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DOMESTIC SAVING AND INTERNATIONAL CAPITAL FLOWS RECONSIDERED

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ABSTRACT

A long literature since Feldstein and Horioka's seminal contribution documents the strong correlation of domestic saving and investment rates since the 1960s. According to conventional wisdom, the result provides evidence of international capital market imperfections. The macroeconomic theory of small open economies prescribes a relationship between the composition of aggregate demand and its relative price structure, a linkage hitherto ignored in the saving-investment literature. Theory and evidence also suggest a role for growth and demographic effects, well known in previous studies. If one controls for these effects, the standard correlation of saving and investment disappears. International capital markets may be better integrated than once thought, and the former correlations may have been spurious. The pattern of domestic investment rates is better explained by domestic price distortions and other variables than by domestic saving constraints.

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Domestic Saving and International Capital Flows Reconsidered

I. Introduction

Are international capital markets integrated? The question has profound implications for our view of the way the global economy works and how economic convergence has evolved or might yet proceed. Addressing the question "why doesn't capital flow from rich to poor countries?" Robert Lucas noted that, using a naïve Cobb-Douglas production function of the sort common to macroeconomic growth models, the marginal product of capital in India ought to be roughly 58 times that of the United States. Capital markets would have to be imperfect indeed to prevent capital flows from chasing such large profit differentials (Lucas, 1990). Yet empirical evidence does not fit well with theoretical prediction. Thus emerged two stylized facts of recent postwar experience that demand explanation: the small size of international capital flows and the absence of large real interest rate differentials between rich high-saving countries and poor low-saving countries. This paper focuses on the former, a question about market integration as measured by flows, but keeps in mind its relation to the latter, a question about market integration as measured by price differentials.

The stylized facts ran counter to the conventional wisdom which asserted that capital markets had become well integrated. Martin Feldstein and Charles Horioka (FH) confounded this comfortable view with their finding that domestic investment and saving rates were highly correlated (Feldstein and Horioka, 1980). The result focused on a strong condition for perfect capital mobility: if national saving declined, it should not necessarily "crowd out" domestic investment if the current account were able to take up the slack through capital inflows. FH investigated the coefficient B in the following regression equation:

(1) $$(I/Y)_i = A + B(S/Y)_i + u_i$$

Efforts to substantiate the FH results have pursued a similar approach for a variety of sample countries using techniques to address concerns over the simultaneity issues involved and other specification problems. The result that B is significantly different from zero and, in many cases, close to unity, seems robust, implying the existence of crowding out, albeit not always one for one (Feldstein and Bacchetta, 1991). The Feldstein-Horioka paradox—that domestic saving should appear to crowd out domestic investment in a world thought to be populated by open economies with reasonably efficient international capital markets—demanded an explanation even as it continued to "baffle the profession" (Dornbusch, 1991).

Maurice Obstfeld (1986) marshaled theory and evidence to make a number of points in a careful critique of the FH results and their interpretation. First, inference was ill-advised without a theoretical framework, yet, reasoning with a dynamic open-economy model there were strong *a priori* grounds for expecting saving-investment correlations. Obstfeld chose an overlapping-generations framework to make the point, but similar results could also be produced in a representative agent Ramsey-type model. If the economy suffers a temporary positive productivity shock then investment will respond positively and so will saving (permanent income and consumption rise, but not as much as transitory output). Second, time-series evidence, in contrast to the FH cross-section work, was weak. Third, some omitted variable might really account for the observed saving-investment correlation: for example, the rate of growth, as theory might suggest. Fourth, the coefficient **B** is hard to interpret without benchmarks: how small does **B** have to be for consistency with capital mobility? In a jolting calculation, Obstfeld unearths a telling historical perspective: time-series analysis of the classic gold standard, 1871–1912, for the United Kingdom, yields an estimate of **B** of 0.722, not significantly different from one, in a period of undisputed capital mobility. Problems of identification and interpretation thus bedevil the FH approach, notwithstanding its capacity to sharpen our focus of crowding-out issues, and we should therefore consider other tests of capital mobility using price (interest rate) data to complement the FH quantity approach.[1]

Figure 1 reproduces Frankel's (1992) classification of capital mobility criteria. The strong FH condition implies real interest parity across countries, which then implies uncovered interest parity, which, in turn, implies covered interest parity, the weakest of the four conditions, and probably the only "unalloyed criterion" for capital mobility. Frankel (1991) notes that the failure of the FH condition should come as no surprise given the failure of the real interest parity condition to hold, a consequence of persistent "currency premia" (consisting of exchange risk premia and expected real depreciation) despite the absence of "country premia" (covered interest differentials). The dissolution of capital controls and other barriers to international capital flows in the last twenty years might have been supposed to have heightened global financial integration. Increasing integration should see the coefficient **B** falling over time; still, for many samples this prediction has not been supported by the evidence. Even if some tests do show interest parity across countries, for the FH condition to hold a strong assumption must be made that all determinants of a country's rate of investment other than its real interest rate (and, of course, the error term $\underline{u}_i$) are uncorrelated with its saving rate.

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[1] Stefan Sinn (1992)recently highlighted the sensitivity of the FH result, noting that the **B** coefficient was much diminished by a switch to annual data. Sinn's benchmark test, using Romans' data for the U.S. states in the 1950s, found a coefficient of 0.11, not significantly different from zero. I subsequently discuss the problems in interpreting such coefficients as a measure of crowding out.

Finessing the issue of whether capital market arbitrage dissipates real interest differentials, I argue that the FH criterion, properly implemented, does hold for most of the sample countries heretofore considered. Previous studies (oft stymied by data constraints) have failed to control for an important determinant of the structure of aggregate demand, namely, the relative price structure. All studies use saving and investment measures evaluated as shares of output at domestic nominal prices. In contrast, theory prescribes no theory of nominal consumption (thus, saving) and investment and emphasizes the rôle of relative prices in decisions governing real quantities of consumption and investment. It is well known that the relative prices of investment and consumption, not to say output, vary considerably from country to country. The latest data from the International Comparisons Project may be usefully put to work here (Summers, et al., 1993). I extend the FH framework in other ways. In addition to the previously observed demographic effects, I also consider the implications of transitional dynamics in a standard open-economy growth model, and I allow the interaction of growth and demographic effects prescribed by current household models of saving. I conclude that the crowding out results follow from omitted variables: common factors such as growth, demographic structure and relative prices affecting both saving and investment.

II. Theory and Methodology

As Obstfeld warned, we should consider the general theoretical context for a test of crowding out consistent with the FH approach. How can the crowding-out property be characterized? It says something about the relationship between two components of aggregate demand: I, investment; and $S = Y - C - G - CA$, national saving, equal by identity to income minus private and public consumption minus the current account. Generalizing from (1), we might say that crowding-out prescribes a functional relationship $F(s, i, X)=0$ between the saving and investment shares of GDP, here demoted s and i, respectively, which depends on other variables X. If we knew the exact functional form of F, the coefficient B, easily derivable using the Implicit Function

Theorem, would just be the slope of the curve of $\underline{F}$ in ($\underline{s}$, $\underline{i}$)-space, $\underline{B}=\partial \underline{s}/\partial \underline{i}|_{\underline{X}}$, where the derivative is evaluated along the curve, holding X fixed. Figure 2(a) considers the empirical implications of such a crowding-out definition. The true $\underline{B}$ might indeed be positive and close to one, but if country observations A and B are characterized by differing values of $\underline{X}$, then naïve econometrics would yield a zero (or conceivably negative) $\underline{B}$, prompting us to falsely reject crowding out. Conversely, as in the case of country observations C and D, failure to account for the variable $\underline{X}$ would lead us to spuriously accept a crowding out hypothesis.[2] Various authors have suggested that factors common to saving and investment might account for the FH result, including effects due to growth and tax policy, and such linkages are not ruled out here (Obstfeld, 1986; Summers, 1988; Barro, Mankiw and Sala-i-Martin, 1992).

The econometric implications are clear yet easily overlooked: components of $\underline{s}$ and $\underline{i}$ that are driven by common variables $\underline{X}$ tell us nothing about crowding out; we must distinguish movements along the curve of $\underline{F}$ from shifts in the curve itself; we need to control for $\underline{X}$ or $\underline{B}$ will be biased. The econometric geometry in Figure 2(b) details the problem. When $\underline{s}$ and $\underline{i}$ have components parallel to $\underline{X}$, raw correlations appear big but reveal nothing. $\underline{X}$ must be held fixed, so the appropriate statistic is the partial correlation, the correlation of $\underline{s}^{\perp}$ and $\underline{i}^{\perp}$, the components orthogonal to $\underline{X}$.[3] Standard simultaneous-equations techniques are a diversion: two-stage least squares first projects $\underline{s}$ on instruments $\underline{X}$ to obtain $\hat{\underline{s}}$, but this may only heighten the apparent

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[2] For example, suppose countries C and D are part of a perfect world capital market with governing interest rate $\underline{r}^*$. Suppose country C and country D are alike except that country C has a distorted price structure: high prices for capital goods and low prices for consumption goods. The former would tend, ceteris paribus, to depress investment, and the latter to (boost consumption and) depress saving. As drawn, despite no capital market imperfections, both countries exhibit saving-investment correlation in the corresponding scatter plot, a spurious result.

[3] The pricing problem, shortly to be discussed, indicates why a simple partial correlation approach—say, including the control variables in a regression of investment on saving—may be inappropriate.

correlation without taking us into the space $\underline{X}^{\perp}$ orthogonal to $\underline{X}$ where the derivative along the curve may be estimated.[4]

In what follows, I discuss several appropriate controls necessary to eliminate such bias from a test of the FH criterion. As the scatter plots suggest, the test, properly applied, should detect not the correlation of saving and investment, but the correlation of saving and investment residual components unexplained by exogenous forces. The methodology is complicated, however, by the prescriptions of theory that we may only posit a theory of the real components of aggregate demand, whereas crowding out is intrinsically a question of interactions among nominal variables. Accordingly, I first estimate real aggregate demand equations for public and private consumption and investment, drawing on theoretical motivations for including certain determinants: relative prices, demographic variables and growth. Then, having controlled for these variables, I effect a switch to nominal prices in the orthogonal components to examine crowding out. I begin with theoretical foundations for the controls.

2.1. Relative Prices

Almost any reasonable model of aggregate demand will generate consumption and investment demands that vary inversely with the prices of each component. Consider, for example, a textbook variant of the basic neoclassical representative-agent growth model for a small open economy (Blanchard and Fischer, 1989, 58–69, 76–77). The decentralized and command optima are equivalent, so we may focus on the latter. The problem, allowing for possible variations in the relative price structure, is

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[4] Fundamentally, the (somewhat obvious) point to be made is that instrumental variable techniques invoked to address simultaneity issues do not confront the omitted variable problem. In this study the variables $\underline{X}$ include the macroeconomic price structure, the demographic structure and growth performance, as discussed below. Hence, the space orthogonal to $\underline{X}$ consists of shocks to saving and investment arising from other sources—say technology, preferences or other exogenous disturbances. The question posed in this paper is whether saving and investment exhibit any correlation with respect to this restricted set of perturbations under the small-open-economy null.

(2) max $$U_0 = \int_0^\infty u(c_t)\exp(-\theta t)\,dt$$

subject to $$\frac{db_t}{dt} = p_c c_t + p_i i_t\left[1 + T\left(\frac{i_t}{k_t}\right)\right] + \theta b_t - f(k_t); \quad \frac{dk_t}{dt} = i_t,$$

given $$T(0) = 0; \quad T' > 0; \quad 2T' + \frac{1}{kT''} > 0;$$

where U_0 is the utility function, c_t is consumption, i_t is investment, b_t is debt, θ is the world interest rate ($r^* = \theta$) and the rate of time discounting, and T is the installation cost function with the usual convexity properties.[5] Here p_c and p_i represent the price of (tradable) consumption and investment goods in the economy (relative to the numéraire, output). In other respects, this is the basic model.[6] Standard solution procedures for the dynamic programming problem yield the familiar results, and the details need not be repeated here. We simply reproduce the textbook solutions, adjusting for our explicit treatment of relative prices.

The standard investment problem has a solution where investment is a function ϕ of q, the shadow price of capital, equal to the discounted sum of future marginal products of investment adjusted for the relative price of investment goods:

(3) $$i_t = k_t\,\phi(q_t); \quad \phi' > 0; \quad \phi(1) = 0; \qquad q_t = \frac{\int_0^\infty \left\{ f'(k_v) + p_i\,\phi(q_v)^2 T'[\phi(q_v)] \right\} \exp(-\theta t)\,dt}{p_i}.$$

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[5]As always, the interest rate and discount rate must equalize to rule out explosive paths for the country's debt.

[6]It would be a straightforward generalization to allow the prices to follow a time-varying path. The assumption about the tradability of goods is not innocent, and a model which incorporates non-tradables can yield complex and non-intuitive paths for consumption, investment and the current account (Gavin, 1990). The waters are likewise muddied in a many-goods environment (Taylor, 1991). We maintain presently the simple form of the text for tractability, because our empirical studies will use aggregate data that do not distinguish many goods or tradables, and because even at this level of generality the introduction of a specific model adds a context for understanding the FH condition and its verification.

A rise in the relative price of investment goods lowers the profitability of a given investment measured in terms of output, lowering $\underline{q}$. Thus investment will be negatively correlated with a shock to the price level of investment.

Consumption smoothing yields a value of consumption at all times equal to permanent consumption, itself a function of net wealth at time zero:

$$(4) \qquad \int_0^\infty \underline{p}_c \underline{c}_t \exp(-\underline{\theta t})\, \underline{dt} = \int_0^\infty \left\{ \underline{f}(\underline{k}_t) - \underline{p}_i \underline{i}_t \left[1 + \underline{T}\left(\frac{\underline{i}_t}{\underline{k}_t} \right) \right] \right\} \exp(-\underline{\theta t})\, \underline{dt} - \underline{b}_0 = \underline{v}_0; \qquad \underline{c}_t = \underline{c}_0 = \frac{\underline{v}_0}{\underline{p}_c}.$$

To convert wealth (discounted future output) into consumption goods, exchange occurs according to the relative price of consumption goods. Thus consumption will be negatively correlated with a shock to the price level of consumption.[7] The above makes no statement regarding the influence of government and the choice of public consumption ($\underline{g}$). It may be reasonable, in a representative agent model, to treat consumption of public and private goods as one, in which case the price effects may be similar for government spending. Heuristically speaking, if the price ($\underline{p}_g$) of government goods and services is high, agents (public or private) may seek private sector alternatives, depressing public consumption.

One last remark is in order: the proposition that relative prices relate to aggregate demand structure should be relatively insensitive to the precise theoretical specification. It would have been simple to cast the downward-sloping demand schedules for consumption and investment as a consequence of other static or dynamic models, not just the growth model approach taken here.[8]

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[7] Of crucial importance is the fact that investment and consumption decisions are separable, given perfect capital mobility at the world interest rate $\underline{\theta}$, and from this follows the equivalence of command and decentralized equilibria. In this framework, consumption (hence, saving) decisions are independent of investment decisions, and shocks to the path of one do not directly affect the other. Of course, we have seen that dynamic responses of such a system may, in fact, give appearances to the contrary.

[8] Strictly speaking, the infinite horizon model relates aggregate demand structure not just to current prices $\underline{p}_t$, but rather to the entire path of future prices $\{\underline{p}_t\}_0^\infty$.

2.2. Growth Rates and Transitional Dynamics

The neoclassical model eventually converges to a steady state, with consumption levels constant, investment levels declining to zero (as marginal product diminishes) and output rising to a steady-state level at an ever diminishing growth rate (associated with diminishing levels of investment and capital deepening). Figure 3 traces a typical open economy with just such transitional dynamics. The economy begins by borrowing from the rest of the world to finance investment activity in excess of domestic saving, a necessary corollary of permanent consumption levels being relatively high at that point in time. Along the transition, output rises until saving (income minus permanent consumption) exceeds investment. The country then lends capital outflows which, discounted over time, exactly offset the earlier borrowed inflows.

A methodological issue arises: where is an economy on the transition and how does this affect the saving-investment correlation? If we sampled several countries, but they all happened to be close to point B on the transition (just moving from an immature developing borrower to a mature developed lender) then, necessarily, saving and investment rates in the sample would appear closely correlated. However, this would merely be an artifact of the countries' positions on the transition path. Clearly, transitional dynamics must be controlled for in some way.[9] The growth rate provides a suitable control variable: high during early development when investment typically exceeds saving (point A), and low later on when the converse holds (point C).

2.3. Demographic Forces

The representative agent model leaves much unsaid about the impact of population heterogeneity on the composition of aggregate demand. Theory and evidence point to important linkages here, both in terms of dependency rate theories of saving and theories of population-sensitive capital formation. The literature on saving dates back to the seminal contribution of Leff, who found that

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[9]And the need for such control is not obviated even in a "new growth model" where countries' transitional dynamics may lead to different steady states.

saving rates were highly sensitive to age structure via the dependency rate, the share of dependents in the population, both young and old (Leff, 1969). The qualitative point is clear enough—dependents are mostly unproductive, consuming more than they produce, and dependent on the provision of goods by productive members of the country's workforce from the complementary segment of the population.[10]

The fierce debate stimulated by Leff's findings found the effect to be highly sensitive to sample and specification, and lacking in theoretical motivation, as a survey by Jeffrey Hammer makes clear (Hammer, 1986). However, the population-saving linkage has enjoyed a renaissance with the work of Andrew Mason and Maxwell Fry on the micro-foundations of household saving behavior (Mason, 1981; Fry and Mason, 1982; Fry, 1984; Mason, 1987; Mason, 1988). They also introduced the growth-dependency interaction, the logic of which is simple enough: in steady-state, all cohorts enjoy the same permanent income and, hence, permanent consumption; but in fast-growth conditions, young cohorts have higher permanent incomes and consumption than their elders. The relevant control variable interacts the dependency rate with the growth rate of output. Empirically, more robust findings are being produced, both in the original study by Mason and in the recent work of Higgins that allows for a more sophisticated treatment of age structure effects following Fair and Dominguez (Fair and Dominguez, 1991; Higgins, 1992).

2.4 Specification

Accordingly, the specification of our consumption function warrants augmentation to incorporate demographic and growth effects (both direct growth effects as above, and growth-demographic interaction terms, as here). Subject to the overarching concern about the substitutability of public and private consumption, the modifications apply to the determinants of both $\underline{c}$ and $\underline{g}$. Thus, let

[10] The result also follows from the life-cycle theory of consumption of Modigliani and others, where high income and saving in mid-life offset dis-saving when young and old (Modigliani and Brumberg, 1954; Modigliani and Ando, 1957; Ando and Modigliani, 1963; Modigliani, 1966; Modigliani and Sterling, 1983).

(5) $\underline{c} = \underline{c}(\gamma, \underline{d}, \gamma\underline{d}, \underline{p}_c)$, $\quad \underline{g} = \underline{g}(\gamma, \underline{d}, \gamma\underline{d}, \underline{p}_g)$,

where γ is the growth rate of the economy, and $\underline{d}$ represents an age-structure vector.

A similar form might easily be introduced into the investment function. Many categories of investment are population sensitive, for example, spending on housing, infrastructure and public health. Likewise, the size of the working population may reasonably be supposed to affect the derived demand for capital through its impact on the scarcity of labor. Moreover, growth effects should be admitted as a control for transitional dynamics. Accordingly, I adopt the following specification,

(6) $\underline{i} = i(\gamma, \underline{d}, \gamma\underline{d}, \underline{p}_i)$.

Exogeneity of the proposed independent variables is a vexing and delicate issue, and the choice of specification is not innocent, albeit no worse in many respects than previous choices in the literature. Even if pre-determined, the proposed independent variables may be simultaneous. Non-tradable prices are clearly endogenous to each country in a way only multi-sector trade models could describe, requiring data beyond our ken. Demographic structure is widely acknowledged to be a function of economic development, an empirical regularity with theoretical justification. Economic growth is surely a function of investment, as well as vice versa. Such are the shortcomings of this framework, and although this approach claims methodological advances and a broader data set to support its conclusions, it has certainly not examined these issues in their fullest depth, and further research should examine the extent and importance of the endogeneity and simultaneity issues alluded to above.

III. Evidence

Data

I began empirical investigation with the construction of a five-period panel data set covering 103 countries sampled using five-year averages over the period 1965–1989. Demographic variables were taken from the World Bank's Social Indicators of Development (SID), and information on the composition and prices of aggregate demand was gleaned from Robert Summers et al.'s latest incarnation of the Penn World Table (PWT), Version 5.5 (The World Bank, 1991; Summers, et al., 1993).[11] Period averages have some natural appeal: (a) they abstract from short-term business-cycle fluctuations that cannot be appropriately modeled and which are of little relevance for long-term capital movement; and (b) they overcome intrinsic averaging in the underlying data, most of which, particularly the demographic data, relies on benchmark or census observations punctuated by interpolation—since the real data do not have annual frequency, it seems unwise to proceed with estimation as if they do.[12] The sample includes the entire OECD and EC groups, and covers 22 high-income countries, 41 middle-income countries, and 27 low-income countries according to the World Bank's latest classification (The World Bank, 1993). As is well known, the quality of the data is correlated with the level of development, and the results derived for samples including low- and middle-income countries must be interpreted with this in mind.

It suffices to say that the sample data contains no surprises—poorer countries have higher dependency rates, and relatively low saving and investment rates (Figure 4). They also have relatively distorted price structures, with capital goods expensive and consumption goods cheap,

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[11] SID includes 176 countries and PWT 150 countries, yet the two only overlap in the period 1965–89 to provide complete coverage of the requisite variables for 103 countries.

[12] For these and other reasons, the multi-year averaging approach is common in the saving-investment literature and elsewhere (Feldstein and Bacchetta, 1991; Brander and Dowrick, 1993).

a relationship that has been the subject of much attention in the trade and growth literature. Presently, the data provides a means to assess the FH criterion anew. The study departs from the previous literature by using an expanded panel data-set to: (a) control for price structures, demographic effects and growth as suggested by theory; (b) increase our range of country observations; and (c) track the evolution of international capital markets over time.

Determinants of Aggregate Demand

The data are used to implement estimations of the determinants of real aggregate demand shares, according to the functional forms of equations (5) and (6). Appropriately, the shares of private consumption (CC), investment (CI) and public consumption (CG) evaluated at current international prices are the dependent variables in the regressions shown in Table 1. Explanatory variables include the growth rate of the economy (G), the age-structure measured by a three-component vector (D1, D2, D3—the population shares aged 0–14, 15–64 and 65+ respectively) and its interaction with G, and the log of the relative price of each aggregate demand component.[13] The model is estimated for various sample choices: Feldstein and Bacchetta's EC nine; the EC12; the OECD; the World Bank's high-, low- and middle-income groups; the regions of Africa, Asia, and South & Central America; and the full sample.

Standard panel estimation procedures were followed, allowing for random effects, fixed effects or no effects (OLS) by individual (country). In every case, specification tests overwhelmingly favored random effects, but similar results were obtained with fixed effects. The panel data approach follows Brander and Dowrick (1993), who also seem to favor a random effects model in a similar panel study. In every case, F-tests found the demographic variables to be highly significant, a pleasant confirmation of the extensive analysis of Higgins (1992). In almost every case (except consumption in middle- and low-income samples and in Africa and

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[13] Since D1 + D2 + D3 = 1, a collinearity of (D1, D2, D3) with the intercept term and of (G D1, G D2, G D3) with G is avoided by constraining the coefficient of these sets of variables to sum to zero.

Asia), relative price effects were negative and highly significant, offering strong support for the theoretical arguments motivating their inclusion. Relative price effects on investment and growth have been examined elsewhere, in early empirical work by Agarwala for The World Bank, and recently in the resurgent literature on investment, price distortions and economic growth provoked by the novel findings of Barro, De Long and Summers (Agarwala, 1983; The World Bank, 1983; Barro, 1991; De Long and Summers, 1991; De Long, 1992; Jones, 1992; Taylor, 1992; Brander and Dowrick, 1993).

Some discussion of the estimated coefficients is in order. The empirical findings mesh with the predictions of the theory for the most part, but in the case of samples including large numbers of countries with recognized poor data quality in PWT (such as those on the right of Table 1) we cannot know if strange results follow from poor numbers or a poor model. Nonetheless, although imperfect, the regression structures do present some insights.

For private consumption, demographic effects appear strongest in the developing countries and the magnitude of the coefficient looks reasonable in the last six columns. For example, in the MIDINC sample, were an increase of one percentage point in the number of children associated with proportionate decreases in the other age groups, then steady-state consumption would rise by about 1.2 percentage points (twice 0.63).[14] The original estimates of Leff (1969) and recent rule-of-thumb guidelines from the IMF (1990) are of this order of magnitude. The positive impact of the D2 variable seems odd, until the large negative impact of D3 is recognized (the D variable coefficients sum to zero). The finding that the elderly have a high propensity to save—not dis-save as in the life-cycle and dependency rate models—confirms earlier findings, and suggests that bequest motives may be at work among a segment of the population with often large asset accumulation (Kotlikoff and Summers, 1981). Growth interaction terms support the Mason-Fry effect to some degree, most strongly for the developed

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[14]Out of steady-state the growth interaction coefficients do little to change the story for these groups. Note that for the first four columns the G D1 coefficent being large and positive tends to counteract that D1 coefficient.

countries, where more developed intergenerational capital markets may allow rich young cohorts to borrow better against their relatively high lifetime earnings potential.

For investment, price effects are quite uniform, suggesting a semi-elasticity of about –0.1: a 10% increase in the relative price of investment goods lowers the investment rate by one percentage point. Demographic determinants point to a powerful labor-supply effect: an increase of one percentage point in the share of the population of "working age" 15–64, with proportionate decreases in D1 and D3, raises the investment rate by between one half and one percentage point (twice the coefficient of D2).[15] The coefficient of D1 appears positive for more developed countries, and negative otherwise, which would be consistent with the view that population-sensitive categories of investment such as housing, public health and infrastructure are less significant outside the developed countries.

For public consumption, the model provides less powerful explanations (R-squared statistics are lower), but elements of the same forces that drive private consumption are manifested here: a strong growth-dependency interaction in the developed countries, and strong direct dependency-effects in some of the developing countries. Relative price effects are uniformly strong with a semi-elasticity of around –0.05.

With the above econometric models in hand, we now turn to the main question posed in this paper: does consumption crowd out investment as the Feldstein-Horioka tests have formerly suggested, or do common external factors better explain the raw correlation of investment rates and saving rates?

[15] The labor-supply effect was noted by Brander and Dowrick (1993), with strong implications for long-run growth. Higgins (1992) also found a similar effect. The price effect was also noted by Brander and Dowrick (and others). It will be concluded later that such a price effect might explain a good deal of the cross-sectional saving-investment correlations in the current literature. For the present, then, we should note that the price effect estimated in this paper is not unusually large—only as large and significant as that found in many other studies of investment determinants.

Is Investment Saving-Constrained?

At issue is the exogeneity issue described in Figure 2. We know that saving and investment correlations have been found to be present in many samples, even controlling for certain simultaneity and exogeneity problems. We now ask whether the story holds true for a wider set of samples and in the presence of controls. We want to know the coefficient $\underline{B}=\partial \underline{s}/\partial \underline{i}|_{\underline{X}}$, a measure of how much saving crowds out investment once we control for determinants $\underline{X}$ common to both saving and investment. That is, we should ask whether the unexplained residual components of the aggregate-demand regressions in Table 1 reveal any tendency for consumption to crowd out investment.

As anticipated, a pricing problem arises. The Penn World Table is a system of real national accounts (SRNA), but the saving-investment correlation is a property of nominal variables valued at domestic prices—does $10 of saving augment investment by $10?—and hence should be based on data from a conventional system of national accounts (SNA). Summers and Heston (1991) are the first to point to the dangers of using PWT data inappropriately for questions such as these. Nonetheless, it is easy enough to extract SNA data from the SRNA data in PWT—one must simply adjust country aggregate demand components for relative price levels to convert from international prices to domestic prices.[16] Accordingly, I report the correlation coefficient $\underline{\beta}'$ (properly interpreted as minus $\underline{B}$, the standard FH coefficient) for duly price-adjusted consumption and investment shares, according to the following regression run on the domestic-valued residuals:

(7) $\quad$ $(\text{CI domestic-valued residual})_{\underline{i}} = \underline{\alpha} + \underline{\beta}\ (\text{CC} + \text{CG domestic-valued residuals})_{\underline{i}} + \underline{u}_{\underline{i}}$,

that is,

$$(\text{CI residual} \cdot \text{PI})_{\underline{i}} = \underline{\alpha} + \underline{\beta}\ (\text{CC residual} \cdot \text{PC} + \text{CG residual} \cdot \text{PG})_{\underline{i}} + \underline{u}_{\underline{i}}.$$

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[16]For advice on price corrections using PWT 5.5, where price definitions differ from previous versions, I am grateful to Robert Summers (personal communication). For econometric advice I am grateful to Mark Watson.

The striking results, which appear to overturn the conventional story about the FH test, appear in Table 2. In almost all cases the coefficient is much smaller than previous estimates, being far from close to unity: the case that crowding out might be less than one for one can surely be made. Furthermore, the time path of the coefficient, although fluctuating, follows a distinct downward trend over much of the sample period, at least for the more-developed (better-data) samples on the left side of the table (columns 1–5). Indeed, by period's end the coefficient is not significantly different from zero for the developed countries. Capital markets may be said to have become more integrated over time, arguably reaching a point now where saving-investment correlations have all but disappeared, with close-to-zero crowding out for high-income economies, the OECD and the EC. For low- and middle-income economies, the saving-investment correlations are still significant (though less than one for one) and, until the late eighties, had shown a dramatic decline—subject to concerns regarding the quality of our underlying data for these samples.

I conclude that conventional determinants of consumption and investment (evident in Figure 4) play an important rôle in determining the allocation of resources for consumption and investment uses, and that the co-movement of investment and consumption which arises plays an important part in the widely observed saving-investment correlations, rather than pure crowding out. Poorer countries tend to have high child dependency rates and low relative prices of consumption compared to rich countries, effects which account for higher consumption rates, hence lower saving rates. Poorer countries also tend to have lower labor supply from the population share of working age and high relative prices of investment compared to rich countries, effects which account for their low investment rates. In tandem, these influences explain no small part of the observed raw saving-investment correlations.

IV. Context and Implications of the Results

Sources of Price Distortions

This study made extensive use of relative price effects to account for aggregate demand patterns. The existence of price dispersion across countries has been well known for some time, and dates back to early work on purchasing power parity by Balassa, Kravis and others.[17] That price distortions may account for differing levels of investment (and, hence, economic growth) has also been discussed elsewhere (Agarwala, 1983; The World Bank, 1983; Barro, 1991; De Long and Summers, 1991; De Long, 1992; Jones, 1992; Taylor, 1992; Brander and Dowrick, 1993).

An actual country experience proves instructive. Until recently, Argentina had one of the most distorted price structures in the world, a legacy of reactive policy choices in the Great Depression, codified under Péron to produce bread-and-circuses (cheap consumption goods) for the working masses (his base of popular support), and to encourage import substitution using multiple exchange rates and exchange rationing for low-priority capital-goods imports (expensive investment goods, particularly equipment and machinery). The available data presented by Díaz-Alejandro (1970) documents the spectacular price twists that ensued—for example, machines costing two or three times as much as in the United States. Although an extreme case, the Argentine example illustrates some not atypical developing-country policy choices. The problem amounted not only to a perpetual static distortion of prices, encouraging rent-seeking and misallocation, but also to a dynamic distortion.

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[17] The Penn World Table had its genesis in the work of Kravis and others on national price levels. Balassa marshalled theory and evidence to expalin how price levels systematically vary across rich and poor countries in terms of relative productivity in non-tradables (Balassa, 1964; Kravis and Lipsey, 1982).

Why Capital Doesn't Flow from Rich to Poor Countries

The results thus offer an alternate explanation of the puzzling stylized fact that so little capital flows from rich to poor countries. Lucas, having established the absurd differences in marginal productivity implied by a crude Cobb-Douglas production function, went on to discuss other explanations including the possibility of international capital market failures and the omission of other factors that enhance productivity levels in developed countries, notably human capital (Lucas, 1990). Gregory Clark interpreted differing productivity levels across countries to be a manifestation of fundamentally different inherent labor productivity (Clark, 1987). Deepak Lal explored the possibility of differences in the efficiency of capital across countries, and found that, for a small sample of countries, there may be very little dispersion in the marginal product of capital. Lal suggested that there may be no conundrum at all once the profitability of investments in different countries is taken into account. In that case, we have no reason to expect large capital flows—there are no rate of return differentials to be arbitraged away (Lal, 1991).

In this sense, the present study is most closely linked to the ongoing work of Matthew Higgins (1993). Like Lal, he is concerned with correctly measuring the profitability of investments, and he takes seriously the importance of the relative price of investment. The holding return on capital in any country is inversely correlated with the relative price of investment (analogous to our expression for $\underline{q}$ earlier). The Higgins formula for the price-adjusted marginal product of capital is:

$$MPK_t = \frac{\underline{p}_{t+1}}{\underline{p}_{I,t}} f'(\underline{k}_{t+1})$$

Taking measurements, after Lucas, of the marginal product of capital corrected for relative prices he derives the holding returns, the dispersions of which are remarkably small; indeed, they appear lower for some developing countries than for the United States. For example, Kenya's MPK at international prices is apparently about 36%, but at domestic prices falls to about 17%, well below the U.S. value of 24%.

The Argentine example makes the idea concrete: with a relative price of capital more than twice the United States level, holding returns on Argentine capital would be less than half the

United States level at the same level of productivity. What Higgins and Lal assert for rate-of-return criteria, the present study asserts for flow criteria, addressing the other angle of the capital mobility debate in Figure 1, the FH condition: controlling for relative price effects, saving and investment show comparatively little cross-country correlation.

Implications for Growth and Convergence

Price distortions lower economic growth, or so theory and evidence seem to suggest. The linkage is quite straightforward: a higher price of investment goods is just like a tax on investment.[18] Investment is a powerful determinant of economic growth (Dowrick and Nguyen, 1989; Barro, 1991). When productivity depends on capital intensity, such disincentives to capital formation will lower growth rates. The linkage appears particularly strong for equipment and machinery, the more tradable categories of capital goods (De Long and Summers, 1991; De Long, 1992).

The Argentine experience is again a canonical example: the pricing of investment goods was associated with very low levels of real investment measured at international prices (although very high measured at domestic prices, of course), which depressed capital deepening and, hence, retarded economic growth—perhaps accounting for the greater part of Argentina's retardation relative to the OECD (Taylor, 1992). Similar stories about policy-induced price distortions may be told about India (De Long and Summers, 1991; Jones, 1992) and, likely, many other developing countries.[19] In fact, investment prices coupled with demographically induced labor-supply effects, as here, offer an attractive model of capital formation and economic growth (Brander and Dowrick, 1993).

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[18] The linkage was established in independent work by Jones and Taylor. The former focused on a single-period study 1960–85 for a cross-section of countries, with special reference to tax policy in India. The latter involved a panel data study 1960–85 with special reference to Argentine economic retardation (Jones, 1992; Taylor, 1992).

[19] Both Argentina and India ranked middling to high on The World Bank's crude measure of price distortions in the 1970's (The World Bank, 1983, 62).

Capital Market Integration

What do the results say about the general trend in world capital-market integration in recent postwar experience? Figure 5 offers a graphical interpretation of the path of the FH coefficient for some of our subsamples. Overall, the high-income economies seem to have a greater degree of capital market integration (less crowding out), as one might have expected. For the OECD, HIINC and MIDINC samples, a peak in 1970–75 is evident, suggestive of disintegration tendencies in the wake of the collapse of the Bretton Woods system and the ensuing confusion in international financial markets. National policy responses to the first oil shock may also have played a part in generating an autarkic tendency in capital markets. Both events could be associated with a structural shift in the system due to, say, perceived increases in the risks associated with international lending.

All the same, a general decline in the coefficient is evident through the early 1980s, heralding the return of integrative forces, forces powerful enough to reduce the coefficient to insignificant levels for the EC12, the OECD and the HIINC samples by the end of the decade. Poorer countries, although sharing the same trend, experienced an abrupt reversal in the latter half of the 1980s, a disintegration experience again almost certainly associated with unrest in international financial markets—in this case, the onset of the debt crisis. Although rising interest rates and exploding debt burdens were evident in the early 1980s, a series of defaults and renegotiations alleviated the need for heavily indebted developing countries to take immediate steps to redress their external (and internal) imbalance problems. A plethora of rescheduling in 1984–85 (The World Bank, 1985) was followed by the harsh impositions of World Bank and IMF conditionality in the late-1980s. The political viability of the reforms depended on the emergence of liberal-minded governments. In this way, the immediate sanctions on the debtor countries did not really bite until several years after the deluge, and in the short run, indeed, external imbalance (that is, the disparity between domestic saving and investment) often widened as help from anxious banks and aid agencies made bridging loans and grace periods available, generating continued capital inflows. Only time will tell if the end-of-period peaks in the middle-income and (especially) the low-income coefficients are merely transitory blips on a continuing integration trend, or a more permanent disintegrative shock to world capital markets.

This paper has extended the saving-investment literature by investigating the determinants of the aggregate demand structure in a post-WWII panel data set covering over one hundred low-, middle- and high-income countries. The empirical findings mesh with theory, and show powerful price, demographic and growth effects in the demand functions for private and public consumption and investment. Such effects, in their magnitude and direction, are consistent with, and give confirmation to, earlier studies of investment and saving alone. Here the aggregate demand determinants are used to explore the possibility that common variables might explain the puzzling cross-section saving-investment phenomenon known as the Feldstein-Horioka paradox, a result somewhat at odds with evidence more favorable to capital-market integration seen in time-series saving-investment studies and in studies of price (interest rate) criteria.

The main contribution of the paper is to show that the Feldstein-Horoika correlation, so often replicated, might be an artifact of omitted variable bias, since a common set of variables does influence national saving and investment rates, and sufficiently so to explain much of the correlation. In this framework, international capital markets do exhibit a recent tendency toward increased integration over time. The high-income economies may already have achieved a degree of integration where crowding out is negligible, a strong criterion for capital mobility (Figures 1, 5). The result contradicts saving-investment correlations in the raw data because account has been taken of powerful exogenous determinants common to consumption and investment—relative prices, growth and demographic structure—that vary systematically across countries. For Obstfeld (1986, 94–95), the puzzle was how to square the Feldstein-Horioka paradox with interest rate criteria that supported the capital mobility view, and to reconcile conflicting evidence on the saving-investment correlations from time-series and cross-section studies. Perhaps, given the present results, we should not be baffled by these earlier findings: cross-section saving-investment correlations might just be a figment of a lack of control for common determinants of both saving and investment.

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TABLE 1
DETERMINANTS OF AGGREGATE DEMAND

Sample	FBEC9	EC12	OECD	HIINC	MIDINC	LOINC	AFRI	ASIA	SCAM	ALL
NOBS	45	60	110	110	205	135	170	85	115	515
Dep. vble.: CC	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A
G	9.37	9.16	6.77	9.34	6.22	1.30	-3.58	13.12	9.11	6.05
	(3.10)	(5.14)	(5.08)	(8.39)	(2.85)	(0.17)	(0.74)	(3.85)	(3.25)	(4.60)
D1	-0.07	0.03	0.18	-0.12	0.63	0.74	0.84	0.90	0.69	0.51
	(0.38)	(0.18)	(2.00)	(1.28)	(6.81)	(3.10)	(4.26)	(6.77)	(6.63)	(10.31)
D2	1.20	1.19	1.12	1.16	0.88	0.80	0.71	0.66	0.91	1.00
	(29.68)	(32.77)	(45.75)	(44.63)	(13.06)	(3.99)	(4.25)	(6.43)	(12.70)	(29.45)
D3	-1.13	-1.22	-1.30	-1.04	-1.51	-1.54	-1.55	-1.56	-1.60	-1.50
	(7.05)	(9.19)	(18.06)	(13.39)	(36.54)	(27.83)	(31.61)	(30.78)	(34.41)	(58.16)
G D1	8.23	5.33	2.63	8.64	-2.96	0.99	-0.85	-9.17	-3.72	-1.53
	(1.69)	(1.69)	(1.42)	(6.07)	(1.62)	(0.13)	(0.18)	(2.53)	(1.72)	(1.55)
G D2	-20.21	-19.29	-14.30	-20.10	-10.44	-3.36	7.75	-18.74	-15.88	-11.07
	(3.55)	(5.20)	(5.74)	(10.38)	(3.12)	(0.32)	(1.16)	(4.23)	(3.48)	(5.16)
G D3	11.98	13.96	11.67	11.45	13.39	2.37	-6.90	27.91	19.59	12.60
	(1.58)	(4.48)	(3.98)	(4.71)	(2.85)	(0.14)	(0.66)	(3.75)	(3.25)	(4.50)
ln PC	-0.49	-0.55	-0.39	-0.44	0.01	0.15	0.18	-0.04	-0.14	0.11
	(2.53)	(4.06)	(5.00)	(5.20)	(0.23)	(4.44)	(5.00)	(0.44)	(1.73)	(4.50)
RSQUARED	.99	.99	.99	.98	.93	.93	.92	.97	.96	.93
Dep. vble.: CI	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B
G	6.92	4.54	4.86	1.53	0.42	-1.48	3.83	-3.98	0.92	2.77
	(2.16)	(2.47)	(3.76)	(1.28)	(0.24)	(0.31)	(1.18)	(1.37)	(0.41)	(2.99)
D1	0.62	0.57	0.40	0.35	-0.02	-0.05	-0.06	-0.21	0.11	-0.08
	(2.75)	(3.47)	(4.11)	(3.01)	(0.30)	(0.40)	(0.46)	(1.79)	(1.53)	(2.40)
D2	0.30	0.32	0.38	0.35	0.42	0.35	0.40	0.55	0.29	0.45
	(5.97)	(8.49)	(12.16)	(9.08)	(9.14)	(3.26)	(3.62)	(6.14)	(6.48)	(20.72)
D3	-0.92	-0.89	-0.78	-0.71	-0.40	-0.30	-0.34	-0.33	-0.40	-0.37
	(4.91)	(6.72)	(10.59)	(7.97)	(13.20)	(9.77)	(9.92)	(7.47)	(12.90)	(20.19)
G D1	-6.95	-5.96	-6.67	-6.13	1.25	2.18	0.05	3.51	0.62	-1.43
	(1.21)	(1.65)	(3.52)	(3.83)	(0.81)	(0.47)	(0.02)	(1.12)	(0.34)	(1.96)
G D2	-10.78	-6.48	-6.51	0.22	-0.89	1.50	-7.19	5.89	-1.42	-3.70
	(1.80)	(1.69)	(2.65)	(0.10)	(0.33)	(0.23)	(1.60)	(1.56)	(0.39)	(2.46)
G D3	17.73	12.44	13.18	5.91	-0.36	-3.67	7.14	-9.41	0.80	5.13
	(2.21)	(3.65)	(4.65)	(2.27)	(0.09)	(0.36)	(1.01)	(1.48)	(0.16)	(2.59)
ln PI	-0.17	-0.15	-0.09	-0.15	-0.15	-0.08	-0.09	-0.13	-0.15	-0.11
	(2.51)	(3.74)	(2.73)	(3.24)	(7.98)	(7.98)	(6.94)	(5.10)	(8.28)	(14.10)
RSQUARED	.98	.98	.95	.93	.82	.71	.62	.89	.91	.83
Dep. vble.: CG	1C	2C	3C	4C	5C	6C	7C	8C	9C	10C
G	3.24	2.05	2.36	2.51	0.03	4.47	5.34	-0.38	0.42	1.24
	(1.92)	(1.94)	(3.04)	(2.97)	(0.03)	(0.77)	(1.66)	(0.17)	(0.30)	(1.51)
D1	-0.05	-0.11	-0.19	-0.10	0.15	0.32	0.23	0.08	0.11	0.13
	(0.45)	(1.18)	(3.00)	(1.25)	(3.00)	(1.86)	(1.81)	(0.84)	(2.11)	(3.82)
D2	0.34	0.32	0.33	0.32	0.21	0.16	0.24	0.25	0.21	0.26
	(10.49)	(12.41)	(14.17)	(9.76)	(5.58)	(1.10)	(2.23)	(3.66)	(5.72)	(11.75)
D3	-0.29	-0.22	-0.14	-0.22	-0.36	-0.47	-0.47	-0.33	-0.32	-0.39
	(3.07)	(3.06)	(2.97)	(3.81)	(14.77)	(11.25)	(14.55)	(8.08)	(12.07)	(21.62)
G D1	1.63	0.79	1.87	1.14	-0.32	-4.95	-5.11	2.04	-0.97	-0.36
	(0.57)	(0.45)	(1.80)	(1.19)	(0.32)	(0.90)	(1.62)	(0.85)	(0.90)	(0.59)
G D2	-7.65	-4.87	-5.35	-5.60	-0.27	-5.28	-7.02	-0.85	-0.73	-2.64
	(2.41)	(2.24)	(3.69)	(3.72)	(0.15)	(0.68)	(1.58)	(0.28)	(0.31)	(1.96)
G D3	6.03	4.07	3.47	4.47	0.59	10.23	12.13	-1.19	1.70	3.00
	(1.43)	(2.17)	(2.02)	(2.40)	(0.23)	(0.82)	(1.75)	(0.23)	(0.56)	(1.71)
ln PG	-0.07	-0.07	-0.07	-0.07	-0.07	-0.04	-0.04	-0.06	-0.06	-0.05
	(2.34)	(3.55)	(3.78)	(2.78)	(4.53)	(2.09)	(2.21)	(2.87)	(3.95)	(5.52)
RSQUARED	.92	.90	.88	.73	.69	.76	.78	.74	.75	.70

TABLE 1 (CONTINUED)
DETERMINANTS OF AGGREGATE DEMAND

Notes: See text and data appendix. Absolute t-statistics appear in parentheses.
Specification: All regressions are random-effects models with panel data 1965–1989, five year averages, five periods per country. The following sets of coefficients are constrained to sum to zero: {D1, D2, D3} and {G D1, G D2, G D3}.
Tests of restrictions: For each regression, an F-test was applied to test for the presence of demographic effects, the null being that the coefficients of {D1, D2, D3, G D1, G D2, G D3} were equal to zero. Results: null always rejected, significance level P=0.00.
Model selection: The following tests were made of alternate specifications. (a) Fixed effects versus random effects null, Hausman test, null always accepted, significance level P=1.00. (b) Fixed effects versus OLS null, Chow test, null always rejected, significance level P=0.00. (c) Random effects versus OLS null, Breusch-Pagan test, null always rejected, significance level P=1.00. For a discussion of these tests see Greene (1993, ch. 16).
Samples: FBEC9 (Feldstein and Bacchetta's EC nine: omits Spain, Portugal and Luxembourg (Feldstein and Bacchetta, 1991)), EC12 (the whole EC), OECD, HIINC (high income countries), MIDINC (middle income countries), LOINC (low income countries), AFRI (Africa), ASIA, SCAM (South and Central America), ALL (the full sample).
Variables: The variables used are as follows (* denotes a PWT variable, ** an SID variable). CC=CC*/100, share of private consumption in GDP (current international prices); CI=CI*/100, share of investment in GDP (current international prices); CG=CC*/100, share of public consumption in GDP (current international prices); G=growth rate of real output (RGDPCH* times POP*); PC=(PC*/P*), relative price of private consumption; PI=(PI*/P*), relative price of investment; PC=(PG*/P*), relative price of public consumption; D1=AGEA**/100, D2=AGEB**/100 and D3=1–D1–D2 are the share of population in age ranges 0–14, 15–64, and 65+ respectively.
Sources: PWT refers to Penn World Table, version 5.5 (Summers, et al., 1993); SID refers to Social Indicators of Development (The World Bank, 1991). See data appendix.

TABLE 2
FELDSTEIN-HORIOKA TESTS:
CONSUMPTION-INVESTMENT CROWDING OUT FOR UNEXPLAINED RESIDUALS

Period	Sample FBEC9	EC12	OECD	HIINC	MIDINC	LOINC	AFRI	ASIA	SCAM	ALL
1965–69	-0.53	-0.35	-0.11	-0.22	-0.45	-0.56	-0.35	-0.44	-0.64	-0.39
	(2.55)	(1.85)	(0.84)	(1.62)	(3.23)	(3.31)	(1.77)	(2.80)	(3.32)	(3.90)
1970–74	-1.11	-0.35	-0.31	-0.31	-0.91	-0.53	-0.72	-0.54	-0.32	-0.54
	(4.32)	(1.97)	(2.40)	(1.07)	(4.93)	(3.68)	(3.55)	(1.94)	(1.28)	(5.01)
1975–79	-0.19	-0.19	-0.01	-0.09	-0.86	-0.55	-0.78	-0.27	-0.51	-0.60
	(0.44)	(0.71)	(0.07)	(0.60)	(6.08)	(2.95)	(4.49)	(0.85)	(2.88)	(5.14)
1980–84	-0.01	0.01	-0.02	-0.25	-0.36	0.03	0.17	-0.43	-0.38	-0.01
	(0.05)	(0.02)	(0.19)	(1.68)	(2.54)	(0.12)	(0.84)	(1.28)	(2.31)	(0.07)
1985–89	-0.02	0.06	-0.06	-0.13	-0.44	-0.82	-0.83	-0.77	-0.52	-0.50
	(0.07)	(0.30)	(0.34)	(0.74)	(3.16)	(3.47)	(3.92)	(5.04)	(1.99)	(4.65)

Notes: See text and data appendix. The table reports the correlations of the domestic-value adjusted residuals from the corresponding regressions in Table 1. To recover standard SNA series from the Penn World Table, price levels are applied to each residual series to convert valuations from international prices to domestic prices (R. Summers, personal communication). The following regression is then run on the domestic-valued residuals: (CI domestic-valued residual) = $\alpha + \beta$ (CC domestic-valued residual + CG domestic-valued residual), and β is reported with the absolute t-statistic in parentheses. The coefficient is interpreted as minus the standard Feldstein-Horioka coefficient.
Source: Table 1.

APPENDIX TABLE 1
SAMPLES AND SUBSAMPLES

LINE	Country	Samples	LINE	Country	Samples	LINE	Country	Samples
1	Algeria	57	54	Canada	34	101	Myanmar	8
2	Angola	7	55	Costa Rica	59	104	Pakistan	68
4	Botswana	57	57	Dominican Rep.	59	105	Philippines	58
6	Burundi	67	58	El Salvador	59	108	Singapore	48
7	Cameroon	57	60	Guatemala	59	109	Sri Lanka	68
9	Central Afr.Rep.	67	61	Haiti	69	110	Syria	58
10	Chad	67	62	Honduras	69	112	Thailand	58
12	Congo	57	63	Jamaica	59	115	Austria	34
14	Egypt	67	64	Mexico	59	116	Belgium	1234
16	Gabon	57	66	Panama	59	118	Cyprus	3
20	Guinea-Bissau	67	67	Puerto Rico	59	119	Czechoslovakia	
22	Kenya	67	70	Trinidad & Tobago	59	120	Denmark	1234
23	Lesotho	67	71	U.S.A.	34	121	Finland	34
25	Madagascar	67	72	Argentina	59	122	France	1234
26	Malawi	67	73	Bolivia	59	123	Germany, West	1234
27	Mali	67	74	Brazil	59	124	Greece	125
28	Mauritania	67	75	Chile	59	126	Iceland	3
29	Mauritius	57	76	Colombia	59	127	Ireland	1234
30	Morocco	57	77	Ecuador	59	128	Italy	1234
31	Mozambique	67	79	Paraguay	59	129	Luxembourg	23
32	Namibia	57	80	Peru	59	130	Malta	
33	Niger	67	81	Suriname	9	131	Netherlands	1234
34	Nigeria	67	82	Uruguay	59	132	Norway	34
36	Rwanda	67	83	Venezuela	59	134	Portugal	25
37	Senegal	57	85	Bangladesh	68	136	Spain	234
39	Sierra Leone	67	88	Hong Kong	48	137	Sweden	34
40	Somalia	7	89	India	68	138	Switzerland	34
43	Swaziland	7	90	Indonesia	68	139	Turkey	5
45	Togo	67	91	Iran	58	140	U.K.	1234
46	Tunisia	57	93	Israel	48	142	Yugoslavia	5
47	Uganda	67	94	Japan	348	143	Australia	34
48	Zaire	7	95	Jordan	58	144	Fiji	
49	Zambia	67	96	Korea, South	58	145	New Zealand	34
50	Zimbabwe	67	99	Malaysia	58	146	Papua N.Guinea	5
52	Barbados	9						

Notes: LINE is the PWT LINE code for each country. The "Samples" column indicates of which subsamples the country is a member, according to the following coding: 1=FBEC9, 2=EC12, 3=OECD, 4=HIINC, 5=MIDINC, 6=LOINC, 7=AFRI, 8=ASIA, 9=SCAM.

Samples: FBEC9 (Feldstein and Bacchetta's EC nine: omits Spain, Portugal and Luxembourg), EC12 (the whole EC), OECD, HIINC (high income countries according to the World Bank), MIDINC (middle income countries according to the World Bank), LOINC (low income countries according to the World Bank), AFRI (African countries according to Summers et al.), ASIA (according to Summers et al.), SCAM (South and Central American countries according to Summers et al.).

Sources: The World Bank (1993); Summers, et al. (1993); Feldstein and Bacchetta (1991).

APPENDIX TABLE 2
SAMPLE STATISTICS

Variable	Sample FBEC9	EC12	OECD	HIINC	MIDINC	LOINC	AFRI	ASIA	SCAM	ALL
NOBS	45	60	110	110	205	135	170	85	115	515
CC	0.61	0.61	0.60	0.60	0.67	0.71	0.69	0.66	0.71	0.67
CI	0.26	0.26	0.28	0.28	0.19	0.11	0.12	0.20	0.16	0.18
CG	0.14	0.13	0.13	0.13	0.16	0.22	0.22	0.17	0.14	0.17
PC	1.00	1.00	1.00	0.99	0.97	1.07	1.01	1.03	0.98	1.00
PI	0.87	0.90	0.87	0.90	1.39	2.57	2.52	1.31	1.34	1.61
PG	1.31	1.29	1.31	1.30	0.95	0.69	0.76	0.90	0.96	0.96
G	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.06	0.03	0.04
D1	0.23	0.23	0.24	0.24	0.40	0.44	0.44	0.39	0.40	0.37
D2	0.64	0.64	0.64	0.64	0.55	0.53	0.53	0.57	0.55	0.57
D3	0.13	0.12	0.12	0.11	0.04	0.03	0.03	0.04	0.05	0.06

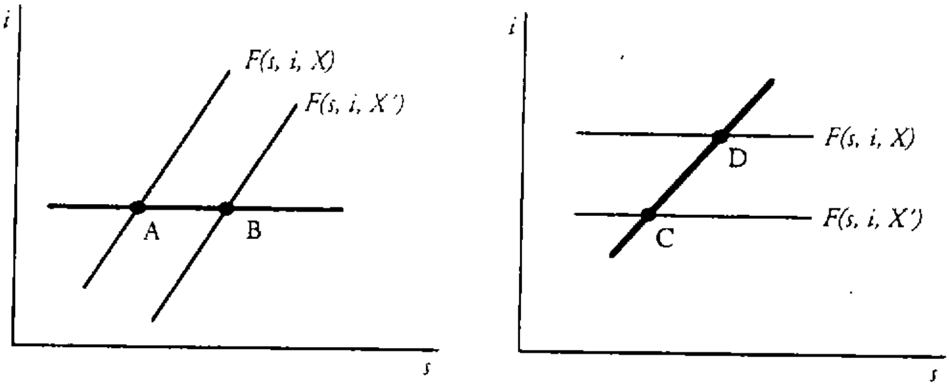
Notes: See Appendix Table 1.
Variables: The variables used are as follows (* denotes a PWT variable, ** an SID variable). CC=CC*/100, share of private consumption in GDP (current international prices); CI=CI*/100, share of investment in GDP (current international prices); CG=CC*/100, share of public consumption in GDP (current international prices); G=growth rate of real output (RGDPCH* times POP*); PC=(PC*/P*), relative price of private consumption; PI=(PI*/P*), relative price of investment; PC=(PG*/P*), relative price of public consumption; D1=AGEA**/100, D2=AGEB**/100 and D3=1–D1–D2 are the share of population in age ranges 0–14, 15–64, and 65+ respectively.
Sources: PWT refers to Penn World Table, version 5.5 (Summers, et al., 1993); SID refers to Social Indicators of Development (The World Bank, 1991).

FIGURE 1
FRANKEL'S CLASSIFICATION OF CAPITAL MOBILITY CRITERIA

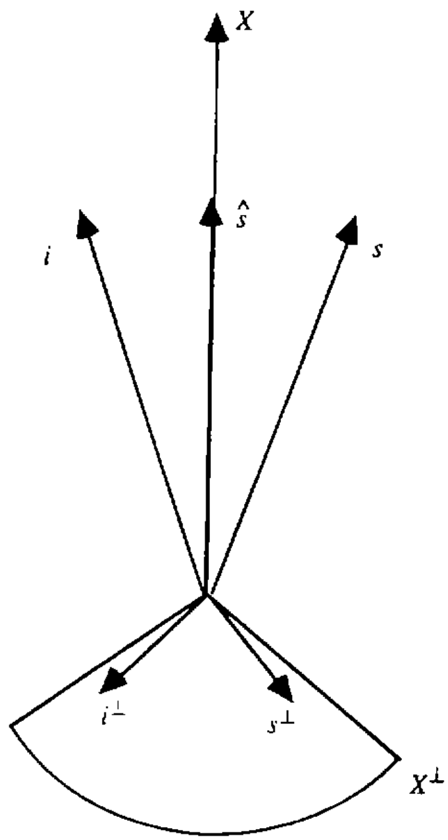
<table>
<tr><th>LEFT COLUMN:
IMPLICATIONS READ BOTTOM TO TOP</th><th>RIGHT COLUMN:
IMPLICATIONS READ TOP TO BOTTOM</th></tr>
<tr><td colspan="2">weak condition</td></tr>
<tr><td colspan="2">COVERED INTEREST PARITY
capital flows equalize interest rates across countries
when contracted in a common currency</td></tr>
<tr><td>is implied by</td><td>plus
no exchange risk
implies</td></tr>
<tr><td colspan="2">UNCOVERED INTEREST PARITY
capital flows equalize expected rates of return on countries bonds,
regardless of exchange risk</td></tr>
<tr><td>is implied by</td><td>plus
no expected depreciation
implies</td></tr>
<tr><td colspan="2">REAL INTEREST PARITY
international capital flows equalize real interest rates across countries</td></tr>
<tr><td>is implied by</td><td>plus
all determinants of national investment other than the interest rate are uncorrelated with rate of national saving
implies</td></tr>
<tr><td colspan="2">FELDSTEIN-HORIOKA CONDITION
exogenous changes in saving rates have no effect on investment rates</td></tr>
<tr><td colspan="2">strong condition</td></tr>
</table>

Source: Frankel (1992).

FIGURE 2
SAVING-INVESTMENT CORRELATIONS: COMMON EXOGENOUS EFFECTS AND CAPITAL MOBILITY



(a) crowding-out curves $\underline{F}(\underline{s}, \underline{i}, \underline{X})$: observed and true relationships



(b) the econometric geometry of saving-investment correlations

FIGURE 3
SAVING AND INVESTMENT PATHS IN THE NEOCLASSICAL GROWTH MODEL

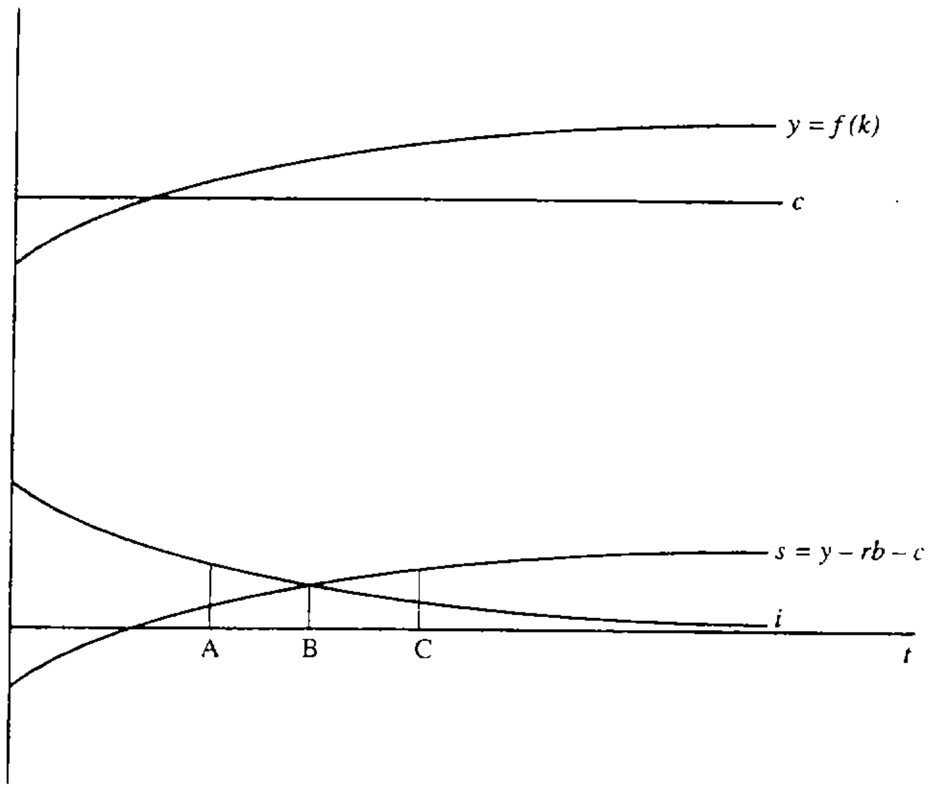
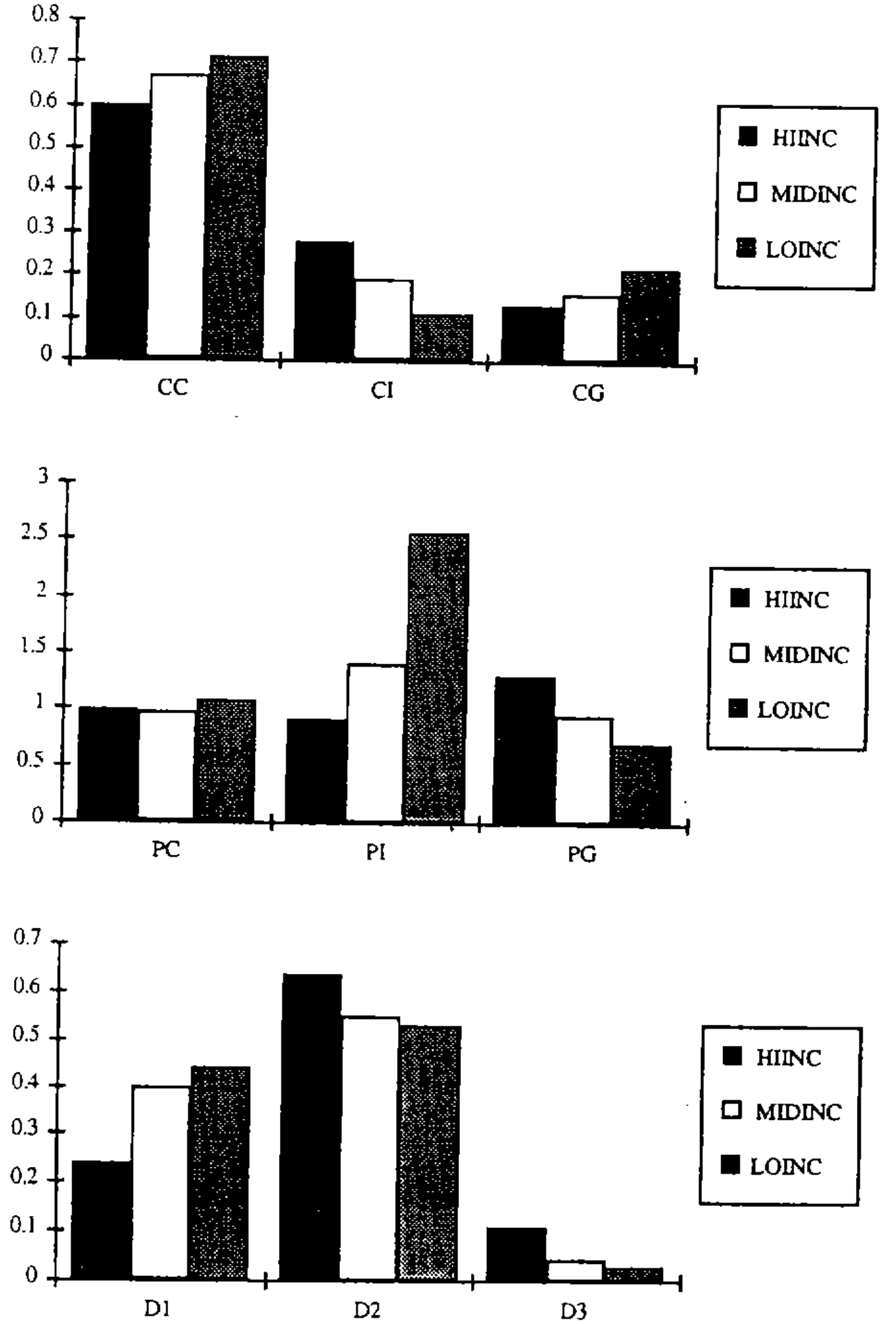
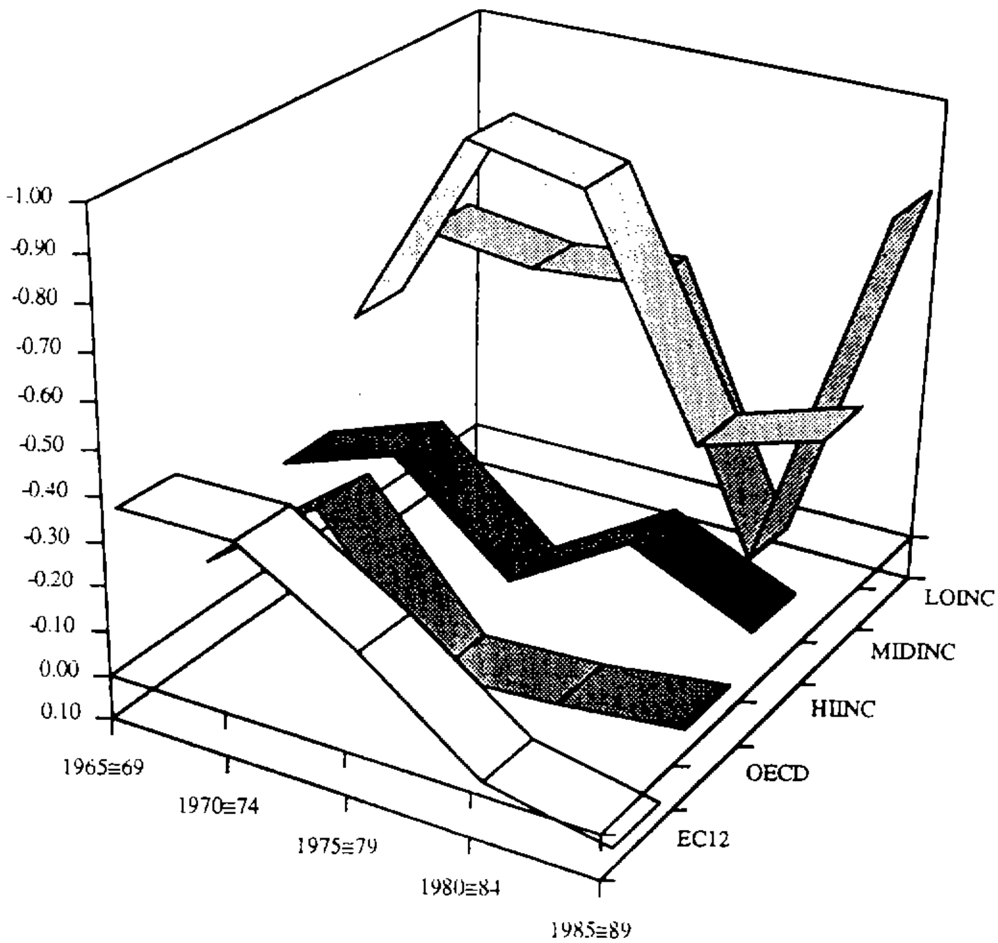


FIGURE 4
SAMPLE STATISTICS FOR HIGH-, LOW- AND MIDDLE INCOME ECONOMIES



Source: Appendix Table 2

FIGURE 5
FELDSTEIN-HORIOKA TESTS:
CONSUMPTION-INVESTMENT CROWDING OUT COEFFICIENTS FOR UNEXPLAINED RESIDUALS



Notes: The vertical scale is inverted: minus the coefficient is displayed, and this is comparable to the standard FH coefficient.
Source: Table 2.