t+1}/s_t = E_t[(1 + i_t^*)s_{t+1}/s_t] + e$, where the prediction error, e, must be a mean-zero random variable. The contents of the information set used to form the expectation $E_t[(1 + i_t^*)s_{t+1}/s_t]$ depend on the efficiency of the foreign exchange market. If the market is weakly efficient, the information set must contain at least the past prediction errors (that is, lagged values of e). Under these circumstances, e must be serially uncorrelated. Now consider the ex post return differential, d_t, given by

$$d_t = (1 + i_t) - (1 + i_t^*)s_{t+1}/s_t. \tag{2}$$

Under the null hypotheses of UIP and rational expectations, d_t is the negative prediction error. Thus the joint hypothesis can be tested by examining whether d_t has a zero mean and is serially uncorrelated.

Several conceptual and empirical complications arise in applying tests of uncovered interest parity. First, differences in rates of return between otherwise identical assets issued in different political jurisdictions are consistent with weak financial integration, so interest parity tests are tests of strong financial integration. Weak financial integration between two countries means that a given financial asset is traded at the same price by residents of both countries so that no profitable arbitrage opportunities remain. Thus, the degree of financial integration can, in principle, be measured as the difference between the prices of identical assets in the two countries. However, the identification of identical assets in different political jurisdictions is not a trivial matter. If an asset is defined by the probability distribution of its prospective returns, then the requirement that two assets are identical, that is, that they offer the same payoff in all states of the world, is very stringent. If the distributions of prospective payoffs for the two assets differ in their second moments, they would probably not be priced so as to yield the same expected rate of return, even in perfectly integrated financial markets, unless agents were risk-neutral.

Second, there is a wide range of assets in each jurisdiction. Arbitrage tests may hold for some assets but not for others. If transaction costs differ across assets, then those assets with the largest transaction costs may effectively be nontraded. Alternatively, some assets (for example, equities) may be more idiosyncratic than others and thus may be less similar to their foreign counterparts. Prices of such assets would fail parity tests, although other domestic assets may pass.

Third, and more fundamental, an operationally meaningful measure of financial integration must focus on the scope for domestic variables to affect the

prices of domestic financial assets, rather than on the validity of restrictions derived from arbitrage considerations. These notions are conceptually distinct. The interpretation of the failure of UIP for industrial countries, for example, remains controversial. The failure may arise from a nonconstant (time-varying) risk premium. The premium could be consistent with strong financial integration, as long as the assets are perfect substitutes after the premium is taken into account. Alternatively, systematic differences in rates of return on otherwise similar assets denominated in different currencies and issued in different political jurisdictions could respond to changes in the relative supplies of such assets. This "imperfect substitutes" case is inconsistent with strong financial integration. In general, the policy implications of the failure of parity conditions depend on the source of the failure.

In addition to these conceptual problems, tests of UIP encounter some empirical complications. One complication is that because the expected future exchange rate is unobservable, tests of UIP are of necessity tests of joint hypotheses, combining equalization of expected returns with a hypothesis about expectations formation. Rejection of the joint hypothesis can arise if either component fails. A second empirical difficulty is associated with the "peso problem" (Krasker 1980). When the exchange rate is fixed, but market participants perceive a finite probability of a discrete devaluation that does not in fact take place during the sample period, the observed forward rate will systematically exceed the future spot rate even if it truly reflects the expected future spot rate. In this case, the null hypothesis (of unbiasedness) will tend to be rejected, even when true, more often than the investigator intends.[4]

Tests of Monetary Autonomy

One of the important policy implications of strong financial integration under fixed exchange rates is that monetary policy becomes powerless to affect aggregate demand. Essentially this is because the domestic monetary authorities lose control over the money supply. Changes in the domestic assets of the central bank (for example, through open market operations) intended to influence the money stock would create incipient changes in the rates of return on domestic assets. But these changes would not in fact materialize, because they would quickly be arbitraged away through foreign borrowing and lending. In the process, the central bank's net foreign assets would change by an amount equal in magnitude but opposite in sign to the triggering change in the central bank's domestic assets, leaving the stock of high-powered money and the total money supply unchanged. This result would not hold if domestic and foreign interest-bearing assets were imperfect substitutes, because then changes in the relative supplies of such assets in private portfolios would affect their relative rates of return. In this case, changes in the domestic assets of central banks could, by

4. Strictly speaking, the difficulty here is not bias, but a small-sample problem. The problem is that the sampling distribution for the hypothesis that $d = 0$ converges very slowly to its limiting distribution under the conditions postulated, so statistical tests based on the asymptotic distribution result in Type I error.

changing the composition of outside assets in private portfolios, alter domestic interest rates and achieve changes in the domestic money stock.

Tests of monetary autonomy are not feasible to perform for large groups of countries, because the tests require the construction of structural models of each country's financial sector. However, analysts have applied tests of monetary autonomy to several developing countries (see Cumby and Obstfeld 1984 for Mexico; Rennhack and Mondino 1988 for Colombia; Bini Smaghi 1982 for Malaysia; Boschen and Newman 1989 for Argentina; and Montiel 1989 and Dowla and Chowdhury 1991 for other developing countries).

Saving-Investment Correlations

Consider a small country that produces a single good and that is perfectly integrated with world goods markets as well as integrated in the strong sense with world financial markets. As previously suggested, changes in domestic saving should have no effect on the rates of return faced by domestic agents, because these rates are determined in the world capital market and accordingly should not affect domestic investment. Based on this insight, Feldstein and Horioka (1980) proposed assessing the degree of financial integration in the world economy by measuring the extent to which national saving and investment rates are correlated. They estimated cross-section regressions of the form

$$(I/Y)_i = a + b(S/Y)_i + e \tag{3}$$

where (I/Y) is the ratio of gross domestic investment to gross national product (GNP), and (S/Y) is the ratio of national saving to GNP. Feldstein and Horioka argued that, under the null hypothesis of perfect financial integration, b should be zero for small countries. For large countries, b should approximate the country's share of the world capital stock, because any increment in domestic saving should be invested without regard to national boundaries.

An attractive feature of this test is that by focusing directly on a macroeconomic implication of strong financial integration, it does not face the problem of asset heterogeneity associated with tests of parity conditions for individual asset types. However, tests of saving-investment correlations have proven to be a very controversial approach to the measurement of financial integration, because Feldstein and Horioka's original estimates of b were close to the high value of 0.9. Feldstein and Horioka interpreted that value as consistent with a low degree of financial integration among industrial countries during the 1970s, a view in direct opposition to what had become the conventional wisdom. Feldstein and Horioka's findings for industrial countries have been confirmed in broad terms by many other researchers who used different samples and different empirical techniques. At best, other investigators have been able, in certain samples, to detect values of b statistically different from the autarky value of unity, but the point estimates of b continue to be relatively high, even among industrial countries with few formal barriers to capital movements.

Although Feldstein and Horioka's empirical findings have proven difficult to refute, their interpretation of the evidence as suggesting that industrial countries

are much less integrated financially than is commonly believed has not been generally accepted. A conceptual problem with their approach is that although zero capital mobility implies that I/Y and S/Y would be highly correlated, the converse is not true—national saving and investment rates could be highly correlated even if world financial markets are perfectly integrated in the sense defined previously. There are at least two ways that saving and investment could be correlated even if financial markets were well integrated, in the sense that uncovered interest parity (UIP) held exactly.

First, I/Y and S/Y could be correlated even if real interest parity also held, because they are both endogenous variables that respond to movements in common factors, both in time series and in cross-section. The source of this correlation differs, however, between time-series and cross-section applications. In time series, the correlation could be caused by any of the following:

- Both I/Y and S/Y could be functions of the state of the business cycle, that is, of a third variable, $Y/\overline{Y}$. In particular, both I/Y and S/Y are known to be procyclical. On analytical grounds, there is reason to believe that temporary real shocks to the productivity of domestic capital and labor, to the prices of imported inputs, or to world real interest rates would move domestic saving and investment in the same direction (Obstfeld 1986a).
- Governments could respond to incipient current account deficits (increases in I/Y in relation to S/Y) by contracting fiscal policy to achieve a current account target. Taking national saving as the sum of private and public saving, this makes national saving endogenous through its public component (Summers 1988).
- The country in question could loom large in world financial markets. Shocks to national saving could thus affect world interest rates and through them domestic investment.
- The pattern of shocks to saving and investment in the country in question could closely replicate that of shocks to world saving and investment. Because the saving-investment correlation for the world as a whole must be unity, such countries would exhibit a high correlation of saving and investment.

In a cross-section context neither the first nor third explanation is relevant. However, national saving and investment rates may be functions of the country's long-run growth rate (Obstfeld 1986a). The dependence of national saving on the rate of growth is a direct and familiar implication of life-cycle consumption theory, whereas steady-state growth implies that $I/Y = (n + \delta)(K/Y)$, where n is the population growth rate and δ is the rate of capital depreciation. If the capital-output ratio (K/Y) depends on a real interest rate that is common to all countries, then (I/Y) is an increasing function of n.

Second, shocks that are specific to saving or investment would also give rise to a positive correlation between the two variables, even under UIP, because goods markets are not as well integrated as financial markets. Frankel (1986, 1992)

develops an argument that reconciles perfect financial integration as measured by tests of nominal interest parity with high saving-investment correlations. Suppose that UIP holds, but that a temporary exogenous increase in saving results in a temporary real exchange rate depreciation (that is, ex ante relative purchasing power parity fails, because the real exchange rate will be expected to appreciate in the future). Since, under UIP, this would cause the expected domestic real interest rate to fall, investment would rise, resulting in a positive correlation between saving and investment. Even a permanent saving shock could have this effect, if the initial real exchange rate depreciation overshot its long-run level.

To the extent that saving-investment correlations arise from this second source, however, they may nevertheless provide evidence of the extent to which exogenous shifts in domestic saving or investment can induce changes in the other variable. As indicated in the introduction, this is one of the key policy issues motivating a concern with the degree of financial integration (see Dooley, Frankel, and Mathieson 1987; Summers 1988; Wong 1988; and Frankel 1986).

Euler Equation Test

Obstfeld (1986a) proposed a test that is an alternative both to arbitrage conditions and to saving-investment correlations as measures of the degree of financial integration among countries. This test is based on the Euler equation that characterizes the optimal intertemporal behavior of consumption. The test attempts to detect whether residents of different political jurisdictions have access to the same risk-free asset.

For domestic residents, the Euler equation for optimal intertemporal consumption plans is

$$U'(c_t) = E_t[\beta U'(c_{t+1})(1 + i_t) P_t / P_{t+1}], \tag{4}$$

which can be written as

$$E_t[(P_t / P_{t+1}) \beta U'(c_{t+1}) / U'(c_t)] = 1/(1 + i_t) \tag{5}$$

for each period t. Here c denotes real per capita consumption, β is a subjective discount factor, P is the domestic price level, and i is the riskless interest rate. The corresponding condition for foreigners is

$$E_t[(s_t P_t^* / s_{t+1} P_{t+1}^*) \beta^* U^{*\prime}(c_{t+1}^*) / U^{*\prime}(c_t^*)] = 1/(1 + i_t) \tag{6}$$

where s is the nominal exchange rate and asterisks denote foreign variables, but where the same risk-free rate i applies. Equations 5 and 6 imply that the expected marginal rates of substitution between current and future units of the domestic currency must be equal for foreign and domestic residents. To test this, Obstfeld assumes that domestic and foreign residents have the same utility function and that utility takes the constant relative risk-aversion form

$$U(c_t) = (1/1 - a) c_t^{1-a}. \tag{7}$$

Under these circumstances, the difference between the marginal rates of substitution between current and future units of the domestic currency, denoted n, is given by:

$$n_t = \left(\frac{c_t}{c_{t+1}}\right)^a \left(\frac{P_t}{P_{t+1}}\right) - \left(\frac{c_t^*}{c_{t+1}^*}\right)^a \left(\frac{S_t P_t^*}{S_{t+1} P_{t+1}^*}\right) \tag{8}$$

and the equality of the expected marginal rates of substitution becomes

$$E_t n_t = 0. \tag{9}$$

In other words, n_t should be expected to be zero based on information available before it is observed; that is, no variable contained in the information set available prior to the present period should help to predict the current value of n.

This test possesses several features that make it more attractive than the tests considered above. Unlike tests of nominal interest parity, the Euler equation test does not require comparisons between rates of return on what might be dissimilar assets. Unlike tests of real interest parity, the null of strong financial integration would not be rejected because of a failure of ex ante relative purchasing power parity. Furthermore, unlike the Feldstein-Horioka tests, it is not vulnerable to indirect sources of saving-investment correlations. Moreover, it focuses specifically on what is meant by weak financial integration—that is, that residents in different political jurisdictions be able to trade the same asset on the same terms.

The disadvantage of the Euler equation test, of course, is that restrictive assumptions are required to implement it. The underlying consumption model must be correct for both countries, and cross-country differences in utility functions must be negligible. Because the test therefore embodies multiple hypotheses, rejections may be difficult to interpret. Finally, as in the case of arbitrage tests, statistically significant rejections may not be economically important if n_t is small on average.

II. Empirical Estimates of Financial Integration in Developing Countries

According to IMF (1991), of 136 IMF-member developing countries, 113 were classified as maintaining formal restrictions on capital-account transactions. Yet, in spite of the controls, the existing evidence for developing countries suggests that few, if any, of them can be considered financially closed. For the majority of developing countries, however, either formal tests of financial integration have not been conducted or only very limited evidence is available. A survey of existing evidence is presented in Montiel (1993). Saving-investment correlations and consumption-based tests have simply not made their way to the developing-country literature. The bits and pieces of evidence on financial integration that exist for developing countries do not lend themselves to drawing systematic conclusions for any but a very few countries. Existing tests have been applied in limited fashion, over disparate periods of time, and use very different

methodologies. To gain a more comprehensive perspective, it is desirable to unify this piecemeal evidence by applying the existing approaches to the measurement of financial integration in a uniform fashion to large samples of developing countries over similar periods of time.

In this section, I apply four of the tests described previously to measure capital mobility during the 1980s in a large number of individual developing countries. The samples in each case are comprised of the largest groups of developing countries for which the relevant data could be acquired conveniently. The four tests consist of measures of gross capital flows, saving-investment correlations, tests of arbitrage conditions, and Euler equation tests. In view of the discussion in section I, these are listed, at least conceptually, in order of increasing reliability as indicators of the degree of financial integration in the sense defined here. All of these tests have shortcomings of varying degrees of severity. By using a battery of tests, the hope is that a coherent picture may emerge for some countries, although each test individually may provide a noisy indicator. Some problems, however, apply to more than one test. Particularly important for the last three regression-based tests, the degree of capital mobility is treated as constant over the period of estimation. Thus, recent changes in financial openness cannot be captured by measures of this sort.

Gross Capital Flows

The first measure to be constructed consists of the value of capital transactions in the balance of payments (average of inflows and outflows) expressed as a fraction of gross domestic product (GDP). This is analogous to measures of commercial openness derived by expressing the sum (or the average) of exports and imports as a ratio to GDP. This measure has the conceptual problem associated with measures of gross flows described in section I and has some very substantial empirical problems.

In particular, the gross capital flow measure could be very sensitive to the level of aggregation at which it is constructed, that is, to the degree of "netting out" in published balance of payments data. To the extent that published data are reported on a net basis, of course, the size of gross flows will be understated, and differences among countries in the size of such flows underlying the net data will distort cross-country comparisons. This would be a problem, for example, where annual balance of payments data record changes in gross stocks during the course of the year, rather than all the transactions that took place during the year. Nevertheless, gross capital flows may be worth examining as the only available indicator of the volume of capital-account transactions for developing countries. To the extent that reported capital-account transactions in the balance of payments reflect the true underlying volume of transactions, this indicator has the dual virtues of serving as a (crude) check on prior beliefs, both across countries and over time, and of being able to be constructed year by year.

Table 1 reports the ratios of trade and capital flows to GDP for eighty-eight developing countries. The second column gives the average ratio of the mean

value of capital inflows and outflows to GDP from 1980 to 1989 (the last year for which data were available for a large group of countries). An interesting contrast emerges between capital and commercial flows. The standard measure of commercial openness (the ratio of the average value of exports and imports of goods and services to GDP) is reported in the first column. Commercial flows are much larger for almost all countries in this group than are reported capital flows.[5] Commercial flows amounted to almost 45 percent of GDP for the group as a whole, whereas capital flows represented only 12 percent of GDP. By this measure, then, developing countries would seem to be much less open financially than they are commercially. However, this conclusion is not warranted, because the "netting out" problem described above does not apply to commercial transactions, implying that the two measures are not directly comparable.

Little movement in the direction of increased financial openness is evident in these data. For most countries, the capital flow ratio exhibits little change in the years from 1984 to 1986 (third column) and from 1987 to 1989 (fourth column). The slight increase in the average between these periods for the group as a whole is largely accounted for by the extreme values reached in Panama during the latter period.

The distribution of capital flow ratios for the countries listed in table 1 is skewed to the right. Eight countries exhibit ratios in excess of 20 percent; thirteen countries in the range below 20 but above 15 percent; fifteen countries below 15 but above 10 percent; thirty-nine countries between 5 and 10 percent; and the remaining thirteen countries below 5 percent. Panama and India are at the extremes of the distribution, with capital flows substantially exceeding GDP in Panama and amounting to only about 1.5 percent of GDP in India.

The group of countries that registered capital flows in excess of a fifth of their GDP included—in addition to Panama—Antigua, Congo, Costa Rica, Jamaica, Nicaragua, São Tomé and Principe, and Singapore. The inclusion of Singapore in this group is consistent with evidence from existing studies of a high degree of financial integration for this country. But neither Malaysia nor Guatemala, which also appear highly integrated with external financial markets on the basis of independent evidence, scored very high on this particular index of openness. Both of these countries were in the modal range of 5 to 10 percent. For several countries in the modal range, independent evidence reviewed in Montiel (1993) is suggestive of an intermediate degree of capital mobility. If this range is used as a benchmark for an intermediate degree of integration, and the gross capital flow ratio is used as an indicator, the overwhelming majority of countries in the sample exhibit at least an intermediate degree of integration with external financial markets. The exceptions are the Bahamas, Bangladesh, Burkina Faso, Haiti, India, Indonesia, Pakistan, Rwanda, South Africa, Sudan, Suriname, and Tonga, where gross flows represented less than 5 percent of GDP.

5. The sole exception is Nicaragua, a country undergoing a civil war for much of this period.

Table 1. *Ratios of Trade and Gross Capital Flows to GDP, 1980–89*
(annual average in percent)

Country	Trade ratio 1980–89	Capital flow ratio 1980–89	1984–86	1987–89
Algeria	24.94	7.34	6.22	9.01
Antigua	99.72	20.21	19.09	19.89
Bahamas, The	70.84	3.84	3.54	3.00
Bahrain	115.94	11.18	9.53	12.09
Bangladesh	13.41	3.79	3.77	3.57
Barbados	62.48	8.08	7.38	6.58
Bolivia	29.46	16.67	18.10	11.26
Botswana	88.73	10.02	11.02	9.07
Brazil	11.75	7.77	9.60	6.94
Burkina Faso	21.74	4.45	4.92	5.01
Cape Verde	44.15	6.38	7.83	4.20
Central African Republic	29.73	6.31	8.37	3.41
Chad	25.02	5.46	6.31	8.80
Chile	32.03	16.70	24.18	13.63
Colombia	17.88	5.89	7.55	6.25
Congo	59.48	31.64	32.43	32.80
Costa Rica	41.29	20.28	17.03	14.86
Côte d'Ivoire	40.56	15.07	14.15	17.58
Cyprus	58.85	9.59	9.74	10.10
Dominica	54.25	8.85	8.04	13.12
Dominican Republic	31.21	6.63	5.72	5.55
Ecuador	28.07	19.73	20.49	20.32
Egypt	33.16	8.55	7.52	7.62
El Salvador	28.92	7.67	7.31	5.46
Ethiopia	17.34	4.10	4.44	5.02
Fiji	51.18	8.10	6.69	8.56
Gabon	54.63	15.93	16.25	21.05
Gambia, The	61.39	17.02	19.78	17.45
Ghana	20.55	6.74	7.98	7.11
Grenada	68.46	10.14	7.90	14.47
Guatemala	18.80	6.66	6.93	8.28
Guinea-Bissau	28.82	18.07	21.59	31.36
Haiti	22.25	3.63	3.80	3.12
Honduras	34.01	10.06	9.59	10.87
India	8.49	1.50	1.51	2.31
Indonesia	25.99	4.96	4.45	7.15
Israel	45.94	12.90	11.86	10.39
Jamaica	60.91	24.39	33.61	22.81
Kenya	29.16	5.99	5.50	6.51
Korea	38.57	5.42	5.27	4.25
Kuwait	68.68	19.47	20.07	19.98
Lesotho	131.66	15.87	13.09	17.32
Libya	41.53	5.38	2.32	10.01
Madagascar	19.22	10.76	9.63	14.45
Malaysia	62.43	9.10	10.10	8.88
Mali	28.59	6.73	7.57	8.25
Mauritania	61.36	17.91	19.33	16.83
Mauritius	59.00	7.04	6.78	7.38
Mexico	17.40	9.01	9.05	6.98
Morocco	28.09	7.23	6.86	5.56
Nicaragua	29.76	29.48	23.61	38.03
Niger	26.29	8.77	9.44	7.18
Nigeria	21.37	9.22	6.65	20.18
Pakistan	18.45	3.58	3.46	4.58

Country	Trade ratio 1980–89	Capital flow ratio 1980–89	1984–86	1987–89
Panama	154.22	140.16	78.85	186.53
Papua New Guinea	51.33	12.99	11.06	9.70
Paraguay	25.35	8.48	8.29	11.00
Philippines	28.51	7.94	9.77	6.09
Rwanda	16.49	3.34	3.38	3.42
São Tomé and Principe	51.79	23.60	33.49	14.25
St. Kitts and Nevis	75.00	15.03	12.99	18.79
St. Lucia	75.10	11.81	8.43	11.64
St. Vincent	79.43	6.77	5.88	9.25
Saudi Arabia	58.02	12.08	11.09	10.54
Senegal	39.88	11.36	10.83	9.36
Seychelles	74.92	11.75	13.55	11.00
Sierra Leone	21.08	12.05	13.95	12.35
Singapore	191.48	21.15	22.99	23.07
Somalia	41.09	12.38	11.77	16.33
South Africa	30.22	2.88	3.25	1.71
Sri Lanka	35.56	9.15	9.14	10.37
Sudan	15.06	4.28	3.32	3.98
Suriname	48.20	4.21	3.11	6.97
Swaziland	99.46	13.74	13.48	19.17
Syrian Arab Rep.	23.94	6.19	5.45	8.26
Tanzania	20.06	9.57	13.47	12.70
Thailand	31.48	6.20	6.45	6.04
Togo	53.65	17.40	16.20	14.12
Tonga	53.54	4.62	3.97	3.13
Trinidad and Tobago	40.97	7.67	6.33	10.79
Tunisia	42.59	9.05	8.65	9.25
Turkey	20.71	6.36	7.24	7.01
Uganda	22.18	10.03	8.02	12.03
Uruguay	25.04	8.04	4.57	9.65
Venezuela	26.29	6.48	3.36	9.04
Western Samoa	47.24	5.67	5.42	4.06
Zaire	25.30	9.29	8.11	12.28
Zambia	41.64	18.38	20.94	23.88
Average	44.89	11.90	11.27	13.12

Note: To calculate the capital flow value, the sum of all inflows and outflows, using the finest classification available to avoid netting, was divided by two and converted into domestic currency using the World Bank's Atlas exchange rate to smooth the effects of changes in exchange rates. This was then divided by GDP.

Source: Author's calculations based on data from IMF (various issues a) and World Bank (various issues).

Saving-Investment Correlations

In spite of the interpretation problems posed by saving-investment correlations as indexes of capital mobility, it is useful to examine what information such correlations can provide about capital mobility in developing countries. Where the data are available, such correlations can be calculated at low cost. The coefficient b derived from time-series estimates of Feldstein-Horioka regres-

Table 2. *Feldstein-Horioka Regressions for Developing Countries: Coefficient of the Saving Ratio, 1970–90*

	Ordinary least squares			*Instrumental variables*		
Country	*Levels*	*First differences*	*Error correction*	*Levels*	*First differences*	*Error correction*
Algeria	0.68[a]	−0.14[b]	−0.01[b]	0.89[a]	−0.22[b]	−0.13[b]
Argentina	1.08[a]	0.21[c]	0.22[b]	0.88[a]	0.34[b]	0.49
Benin	0.04	0.58[c]	0.53[c]	0.07	0.51[c]	0.06
Brazil	0.58[c]	0.13[c]	0.12[c]	0.27[b]	0.39	0.21[b]
Burkina Faso	0.69[a]	0.58[c]	0.37	—	—	—
Burundi	0.87[a]	0.54[c]	0.59[c]	1.52[c]	0.25	0.64
Cameroon	0.42[c]	0.37[c]	0.32[c]	0.42[c]	0.30[b]	0.43[c]
Central African Republic	0.71	0.19[b]	0.32[c]	1.24[a]	0.39	−0.30
Chile	0.51[c]	0.63[c]	0.52[c]	0.40[b]	0.30	0.65[a]
Colombia	0.07	0.07	−0.05	0.03[b]	0.14[b]	−0.01[b]
Congo	0.87[a]	0.24	0.33	0.49[c]	0.10[b]	0.29
Costa Rica	−0.28	0.09	0.09	0.57[a]	0.45	0.93
Côte d'Ivoire	0.36	0.13	0.15	0.06[b]	−1.26	−1.22
Dominican Republic	0.81[c]	0.22[c]	0.31[c]	0.51[c]	0.07	0.41
Ecuador	0.42[c]	−0.23	−0.17	0.73[a]	−0.13[b]	0.22[b]
Egypt	0.43[c]	0.44[c]	0.54[c]	1.07[a]	0.73	0.60
El Salvador	0.29[c]	0.06[b]	0.22[b]	0.50[c]	0.26[b]	0.29[b]
Fiji	2.15[a]	0.34[b]	0.36[c]	−0.34	0.63	1.01
Gabon	0.05[b]	0.38[c]	0.35[c]	0.50[c]	0.14	0.19[b]
Gambia, The	0.00[b]	−0.18[b]	−0.20[b]	−1.44	−0.53[b]	−0.69[c]
Ghana	1.07[a]	0.18[b]	0.51[c]	1.25[a]	1.05	4.43
Guatemala	0.23	0.40	0.34	0.54[c]	0.22	−0.08
Haiti	0.15[b]	0.04[b]	0.08[b]	−0.39	0.16[b]	0.00[b]
Honduras	0.53[c]	0.69[a]	0.59[a]	0.80[a]	1.18[a]	0.50
India	1.02[a]	0.99[a]	0.97[a]	1.45[a]	0.43	0.24
Indonesia	0.82[a]	0.23[b]	0.20[b]	1.37[a]	−0.04[b]	0.23
Israel	−0.18	−0.01[b]	−0.12[b]	—	—	—
Jamaica	0.28[b]	0.09[b]	0.16[b]	—	—	—
Kenya	0.24	0.37[c]	0.12[b]	−0.49[b]	−0.05[b]	−0.49[b]
Korea	0.35[c]	0.15[b]	−0.37[b]	0.31[c]	0.50	0.07[b]
Lesotho	−0.29[b]	0.17[b]	0.20[b]	−0.89[b]	−0.12[b]	−0.16
Madagascar	0.20[b]	−0.02[b]	−0.01[b]	−11.10[c]	0.04	0.54
Malawi	0.79[a]	0.65[a]	0.39[b]	0.59	−0.35	−0.65
Malaysia	0.24	0.11[c]	−0.06[b]	0.41	0.08[b]	0.08[b]
Mali	0.22[c]	0.82[a]	0.11[c]	−0.35[b]	0.11[b]	0.09[b]
Malta	0.62[c]	0.65[c]	0.80[c]	−0.10[b]	−0.68[b]	−0.61[c]
Mauritania	−0.06[b]	0.40[c]	0.50[c]	−0.43[b]	−0.45	0.86
Mauritius	0.56	0.37[c]	0.50[c]	0.43[b]	0.35	0.11
Mexico	0.28[c]	0.05[b]	0.39[c]	0.20[b]	0.01[b]	0.03[b]
Morocco	−0.13[b]	0.37[c]	−0.05[b]	0.48	0.36[b]	0.35[b]
Nepal	1.09[a]	0.80[a]	0.64[c]	0.94[a]	0.38[c]	0.51[c]
Niger	0.98[a]	−0.09[b]	0.84[a]	0.69[a]	0.91[a]	0.74[a]
Nigeria	0.64[a]	0.07[b]	−0.01[b]	1.20[a]	0.65[a]	0.74[a]
Pakistan	0.44[c]	0.73[c]	0.11[b]	1.07[a]	0.04[b]	0.10[b]
Paraguay	0.52[c]	−0.05[b]	−0.03[b]	0.60	−0.66[b]	0.55[b]
Peru	0.43[c]	0.24[b]	0.19[b]	0.53	0.18[b]	0.30[b]
Philippines	1.16[c]	0.56[c]	0.45[c]	1.04[a]	0.49[c]	0.67[c]
Rwanda	0.47[c]	0.02[b]	0.13[b]	1.05[a]	−0.41	0.37
Senegal	0.36[c]	0.19[c]	0.18[c]	0.56[c]	−0.11[b]	−0.04[b]
Sierra Leone	0.00[b]	0.21[b]	0.20[c]	−0.10[b]	−0.02[b]	−0.01[b]
Singapore	0.06[b]	0.08[b]	0.17[b]	—	—	—
Sri Lanka	0.73	−0.08[b]	0.01[b]	—	—	—

Country	Ordinary least squares			Instrumental variables		
	Levels	First differences	Error correction	Levels	First differences	Error correction
Thailand	0.72[c]	0.62[c]	0.55[c]	−0.53	−0.11	−0.30
Togo	0.17[b]	−0.08[b]	−0.05[b]	0.33	0.06[b]	0.22[b]
Trinidad and Tobago	0.22[c]	−0.03[b]	−0.04[b]	—	—	—
Tunisia	0.77[c]	0.15[b]	0.19[b]	1.29[a]	0.44	0.48[c]
Turkey	0.47[c]	0.41[c]	0.41[c]	1.01[a]	0.55	0.45
Uganda	0.07[b]	−0.05[b]	0.02[b]	0.33[c]	0.48	0.32[b]
Uruguay	1.10[a]	0.20[b]	0.28[b]	0.58	0.14[b]	0.20[b]
Venezuela	0.70[c]	−0.28	−0.22[b]	1.88[c]	1.53[a]	1.59[a]
Zambia	0.54[c]	−0.23[b]	0.01[b]	0.81[a]	0.42	0.71
Zimbabwe	0.56[c]	0.64[c]	0.66[c]	1.72	0.36[b]	0.40[b]

— Not available.
a. Different from zero at the 5 percent level.
b. Different from one at the 5 percent level.
c. Different from both zero and one at the 5 percent level.
Source: Author's calculations based on data from World Bank (various issues).

sions at least represents a straightforward index of the degree of capital mobility, an index that can, in principle, be compared across countries.[6]

Table 2 presents the estimates of the coefficient of the saving ratio, b, derived from standard Feldstein-Horioka regressions. The first column presents the estimates in levels (that is, as in equation 8). Ordinary least squares (OLS) is used for a sample of sixty-two developing countries for which data on national saving and gross domestic investment were available in World Bank (various issues) from 1970 to 1990.[7] Of the sixty-two countries in the sample, eleven produced such imprecise estimates of b that they could not be statistically distinguished from either zero or unity at the 95 percent confidence level. Of the remaining group, fourteen yielded estimates of b that could not be statistically distinguished from the closed-economy value of unity, yet were different from zero at the 95 percent confidence level. By contrast, twelve countries were at the other extreme—that is, with b not different from zero but distinguishable from one at the 95 percent confidence level. The remaining twenty-five countries were in an intermediate position. Using the small industrial-country value of 0.6 derived by Murphy (1984) as well as by Caprio and Howard (1984) as a benchmark, nineteen of the countries in the intermediate group produced point estimates of b below what might be considered a "representative" industrial-country value. Thus, consistent with what has been found by others, the Feldstein-Horioka

6. Feldstein and Horioka regressions based on time-series data have not previously been reported for large samples of developing countries.

7. Although the focus here is on the decade of the 1980s, restricting the sample period to this decade would have left too few degrees of freedom.

methodology applied to this group of countries appears to suggest a surprisingly high degree of capital mobility in the majority of developing countries in this sample.

Moreover, one explanation for the high degree of correlation between national saving and investment rates in industrial countries has been the endogeneity of saving in OLS regressions. Thus the estimates above may be biased upward. To address this potential problem, the Feldstein-Horioka regressions were reestimated with instrumental variables, using the share of government consumption in GNP and (one minus) the population dependency ratio as instruments for the saving rate. The results are reported in the fourth column of table 2. Because data on the instruments were not available for some countries, the sample size in this case dropped to fifty-six. Surprisingly, the instrumental-variable correction did not seem to have the effect of reducing the estimated coefficient on the saving rate appreciably. Thirteen countries yielded estimates of b that were too imprecise to be useful, and the remainder were approximately evenly split between those with b not statistically different from unity (nineteen countries) and those with estimated values either not different from zero (twelve countries) or below the benchmark of 0.6 (nine countries).[8]

Several of the studies that have addressed the Feldstein-Horioka results for industrial countries have estimated regressions of investment on saving in first differences. These papers have not always provided a rationale for doing so, but a case can be made that this is indeed the appropriate procedure. To the extent that the reasoning underlying the test is valid, the results should hold as well in first differences, and rerunning the regressions in this form provides at the very least a test of robustness. Estimates of b using first-difference regressions are reported in the second column for the OLS regressions and in the fifth column for the instrumental variable (IV) regressions in table 2. Casual inspection of these columns in comparison with the results of the regressions in levels suggests that the Feldstein-Horioka regressions do not pass the robustness test. Estimates of b change sharply for individual countries in the majority of cases. If b is taken as an indicator of a country's degree of financial integration with the outside world during this period of time, it would appear that several countries could be classified as effectively closed or almost perfectly integrated financially, depending on whether the estimate of b was derived from a regression estimated in levels or first differences.

A possible reason for this result is that the regressions based on levels of the variables may be producing spurious results. A valid reason to estimate in first differences rather than levels is that the saving and investment ratios entering the Feldstein-Horioka regressions may be nonstationary variables. If they are, and they are not cointegrated, then a regression in levels may lead to spurious

8. I exclude Burundi, Madagascar, and Venezuela from any of these categories because the point estimates of b for each of them was estimated with high confidence to be outside the theoretically prescribed range of zero to unity.

correlation (see Granger and Newbold 1974). If each of these variables possesses a single unit root, then first-differencing would render them stationary, and regressions based on changes would not exhibit the spurious correlation problem. As it happens, the null hypothesis of a single unit root cannot be rejected for any of the saving and investment ratios in this data set.[9] Thus the regressions based on levels of the variables may indeed be inappropriate in this case.

However, the first-difference regressions may themselves be misspecified. If the saving and investment ratios for individual countries are cointegrated, the relationship between them can be given an error-correction representation (Engle and Granger 1987). Estimating in first differences has the effect of omitting the error-correction term from the regression, leaving it misspecified. In the case at hand, the null hypothesis of no cointegration could be rejected only for a minority of countries.[10]

Although on the face of it this would suggest that proceeding with the first-difference regressions is acceptable, this conclusion may be unwarranted for two reasons. First, the cointegration tests have very low power, particularly in samples this small (twenty-one observations) and against alternatives involving a high degree of serial correlation. Second and more important, theoretical considerations suggest that saving and investment should be cointegrated, even under perfect capital mobility. The reason is that the current account provides the resources with which a country repays its external creditors. Solvency thus imposes a constraint that prevents deviations between national saving and investment from becoming permanent. Because gaps between saving and investment must eventually be reversed for the country to remain solvent, sufficient observations should show these two series to be cointegrated. This suggests that the failure to reject cointegration in the majority of cases may represent a small-sample problem.

To guard against this possibility, the Feldstein-Horioka regression was also estimated in an error-correction version. To conserve degrees of freedom, given the small number of observations, the simplest such specification was chosen, consisting of a regression of the change in the investment ratio on a constant, the lagged residual from the cointegrating regression, and the change in the saving ratio. The coefficient of the latter is the estimate of b. It is reported in the third column of table 2 for the OLS version and in the sixth column for the IV version. Focusing on the latter, the respecification makes a substantial difference to both the qualitative and the quantitative nature of the results. Of the fifty-six countries in the sample, only four (Chile, Niger, Nigeria, and Venezuela) produced estimates of b insignificantly different from the closed-economy value of unity. Only one country (the Philippines) yielded an estimate that was both precisely estimated and greater than the benchmark value of 0.6. Of the remaining coun-

9. This is based on augmented Dickey-Fuller tests. The results are available on request.

10. Again, the results are available on request.

tries, twenty-five had estimates of b that were either indistinguishable from zero (22 cases) or below the benchmark.[11]

Taken at face value, these results would appear to suggest that the developing countries in this sample have exhibited a substantial amount of capital mobility—more so, in fact, than this methodology is able to detect for industrial countries with more highly developed capital markets and fewer explicit barriers to capital movements. However, alternative interpretations can be provided for this finding. Notice that, unlike the situation for industrial countries, the problem here is to explain why saving-investment correlations are so low, not so high. An easy, but rather destructive explanation is that the data for these countries are simply very poor. Developing-country macro data are commonly held to be much worse than their industrial-country counterparts, and because saving estimates tend to be calculated as residuals, saving ratios may be particularly poor approximations to their true values (Aghevli and others 1990). Errors in variables problems here would indeed tend to bias estimates of b downward. What little can be done about this—that is, using instrumental variables to minimize the negative correlation between the contaminated variable and the error term—has already been done in the sixth column.

An alternative interpretation relies on the role of nonmarket flows. The rationale for the Feldstein-Horioka test is that with zero capital mobility, domestic investment must be financed with national saving, whereas when capital mobility is high, domestic investment can be independent of national saving because external creditors will supply the requisite financing on market terms. In many developing countries, however, domestic investment can differ from national saving even if capital is perfectly immobile in the sense defined here, that is, even if markets do not arbitrage at all between domestic and foreign financial instruments. The reason is that many developing countries have access to a nonnegligible quantity of external financing on nonmarket terms. Bilateral and multilateral external assistance is indeed often intended precisely to supplement national saving as a source of financing for investment. Yet, such nonmarket aid flows do not represent financial integration in the sense described previously, because they do not represent an endogenous response of the market to arbitrage opportunities among financial assets. Most important, such nonmarket flows do not have the policy implications associated above with the presence of a high degree of capital mobility.

Intuitively, because nonmarket flows break the link between national saving and domestic investment, the measured saving-investment correlations should be weakened if nonmarket flows are important. More formally, consider a country that is financially closed, but that receives foreign nonmarket assistance. To the extent that the assistance is devoted to investment, it belongs in the Feldstein-Horioka regression, because domestic investment now depends not

11. Nonsense results (that is, b estimated precisely, but outside the unit interval) were produced by two countries in this case.

just on national saving but also on the magnitude of aid inflows. Omitting the aid flows would leave the Feldstein-Horioka regression misspecified.

Standard specification error analysis suggests that the coefficient of the saving rate would still correctly capture the independent effect of national saving on domestic investment—and thus serve its intended role as an indicator of the degree of capital mobility—as long as all of the aid inflow was absorbed by investment. National saving and aid would be independent variables, and their effects on investment could be independently measured. However, if the receipt of aid affects the saving rate, then the omission of the aid variable from the regression would bias the coefficient of the saving rate, because the latter would pick up some of the effects of the former on domestic investment. Suppose, in particular, that aid receipts are only partially invested, the rest being consumed. Then the receipt of aid would lower the measured saving rate. If aid flows are omitted from the Feldstein-Horioka regression in this case, the coefficient of the saving ratio would be biased downward as a measure of the independent effect of national saving on domestic investment. The bias would be downward because the omitted variable, which has a positive coefficient in the "true" regression, would be negatively correlated with the included variable; that is, an increase in the saving rate would often reflect a reduction in aid receipts, and the latter would lower investment.

To correct for this problem, the regressions underlying the results reported in table 2 were reestimated taking aid flows into account. This was done by measuring aid flows as net financing (disbursements minus repayments) received from multilateral and bilateral creditors expressed as a share of GNP. In addition, the change in net foreign assets of the central bank in each of these countries was treated in the same manner as the receipt of nonmarket financing, essentially because reserve flows represent an additional source for financing saving-investment imbalances in developing countries without relying on private capital markets. Because most of the countries in the sample maintained a fixed exchange rate during the sample period, the contribution of reserve flows is potentially large. Indeed such flows accounted for several percentage points of GNP in a number of instances in this sample. To conserve degrees of freedom, the reestimation was performed under the restriction that each of the financing sources had the same effect on domestic investment. In other words, the saving ratio was replaced by the ratio of the sum of national saving, net nonmarket inflows, and reserve depletion to GNP.

The results of the reestimation are reported in table 3. The estimates of error-correction instrumental variables contained in the sixth column are the preferred results because they simultaneously address all of the econometric issues raised in this subsection. Using these estimates, for nine of the fifty-seven countries in the sample, the null hypothesis of $b = 1$ could not be rejected at the 95 percent level of confidence. This group includes India, Nigeria, the Philippines, and Venezuela, as well as smaller countries such as Ghana, Honduras, Kenya, and Niger. Malawi is also in this group, although the point estimate of 0.53 is below

Table 3. *Modified Feldstein-Horioka Regressions for Developing Countries: Coefficient of the Saving Ratio, 1970–90*

	Ordinary least squares			*Instrumental variables*		
Country	*Levels*	*First differences*	*Error correction*	*Levels*	*First differences*	*Error correction*
Algeria	0.96[a]	0.08[b]	0.27[b]	1.12[a]	0.01[b]	0.21
Argentina	0.63[c]	0.22[c]	0.24[c]	1.07[a]	0.36[c]	0.57
Benin	0.31[c]	0.31[c]	0.33[c]	0.37[c]	0.32[c]	0.33[c]
Brazil	0.19[c]	0.17[c]	0.17[c]	0.31[b]	0.32[b]	0.16[b]
Burundi	0.81[c]	0.61[c]	0.71[c]	0.86[a]	0.68[a]	0.64[c]
Cameroon	0.33[c]	0.39[c]	0.33[c]	0.38[c]	0.39[c]	0.38[c]
Central African Republic	0.69[c]	0.23[c]	0.35[c]	1.00[a]	0.00[b]	0.64
Chile	0.41[c]	0.58[c]	0.52[c]	0.03[b]	0.34	0.35[b]
Colombia	0.36[c]	0.41[c]	0.43[c]	0.35[c]	0.46[c]	0.54[c]
Congo	0.51[c]	0.37[c]	0.49[c]	0.54[c]	0.35[b]	0.66
Costa Rica	0.47[c]	0.28[c]	0.32[c]	0.60[c]	0.36[b]	0.41[c]
Côte d'Ivoire	0.77[a]	0.02[b]	0.11[b]	0.16	−2.32	−2.88
Dominican Republic	0.41[c]	0.24[c]	0.34[c]	0.24[b]	0.02[b]	0.18[b]
Ecuador	0.43[c]	0.19[b]	0.19[b]	0.60[a]	0.25[b]	0.34[b]
Egypt	0.50[c]	0.40[c]	0.41[c]	0.61[c]	0.40[c]	0.42[c]
El Salvador	0.45[c]	0.04[b]	0.15[b]	0.47[c]	0.12[b]	0.21[b]
Fiji	0.51[c]	0.17[b]	0.23[b]	0.25[b]	0.08[b]	0.10[b]
Gabon	0.67[a]	0.50[c]	0.51[c]	0.68[c]	0.42	0.50
Gambia, The	0.52[c]	0.01[b]	0.13[b]	0.76[a]	0.01[b]	0.37[b]
Ghana	0.80[a]	0.37[b]	0.61[c]	1.02[a]	0.90	1.23[a]
Guatemala	0.72[c]	0.41[c]	0.68[a]	0.45[c]	0.30[b]	0.42[b]
Haiti	0.24[c]	0.08[b]	0.12[b]	0.61[a]	0.44[b]	0.48
Honduras	0.72[c]	0.73[a]	0.76[a]	0.78[a]	0.68[a]	0.75[a]
India	1.07[a]	0.92[a]	0.93[a]	1.35[a]	0.72[a]	0.75[a]
Indonesia	1.01[a]	0.37[c]	0.42[c]	1.21[a]	0.61	0.71
Kenya	0.55[c]	0.83[a]	0.77[c]	0.20[b]	0.82[a]	0.78[a]
Korea	0.48[c]	0.53[c]	0.27[b]	0.26[b]	0.83[a]	0.72
Lesotho	−0.16[b]	0.19[c]	0.10[c]	−0.78	0.10[b]	0.00[b]
Madagascar	0.45[c]	0.09[b]	0.10[b]	0.52	0.22[b]	0.28[b]
Malawi	0.75[a]	0.50[b]	0.65[a]	0.64[a]	0.31[b]	0.53[a]
Malaysia	0.54	0.15[b]	0.14[b]	0.82[a]	0.27[b]	0.25[b]
Mali	0.30[c]	0.11[c]	0.11[c]	0.24[b]	0.12[b]	0.11[b]
Malta	0.30[c]	0.54[c]	0.54[c]	0.11[c]	0.13[b]	0.10[b]
Mauritania	0.44[c]	0.58[c]	0.57[c]	0.25[b]	0.38[b]	0.47[c]
Mauritius	0.58[c]	0.47[c]	0.46[c]	0.50[c]	0.45[c]	0.45[c]
Mexico	0.28[c]	0.30[c]	0.37[c]	0.20[b]	0.01[b]	0.03[b]
Morocco	0.59[a]	0.48[c]	0.47[c]	0.48	0.36[b]	0.35[b]
Nepal	0.88[a]	0.48[c]	0.55[c]	0.94[a]	0.38[c]	0.51[c]
Niger	0.91[a]	0.84[a]	0.89[a]	0.69[a]	0.91[a]	0.74[a]
Nigeria	0.99[a]	0.67[c]	0.73[c]	1.20[a]	0.65[a]	0.74[a]
Pakistan	0.80[a]	0.11[b]	0.26[c]	1.07[a]	0.04[b]	0.10[b]
Papua New Guinea	−0.64[c]	−0.27[b]	−0.34[c]	−0.39[b]	−0.26[b]	−0.21[b]
Paraguay	0.24[b]	−0.09[b]	−0.04[b]	0.60	−0.66[b]	−0.55[b]
Peru	0.70[a]	0.40[c]	0.47[c]	0.53	0.18[b]	0.30[b]

Country	Ordinary least squares			Instrumental variables		
	Levels	First differences	Error correction	Levels	First differences	Error correction
Philippines	1.16[a]	0.53[c]	0.72[c]	1.04[a]	0.49[c]	0.67[a]
Rwanda	0.60[c]	0.42[c]	0.57[c]	1.06[a]	−0.41	0.37
Senegal	0.50[c]	0.16[b]	0.20[c]	0.56[a]	−0.11[b]	−0.04[b]
Sierra Leone	−0.10[c]	0.02[b]	−0.01[b]	−0.10[b]	−0.02[b]	−0.01[b]
Thailand	1.13[a]	0.56[c]	0.72[a]	−0.52	−0.11	−0.30
Togo	0.36[b]	−0.02[b]	0.03[b]	0.33	0.07[b]	0.22[b]
Tunisia	1.12[a]	0.42[c]	0.53[c]	1.29[a]	0.44	0.48[c]
Turkey	0.79[a]	0.51[c]	0.52[c]	1.01[a]	0.55	0.45
Uganda	0.14[b]	−0.03[b]	0.05[b]	0.33[c]	0.48	0.32[b]
Uruguay	0.79[a]	0.16[b]	0.18[b]	0.58	0.14[b]	0.20[b]
Venezuela	1.70[c]	1.18[a]	1.29[a]	1.87[c]	1.53[a]	1.59[a]
Zambia	0.59[c]	0.05[b]	0.22[b]	0.81[a]	0.42	0.71
Zimbabwe	0.69[c]	0.54[c]	0.59[c]	1.72	—	—

— Not available.
a. Different from zero at the 5 percent level.
b. Different from one at the 5 percent level.
c. Different from both zero and one at the 5 percent level.
Source: Author's calculations based on data from World Bank (various issues).

the industrial-country benchmark value of 0.6. With the exception of Honduras, all of these countries were found in the modal or below-modal group for the gross-flow index calculated in the previous subsection.[12] At the other extreme are twenty-four countries with b indistinguishable from zero statistically, as well as nine countries in which b can be distinguished from both zero and unity, but with point estimates of b below 0.6. Among countries discussed in the previous section, Brazil, Mexico, and Morocco, all of which were taken as exhibiting financial openness but not necessarily strong financial integration, are in this group. Not surprisingly, so is Malaysia. In this case, thirteen countries produced estimates of b that were too imprecise to be useful.

Overall, taken at face value, the Feldstein-Horioka methodology indicates that developing countries tend to differ substantially among themselves with respect to their degree of financial integration with world capital markets. For a substantial majority of developing countries (thirty-two out of the forty-three relevant cases here), however, the data are consistent with a substantial degree of financial openness. Only about a fifth of the countries in the sample produced estimates of b consistent with financial autarky. What cannot be determined, of course, is the extent to which these results truly reflect a high degree of financial integration, rather than just poor data. The broad consistency of the results with previous estimates as well as with the gross-flow index suggests that the results may have some information content.

12. Honduras, with a gross-flow ratio of 10.06 percent, barely escaped the modal group (see table 1).

Arbitrage Conditions

Direct tests of arbitrage conditions have the advantage not only of avoiding the use of suspect macro data, but also of not being subject to some of the methodological problems with saving-investment correlations discussed in section I. In this section, accordingly, tests of UIP are constructed for a large group of developing countries. Uncovered, rather than covered, interest parity is tested because very few forward markets exist for the currencies of developing countries. Even uncovered interest parity tests are difficult to conduct for very many developing countries, because time-series observations on interest rates of adequate length are often not available. The country sample was determined by the availability of monthly data on interest rates payable to private savers during the period January 1985 to December 1990.[13] The interest rate tended to be either short-term (zero to six-month) deposit rates or six-month treasury bill rates. The countries in the sample and the interest rate chosen for each are listed in table 4.

The tests were based on the behavior of the return differential, that is, the difference between the domestic interest rate and the relevant exchange rate–corrected ex post foreign interest rate.[14] The use of ex post exchange rates is required, as usual, because the appropriate ex ante expectations of future exchange rates are unobservable. If expectations are formed rationally, however, UIP nevertheless imposes some restrictions on the data that can be tested. Among the restrictions are that the mean value of the return differential should be zero and that deviations from the mean should be serially uncorrelated. These propositions are tested in the second and fourth columns and of table 4. The second column lists the mean value of the return differential for each country, with an asterisk indicating cases in which the mean is statistically different from zero at the 95 percent confidence level. Of the forty-eight countries in the sample, thirty-two exhibited mean deviations that were different from zero during this period. Moreover, in all but one case (the rather extreme one of Argentina), Q tests indicated with a very high degree of confidence that deviations from UIP were serially correlated. Thus, leaving Argentina aside, at least one of the predictions of the joint hypothesis of UIP, rational expectations, and weak market efficiency can be rejected in every case.

To facilitate comparisons across countries, I computed for each country the ratio of its mean absolute deviation from UIP (that is, the mean over the sample period of the absolute value of the return differential observed each month) to the mean of the exchange rate–corrected foreign interest rate. Because the for-

13. The data are taken from IMF (various issues b). The restriction that interest rates apply to assets available to private savers ruled out the inclusion of several countries for which only discount rate data were available.

14. The "foreign" interest rate was taken to be the relevant U.S. interest rate in each case. The rate on U.S. three-month certificates of deposit was used when the domestic rate was a short-term deposit rate, and the U.S. six-month Treasury bill rate was used when the domestic rate was a Treasury bill rate. In all cases, the exchange rate was the period-average market-based exchange rate against the U.S. dollar.

eign interest rate indicates what the domestic interest rate would have been if ex post UIP had held exactly during each month of the sample period, the computed ratio measures how far the domestic interest rate deviated on average from what would have been observed under strong financial integration. The ratio for the total sample period is reported in the fifth column of table 4.

Evidently the countries in the sample are divided into two groups: the CFA franc countries of West Africa and everyone else. The ratio is large and negative for CFA franc countries (consisting in this sample of Cameroon, the Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Mali, and Senegal). The appreciation of the French franc against the U.S. dollar during the period made the ex post external interest rate take on negative values averaging close to zero for these countries. The vast majority of the non-CFA countries exhibit average absolute deviations up to twice the magnitude of the UIP interest rate. By this measure, countries such as Chile, Colombia, Costa Rica, Mexico, Sri Lanka, and Uruguay are characterized by a high degree of capital mobility in the sense that their domestic interest rates show relatively small deviations from their UIP values, whereas Cyprus, Mauritius, and Seychelles are at the opposite extreme of very low capital mobility.

To assess whether comparisons of this type provide any evidence of an increase in the degree of integration with world financial markets among the sample countries in recent years, the sample period was divided in half for each country, and mean absolute deviations were calculated separately for each half of the period. The results are reported in the last two columns of table 4. In eleven of the forty-eight countries, there was a statistically significant decline in the mean absolute deviation during the second half of the sample. Among the larger countries in this group were Israel and Mexico. There were seven cases in which the mean absolute deviation increased in the second half of the sample, including in Argentina, Brazil, Egypt, the Republic of Korea, and Turkey. Overall, there is little evidence of widespread increases in financial integration here, although several countries may indeed have evolved in this direction.

These results must be viewed with caution, however. First, the peso problem may be endemic in this data set. The majority of the countries in the sample maintained predetermined exchange rates during the sample period. It is possible that ex post deviations from UIP reflected expected devaluations that did not come to pass, or surprise devaluations, particularly because several countries in the sample did experience large discrete devaluations during this time. Second, in many cases the interest rates used for these calculations do not reflect market-determined rates, but rather the administered rates characteristic of a repressed financial system. Frankel (1991) has argued that this problem does not matter, because the ability to sustain domestic interest rates at levels that differ from their international counterparts is precisely what we mean by imperfect capital mobility. This argument is not convincing, however, for three reasons:

- The interest rates in the formal financial system may indeed deviate substantially from their foreign counterparts, as do many of the interest rates in the

Table 4. *Deviations from Uncovered Interest Parity in Developing Countries, 1985–90*
(percent)

Country	Interest rate	Mean deviation	Standard error	Q(6)	Ratio of mean absolute deviation to mean of uncovered interest parity		
					Total	First half	Second half
Argentina	Deposit rate	−66,234	61,513	6.17	1.15	0.00	2.30[a]
Bhutan	Deposit rate	−8.17*	1.42	72.32	0.76	0.52	10.01[a]
Botswana	Deposit rate	−7.40	4.98	54.34	2.00	2.62	1.37[a]
Brazil	Treasury bill rate	−1,168	374.56	89.75	0.87	0.12	1.63[a]
Cameroon	Deposit rate	9.11*	2.67	46.46	−11.82	−12.42	−11.23
Central African Republic	Deposit rate	9.07*	2.66	46.04	−11.77	−12.42	−11.13
Chad	Deposit rate	6.49*	2.70	48.15	−11.27	−11.51	−11.02
Chile	Deposit rate	−1.14	2.43	45.10	0.50	0.50	0.49
Colombia	Deposit rate	−13.79*	1.48	105.80	0.34	0.39	0.28
Congo	Deposit rate	9.60*	2.67	46.40	−11.95	−11.78	−11.11
Costa Rica	Deposit rate	−5.77*	1.05	88.76	0.29	0.24	0.33
Cyprus	Deposit rate	4.25*	2.04	36.44	9.49	9.93	9.05
Ecuador	Deposit rate	−70.25*	19.36	29.82	0.80	0.83	0.76
Egypt	Deposit rate	−67.23*	29.83	32.32	0.94	0.05	1.83[a]
El Salvador	Deposit rate	−72.82*	36.40	27.86	0.97	1.42	0.52
Equatorial Guinea	Deposit rate	8.81*	2.70	48.15	−11.87	−12.67	−11.07
Ethiopia	Deposit rate	−4.65*	0.14	83.25	0.60	0.51	0.70
Gabon	Deposit rate	5.96*	2.80	44.28	−10.84	−11.49	−10.31
Gambia, The	Maximum deposit rate	−41.94	23.57	21.60	1.28	2.04	0.51
Ghana	Treasury bill rate	−46.13*	7.16	65.76	0.80	1.20	0.40[a]
Guatemala	Maximum deposit rate	−199.84	104.73	31.05	0.97	1.76	0.18
Honduras	Deposit rate	−63.65	36.28	29.99	0.92	0.04	1.80
Indonesia	Deposit rate	−6.10	4.16	80.50	1.00	0.95	1.04
Israel	Treasury bill rate	16.73	10.39	37.54	1.04	1.78	0.31[a]
Jamaica	Treasury bill rate	6.03*	2.04	132.62	1.12	1.15	1.11
Kenya	Maximum deposit rate	4.26*	1.73	53.01	0.79	0.81	0.77
Korea	Deposit rate	0.76	2.22	203.72	1.00	0.91	1.09[a]
Lesotho	Treasury bill rate	−10.12*	3.81	52.21	1.44	1.81	1.08[a]
Malawi	Treasury bill rate	8.85*	1.83	132.38	−18.26	−24.32	−18.21[a]
Malaysia	Deposit rate	−4.29*	1.09	50.94	0.79	0.81	0.77
Mali	Deposit rate	7.25*	2.69	46.44	−11.27	−12.42	−10.12
Mauritius	Deposit rate	2.78	2.26	43.22	2.01	1.84	2.17
Mexico	Treasury bill rate	−17.30*	8.10	138.61	0.61	0.77	0.44[a]

Country	Interest rate	Mean deviation	Standard error	Q(6)	Ratio of mean absolute deviation to mean of uncovered interest parity: Total	First half	Second half
Nepal	Treasury bill rate	−12.42*	1.79	76.48	0.78	0.74	0.83
Nigeria	Deposit rate	−333.75	194.60	11.84	1.00	1.83	0.16
Philippines	Treasury bill rate	3.55*	1.37	27.31	0.59	0.71	0.48
Rwanda	Deposit rate	4.41*	1.66	41.45	1.65	2.23	1.07[a]
Senegal	Deposit rate	7.79*	2.70	47.14	−11.57	−11.80	−11.34
Seychelles	Treasury bill rate	12.29*	1.24	91.89	11.54	15.24	7.84
Sierra Leone	Treasury bill rate	−383.25*	128.12	65.87	1.00	1.72	0.31[a]
Singapore	Deposit rate	−0.20	1.06	50.94	1.83	1.69	1.97
South Africa	Treasury bill rate	−3.24	3.76	52.49	1.42	1.85	0.97a
Sri Lanka	Treasury bill rate	−3.67*	1.27	84.60	0.40	0.19	0.60[a]
Thailand	Deposit rate	4.14*	0.70	37.90	0.94	1.11	0.77[a]
Trinidad and Tobago	Treasury bill rate	−18.64*	4.82	80.45	0.81	1.18	0.44[a]
Turkey	Deposit rate	−4.62	3.72	83.25	0.45	0.34	0.57[a]
Uruguay	Deposit rate	−3.54	2.59	61.13	0.19	0.19	0.18
Venezuela	Deposit rate	−265.84*	119.94	31.09	0.97	0.45	1.49

*Different from zero at the 5 percent level.

a. Statistically significant change in the mean absolute deviation between the first and second half of the period.

Source: Author's calculations based on data from IMF (various issues b).

present sample. But unobserved market-determined domestic interest rates, such as those in informal financial markets, may be tied much more closely to external rates. To the extent that external rates represent the marginal cost of funds in the domestic economy, the policy environment may be more closely characterized as one with high capital mobility than one with capital immobility.

- The prevalence of domestic deposit interest rates that are substantially different from foreign ones may not reflect the absence of arbitrage, but rather imperfect substitutability arising from liquidity services rendered by claims on domestic banks.
- Reported Treasury bill interest rates may not in fact reflect rates of return on assets that are willingly held, but rather the administered interest rates paid on instruments that financial institutions are required to hold in order to satisfy legal "liquidity" requirements.

Thus, the use of interest rates that are not market determined raises an impor-

tant caveat in the interpretation of the results of tests of arbitrage conditions. The finding that reported domestic interest rates move closely with foreign rates may indeed suggest a high degree of capital mobility. The opposite finding may simply indicate that financial repression is high and that a closer examination of the behavior of domestic market–determined interest rates is required.

Euler Equation Tests

Euler equation tests may provide the most direct tests of financial integration. They also avoid some of the conceptual difficulties associated with tests of arbitrage conditions and saving-investment correlations. The data required are time series on real per capita private consumption, national price levels, and exchange rates. Although consumption data are often a binding constraint in developing countries, the Summers-Heston (1991) data set provides the relevant series (in annual form) for many developing countries for the period 1960–85. Thus the variable n_t used by Obstfeld (1986b), as defined in equation 8, was constructed for the sixty developing countries for which at least fifteen years of data were available. The data for the nominal exchange rate against the U.S. dollar are from Summers and Heston (1991), while the data for the consumer price index are from IMF (various issues b). The variable n_t was constructed with the United States as the domestic country and each of the developing countries in the sample in turn as the foreign country. Two alternatives were chosen for the parameter a (the inverse of the intertemporal elasticity of substitution): 2 and 1. These correspond to the values estimated by Obstfeld for the United States and Japan, respectively. The procedure involves determining whether variables contained in the information set available before time t can help to predict n_t.

The results are presented in table 5. The probability values are for the likelihood-ratio test of exclusion restrictions on the constant and a single lagged value of n_t, as well as on the constant and two lagged values of n_t, for $a = 2$ and for $a = 1$. Failure to reject the null hypothesis embodying the exclusion restrictions is consistent with perfect capital mobility, that is, with complete financial integration. Rejection is indicated if it occurs with either one or two lags. No additional lags were tried because of the scarcity of degrees of freedom.

The outcomes of these tests are quite similar to those of the saving-investment correlations reported in tables 3 and 4. For the large majority of countries the results would seem to be consistent with a high degree of capital mobility. Specifically, the null is rejected in only twenty-five of the sixty countries tested with $a = 2$, and in only 17 countries with $a = 1$. With the single exception of Singapore, every case of rejection with $a = 1$ was also a rejection with $a = 2$. As in the case of saving-investment correlations, however, the interpretation of these results is complicated by poor data and few degrees of freedom. Because the null is consistent with a high degree of capital mobility, it is unclear whether a failure to reject reflects poor data or substantial financial integration.

Summers and Heston provide an indicator of the relative quality of their data

across countries. This data "grade" is reported in table 5, with quality deteriorating from A to D. For $a = 2$, the incidence of rejection for grades A to C was twenty of forty-four countries, whereas for countries graded D it was only five of sixteen. For $a = 1$, only 2 of 16 countries with grade D rejected the null, whereas for those graded C and higher about a third (fifteen of forty-four) involved rejections. This disparity suggests a clear association between poor data quality and failure to reject, and it implies that Euler equation tests using annual data for large groups of developing countries can in many cases provide only weak evidence on the issue of financial integration.

III. Summary and Conclusions

An economy's degree of financial integration with the rest of the world is a key determinant of many of its most important macroeconomic properties. For the vast majority of developing countries, however, little is known about the nature of the links between domestic and external financial markets. As a result, conflicting assumptions are often made about this important feature of developing economies in both analytical and policy work. The question addressed here is whether the data impose any restrictions on assumptions about financial integration. This article presents the first systematic application of existing approaches to the measurement of capital mobility to large groups of developing countries.

Unfortunately, a number of complicating conceptual and empirical factors are encountered in attempting to answer this question. Conceptually, there are two types of complicating factors. First, there is no widely accepted empirical measure of the degree of an economy's financial integration with the rest of the world. This problem arises precisely because of the large number of implications that follow from financial integration in the strong sense. Because tests of financial integration essentially examine whether the data are consistent with these implications, each such implication provides a separate test. Second, each of the existing empirical tests presents problems of interpretation. The tests are based on the magnitude of gross capital flows, the strength of saving-investment correlations, the applicability of arbitrage conditions, the scope for sterilization, and the cross-country uniformity of Euler equation relationships.

Perhaps the most widely used tests of financial integration have been tests of arbitrage conditions and saving-investment correlations. Yet tests of arbitrage conditions suffer from the need to identify comparable assets across countries and to make ancillary assumptions about unobservable expectations and agents' information sets (resulting in tests of joint hypotheses). They also suffer from the peso problem. Moreover, the policy implications of rejections of arbitrage conditions depend on the reasons for rejection, and this has proven to be a difficult question to resolve in the industrial-country context. Tests of saving-investment correlations, by contrast, are contaminated by a host of factors that could cause

Table 5. *Euler-Equation Estimates of Capital Mobility*

Country	Sample period	Quality of data[a]	$a = 2$			$a = 1$		
			1 lag	2 lags	Reject?	1 lag	2 lags	Reject?
Bangladesh	1961–84	C	0.37	0.03	Yes	0.39	0.02	Yes
Bolivia	1961–85	B	0.24	0.44	No	0.44	0.67	No
Burundi	1967–84	D	0.64	0.23	No	0.89	0.97	No
Cameroon	1970–84	C	0.84	0.12	No	0.59	0.8	No
Chile	1961–84	C	0.38	0.56	No	0.5	0.7	No
Colombia	1961–84	B	0.47	0.6	No	0.39	0.55	No
Congo	1961–84	D	0.06	0.13	No	0.32	0.56	No
Costa Rica	1961–84	B	0.14	0.01	Yes	0.28	0.01	Yes
Côte d'Ivoire	1962–84	C	0.16	0.16	No	0.18	0.25	No
Cyprus	1961–84	B	0.7	0.49	No	0.65	0.46	No
Dominican Republic	1961–84	C	0.9	0.92	No	0.75	0.8	No
Egypt	1961–84	D	0.88	0.54	No	0.99	0.75	No
El Salvador	1961–84	B	0	0	Yes	0.01	0	Yes
Ethiopia	1967–84	C	0.03	0.12	Yes	0.26	0.57	No
Gabon	1964–84	C	0.64	0.78	No	0.97	0.67	No
Gambia, The	1963–84	D	0.49	0.79	No	0.48	0.71	No
Ghana	1966–84	D	0.01	0.03	Yes	0.01	0.02	Yes
Guatemala	1961–84	B	0	0	Yes	0	0	Yes
Guyana	1961–84	C	0.42	0.44	No	0.35	0.2	No
Haiti	1961–84	C	0.16	0.29	No	0.56	0.61	No
Honduras	1961–84	C	0.02	0.02	Yes	0.02	0.04	Yes
India	1961–84	B	0.01	0.16	Yes	0.04	0.02	Yes
Iran, Islamic Rep. of	1961–84	C	0.02	0.04	Yes	0.01	0.02	Yes
Israel	1961–84	A	0.25	0.77	No	0.14	0.58	No
Jamaica	1961–84	C	0.23	0.18	No	0.3	0.18	No
Kenya	1961–84	B	0.18	0.01	Yes	0.08	0	Yes
Korea	1968–84	B	0.15	0.31	No	0.46	0.76	No
Liberia	1967–84	D	0.1	0.29	No	0.21	0.45	No
Madagascar	1966–84	C	0.03	0.04	Yes	0.16	0.28	No
Malaysia	1961–84	B	0.16	0	Yes	0.19	0.16	No
Mauritius	1965–84	D	0.5	0.62	Yes	0.46	0.54	No
Mexico	1961–84	B	0.38	0.01	Yes	0.62	0.03	Yes
Morocco	1961–84	C	0.01	0.08	Yes	0.04	0.14	Yes
Myanmar	1961–84	C	0.72	0.81	No	0.58	0.38	No
Nepal	1966–84	D	0.03	0.39	Yes	0.05	0.01	Yes
Niger	1965–84	D	0.08	0.02	Yes	0.69	0.63	No
Nigeria	1961–84	C	0.11	0.24	No	0.27	0.4	No
Pakistan	1961–84	B	0.18	0.32	No	0.2	0.32	No
Panama	1961–84	B	0.48	0.42	No	0.46	0.41	No
Paraguay	1961–84	C	0.02	0.04	Yes	0.03	0.04	Yes
Philippines	1961–84	A	0.61	0.01	Yes	0.53	0.9	No
Rwanda	1968–84	D	0.99	0.96	No	0.49	0.64	No
Saudi Arabia	1965–84	C	0	0	Yes	0	0	Yes
Senegal	1969–84	C	0.34	0.33	No	0.3	0.5	No
Sierra Leone	1961–84	D	0.02	0.05	Yes	0.23	0.23	No
Singapore	1962–84	C	0.11	0.27	No	0.04	0.02	Yes

Country	Sample period	Quality of data[a]	a = 2			a = 1		
			1 lag	2 lags	Reject?	1 lag	2 lags	Reject?
Somalia	1962–84	D	0.07	0.15	No	0.36	0.63	No
South Africa	1961–84	B	0.13	0.18	No	0.09	0.07	No
Sri Lanka	1961–84	B	0.31	0.03	Yes	0.12	0.17	No
Sudan	1961–84	D	0.09	0.09	No	0.2	0.25	No
Swaziland	1967–84	D	0.99	0.36	No	0.9	0.39	No
Tanzania	1967–84	C	0.97	0.2	No	0.52	0.14	No
Thailand	1961–84	C	0.8	0.96	No	0.63	0.83	No
Togo	1968–84	D	0.09	0.14	No	0.23	0.49	No
Tunisia	1961–84	C	0.04	0.04	Yes	0	0.02	Yes
Turkey	1962–84	B	0.55	0.24	No	0.51	0.73	No
Venezuela	1961–84	B	0.17	0.4	Yes	0.24	0.5	No
Zaire	1966–84	D	0.29	0.33	No	0.64	0.57	No
Zambia	1962–84	B	0.01	0.04	Yes	0.01	0.01	Yes
Zimbabwe	1966–84	C	0.1	0.21	No	0.15	0.26	No

Note: The parameter a is the inverse of the intertemporal elasticity of substitution.

a. The quality of data deteriorates from A to D.

Source: Author's calculations based on data from Summers and Heston (1988) and IMF (various issues b).

saving and investment to move together even under perfect capital mobility. Tests of restrictions implied by Euler equations, a more promising recent approach that avoids the problems associated with arbitrage conditions and saving-investment correlation, require very strong restrictions on consumer behavior across countries for their implementation.

Empirically, developing-country data provide a serious challenge that compounds these conceptual problems. The main difficulties are that the national income accounting data that underlie both saving-investment correlations and tests based on Euler equations tend to be of poor quality. The resulting errors-in-variables problem makes it difficult to reject null hypotheses consistent with high capital mobility. Reported data on interest rates often do not refer to market-determined rates. Arbitrage conditions may therefore not tend to hold for observed interest rates but may well hold for "informal" rates that represent the true cost of funds in the economy. This could lead to a rejection of high capital mobility when it indeed holds. The central difficulty is that these data problems operate in opposite directions. Poor macro data will yield results consistent with a high degree of financial integration when saving-investment correlations and Euler equation tests are applied, whereas poor interest-rate data will cause tests of arbitrage conditions to support a finding of low financial integration.

In view of the direction of these biases, the juxtaposition of several tests may be the most judicious manner to formulate at least a first-pass impression of the extent to which large groups of individual developing countries have been inte-

grated with world financial markets in recent times. This was attempted in section II. For the 103 countries contained in the various samples examined, the weight of the evidence in each case is summarized in the appendix. Of this group, a majority of countries provided enough evidence to permit at least a crude subjective characterization of their degree of integration with world financial markets during the period considered here. In some cases, however, the tests proved contradictory, and such cases will require further study.

The degree of financial integration with the rest of the world is characterized for 58 of the 103 developing countries listed in the appendix. The financial integration of the countries is characterized as high, intermediate, or low. An important finding of this article, consistent with a growing body of empirical work, is that a large number of developing countries can be described as financially open. Thirty-nine of the 58 countries classified in the appendix are characterized as exhibiting a high or intermediate degree of financial integration. And in some of the countries characterized as having a low degree of financial openness, other forms of evidence (for example, capital flight from Venezuela) indicate that financial autarky is not an apt description of the nature of their relationship with world financial markets. Specific policy implications for individual countries will have to await more careful country-specific work to yield more refined measures of the degree of financial integration in specific cases. Nonetheless, both the evidence in the existing literature and that presented here imply that, although cases of strong financial integration may be rare in the developing world, the majority of developing countries must be regarded, for both policy and analytical work, as de facto financially open.

Appendix

Table A-1 is a country-by-country summary of the results of the tests that appear in the text and includes all the countries contained in any of the samples. On the basis of the results, each country has also been classified subjectively as being in one of three categories of financial integration (high, intermediate, or low) during the 1980s. Countries for which information was available for only one measure of integration (typically the gross-flow ratio measure, or GFR) were left unclassified, as were those for which the various measures were judged too contradictory to permit even a rough classification. No systematic rules were imposed on the classification procedure except that the presumption was against classification in the high range if the preferred Euler equation test rejected integration. By contrast, little weight was given to this test when it failed to reject integration with poor data (rated D by Summers and Heston 1991).

The group classifications reported in table A-1 for the GFR measure refer to the ranges reported in the text: the GFR for group 1 was greater than 20 percent; the GFR for group 2 was between 15 and 20 percent; the GFR for group 3 was between 10 and 15 percent; the GFR for the modal group 4 was between 5 and 10 percent; and the GFR for group 5 was below 5 percent.

Table A-1. *Results of Tests of Financial Integration for 103 Countries*

Country	Classification of the degree of financial integration	Gross-flow ratio measure group	Test results		
			Feldstein-Horioka b coefficient	Euler	Uncovered interest parity differential
Algeria	—	4	Not different from 0 or 1	—	—
Antigua	—	1	—	—	—
Argentina	—	—	—	—	Not different from 0
Bahamas	—	5	—	—	—
Bahrain	—	3	—	—	—
Bangladesh	Low	5	—	Rejects integration	—
Barbados	—	4	—	—	—
Benin	—	—	Different from 0 and 1	—	—
Bhutan	—	—	—	—	Different from 0, but not large
Bolivia	High	2	—	Fails to reject integration; data quality B	—
Botswana	Intermediate	3	—	—	Not different from 0, and high
Brazil	—	4	Test rejects $b = 1$, but not $b = 0$	—	—
Burkina Faso	—	5	—	—	—
Burundi	Intermediate	—	Different from 0 and 1	Fails to reject integration; data quality D	—
Cameroon	Intermediate	—	Different from 0 and 1	Fails to reject integration; data quality C	—
Cape Verde	—	4	—	—	—
Central African Republic	—	4	Not different from 0 or 1	—	—
Chad	—	4	—	—	—
Chile	High	2	Test rejects $b = 1$	Fails to reject integration; data quality C	Not different from 0
Colombia	Intermediate	4	Intermediate range	Fails to reject integration; data quality B	Different from 0, but low
Congo	High	1	Intermediate range	Fails to reject integration; data quality D	—
Costa Rica	Intermediate	1	Intermediate range	Rejects integration	Different from 0, but low
Côte d'Ivoire	High	2	Intermediate range	Fails to reject integration; data quality C	—

(Table continues on the following page.)

Table A-1. *(continued)*

Country	*Classification of the degree of financial integration*	*Gross-flow ratio measure group*	*Test results*		
			Feldstein-Horioka b coefficient	*Euler*	*Uncovered interest parity differential*
Cyprus	Intermediate	4	—	Fails to reject integration; data quality B	Different from 0, and large
Dominica	—	4	—	—	—
Dominican Republic	High	4	Low	Fails to reject integration; data quality C	—
Ecuador	Intermediate	2	Test rejects $b = 1$, but not $b = 0$	—	Not different from 0
Egypt	Intermediate	4	Intermediate range	Fails to reject integration; data quality D	Different from 0
El Salvador	Low	4	Test rejects $b = 1$, with low b	Rejects integration	Different from 0
Equatorial Guinea	—	—	—	—	Different from 0
Ethiopia	Low	5	—	Rejects integration	Different from 0, but not large
Fiji	—	4	Test rejects $b = 1$, but not $b = 0$	—	—
Gabon	High	2	Intermediate range	Fails to reject integration; data quality C	—
Gambia, The	High	2	Test rejects $b = 1$, but not $b = 0$	Fails to reject integration; data quality D	Not different from 0
Ghana	Low	4	Test rejects $b = 0$, but not $b = 1$	Rejects integration	Different from 0
Grenada	—	3	—	—	—
Guatemala	Intermediate	4	Test rejects $b = 1$, but not $b = 0$	Rejects integration	Not different from 0
Guinea-Bissau	—	2	—	—	—
Guyana	—	—	—	Fails to reject integration; data quality C	—
Haiti	Intermediate	5	—	Fails to reject integration; data quality C	—
Honduras	Low	3	Test rejects $b = 0$	Rejects integration	Not different from 0 (would be rejected at slightly higher significance level)
India	Low	5	Test rejects $b = 0$, and b is high	Rejects integration	—

Country	Classification of the degree of financial integration	Gross-flow ratio measure group	Test results		
			Feldstein-Horioka b coefficient	Euler	Uncovered interest parity differential
Indonesia	—	5	—	—	Not different from 0
Iran	—	—	—	Rejects integration	—
Israel	High	3	—	Fails to reject integration; data quality A	Not different from 0
Jamaica	High	1	—	Fails to reject integration; data quality C	Different from 0, and high
Kenya	Low	4	Different from 0, not different from 1	Rejects integration	Different from 0
Korea	Intermediate	4	—	Fails to reject integration; data quality B	Not different from 0
Kuwait	—	2	—	—	—
Lesotho	Intermediate	2	Test rejects $b = 1$, but not $b = 0$	—	Different from 0, and high
Liberia	—	—	—	Fails to reject integration; data quality D	—
Libya	—	4	—	—	—
Madagascar	Intermediate	3	Test rejects $b = 1$, but not $b = 0$	Rejects integration	—
Malawi	Intermediate	—	Test rejects $b = 0$, but estimate is low ($b = 0.53$)	—	Different from 0
Malaysia	Intermediate	4	Test rejects $b = 0$, and b is very low (0.25)	Rejects integration	Different from 0
Mali	—	4	Test rejects $b = 1$, but not $b = 0$	—	—
Malta	—	—	Test rejects $b = 1$, but not $b = 0$	—	—
Mauritania	Intermediate	2	Intermediate range	—	—
Mauritius	Low	4	Intermediate range	Rejects integration	Not different from 0, and high
Mexico	Intermediate	4	Test rejects $b = 1$, with very low b	Rejects integration	Different from 0, but low
Morocco	Low	4	Test rejects $b = 1$, but not $b = 0$	Rejects integration	—

(Table continues on the following page.)

Table A-1. *(continued)*

Country	Classification of the degree of financial integration	Gross-flow ratio measure group	Test results		
			Feldstein-Horioka b coefficient	Euler	Uncovered interest parity differential
Myanmar	—	—	—	Fails to reject integration; data quality C	—
Nepal	Low	—	Intermediate range	Rejects integration	Different from 0
Nicaragua	—	1	—	—	—
Niger	Low	4	Test rejects $b = 0$, but not $b = 1$	Rejects integration	—
Nigeria	Low	4	Test rejects $b = 0$, but not $b = 1$	Fails to reject integration; data quality C	Not different from 0, but high
Pakistan	Intermediate	5	Test rejects $b = 1$, but not $b = 0$	Fails to reject integration; data quality B	—
Panama	High	1	—	Fails to reject integration; data quality B	—
Papua New Guinea	Intermediate	3	Test rejects $b = 1$, but not $b = 0$	—	—
Paraguay	Low	4	Test rejects $b = 1$	Rejects integration	—
Peru	—	—	Test rejects $b = 1$	—	—
Philippines	Low	4	Test rejects $b = 0$, but not $b = 1$	Rejects integration	—
Rwanda	Low	5	Imprecise	Fails to reject integration; data quality D	Different from 0, and high
São Tomé and Principe	—	1	—	—	—
St. Kitts	—	2	—	—	—
St. Lucia	—	3	—	—	—
St. Vincent	—	4	—	—	—
Saudi Arabia	—	3	—	Rejects integration	—
Senegal	High	3	Test rejects $b = 1$, but not $b = 0$	Fails to reject integration; data quality C	—
Seychelles	Intermediate	3	—	—	Different from 0, and very high
Sierra Leone	Intermediate	3	Test rejects $b = 1$, but not $b = 0$	Rejects integration	Different from 0
Singapore	High	1	—	Rejects integration	Not different from 0
Somalia	—	3	—	Fails to reject integration; data quality D	—

Country	Classification of the degree of financial integration	Gross-flow ratio measure group	Test results		
			Feldstein-Horioka b coefficient	Euler	Uncovered interest parity differential
South Africa	Low	5	—	Fails to reject integration; data quality D	Not different from 0, though high
Sri Lanka	Low	4	—	Rejects integration	Different from 0
Sudan	—	5	—	Fails to reject integration; data quality D	—
Suriname	—	5	—	—	—
Swaziland	—	3	—	Fails to reject integration; data quality D	—
Syrian Arab Rep.	—	4	—	—	—
Tanzania	—	4	—	Fails to reject integration; data quality D	—
Thailand	Intermediate	4	—	Fails to reject integration; data quality C	Different from 0
Togo	High	2	Test rejects $b = 1$, but not $b = 0$	Fails to reject integration; data quality D	—
Tonga	—	5	—	—	—
Trinidad and Tobago	Intermediate	4	—	—	Different from 0, but not large
Tunisia	Low	4	Intermediate range	Rejects integration	—
Turkey	Intermediate	4	—	Fails to reject integration; data quality C	Not different from 0
Uganda	Intermediate	3	Test rejects $b = 0$, but not $b = 1$	—	—
Uruguay	High	4	Test rejects $b = 1$	—	Not different from 0, and small
Venezuela	Low	4	Test rejects $b = 0$	Rejects integration	Different from 0
Western Samoa	—	4	—	—	—
Zaire	—	4	—	Fails to reject integration; data quality D	—
Zambia	—	2	—	Rejects integration	—
Zimbabwe	—	—	—	Fails to reject integration; data quality D	—

— Not available.
Source: Author's calculations.

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