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THE DYNAMIC–OPTIMIZING APPROACH TO THE CURRENT ACCOUNT: THEORY AND EVIDENCE

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ABSTRACT

The past decade has witnessed the development of a large theoretical literature on the intertemporal approach to the current account. These models typically emphasized the effects on the current account balance of real factors such as productivity, terms of trade, government spending and taxes via intertemporal substitution in consumption, production and investment. Could this micro based theory in any meaningful sense be wrong? The answer lies in the efforts to derive its empirical implications. Essentially the test of this theory is in proving the empirical importance of the role played by the intertemporal substitution. While this paper does not engage in formal statistical testing of the theory, the numbers it presents and the analysis of them shed light on the validity of the key testable hypotheses. The paper models investment and consumption (saving) in ways that emphasize intertemporal optimization and the differing effects of various shocks. Four different kinds of shocks are distinctly treated: transitory or persistent in duration, and common or idiosyncratic across countries. Incorporating these considerations the paper brings out a body of evidence in support of the key propositions of the dynamic-optimizing approach.

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[1]I thank Giuseppe Bertola and Peter Kenen for useful comments.

The past decade has witnessed the development of a large theoretical literature on the intertemporal approach to the current account. These models typically emphasized the effects on the current account balance of real factors such as productivity, terms of trade, government spending and taxes via intertemporal substitution in consumption, production and investment. Could this micro- based theory in any meaningful sense be wrong? The answer lies in the efforts to derive its empirical implications. Essentially the test of this theory is in proving the empirical importance of the role played by the intertemporal substitution. While this paper does not engage in formal statistical testing of the theory, the numbers it presents and the analysis of them should shed some light on the validity of the key testable hypotheses.

In the traditional Mundell-Fleming approach the trade balance was a side show, important only for its effect on current output; perhaps because the traditional theory paid little attention to capital and debt accumulations. In the center stage were the exchange rate, output and employment. Under the flexible exchange rate regime a current transitory fiscal expansion, which does not alter expectations concerning the future value of the exchange rate induces a rightward shift of the IS schedule, raises the level of output (under the Keynesian assumption of price rigidity) and induces a rise in the domestic interest. In order to maintain interest parity the rise in the rate of interest results in the appreciation of the domestic currency. The current account must deteriorate since output has risen and the domestic currency has appreciated.

Under a fixed exchange rate, interest arbitrage ensures equality between the domestic and foreign rates of interest. Consequently, a fiscal expansion which induces a rightward shift of the IS schedule gains full potency in raising the level of output, because the offsetting force induced by currency appreciation is absent. The country's current account position must deteriorate in this case too. The connection between the fiscal deficit and the trade deficit and the value of the domestic currency is, however, empirically weak (see, for example, Kotlikoff (1992, ch.3).

In contrast with the standard, static, model, the modern intertemporal optimizing approach provides a framework suitable for a positive and normative analysis of current account dynamics. An explicit account of the intertemporal budget constraint and optimization by individual households and firms sharpens the predictive content of the economic model.

The key factors governing the nature of the macroeconomic equilibrium differ drastically across the two models. In the static income-expenditure model these key factors reflect relative magnitudes of parameters measuring the effects of changes in income on spending and money demand. In contrast, in the dynamic-optimizing model the key factors reflect intertemporal parameters and the debt-income position.

A basic assumption that characterizes intertemporal models is capital mobility. If there is no such mobility, of course, there is no intertemporal approach. It is suggestive to think in terms of a dichotomy between perfect capital mobility and imperfect capital mobility. It seems that the first kind of capital mobility exists, more or less, among OECD countries, while the second kind prevails between developed and less developed countries. To the extent that this observation is true, we should expect the intertemporal model to perform better in explaining current account fluctuations among OECD countries than for the LDCs.

The organization of this paper is as follows. Section I builds an empirically implementable model of the current account. Likewise, Section II derives the essential time series properties of the real exchange rate. Positive implications of the intertemporal approach against panel and international cross section data are analyzed in Section III. Section IV brings out evidence relevant for the normative implications of the intertemporal approach, highlighting the role of taxes and incentives, capital controls, and convergence of growth rates. Section V concludes.

I. CURRENT ACCOUNT THEORY

The intertemporal approach, like the old absorption approach, begins with the national-income identity. Unlike earlier approaches, however, it models investment and consumption (saving) in ways that focus on intertemporal optimization and the differing effects of various shocks. It emphasizes the distinction among four different types of shocks. Shocks can be transitory or persistent in duration; they may also be either common across countries or idiosyncratic (country specific). The dynamics of the country's investment-saving balance (the current account balance) is driven by shocks of this sort in a distinctly differentiable manner.

We first look at the modeling of investment and then at the modeling of consumption (saving).

1. Investment

Consider a small open economy, producing a single aggregate tradable good.[2]

Output, Y, is produced by a Cobb-Douglas production function

$$Y_t = AK_t^{\alpha} \tag{1}$$

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[2]See Glick and Rogoff (1992) , Leiderman and Razin (1991) and Mendoza (1991).

where A, α, and K denote the productivity level, the capital distributive share and the capital stock, respectively. We assume that the productivity shocks follow a first-order autoregressive stochastic process

$$A_t = \rho A_{t-1} + \varepsilon_t, \quad 0 \leq \rho \leq 1 \qquad (2)$$

where ρ and ε denote the persistent parameter and a zero-mean i.i.d. term, respectively.

Firms maximize the expected value of the discounted sum of profits subject to the available production and a cost-of-adjustment investment technologies. According to the investment technology gross investment, Z, is specified as

$$Z_t = I_t\left(1 + \frac{g}{2}\frac{I_t}{K_t}\right), \qquad (3)$$

where $I_t = K_{t+1} - K_t$ and g denote the net capital formation and the cost-of-adjustment coefficient, respectively. Thus, in the presence of costs of adjustment, gross investment typically exceeds net capital formation, due to labor reorganizations and training costs associated with the installation of the new capital equipment.

The optimal investment rule implies that the cost of investing an additional unit of capital in the current period must be equal to the expected present value of the sum of next period marginal productivity of capital, next period induced fall in investment cost of adjustment (due to the enlarged stock of capital), and the next period residual value of capital remaining for the entire future:

$$E_t R^{-1}\left[\alpha A_{t+1} K_{t+1}^{\alpha-1} + \frac{g}{2}\left(\frac{I_{t+1}}{K_{t+1}}\right)^2 + q_{t+1}\right] = q_t \qquad (4)$$

where E_t is the expectation operator based on period t information, and $q_t = 1 + g(I_t/K_t)$, and R, denote the firm market value per unit of capital (the Tobin q measure), and the interest factor (one plus the real world 's rate of interest), respectively.

At a steady state the investment rate reduces to an equality between the rate of interest and the marginal productivity of capital:

$$R - 1 = \alpha\bar{A}(\bar{K})^{\alpha-1} \tag{5}$$

where $\bar{A}$ and $\bar{K}$ are the steady state levels of productivity and the stock of capital, respectively.

Linearizing equation (4) around the steady state yields

$$k_{t-1} + a_o k_t + a_1 E_t k_{t+1} = -bE_t A_{t+1}, \; b > 0 \tag{6}$$

where $k = K-\bar{K}$ denotes the deviation of the capital stock from its steady state level. The solution for k_t (see Sargent, 1987, pp. 197-204) is given by

$$k_t = \lambda_1 k_{t-1} + \lambda_1 b \sum_{i=0}^{\infty} \left(\frac{1}{\lambda_2}\right)^i E_t A_{t+1+i} \tag{7}$$

where $\lambda_1 < 1$ and $\lambda_2 > 1$ are the roots of the quadratic equation $1 + a_o\lambda + a_1\lambda^2 = 0$. Lagging (7) by one period and subtracting from period t equation yields the corresponding solution for desired investment flows:

$$z_t \equiv I_t = \lambda_1 I_{t-1} + \lambda_1 b \sum_{i=1}^{\infty} \left(\frac{1}{\lambda_2}\right)^{i-1} [E_t A_{t+i} - E_{t-1} A_{t+i-1}] \tag{8}$$

The first term on the right hand side of (8) captures the effects on period t investment of lagged productivity shocks and the second term the revisions of expectations (based on the change in information from period t-1 to period t) of the future productivity shocks.

If the shocks are <u>country specific</u> and <u>permanent</u>, ρ in equation (2) is equal to 1 we have a random walk process. Substituting equation (2) with $\rho = 1$ into (8) yields

$$I_t = \lambda_1 I_{t-1} + \left(b \frac{\lambda_1 \lambda_2}{\lambda_2 - 1}\right) \Delta A_t \tag{9}$$

Subtracting I_{t-1} from both sides yields

$$\Delta Z_t = \Delta I_t = (\lambda_1 - 1) \Delta I_{t-1} + \left(b \frac{\lambda_1 \lambda_2}{\lambda_2 - 1}\right) \Delta A_t \tag{10}$$

Thus, current investment is positively correlated with a permanent country-specific productivity shock.

If, on the other hand, $\rho = 0$ in equation (2), the country-specific shocks are only <u>transitory</u>. Substituting the modified stochastic process into the right-hand side of equation (8), and recomputing the change in investment, yields

$$\Delta Z_t = \Delta I_t = (\lambda_1 - 1) \Delta I_{t-1} \tag{11}$$

Thus, the transitory productivity shock has no impact whatsoever on current investment.

Consider now what happens if productivity shocks are <u>common</u> to all countries. A persistent common productivity-enhancing shock raises the world rate of interest, R-1. The rise in the cost of capital outweighs the expected rise in future productivity (when the shock is persistent) thereby weakening the effect on current investment. If the global shock is not persistent and thus has no effects on future productivity, it follows that the shock will affect investment only marginally through its impact on world saving and thereby on the world rate of interest.

2. Consumption

We now turn to the modeling of consumption (saving). Consider the key elements of consumption behavior, based on the familiar permanent-income hypothesis, which emerges when the representative consumer has full access to the world capital markets. Accordingly, the representative agent chooses a consumption path so as to maximize its lifetime utility

$$E_t \sum_{i=1}^{\infty} \delta^i u(C_{t+i}) \ , \quad u(C) = hC - \frac{1}{2}C^2 \ , \tag{12}$$

subject to the constraint

$$C_t + F_t = Y_t + RF_{t-1} \ , \tag{13}$$

where δ and F denote the subjective discount factor and the stock of foreign assets, respectively. Net output, Y, accounts for the resources used up in investment. The solution to the consumer optimization problem (assuming for simplicity that $\delta R = 1$) is given by

$$c_t = \beta W_t \ , \quad \beta = \frac{R-1}{R} \tag{14}$$

where W denotes wealth (and thus, $(R-1)/(R)W$ represents the corresponding permanent income flow) consisting of the expected discounted flow of current and future income, and initial foreign assets:

$$W_t = E_t \sum_{i=0}^{\infty} \left(\frac{1}{R}\right)^i Y_{t+i} + RF_{t-1} \ . \tag{15}$$

The general-equilibrium aspect of our framework is captured by the fact that the representative agent's wealth depends on the economy-wide output stream, determined by the investment behavior. Accordingly, the realized sequence of current and future productivity shocks(and the induced investment path) are the driving forces behind the consumption spending. Specifically, the linear approximation of the production function around the steady state yields

$$Y_t = d_0 + d_k K_t + d_A A_t \ . \tag{16}$$

Substituting (16) together with (2) and (7) into the wealth term in (14) and (15) yields the closed-form solution for current consumption spending as a function of the observable (current and past) productivity levels and foreign asset holdings.

Consider specifically the effects on consumption of country-specific productivity shocks, <u>persistent</u> in duration, in the extreme case $\rho = 1$. First differentiating equation (16) and substituting equation (2) and (9) into the resulting expression yields

$$\Delta Y_t = (\lambda_1 - 1) d_K \Delta I_{t-1} + \left(\frac{\lambda_1 \lambda_2}{\lambda_2 - 1} b d_K + d_A \right) \Delta A_t . \tag{17}$$

In addition, first differentiating the consumption equation (17) and substituting equations (2), (9) and (15) yields

$$\Delta C_t = \left\{ \frac{\lambda_1 \lambda_2}{\lambda_2 - 1} b d_k \left(1 + \frac{\lambda_1}{R} \, \frac{(R-1)}{(R - \lambda_1)} \right) + d_A \right\} \Delta A_t + (R-1) \Delta F_{t-1} \ . \tag{18}$$

Observe that the coefficient of ΔA in (18) is larger than the corresponding coefficient in (17). The economic intuition is straightforward. The effect of a productivity change, ΔA_t, on current consumption is subject to two reinforcing forces: (a) If investment were to be held constant in response to the shock, then current income and current consumption should rise by the same amount. This effect is captured by the term $\lambda_1\lambda_2 bd_K/(\lambda_2 - 1) + d_A$ (18) and (17). (b) But the productivity shock, ΔA_t, raises the entire expected investment path throughout the future and thus leads to a larger future capital stock and larger future income. Consequently, permanent income (and along with it also current consumption) should rise by more than current income. This effect is captured by the term $\lambda_1\lambda_2 bd_K/(\lambda_2 - 1)$ in (18).

In contrast, if the productivity shock is transitory ($\rho = 0$) then it follows that investment is not affected at all (see (11)) and the change in wealth must be equal to the transitory increment to current income with no change in future expected income. Consequently, in this case we have

$$\Delta C_t = (R-1)\left(\Delta F_{t-1} + \frac{d_A}{R}\Delta A_t\right) \tag{19}$$

Comparing (18) and (19) it is evident that transitory shocks have relatively weak effect on current consumption, in line with the standard consumption theory.

It is noteworthy that disturbances other than productivity shocks, such as changes in government spending, can be incorporated with only slight modification of the framework. Recall that even under Ricardian assumptions government spending can have real effects in an intertemporal framework. (See Frenkel and Razin (1987) and Backus, Kehoe and Kydland (1992) which looks at the effects of temporary and permanent changes in government changes.)

3. External Balance

By the national accounting identity,the change in the current account, CA, is given by

$$\Delta CA_t = \Delta Y_t - \Delta Z_t - \Delta C_t + (R-1)CA_{t-1} \,. \tag{20}$$

The effects on the current account of persistent country-specific shocks (with $\rho=1$) are obtained upon substituting equations (10), (17) and (18) into the current account equation (20):

$$\Delta CA_t = \left\{ - \frac{\lambda_1\lambda_2}{\lambda_2-1} b d_K \frac{\lambda_1}{R} \frac{(R-1)}{(R-\lambda_1)} - \frac{\lambda_1\lambda_2}{\lambda_2-1} b \right\} \Delta A_t + (R-1)CA_{t-1} - (R-1)\Delta F_{t-1} - 7(\lambda_1-1)\Delta I_{t-1} \quad (21)$$

The coefficient of ΔA_t in equation (21) is negative. Consequently, permanent country-specific (productivity-raising) shock must worsen the current account for two reasons: first, because it causes investment spending to rise; second, because it causes current consumption spending to rise in excess of the current rise in output. This means that the current account has to be negatively correlated with persistent country - specific productivity shocks.

When shocks of this sort are not persistent, ($\rho = 0$), however, consumption responds only weakly and investment does not respond at all. Specifically,

$$\Delta CA_t = \frac{d_A}{R} \Delta A_t + (R-1)CA_{t-1} - (R-1)\Delta F_{t-1} - (\lambda_1-1)\Delta I_{t-1} \quad (22)$$

The positive coefficient of the productivity term implies that a positive transitory productivity shock tends to move the external balance into surplus. This means that the current account has to be positively correlated with non-persistent country specific shocks.

A global shock which impacts on all countries should have a significantly different effect on the external balance than country-specific shocks. A persistent positive productivity shock, common to all countries will raise the world rate of interest. The rise in the interest rate should dampen the rate of increase in current consumption and investment spending which would have occurred in the presence of a comparable country-specific shock. Thus, the response of the current account to a persistent global shock must be smaller than to an idiosyncratic country-specific shock. A global non-persistent positive shock generates excess world savings, and thereby exerts a downward pressure on the world rate of interest. The fall in the world rate of interest will stimulate current spending. Consequently, in the case of transitory shocks the response of the current account to the shocks must be weaker under global than country-specific shocks.

These effects of productivity shocks on the current account of a single country, which is small relative to the world economy need not extend to a large country. As the current accounts of all countries must add up to zero, a global shock has no effect, on average, on the current account of a large country.

To sum up this section, the empirical test of the intertemporal trade theory requires a four-way delineation of shocks by their nature, which is either global or idiosyncratic and temporary or persistent.

4. Saving - Investment Correlations

The typical impulse response of savings (i.e., the difference between output and consumption to a positive but not fully persistent productivity shock is presented in Figure 1. The Figure displays a positive impact effect and a downward monotonic adjustment to the initial equilibrium, reflecting the fact that consumption is smoothed relative to output. The impulse response of investment in the Figure indicates a large positive impact effect, followed by a sharp drop and a monotonic convergence to the initial equilibrium, reflecting the intertemporal substitution in investment that is induced by the shock.

These typical patterns explain why the covariance between savings and investment is typically positive under the perfect capital mobility assumption (see Obstfeld (1986)). Recall that the covariance includes a quadratic term, the product of savings and investment. Therefore the observations with large deviations from the initial equilibrium, such as the positive impact effects, are given larger weights in the covariance formula. Consequently the covariance is positive if the time spent at each point on the impulse functions is the same.

The observed covariance between savings and investment should not necessarily be interpreted as an indication of capital immobility (the Feldstein and Horioka (1980) original interpretation. In fact the narrow off-shore on-shore interest differentials on assets that are denominated in the same currency indicate that capital mobility is more nearly perfect among the industrialized countries. Furthermore, the observed positive covariance does not pose a challenge to the intertemporal approach since it predicted by this approach.

II.REAL EXCHANGE RATE THEORY

Up to this point we have assumed that all goods are internationally traded in world markets. In this section we allow for goods that are nontraded internationally, and whose relative prices are determined exclusively in the domestic economy. In this case the domestic effects of macro shocks also operate through changes in the relative price of nontraded goods, the inverse of the real exchange rate.

The intertemporal approach provides important insights for the time-series properties of the real exchange rate, the relative price of tradable in terms of nontradables. Following recent intertemporal models of the trade balance and the real exchange rate (see Razin (1984), Mendoza (1992), Rebelo (1992), and Rogoff (1992)) I assume in this section a stylized two-sector model of a small open economy. Preferences over consumption of tradable, C^T, and nontradables, C^N, are represented by a Cobb-Douglas intratemporal utility function

$$V(C^T, C^N) = (C^T)^{1-\gamma}(C^N)^{\gamma} \tag{23}$$

with the associated first-order condition

$$P = \frac{(1-\gamma)\,C^N}{\gamma C^T} \tag{24}$$

where P denotes the relative price of tradable in terms of nontradables. The representative agent is infinitely lived who seeks to maximize

$$U = \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{1-\sigma} V_t^{1-\sigma} - 1\right] \tag{25}$$

Sectoral outputs are represented by Cobb-Douglas production functions

$$Y^T = A^T (K^T)^{1-\alpha} (L^T)^{\alpha} \tag{26}$$

$$Y^N = A^N (K^N)^{1-\nu} (L^N)^{\nu} \tag{27}$$

a. Intersectoral Factor Mobility

The classic model of the real exchange rate, which was developed by Balassa (1964) and Samuelson (1964) assumes that capital and labor can move freely between sectors. Thus, it may be consistent with the long run equilibrium of the economy. The standard profit maximization conditions, given the common wage and rental in the two sectors imply

$$dp = \left(\frac{\nu}{\alpha}\right) da^T - da^N \tag{28}$$

where lower case letters denote the logarithm of a variable indicated by the corresponding upper case letter.

Thus, the path of the logarithm of the real exchange rate is completely determined by the productivity shocks da^T ,and da^N ,regardless of the aggregate demand conditions. Under the regime of a fixed exchange rate with purchasing power parity holding for tradable goods, the rate of domestic inflation is driven exclusively by shocks to tradable and nontradables, as indicated by Equation (27). Factor mobility implies, therefore, relatively high sensitivity of the real exchange rate to shocks to the tradable goods' sector; and to the extent that these shocks are transitory, a relatively low degree of persistence for the time series of the real exchange rate.

b. Sector Specific Factors

The polar opposite case to the one considered in (a) is the one in which factors are intersectorally immobile. This case can be viewed as the short run equilibrium model, explaining month-to-month fluctuations of the real exchange rate. As has been emphasized by Rogoff (1992), the short run equilibrium real exchange rate responds mainly to aggregate demand shocks in a way which is akin to the consumption behavior, which smoothed out transitory shocks to income.

Intertemporal smoothing of expected marginal utility implies

$$(x_t)^{1-\gamma}(V_t)^{-\sigma}=\beta R E_t (x_{t+1})^{1-\gamma}(V_{t+1})^{-\sigma},\ x=\frac{C^N}{C^T} \tag{29}$$

In the absence of shocks to the supply of nontradable goods (so that C^N is constant), and consumption tilting (so that the product of the subjective discount factor and one plus the rate of interest is equal to one), we can substitute Equation (24) into Equation (29) to get

$$P_t^{(1-\gamma(1-\sigma)}=E_t P_{t+1}^{(1-\gamma(1-\sigma)} \tag{30}$$

Approximating P^x by (1 + xp), where p denotes the logarithm of P, Equation 31 reduces to

$$p_t=E_t p_{t+1} \tag{31}$$

Thus, the logarithm of the real exchange rate would follow a random walk, regardless of the underlying shocks to the traded goods sector. Factor immobility implies therefore a relatively high degree of persistence for time series of the (logarithm) of the real exchange rate.

III. POSITIVE IMPLICATIONS OF THE INTERTEMPORAL APPROACH

After setting out the theory, which aimed at alerting the reader to the relevant issues, we proceed in this section to look at the evidence. The section is concerned with two types of empirical work -- on the nature of shocks and on the testable implications of the intertemporal approach.

1. Evidence on Persistence and Commonality of Shocks

Drawing on Razin and Rose (1992) we provide in this subsection some evidence on the time-series nature of the shocks that operate on output consumption and investment. The data is taken from the Penn World Table (documented in Summers and Heston (1991)). The data set comprises 138 countries and span over the period 1950-1988.

a. Persistence

To address the issue of persistence, Razin and Rose (1992) compute simple Dickey-Fuller tests for (the logs of) each of our variables. The data typically do not reject the hypothesis that a single unit-root exists in the univariate representation of output, consumption and investment at conventional levels of statistical significance. They computed three tests (one for each of consumption, output and investment) for each of our 138 countries; of these, eighteen (4.5%) tests reject the null hypothesis of a unit root at the 5% significance level, while five of these (1.3%) reject the null at the 1% significance level. These results are quite close to what would be expected under the null hypothesis, implying that the data are consistent with the hypothesis of unit-roots in the autoregressive representations of the variables.

It is well-known that such tests have low power against stationary alternatives, and that there are serious problems in interpreting our tests results as demonstrating a high degree of persistence. Thus, we view our findings as consistent with a high degree of persistence in shocks, but by no means definitive.

b. Commonality of Shocks

The current account theory indicates that dynamics of the saving-investment balance should depend critically on whether shocks are common across countries, or country-specific. To get a handle on this issue, Razin and Rose(1992) used standard factor-analytic techniques to test for the nature of the shocks. The factor analysis is performed cross-country on the detrended measures of output, consumption and investment. Their results are given in Table I. Since the national accounts data in Penn World Tables are sometimes unavailable for the entire 1950-1988 period, table I tabulates results for two sets of countries: those with at least twenty annual observations, and those with at least thirty-five observations; results for different sets of countries (with different minimum sample lengths) are quite comparable.

Factor analysis results depend critically on the method of detrending. When the variables are detrended using the standard linear trend (TS) method, four factors (the factors corresponding to the largest four eigenvalues)

Table I: Cross-Country Factor Analysis of Shocks

Proportions of Total Variance Explained

Countries with at least 20 annual observations

	Output		Consumption		Investment	
	TS	DS	TS	DS	TS	DS
1 Factor	43	20	37	16	35	19
4 Factors	85	49	80	45	78	53

Countries with at least 35 annual observations

	Output	Consumption

typically account for around three-quarters of the variation in all three series; the first factor alone accounts for over a third of the total variation. This finding may indicate that there may be a small number of important global shocks that are common across countries. However, these fractions fall by approximately one-half when the first differencing (DS) method of detrending is employed (implicitly adopting a random walk model of trends).

To summarize the evidence indicates that many business cycle shocks are both persistent and common to many countries.

2. Volatility, Persistence and Correlations

Intertemporal trade theory predicts that the degree of capital market integration and the nature of shocks are key determinants of the volatility of consumption (saving), investment, and the current account. In this subsection we provide time-series evidence on current account dynamics so as to shed some light on the empirical validity of the theoretical effects which have been discussed in sections I -III.

The volatility measures for the current account (as a percentage share of GDP) and the logarithm of per capita GDP are exhibited in Figure 2 for a sample of 133 countries, based on the Penn World Table (Mark 5) for the period 1967 - 1990. We use, as our measure of volatility, the standard deviation of the (first - difference) detrended variable. The country is referred to by the first three letters of its name.

There is a cluster of mainly industrialized countries and fastest growing developing countries that show relatively low current account and output volatility. The low current account volatility and high output volatility list includes countries such as Japan and Indonesia. The list of high current account volatility and low output volatility includes countries such as the oil producing countries such as Venezuela and Iran.

The major conclusions that could be gleaned from the Figure are :

1)LDCs show more volatility of both output and current account than DCs.

2)The ratio of current account volatility and output volatility (as indicated in the Figure by the slope of a ray from the origin that fits the cluster of observations) is not markedly different among LDCs and DCs.

Table 2 provides a set of statistical properties of the trade balance, output, the terms of trade, the real effective exchange rate and the rate of interest for the 7 largest industrialized countries and a sample of developing countries. The Table reports measures of volatility and persistence, and the correlations (see also Mendoza (1992)). A crucial aspects of relative price changes (such as changes in the terms of trade, the real exchange rate and the rate of interest) is that they cause income effects for the country akin to shifts in output, in addition to the direct substitution effects. Thus, for example, since a deterioration in the terms of trade means that with the same quantity of exports the country is able to import reduced amount of goods and services from abroad real income falls. The distinction between temporary and permanent changes are as relevant here as for the case of output shocks. The temporary vs. permanent distinction is also relevant for the intertemporal substitution effect (see Razin and Svensson (1983)).

The main regularities shown in the table can be summarized as follows.

1) There is significant degree of persistence of output, terms of trade, and the real exchange rate, similar to our earlier finding based on the World Penn Tables.

2) The Trade balance is in most cases more volatile than the terms of trade, or output.

3) The trade balance and the terms of trade are positively correlated for most of the countries, in line with the Harberger-Laursen- Metzler effect. Recall that this older problem is concerned with the effects of changes in the terms of trade on savings. According to the intertemporal approach a temporary deterioration in the terms of trade will induce a substitution away from current consumption into future consumption (saving), while a permanent change will not induce that substitution.

4) Looking across countries, the potential link between the persistence of output or terms of trade shocks and the correlation between the trade balance and the

terms of trade or output, as indicated by the theory, is not visible. A more structural econometric approach is called for to test the validity of this proposition of the intertemporal approach.

Noteworthy, Mendoza (1992) constructs two benchmark economies to characterize a "typical" Less Developed Country and a "typical" Developed Country. Conditioning them with empirically-based parameters of terms of trade shocks' processes, he is able to simulate the Harberger-Laursen-Metzler effect, whereby the persistent parameter of the terms-of-trade shocks is positively associated with the correlation between the terms of trade and the trade balance. Thus, empirically-based parameters embedded into a structural intertemporal model provide evidence as to the role played by the persistence of the terms-of-trade shocks.

5) Both real rate of interest and terms of trade are more volatile for developing countries than for industrialized countries and, similarly, the trade balance volatility of the developing countries is significantly larger than that of the industrialized countries.

6) The correlation between the rate of interest and the trade balance is positive for most countries. This crude parameter may indicate a policy reaction whereby an easy monetary policy is implemented in response to a trade balance deterioration.

7) The real exchange rate is only weakly correlated with the trade balance. This may suggest an equilibrium outcome based on competitive driving forces on the one hand, and trade policy reactions to movements in the external balance, on the other.

8) The real exchange rate shows a high degree of persistence and relatively low correlation with the terms of trade shocks. This may support the validity of the consumption-smoothing model of the real exchange rate discussed in Section IIb.

Sachs (1981) investigated nonstructural regressions of the behavior of the current account in both industrialized and developing economies. He has emphasized the point that most of the explanatory power in his regressions was due to an investment surge that led to current account deficits while saving rates have changed little. Further developments in theory and methodology enabled more structural testing.

3. Structural Testing

Empirical implementation of the intertemporal trade balance model has been limited. A full-blown optimizing model is difficult to estimate since it is often impossible to reduce it to a small number of tractable equations. By now there are a few beginnings.

The intertemporal model predicts that shocks that are common to all countries and persistent (formed by a GNP-weighted average of the individual productivity measures) have no effect on the trade balance. Using the delineation of the Solow residual measure among country-specific and global shocks, and transitory and persistent shocks, Glick and Rogoff (1992) found that both enter the regressions with the predicted sign. The hypothesis could not be rejected for the annual data of 8 industrialized countries for 1960-1990 that they considered. They did, however, uncover an important puzzle. The coefficient of the productivity explanatory variable on the trade balance dependent variable has been smaller than the corresponding coefficient on the investment dependent variable, while the theory predicts the opposite. But they have not incorporated the cross-equation restriction that the theory implies, and in several cases the fitness of their regression analysis is weak.

Leiderman and Razin (1991) estimated the model with a monthly data for Israel in the 1980s. They found strong evidence in favor of consumption smoothing (indicated by an offsetting response of private saving to changes in government saving and absence of liquidity constraints) as well as strong response of investment to country-specific productivity shocks.

Mendoza (1991,1992) provides recurssive simulations based on a calibrated model with empirically-based parameter that lend support to the to the emphasis on persistency of shocks and intertemporal consumption trade in this approach.

Razin and Rose (1992) provide indirect testing of the trade balance theory. The intertemporal-international model predicts that capital market integration should lower consumption volatility while raising investment volatility to the extent that shocks to productivity are idiosyncratic and nonpersistent. They use a unique panel data set (ranging from the 1950s to the late 1980s for industrialized as well as developing countries) which includes indicators of barriers to trade in goods and (financial) capital. Their results are inconclusive since they did not find a strong link between business cycle volatility and openness. For instance, countries with greater capital mobility do not appear to have systematically smoother consumption streams, or more volatile investment behavior.

III.NORMATIVE IMPLICATIONS OF THE INTERTEMPORAL APPROACH

1.Taxes and the Saving-Investment Balance

Taxation on capital income may potentially have large disincentive effects on saving and investment. It therefore especially relevant for the discussion of the intertemporal approach to the current account.

With complete integration of the world capital market arbitrage possibilities imply that

$$r(1-t_D)=r^*(1-t_N-t_F) \tag{32}$$

$$r(1-t_N - t*_F)=r*(1-t*_D) \tag{33}$$

where an asterisk denotes "rest of the world" and subscripts D,N and F denote taxes levied on the domestic-source income of residents,taxes levied on non-residents,and taxes levied on foreign-source income of residents, respectively. A credit for the tax paid abroad which is deducted from the tax liability in the home country is captured by having $t_F = t^{*N}$.

In a world with international capital mobility the equality between saving and investment need not hold for each individual country. This separation implies that different tax principles may have fundamentally different implications for the world allocation of saving and investment across countries. The two polar principles of international taxation are the source and the resident principles. According to the first principle, foreign source income of residents is not taxed and residents and nonresidents are taxed at a uniform rate on income from a domestic source. According to the second principle residents are taxed uniformly on their world-wide income, regardless of the source of income.

Thus, in conjunction with the arbitrage conditions, the source principle implies that the intertemporal marginal rate of substitution in consumption (which is equated to the post-tax rate of return on capital) is equalized across residencies. At the same time, however, the marginal productivity of capital in each country will depend on the country-specific tax rates. The residence principle, in conjunction to the arbitrage conditions, imply that the marginal productivity of capital (the pre-tax rate of return on capital) is equalized across countries. At the same time the intertemporal marginal rate of substitution in consumption will differ according to the cross-country differences in tax rates (see Frenkel, Razin and Sadka (1992)).

Since the predominant tax principle in industrialized country is the residence principle we should expect that correlation between the saving ratio and country specific tax rates on capital income will be larger than the corresponding correlation between the investment ratio and the country-specific tax rate.

To understand why according to the intertemporal approach the all-inclusive capital income tax is directly related to savings recall from saving theory how the marginal rate of intertemporal substitution and the after tax are brought into equality for every consumer. Specializing the utility function to the isoelastic form and allowing for capital income taxation yields:

$$1+g_{ct}=[\beta(1+\bar{r}_t)]^{(1/\sigma)} \qquad (34)$$

where

$\bar{r}_t = r(1-t_k)$ and g_c, beta, sigma, r and t_k denote the growth rate of consumption, the subjective discount factor, the reciprocal of the intertemporal elasticity of substitution in consumption, the pretax rate of return on capital and the capital income tax rate, respectively.

This formula suggest that the negative effect on consumption growth (e.g. savings) of the capital income tax is directly related to the intertemporal elasticity of substitution in consumption.

Mendoza,Razin and Tesar (1992), have recently computed the revenue-based flat-rate average taxes on income derived from capital for the 7 major industrialized countries. Using OECD data set they compute the actual rate of capital income tax by the following method. The tax rate is equal to the individual overall income tax rate times the sum of operating surplus of private unincorporated enterprises and household property and entrepreneurial income plus taxes on income, profits, and capital gains of corporations, divided by the total operating surplus (in the terminology used by the OECD). Since all sources of individual income are taxed at the same rate, the individual overall income tax rate is computed as taxes on income, profits, and capital gains by individuals divided by the sum of wages and salaries, operating surplus of unincorporated enterprises and household's property and entrepreneurial income.

Table 3 presents means and individual country correlations of saving, investment and the computed capital tax rate. As expected, the saving and investment ratios are in most cases negatively correlated with the capital income tax rate. Looking across countries the mean rate of tax is negatively associated with saving and investment rates, except for Japan which exhibits the highest saving and investment ratios, in spite of its relatively high tax rate on capital income. The correlations between the saving ratio and the tax rate are larger than that between the investment ratio and the tax rate,consistent with the prediction of the theory for open economies. Since in an open economy where savings and investment are separated,the tax that drives savings is the abovementioned all inclusive capital income tax where if true depreciation is allowed the interest rate deductibility of taxes cancels out the effect of corporate taxation on the firm's income and the latter is neutral with regard to the firm's investment (see Samuelson (1961)). Thus, capital income taxation is expected to have stronger effects on savings compared to investment if free international capital mobility is allowed. In contrast, in a closed economy, the close link between savings and investment implies that the all-inclusive capital income tax drives both savings and investment.

2. Capital Movements and Growth

A recurrent theme in the open-economy macroeconomics literature is that capital controls are frequently advocated under floating exchange rates as a stabilization policy instrument. Under a regime of free capital flows, an expansionary fiscal policy that tends to provoke an appreciation of the domestic currency (through induced capital inflows) would lead to a currency depreciation in the presence of capital controls since the foreign exchange market is then dominated by the imbalances in goods flows rather than assets flows. However, once capital controls are put in place it has often proved difficult to remove them, and persistent capital controls have important implication for long run growth.

Intertemporal consumption trade tends to be a growth-equalizing force. To see this recall that free trade brings to equality (through a common set of relative prices faced by consumers/producers across countries) the marginal rates of substitution and the marginal rates of transformations between any traded commodities. In the intertemporal consumption trade context this implies a cross-country equalization of the intertemporal marginal rates of substitution in consumption and the marginal product of capital.

Under free capital mobility, the law of diminishing returns implies that capital will move from capital-rich (low marginal product of capital) countries to capital-poor (high marginal product of capital) countries. Over time, such international capital flows will equalize the marginal product of capital across countries. The short run effect of such capital movement is to shorten the transition path of the capital importing country and to lengthen the path of the capital exporting country. In the long run where rates of growth of all growing variables are constant (so that ratios among these variables are time-invariant) total income growth rates will be uniform across countries (Proposition 1 in Razin and Yuen (1992)). The reason is that the stock of capital flowing from one country to another must be growing at the same rate as the total income in the former country as well as that in the latter country for growth to be balanced.

Two important empirical implications follow this simple reasoning:

(a)Long-term rates of growth of population and per capita incomes should be negatively correlated across countries; and

(b)Total income growth rates should exhibit less variation than per capita income growth rates. Razin and Yuen (1992) provides some evidence that supports these hypotheses from the World Development Report data covering the period 1965-87 and includes 120 DCs and LDCs.

An important implication is that per capita income growth rates may not converge, and diversity among them is affected by the prevailing capital income tax principles. Following Rebelo (1992) assume that the representative household makes his saving decision so as to maximize the life-time utility

$$U=\Sigma(\beta(1+g_N)^{\eta})^{t}u(c_t),\, u(c_t)=\frac{c_t^{1-\sigma}}{1-\sigma} \tag{35}$$

where g_N denotes the rate of population growth. These preferences are consistent with steady state growth. They imply that the representative household expands consumption at a constant rate whenever the rate of interest is constant.

$$\frac{(1+g_N))^{t}u_c(c_t)}{(1+g_N)^{t+1}u_c(c_{t+1})}=\beta(1+r) \tag{36}$$

Consider the familiar marginal condition for the intertemporal consumption(36) At a steady state where consumption growth rate must be equal to the income (per capita) growth rate, g_y, the intertemporal condition yields

$$1+g_y=(\beta(1+g_N)^{\eta-1}(1+r))^{\frac{1}{\sigma}} \tag{37}$$

This formula suggests that if two countries have identical preferences then their rates of consumption growth can differ only if they have either different population growth rates or different after-tex rate of return on capital. Equalizing the after-tax rate of return on capital in different countries, as for instance by the adoption of the "source principle", is growth-equalizing. The reverse is true for the "residence principle" since in this case the after-tax rate of return on capital is not equalized across countries. Diversity in rates of return on capital across countries may be due to capital controls. Thus the formula suggests that capital controls may account for the observed diversity in rates of growth of per capita income across countries (see Razin and Yuen (1992)).

IV. CONCLUSION

Unsynchronized changes in national fiscal and monetary policies which have characterized recent major developments have resulted in large budgetary imbalances, volatile real rates of interest and real exchange rates, and large imbalances in national current account positions. The dynamic-optimizing approach to the trade balance offers a coherent theory that can potentially account for the observed diversity in trade balance positions across countries. The present paper illustrates the potential implications of the intertemporal approach for current account dynamics and the evidence supporting it.

The intertemporal approach begins with the national income identity and detailed descriptions of the intra- and inter-temporal budget constraints faced by the decision-making units. It models investment and consumption (saving) in ways that emphasize intertemporal optimization and the differing effects of various shocks. Four different kinds of shocks are treated distinctly. Shocks can be transitory or persistent in duration. They may also be either common across countries (i.e.,global) or idiosyncratic (i.e.,country-specific). The present paper specifies how these distinct shocks affect saving and investment behavior in the context of the intertemporal model. Through the saving-investment balance mechanism these shocks affect the trend and volatility of the current account position. The paper provided a blend of theoretical and empirical work concerning the logic and the empirical validity of key propositions of the intertemporal approach.

Do short cuts exist which are more simple to implement than the rigorous modern approach that could tell us what essentially drives current account behavior?

A popular approach in applied analysis is to regress the current account deficit on the real exchange rate,interest rates, such as "price" variables , and output, government spending, tax burden indicators,government debt and money creation, such as "income" variables. The typical regression uses mostly current variables, except that lagged output is added so that with current output they both form a proxy of permanent income. Most applied work still emphasizes income and price elasticities of exports and imports, based on partial equilibrium of essentially one-period model.

Traditional studies test debt neutrality by the restriction that the coefficient of taxes and debt are not significantly different from zero. Likewise they test whether the exchange rate is effective in improving the trade deficit by the sign and statistical significance of the coefficient of the real exchange rate, allowing possibly for simultaneous equations' bias by the use of instrumental variables. However, in this reduced-form analysis none of the expected variables suggested by the intertemporal model are explicitly included in the estimated equation. Similarly, no distinction is made among shocks that are persistent in nature and those which are only transitory. Likewise, no distinction is made between different types of taxation (e.g., taxes on capital income, labor income or consumption).

The reduced-form equation of the trade balance is not likely to provide relevant information on the validity of debt neutrality, the sensitivity of the current account to exogenous policy changes in the exchange rate or the rate of interest, and a host of other policy related issues. Because, if current taxes are a good predictor of future government spending, the fact that the tax coefficient is significantly different from zero is evidently in line with the neutrality proposition, contrary to the traditional interpretation. Likewise,a large positive current output coefficient may indicate persistent productivity shocks which play no role in the traditional approach.

The empirical implementation of the intertemporal approach has not been widespread. Inherently to the approach, models are not always tractable and there demand on data is quite high. Nevertheless there have been recent attempts to test some of the key hypotheses of this approach. The performance of the model and its key implications is quite encouraging, as indicated in this paper.

A drawback of the existing approaches is their inability to account for fiscal and monetary regime changes. For example, an increase in the stock of government bonds may signal future increase in taxes in order to service the new debt. But the debt increase may also signal future fall in government spending,or a forthcoming monetary accommodation and inflation. Current econometrics cannot distinguish between different forms of regime changes, with different implications for the debt-neutrality question and other important hypotheses. Potentially, new advents in the theory of endogenous policy should prove useful in this context.

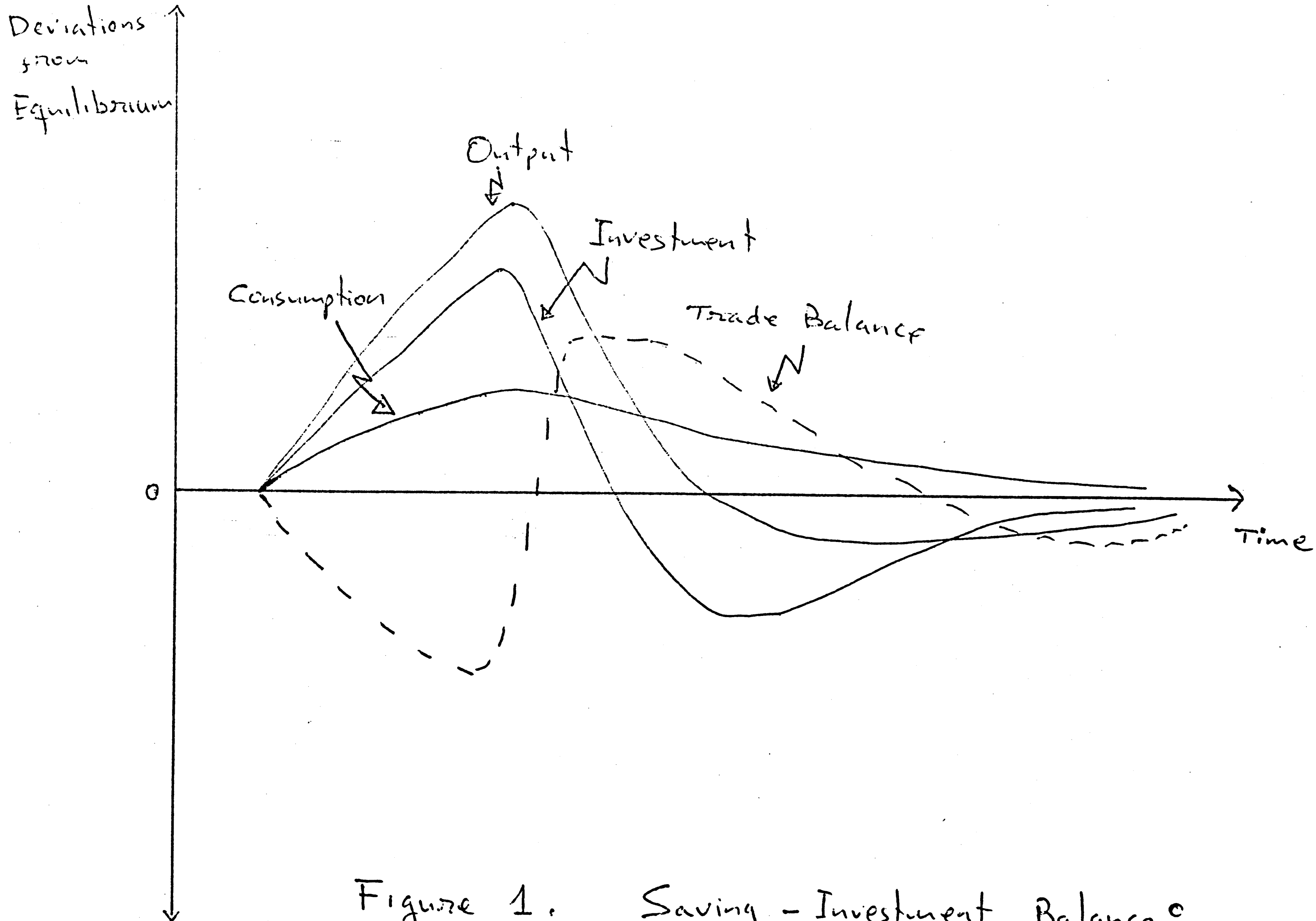
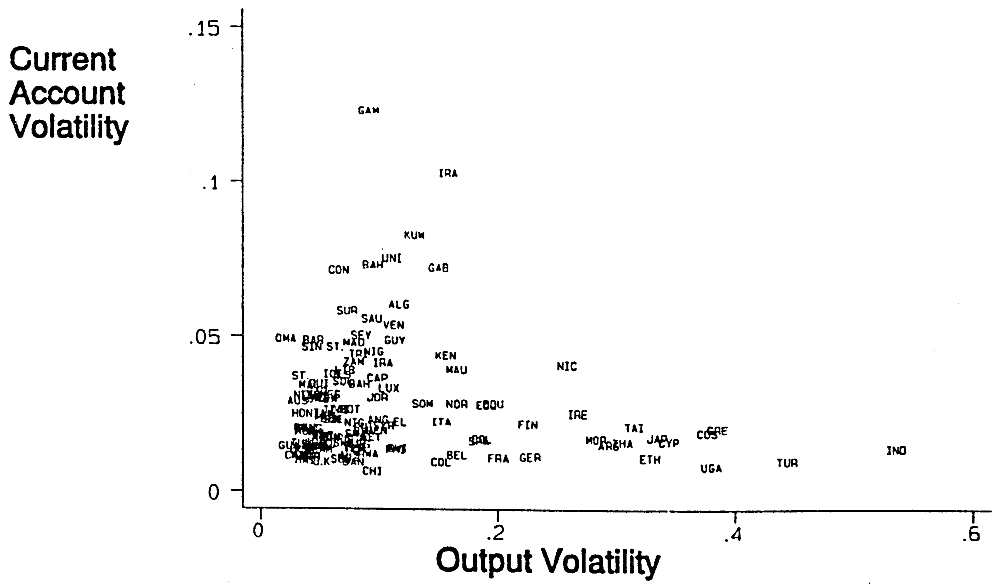


Figure 1. Saving - Investment Balance:
Impulse Response to Productivity Shock



Current Account and Output Volatility

Detrending: First Differences

Figure 2

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Table 2: Statistical Properties of Output, Trade Balance, Terms of Trade, Real Exchange Rate and Real Rate of Interest in the Seven Largest Industrialized Countries and Twenty-One Developing Countries[1]

Country	GDP		Terms of Trade		Trade Balance		Real Effective Exchange Rate		Real Rate of Interest		CORRELATIONS							
	σ	ρ	σ	ρ	σ	ρ	σ	ρ	σ	ρ	$\rho_{tb.tot}$	$\rho_{tot.e}$	$\rho_{tot.r}$	$\rho_{tb.e}$	$\rho_{tb.r}$	$\rho_{e.r}$	$\rho_{tb.y}$	$\rho_{tot.y}$
Seven Largest Industrialized Countries:																		
United States	2.17	0.446	7.11	0.776	9.00	0.509	12.68	0.814	2.46	0.694	-0.378	0.393	-0.039	-0.481	0.078	0.712	-0.277	0.197
United Kingdom	1.98	0.524	4.56	0.460	7.98	0.685	10.83	0.799	3.57	0.676	0.634	0.499	0.539	0.690	0.816	0.681	-0.538	-0.230
France	1.49	0.654	5.38	0.683	4.59	0.183	6.11	0.695	2.24	0.449	0.351	-0.463	-0.530	-0.372	-0.356	-0.183	-0.019	0.287
Germany	1.92	0.439	7.69	0.766	6.19	0.640	6.58	0.751	1.73	0.241	0.590	0.458	-0.351	0.299	-0.083	-0.324	-0.299	0.239
Italy	2.17	0.537	7.83	0.764	10.20	0.496	5.62	0.720	2.84	0.268	0.572	0.426	-0.231	-0.034	0.021	0.050	-0.210	0.112
Canada	2.01	0.540	3.64	0.577	5.37	0.532	7.76	0.682	2.08	0.565	-0.026	-0.312	0.286	0.012	0.430	0.067	-0.709	-0.034
Japan	3.58	0.812	14.77	0.820	13.48	0.546	9.66	0.670	3.21	-0.166	0.600	0.287	-0.264	0.075	0.122	-0.358	0.054	0.559
Developing Countries:																		
Argentina			10.64	0.295	26.84	0.347			57.44	-0.020	0.179		0.271		0.321			
Brazil			14.17	0.614	27.33	0.679			37.14	0.053	0.031		-0.110		0.004			
Chile			13.62	0.518	18.86	0.435			8.27	0.127	0.277		-0.540		-0.084			
Mexico			14.20	0.741	30.84	0.718			11.50	-0.219	0.368		0.290		0.142			
Peru			10.77	0.337	26.57	0.572			13.56	0.385	0.304		-0.016		0.337			
Venezuela			35.07	0.786	28.04	0.386			7.72	0.231	0.291		0.341		0.544			
Israel			5.94	0.667	11.77	0.490			367.08	-0.574	0.313		0.112		-0.344			
Egypt			9.78	0.413	17.35	0.665			3.35	0.092	-0.157		-0.133		0.378			
Taiwan			10.44	0.699	13.82	0.575			7.08	-0.023	0.556		-0.063		-0.054			
India			10.05	0.667	18.29	0.723			2.55	-0.131	0.439		-0.183		0.114			
Indonesia			29.17	0.817	12.35	0.268			3.08	-0.367	0.337		0.181		0.137			

Korea	10.56	0.778	16.19	0.574	9.03	0.527	0.243	0.332	0.188
Philippines	13.68	0.815	13.93	0.377	7.59	-0.037	0.444	0.103	-0.002
Thailand	9.76	0.586	13.16	0.551	4.05	0.388	-0.339	-0.491	-0.206
Algeria	35.59	0.761	23.83	0.343	2.70	0.052	0.181	-0.288	-0.450
Cameroon	22.70	0.812	17.25	0.467	2.94	0.322	0.421	0.334	-0.016
Zaire	19.14	0.647	18.97	0.723	16.80	-0.241	0.390	0.276	0.069
Kenya	9.94	0.450	16.05	0.374	4.42	0.416	0.204	-0.064	0.226
Morocco	10.46	0.582	15.86	0.659	3.21	0.207	0.259	0.135	0.192
Nigeria	39.95	0.785	31.33	0.527	9.10	0.181	-0.217	0.022	-0.025
Tunisia	24.09	0.852	12.50	0.452	2.29	0.304	-0.138	-0.620	0.047

[1] Data for the terms of trade and the trade balance are for the period 1960-1989, and for GDP for the period 1965-1989, expressed in per-capita terms and detrended using the Hodrick-Prescott filter with the smoothing parameter set at 100. GDP is gross domestic product at constant domestic prices from National Income Accounts, the terms of trade are the ratio of U.S. dollar unit value of exports to U.S. dollar unit value of imports, the real effective exchange rate is the ratio of unit value of exports to GDP, the trade balance is exports minus imports of merchandise from the Balance of Payments expressed at constant import prices (the detrended trade balance corresponds to detrended exports minus detrended imports). Source: International Monetary Fund, International Financial Statistics and Data Base for the World Economic Outlook. σ is the percentage standard deviation, ρ is the first-order serial autocorrelation, $\rho_{tb.tot}$ is the correlation of the trade balance with the terms of trade, $\rho_{tot.e}$ is the correlation of the terms of trade with the real effective exchange rate, $\rho_{tot.r}$ is the correlation of the terms of trade with the real rate of interest, $\rho_{tb.e}$ is the correlation of the trade balance with the real effective exchange rate, $\rho_{tb.r}$ is the correlation of the trade balance with the real rate of interest and $\rho_{e.r}$ is the correlation between the real effective exchange rate and the real rate of interest.

Table 3. Savings, Investment, and Capital Income Tax Rates

Country	Savings/GDP Ratio		Investment/GDP Ratio		Capital Tax Rate
	mean	corr.(tk)[1]	mean	corr.(tk)[1]	mean
United States	0.17	0.32	0.18	0.11	0.43
United Kingdom	0.18	-0.23	0.18	-0.37	0.56
Germany	0.25	-0.85	0.22	-0.69	0.25
Italy	0.21	-0.43	0.21	-0.93	0.26
France	0.23	-0.95	0.22	-0.81	0.24
Japan	0.33	-0.45	0.31	-0.58	0.33
Canada	0.24	-0.12	0.22	0.11	0.40

contemporaneous correlation with the capital income tax rate.

Note: Data for the period 1965-1988, except for Italy (1980-1988) and France (1970-1988).

Source: Enrique Mendoza, Assaf Razin, and Linda Tesar, "International Cross Sectional Analysis of Taxation," mimeo, IMF, 1992.

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