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DETERMINANTS OF EXTERNAL IMBALANCES: THE ROLE OF TAXES, GOVERNMENT SPENDING AND PRODUCTIVITY

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ABSTRACT

This paper develops and estimates a dynamic optimizing model of the current account. The model focuses, on real factors that determine the evolution of saving and investment, and hence the external balance. Three types of shocks are at the center of the analysis: productivity shocks, shocks to labor input, and tax policy shocks. While our approach is in line with the real business cycle models of the current account, the distinguishing feature of the work is the application of econometric methods to time series data for a small open economy so as to directly estimate the parameters governing saving and investment under rational expectations restrictions.

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I. Introduction and Overview

The purpose of this paper is to provide a framework for empirical analysis of the dynamics of external balance in a small open economy. Our main emphasis is on assessing the effects of changes in fiscal policy, such as changes in taxes or public spending, as well as in underlying real factors such as the level of productivity. The framework is implemented on time series data for Israel. We first uncover a set of stylized facts that characterize the behavior of the external balance, and then develop and estimate an intertemporal optimizing model of external balance. The main feature that distinguishes our approach from most previous studies is that the external balance is analyzed in terms of the gaps between saving and investment that arise in a dynamic equilibrium model of intertemporal optimization.[1] On the basis of the estimates of the fundamental parameters obtained in the econometric analysis, we povide a set of dynamic simulations of the effects of changes in policies and in institutional and technological driving factors on the saving-investment balance.

Most policy discussions of structural adjustment focus on the current account, which measures the rate of accumulation of external assets. A broader definition of changes in national wealth incorporates also changes in the value and quantity of the domestic capital stock, due to investment. Accordingly, we also analyze the evolution of this broader measure in order to highlight the role of this key determinant

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[1]See, for example Obstfeld (1986).

of changes in national wealth. Comparing these two measures of asset accumulation is useful for the design of structural adjustment policies in the presence of a tradeoff between investment and the external position.

The time series behavior of Israel's import surplus, our main measure for external balance, exhibits two main features. First, there is no noticeable trend in the long run movements of this surplus, which since the late 1960s has on average remained at a level of about 15 percent of domestic output. Second, there are marked short and medium run cyclical movements in the import-export imbalance. The amplitude of these cycles has varied over time, and the largest difference between peak to trough, of about 15 percent of GDP, occurred from 1972 to 1974. These features are transparent from the behavior of the ratio of domestic absorption to GDP, the mirror image of the ratio of the import surplus to GDP, in Figure 1.

Economic analysis and policymaking discussions have traditionally attributed imbalances between exports and imports primarily to movements in the real exchange rate. The evidence for two measures of the real exchange rate (i.e., the export/domestic and import/domestic price ratios) is presented in Figure 1.

In terms of long run real exchange rate movements, while there is a mild trend of real depreciations from the late 60's to the reform of 1977, the pattern is reversed as a trend of sharp real appreciations appeared after 1977. Coupling the trendless long run behavior of the import surplus together with the time varying trends of the real exchange rate suggests that in the long run there is a weak statistical link between these variables. In the short run, however, one can identify several subperiods in which the comovement of the real exchange rate and the import surplus conforms with the traditional view asserting that there is an inverse relation between real appreciation and the economy's external balance stance, yet there is also evidence against this view.

The absence of clear-cut long run statistical links between the real exchange rate and the import surplus and the fact that in some subperiods these variables move in the same direction seem to contradict the traditional view. These links, however, can be accounted for in a general equilibrium framework; see e.g. Frenkel and Razin (1987). In such framework, the comovement between these two variables is explained by changes in the fundamental factors underlying policy, preferences, and technology. In other words, their time patterns depend on the specific demand and supply shocks that impinge on the economy at any particular time period.

As is well known, national income accounting implies that the import surplus must be equal to the discrepancy between aggregate saving and investment. Aggregate saving, in turn, is typically decomposed into private sector and public sector components. Previous work commonly used a working hypothesis whereby changes in public sector saving -- which are in effect changes in the government budget imbalances -- influence directly the import surplus. Specifically, a rise in government's budget deficit is typically predicted to result in a fall in national saving and thus worsening the external deficit. In recent years this working hypothesis has been questioned both on theoretical and empirical grounds (see e.g. Barro (1988)).

The behavior of national saving and its private sector and public sector components (expressed as ratios of total income) is presented in Figure 2. From the late 1960's, the long run behavior of the aggregate saving ratio does not exhibit a clear-cut trend. The saving ratio fluctuates around a level of about 15 percent of total income (GNP plus unilateral transfers from abroad). Over shorter periods, there have nevertheless been pronounced cycles in the saving ratio. In particular, there is an increase in saving in the early 80's which turns into a sharp fall of aggregate saving after 1985. Along with the relatively trendless behavior of the aggregate saving ratio in the long run, private sector and public sector saving have generally behaved as mirror images of each other. Until the late 70's the private saving ratio exhibits an upward trend and the public saving ratio shows a downward trend. In contrast, during the 1980's this pattern is reversed. This evidence of private sector saving offsetting, to a large extent, movements in public sector saving does not conform with the view that changes in the government budget deficit have a direct impact on the import surplus (i.e., that the "twin deficits" should move in the same direction). As regards investment, the most salient empirical regularity is the downward trend that prevailed since the early 1970's; see Figure 3.[2] Furthermore, public sector investment also declined sharply through time. The public investment to GNP ratio in the 1980's

[2]For a related discussion of these empirical regularities, see Ben Porath (1987). Note that it is not straightforward to translate the evidence in Figures 2 and 3 into implications for the import surplus based on Figure 1. The reason is that different variables are used as denominators in expressing the alternative ratios.

is about two-thirds of its level in the 1970s.[3]

Interestingly, saving-investment and current-account patterns of this type are not unique to Israel (see Barro (1988)). In a number of countries it has recently been observed that changes in government saving (the budget surplus) have been offset by opposite changes in private sector saving. This offset is potentially compatible with the notion of the so-called Ricardian neutrality, provided that the changes in the government budget are mostly the result of changes in taxes. As a consequence of such neutrality, observed movements in the current account were mainly driven by movements in investment.

In our framework, the dynamics of the current account is accounted for in terms of forward looking optimizing behavior of firms and consumers, operating in the presence of changes in three types of fundamental factors: productivity, labor input (which can also be interpreted as real wage changes), and tax revenue. A fourth factor, government spending, was included in our previous work using a similar sample (Leiderman and Razin (1988a)). Our present focus on real factors determining the current account[4] supplements previous research that focused on nominal factors, such as nominal exchange rate policy (see e.g. Leiderman and Razin (1988b)).

Table 1 provides evidence on key variables from the production side of the model. During the 1980's there is a marked slowdown in the

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[3]See Meridor (1988).

[4]Our emphasis on real factors, such as productivity and labor supply changes, is along the lines of the modern real business cycle approach; see Kydland and Prescott (1982) and Long and Plosser (1983).

growth rate of output, which is accounted for by slowdowns in the rates of growth of capital, labor input, and productivity.[5] In part, this

TABLE 1 - PRODUCTION-SIDE INDICATORS
(Annual Percentage Rates of Change)

Period	Output	Labor Input	Capital Input	Productivity
1960-65	9.1	4.6	10.1	2.8
1966-72	9.2	2.7	7.4	5.1
1973-79	3.9	0.8	6.3	1.4
1980-85	2.4	1.1	3.8	0.4
1986-88	3.7	2.1	2.7	1.4

Note: The figures correspond to the business sector.
Source: Annual Report 1988, Bank of Israel, Table F-1.

TABLE 2 - FISCAL INDICATORS
(percents of GNP)

	Domestic Government Spending				Tax Revenue	
Period	Consumption	Investment	Debt Service	Total	Gross	Net
1960-66	16.3	4.5	0.9	21.7	31.2	23.8
1967-72	22.6	4.3	2.2	29.1	37.0	24.7
1973-77	26.2	4.9	4.0	35.1	44.9	22.9
1978-80	25.7	3.9	4.3	33.9	47.0	21.1
1981-86	25.9	3.1	4.1	33.1	47.6	20.8

Note: All variables refer to domestic components of the government budget. Net taxes are gross taxes minus transfers and subsidies to the private sector.

Source: Meridor (1988), Tables 1 and 2.

[5] For a discussion of the relation between employment in public and private sectors, see Ben Porath (1987).

reflects the declining share of private sector employment in total employment.

Turning to underlying fiscal factors such as tax revenue and government spending, see Table 2, tax revenue (net of transfers to the private sector) decreased from about 24 percent of GNP in the 60's and early 70's to about 21 percent in the 80's. At the same time, government spending (for consumption and investment purposes as well as domestic debt servicing) increases from about 25 percent of GNP in the 60's and early 70's to about 34 percent of GNP in the 80's. Note that after the disinflation policy adopted in 1985 there was a sharp increase in tax revenue and a decrease in government spending, thus resulting in a narrowing of the government deficit to levels similar to those of the 1960's.

The remainder of the paper is structured as follows. Section II develops a dynamic model of the determination of the import surplus. Empirical estimates are reported in Section III. We use monthly data on Israel from 1980 to 1988. Dynamic simulations of the effects of changes in tax policy are provided in Section IV. Section V extends the model to allow for substitution between public and private consumption. Section VI concludes the paper. Formal derivations appear in the appendix.

II. A Dynamic Model of the Current Account

Consider a small open economy, producing and consuming a single aggregate tradable good. Output, Y, is produced by a Cobb-Douglas production function with two inputs, labor, L, the capital, K, i.e.,

$Y_t = a_0 K^{a}_{t-1} L_t^{(1-a)} \epsilon'_t$, where ϵ'_t measures the level of productivity and a is the capital distributive share. Labor supply to the private sector and productivity changes are specified as exogenous stochastic processes.[6] They are:

$$(1) \qquad L_t - L = \phi(L_{t-1} - L) + \xi_{Lt},$$

$$(2) \qquad \epsilon_t - \epsilon_{t-1} = \zeta(\epsilon_{t-1} - \epsilon_{t-2}) + \xi_{\epsilon t}$$

where ϕ, ζ and L are fixed parameters and ξ_{Lt} and $\xi_{\epsilon t}$ are zero mean random variables.

Firms are assumed to maximize the expected value of the discounted sum of profits subject to the production function and to a cost-of-adjustment investment technology. Accordingly, gross investment, Z, is given by:

$$(3) \qquad Z_t = (K_t - K_{t-1})(1 + \frac{g}{2}[\frac{K_t - K_{t-1}}{K_{t-1}}])$$

where g is a cost-of-adjustment coefficient.[7]

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[6]What we have in mind is an inelastic total labor supply out of which government absorbs a certain part, leaving a residual for the private sector that behaves as specified in equation (1). This specification is especially relevant for economies in which the public sector employs a relatively sizable fraction of the labor force.

[7]As a first approximation the specification in equation (3) abstracts from changes in the relative price of investment goods. In an open economy, investment goods may have a sizable import component, and if so their relative price correlates with the real exchange rate. We plan to incorporate this channel in future work. Observe that in the extended framework, highly fluctuating exchange rates (due to, say, inconsistencies between exchange rate and fundamentals) may lead to speculative bunching of

In this formulation, in order to effectively augment the capital stock by $K_t - K_{t-1}$ firms have to invest an amount Z_t of resources. Evidently, in the absence of costs of adjustment (i.e., $g = 0$), $Z_t = K_t - K_{t-1}$. However, when these costs are present, gross investment exceeds net capital formation.

The optimal investment rule sets, as usual, the cost of investing an additional unit of capital in the current period equal to expected present value of the next period sum of the marginal productivity of capital, the decrease in investment costs of adjustment due to a larger capital stock and the market price of next period's capital, net of depreciation. Linearizing around a steady state point, using the forward solution for investment, incorporating the stochastic processes of the driving variables, and also linearizing the production function yields linear reduced-form equations for capital stock and output:

$$(4)\quad K_t = K + \lambda_1(K_{t-1} - K) + m_L(L_t - L) + m_e(\epsilon_t' - \bar{\epsilon}') + m_e(\epsilon_t' - \epsilon_{t-1}'),$$

$$(5)\quad Y_t = Y + h_k(K_{t-1} - K) + h_L(L_t - L) + h_\epsilon(\epsilon_t' - \bar{\epsilon}'),$$

where K and Y are the steady-state levels of capital and output, respectively, and λ_1, m_L, m_ϵ, m_e, h_L, are reduced-form fixed coefficients. Given labor employment as in equation (1), linearization of the marginal-productivity-of-labor condition yields the real wage equation:

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investment spending in periods of expected exchange rate adjustment.

$$S_t = \bar{S} + s_k(K_{t-1} - \bar{K}) + s_L(L_t - \bar{L}) + s_\epsilon(\epsilon'_t - \bar{\epsilon}'), \tag{6}$$

where S_t denotes period t real wage, and $\bar{S}$, s_k, s_L, and s_ϵ are reduced-form coefficients. Observe (see Appendix) that, along with the Lucas (1976) critique argument, the reduced-form coefficients of equations (4)-(6) depend on the parameters of the production and investment technologies as well as on the parameters of the stochastic processes of the driving variables. Also appearing in Equations (4)-(6) are the steady-state values of capital, output and the real wage. These are explicitly given in our model by:.

$$\begin{aligned} \bar{K} &= \bar{L}[(R-1)/\alpha a_0]^{\frac{1}{\alpha-1}} \bar{\epsilon}', \\ \bar{Y} &= a_0(\bar{K})^\alpha(\bar{L})^{1-\alpha} \bar{\epsilon}', \\ \bar{S} &= (1-\alpha)a_0(\bar{K}/\bar{L})^\alpha \bar{\epsilon}'. \end{aligned} \tag{7}$$

As is common $\bar{K}$ is derived from the equality between the rate of interest and the marginal product of capital, $\bar{Y}$ is derived from the resulting value of $\bar{K}$, and $\bar{S}$ is the resulting value of the marginal productivity of labor. Investment in the steady state amounts to what is required in order to maintain a fixed capital stock.

Turning to the consumption side of the model, the basic setup (see Leiderman and Razin (1988a)) allows for real effects of intertemporal tax shifts and also incorporates durable consumer goods. The per-capita stock of consumer goods which generates a flow of consumption services is the argument in the utility function. This per-capita stock, C_t, which is subject to depreciation, is augmented every period by purchases of consumer goods, X_t, according to the relation:

(8) $$C_t = (1-\omega)C_{t-1} + X_t,$$

where ω is the depreciation coefficient. The consumer faces a risk-free real interest factor R (one plus the rate of interest). Due to lifetime uncertainty, the effective (risk-adjusted) interest factor is, however, $(R/\gamma) > R$, where $0 < \gamma < 1$ denotes the probability of survival from one period to the next.. Maximization of expected lifetime utility, with a quadratic utility function $u = hc - 0.5c^2$, where c represents consumption of the individual, yields a linear consumption function:

(9) $$C_t = \beta_0 + \beta_1\left[E_tW_t - \frac{R}{\gamma} A_{t-1} + (1-\omega)\gamma C_{t-1}\right],$$

where E_tW_t denote the expected value of the discounted sum of current and future levels of disposable income, A_{t-1} denotes last period debt, and β_0 and β_1 are the consumption function parameters. These parameters depend on the intertemporal elasticity of substitution, the subjective discount factor, the rate of interest, the survival probability, and the consumption stock rate of depreciation (see Appendix). Assuming rational expectations, expected future income streams are calculated by taking into account the output path implied from the capital-formation process and from the processes governing changes in labor supply and productivity, using equations (1)-(5). Likewise, the discounted sum of taxes is assumed to be governed by an exogenous stochastic process, as follows:

$$(10) \qquad T_t = T_{t-1} + \kappa(T_{t-1} - T_{t-2}) + \xi_{Tt},$$

where κ is a fixed coefficient and ξ_T is a zero-mean finite-variance random term. Using (1)-(5) and (9), the expected value of the discounted sum of disposable income is given by:

$$(11) \qquad E_t V_t = n_0 + n_k(K_{t-1} - K) + n_L(L_{t-1} - L) + n_\epsilon(\epsilon_{t-1} - \bar{\epsilon}) + \\ + n_{T1}T_{t-1} + n_{T2}T_{t-2},$$

where the n coefficients (see Appendix) depend on the parameters of the underlying production and investment technologies as well as on the parameters of the driving variables: labor, productivity, and taxes. Substituting equation (11) into equation (9) yields a relation for the stock of consumption goods as a function of lagged values of the capital stock, labor employment, productivity, taxes, consumption stock, and debt. Given this relation, the implications of the model for the flow of consumption purchases can be derived using equation (8). Notice that changes in the parameters that characterize the underlying preferences, technology, and tax policy will alter the coefficients in the reduced form for consumption. This holds in particular for changes in the degree of persistence of tax policy shocks, employment and productivity shocks. In the present section as well as in section IV below it is assumed that fiscal spending is endogenously determined so as to satisfy the government intertemporal budget constraint.

In order to determine the model's implications for the current account of the balance-of-payments, we combine the relationships which describe the consumption side of the model with those pertaining to the production-investment side, and use the national-income accounts relation:

(12) $$CA_t = (Y_t - rA_{t-1} - T_t) - (X_t + Z_t),$$

where CA denotes the private-sector current-account surplus, and r is the real rate of interest.

While equation (12) is a conventional definition of the private sector current account surplus, it does not take into account changes in the market value of the capital stock due to capital gains or losses. In our model, the market value of one unit of domestic capital is equal to

$$q_t = 1 + g\frac{I_t}{K_t}.$$

Accordingly, a broader definition of changes in private-sector (physical) wealth is given by:

(13) $$CW_t = q_t K_t - q_{t-1}K_{t-1} + CA_t.$$

III. Empirical Implementation

We implement the model on monthly time series data for Israel covering the period from 1980:1 to 1988:12. The data consist of quarterly national income accounts figures and monthly figures for government cash flows, imports of investment goods, industrial production, and consumer goods sales of large retailers.[8] Quarterly national income accounts series are converted into monthly series by using the corresponding behavior of their monthly counterparts within each quarter. Since the productivity variable is unobservable, we obtained time series for this variable by estimating the Solow residual from a logarithmic version of the production function (under the assumption that the labor elasticity is .75).

Estimation proceedes in two steps. First, we estimate the stochastic processes governing the evolution of productivity and labor input through time (equations (1) and (2)), and the investment behavior equation:

$$(14)\quad \frac{1}{2}R\left(\frac{I_{t+1}}{K_t}\right)^2 + \frac{I_t}{K_{t-1}} = \frac{(R-1)}{g} + R\,\frac{I_{t-1}}{K_{t-2}} - \left(\frac{\alpha\alpha_0}{g}\right)\left(\frac{K_{t-1}}{L_t}\right)^{\alpha-1}\epsilon_t' + \theta_t .$$

This equation is derived from the optimal investment rule by replacing the expected by the corresponding realized values in that rule based on the assumption of rational expectations, where the residual θ_t is a rational forecast error and the monthly interest factor R is assumed to be equal to 1.002. The second step consisted of estimating the consumption purchases relation (based on equations (9) to (11)). This second step requires taking into account rational expectations forecasts of the future time path of disposable income, and this was derived using the estimates from the first step.

[8] Sources for data are the Central Bureau of Statistics and the Bank of Israel.

Table 3 presents the parameter estimates from the first step. The estimates of the AR1 parameters of the stochastic processes of labor and productivity change indicate that labor input shocks have a relatively large degree of persistence and that productivity shocks give rise to cycles in first differences of productivity. The estimated value of g implies that at the sample mean 2.8 percent of gross investment is accounted for by the cost of adjustment.[9] To assess the relative importance of the labor input and productivity shocks for capital accumulation, we calculated a variance decomposition based on equation (4) and found that about 55 percent of the variance of capital accumulation is accounted for by the productivity shocks. This indicates an important role of these shocks in the process of investment. Actual and fitted values of the capital stock are plotted in Figure 4. The plots indicate relatively good fits.

Second, we estimate the consumption-side parameters jointly with the process for tax revenue (eq.10)). The system is estimated under several auxiliary assumptions: (i) the interest factor, R, is set equal to 1.002 (as in the estimation of the investment equation); (ii) the finite-life coefficient, γ, is set equal to 0.998, the value obtained in our previous work (see Leiderman and Razin (1988a)); and (iii) the number of lags of consumption purchases is set equal to eight. The system is estimated for the sample period 1980:10 - 1988:12.

Table 4 reports non-linear least squares estimates for the unrestricted and retricted versions of the system. The parameter

[9]Interestingly, Shapiro (1986) reports a similar magnitude for the cost of adjustment (2.4 percent in his case) for postwar U.S. quarterly data.

estimate for κ is negative (and smaller than one in absolute value), indicating that shocks to taxes give rise to a one-month cycle in tax revenue. The utility function parameter h is positive and its per-capita value at population'ssample mean, is 37.86. This value (which is not precisely estimated) is larger than per-capita consumption values over the sample, as required to ensure positive marginal utility. The implied degree of relative risk aversion (C/(h-C)) is 0.1 at consumption's sample mean. The monthly subjective discount factor is close to one, and the consumer durability parameter is 0.569. All in all, the estimates seem to conform to their theoretical counterparts in the model.

TABLE 3 - PRODUCTION-SIDE PARAMETER ESTIMATES

ϕ	= 0.940 (0.031)	(AR1 parameter for labor input process)
ρ	= -0.347 (0.094)	(AR1 parameter for first difference in productivity process)
g	= 3.00 (0.20)	(Coefficient of Investment Cost of Adjustment)
λ_1	= 0.926	(Roots of the Investment Behavior Equation)
λ_2	= 1.082	

Note: Figures in parentheses are estimated standard errors. The λ_1 and λ_2 coefficients were computed according to the formula appearing in Appendix 1.

TABLE 4: CONSUMPTION-SIDE PARAMETER ESTIMATES

I. Unrestricted System

$$T_t - T_{t-1} = -\underset{(0.085)}{0.573}\,(T_{t-1} - T_{t-2})$$

$$X_t = \underset{(1880.6)}{6262.6} + \underset{(0.002)}{0.005}\,k_{t-1} + \underset{(3.765)}{13.032}\,\ell_{t-1} + \underset{(1101.7)}{3182.4}\,\epsilon_{t-1}$$

$$-\underset{(1209.0)}{2452.2}\,e_{t-1} + \underset{(0.091)}{0.103}\,T_{t-1} + \underset{(0.091)}{0.241}\,T_{t-2} +$$

$$\underset{(0.096)}{0.275}\,X_{t-1} + \underset{(0.102)}{0.052}\,X_{t-2} + \underset{(0.093)}{0.114}\,X_{t-3} - \underset{(0.089)}{0.045}\,X_{t-4} + \underset{(0.096)}{0.156}\,X_{t-5}$$

$$-\underset{(0.102)}{0.102}\,X_{t-6} - \underset{(0.100)}{0.140}\,X_{t-7} + \underset{(0.090)}{0.010}\,X_{t-8}$$

II. Restricted System

$\kappa = -0.545$ (0.079) (AR1 coefficient in tax equation (20))

$h = 159000.0$ (189000.0) (constant in the utility function $hc - 1/2c^2$)

$\delta = 1.003$ (0.016) (subjective discount factor)

$\omega = 0.431$ (0.082) (consumer goods depreciation coefficient)

Figures in parentheses are estimated standard errors.

IV. Dynamic Simulations

The linearized model Table 5. Equation (S.1) corresponds to eq.(4) in the text; eq. (S.2) corresponds to eq. (5) in the text, eq. (S.3) is a linearized version of eq.(6), and eq. (S.4) corresponds to eq. (3) in the text. Eq. (S.5) is derived from eqs. (9) and (11), and eq. (S.6) corresponds to eq. (8) in the text. Eq. (S.7) is the resource constraint of the private sector and eq. (S.8) is the current account surplus of the private sector (external balance). The remaining equations are the dynamic processes for the driving variables. We have set $e_0 = \ell_0 = 0$ to assure the existence of a steady state. The various parameters are detailed in the Appendix. The parameter values and initial conditions for the baseline used in the simulations are given in Table 6.

In what follows, we discuss the simulated impacts of changes in productivity and taxes.

1. Productivity

In the present one-good model, productivity increases can be interpreted as arising from several sources: (i) increased government investment in infrastructures, R & D, and higher education; (ii) an improvement in the terms of trade of the private sector (which may be

TABLE 5: THE SIMULATION MODEL

(S.1) $K_T = \bar{K} + \lambda_1 k_{t-1} + m_\ell \ell_t + m_\epsilon \epsilon_t + m_e e_t,$ (Capital)

(S.2) $Y_t = \bar{Y} + h_k k_{t-1} + h_\ell \ell_t + h_\epsilon \epsilon_t,$ (Output)

(S.3) $S_t = \bar{S} + s_k k_{t-1} + s_\ell \ell_t + s_\epsilon \epsilon_t,$ (Real Wage)

(S.4) $Z_t = (k_t - k_{t-1})(1 + \frac{g}{2} \frac{(k_t - k_{t-1})}{k_{t-1}})$ (Investment)

(S.5) $C_t = \beta_0 + \beta_1 \Big[n_0 + n_k k_{t-1} + n_\ell \ell_{t-1} + n_\epsilon \epsilon_{t-1} + n_e e_{t-1} + n_{T1} T_{t-1} + n_{T2} T_{t-2} - RA_{t-1} + (1-\omega)\gamma C_{t-1} \Big]$ (Consumption Stock)

(S.6) $X_t = C_t - (1-\omega)C_{t-1}$ (Consumption Purchases)

(S.7) $X_t + Z_t = Y_t - ra_{t-1} - T_t + (A_t - A_{t-1})$ (Resource Constraint)

(S.8) $CA_t = A_{t-1} - A_t$ (Private Sector Current Account Surplus)

(S.9) $\ell_t = \phi \ell_{t-1}$ (Employment Process)

(S.10) $\epsilon_t = e_t + \epsilon_{t-1}$ (Productivity)

(S.11) $e_t = \rho e_{t-1}$ (Change in Productivity Process)

(S.12) $T_t = T_{t-1} + \kappa(T_{t-1} - T_{t-2})$ (Taxes' Process)

TABLE 6: BASELINE PARAMETERS

Parameters	Initial Condition
$\phi = 0.94$	$k_{-1} = -223552$
$\rho = -0.35$	$X_{-1} = 15000$
$\kappa = -0.57$	$a_{-1} = 0$
$R = 1.002$	$\ell_{-1} = 0$
$\gamma = 0.998$	$\epsilon_{-1} = 0$
$\omega = 0.43$	$e_{-1} = 0$
$\delta = 0.997$	$T_{-1} = 0$
$h = 159000$	$T_{-2} = 0$
$\alpha = 0.25$	$L = 1220.$
$\alpha_0 = 1.71$	
$g = 3.0$	

related to an exchange rate policy that enhances competitiveness); and (iii) technological progress. Given the aggregative nature of our analysis, we do not attempt to disentangle observed productivity changes into its different sources. Rises in productivity, meaning that more output is produced from a given bundle of inputs, increase the real wage as well as profits. Accordingly, they lead to an increase in investment. The increases in future wages and profits result in an increase in permanent income and thus in consumption. Whether the rise in consumption exceeds or falls short of the rise in output depends on the exact time profile of the rise in productivity.

The first simulation consists of a permanent 10 percent rise in overall productivity. In discussing this change, it is useful to trace its effects on the various components of the current account equation (11) and on its permanent counterparts. To do so it is useful to express the current account as

$$(15) \qquad CA_t = (Y_t - Y_t^p) - (X_t - X_t^p) - (Z_t - Z_t^p),$$

where the superscript p denotes the permanent value[10] of the relevant variable. In (15) we use the fact that $CA_t = 0$ and assume that government spending does not deviate from its permanent value. The permanent rise in productivity leads to an increase in both current and permanent levels of output, but since the former effect is weaker than

[10]For any variable, y_t, we define its permanent value as that which satisfies $\Sigma_{\tau=0}^{\infty} d_\tau y_{t+\tau} = y_t^p \Sigma_{\tau=0}^{\infty} d_\tau$, where d is the present value factor. We thank Torsten Persson for suggesting to us this useful approach.

the latter, i.e., $Y_t < Y_t^p$ this factor contributes toward a worsening of the current account position. An additional effect in the same direction arises from investment behavior. That is, since current investment after the productivity shock must exceed the permanent level of investment (i.e., $Z_t > Z_t^p$) the latter being the amount of resources required to maintain the permanent stock of capital, this component of the economy's response to the shock worsens the current account position. The consumption component, however, tends to improve the current account since current consumption increases by less than permanent consumption (i.e., $X_t < X_t^p$) due to the overlapping generations structure of the model. The latter implies that in a growing economy future generations have larger permanent income than the current generation.

Despite the worsening of the current account position, there is an improvement in the current account surplus and wealth accumulation when expressed as ratios to output, as seen in Figures 5a and 5b. The rise in the level of output following the productivity shock combined with a deficit position in the baseline current account leads to a decrease in the deficit relative to GDP. Since the productivity shock causes increases in investment and in the market value of the capital stock it results in a rise in the ratio of wealth accumulation to output (see Figure 5b) a rise that indicates that these factors dominate the negative effect arising from the increase in external debt.

Figures 6a and 6b display the effects of a different productivity change, namely a change in the persistence parameter ρ (see equation (2)). Taking as an initial position a rising trend in productivity, this change has noticeable dynamic impacts on the current account and on wealth accumulation, that occur with a lag.

2. Taxes

As is well known, changes in taxes affect private consumption through their impact on disposable income and wealth. In what follows, we analyze changes in the time profile of taxes based on the estimated dynamic process for this variable (see equation (10)). These changes may result in changes in the net present value of taxes. Thus, even though our model of the economy is close to being Ricardian (in the sense that intertemporal substitution of taxes while keeping their net present value unchanged does not significantly affect consumption), the tax policies considered below do have a marked impact on private consumption.[11]

A rise in the initial value of taxes by 10 percentage points of output (with a continuing increase through the tax-evolution equation) decreases consumption by about 3-4 percent relative to the baseline case and slightly improves the current account. This improvement results in an increase in wealth accumulation (see Figures 7a-7b).

Another simulation consists of changing the κ-parameter in the stochastic process for taxes. In Figures 8a-8b, we change κ from -0.57 to -0.50. Using our parameter values and initial conditions, this change amounts to an increase in taxes on the current generation. Notice from Figures 8a and 8b that the current account and wealth accumulation ratios to output exhibit cyclical responses to this change,

[11] Observe that we abstract from the distortionary effects of taxes such as those affecting labor-leisure or consumption-saving choices.

arising from cyclical changes in consumption. The latter can be interpreted in light of the overlapping generations structure of the model. Given the stochastic process of taxes employed here, consecutive generations face alternating high and low tax burdens which are reflected in the cyclical responses of the above.

V. Substitution between Public and Private Consumption

In this section, we discuss how the model can be extended to allow for interaction (i.e., substitution or complementarity) between public consumption and private consumption. We have in mind cases such as education and defense. It is plausible that government spending on education is a substitute for private spending on education. Thus, a 1 shekel increase in government spending on education is likely to be accompanied by some decrease in private sector spending on education. At the same time, government spending on defense may be complementary to private consumption spending because the increased security may enhance consumption. To the extent that the substitution effects of government spending offset the complementarity effects, we are back to the model of the preceding sections.

The extension draws on Leiderman and Razin (1988a). Note that in this extension output follows an exogenous stochastic process. Let the utility function be specified by:

$$(16) \qquad U(c_t, G_t) = h(c_t + \theta G_t) - \frac{1}{2}(c_t + \theta G_t)^2 + V(G_t),$$

where

$$(17) \qquad G_t = (1-\omega)G_{t-1} + g_t,$$

and where G denotes the stock of public consumption, g denotes the flow of government purchases, and θ is a parameter that measures the impact of public consumption in total private effective consumption, $c_t + \theta G_t$ (see Aschauer 1985). $V(G_t)$ denotes the separate role of government consumption in private utility as is implicitly assumed in the model of the preceding sections.

Positive values of θ indicate substitution between government and private consumption, since when G increases by one unit it is required to reduce private consumption, c, in order to maintain constant effective consumption. A negative value of θ indicates complementarity betwen private consumption and public consumption.

For tractability; the rates of depreciation of the stocks of private and public consumption goods are assumed to be identical and are denoted by ω. As shown in Leiderman and Razin (1988a), in this case the analogue of equation (9), expressing aggregate per capita consumption, C_t, is

$$(18) \qquad C_t = \beta_0\Big[E_t \sum_{t=0}^{\infty} \left(\tfrac{\gamma}{R}\right)^{\tau} (y_{t+\tau} + \theta g_{t+\tau}) - RB_{t-1} + \gamma(1-\omega)(C_{t-1} + \theta g_{t-1})\Big] - \theta G_t \,.$$

We assume that the expected flow of future public consumption evolves according to a simple process, given by:

$$(19) \qquad g_t - g_{t-1} = \rho_g(g_{t-1} - g_{t-2}) + \eta_{gt}$$

and that the output and tax processes are:

(20) $$Y_t - Y_{t-1} = \rho_y(Y_{t-1} - Y_{t-2}) + \eta_{yt}$$

(21) $$T_t - T_{t-1} = \rho_T(T_{t-1} - T_{t-2}) + \eta_{Tt}.$$

Results of estimating constrained and unconstrained versions of this system appear in Leiderman and Razin (1988a), where the model was also extended to allow for liquidity-constrained consumers whose consumption is equal to last period's disposable income. The results indicate that the model's overidentifying restrictions are not rejected at the one-percent level. Also, the evidence does not support the hypothesis that a statistically significant proportion of the population is liquidity constrained. The estimated values of ρ_y, ρ_T, and ρ_g are: -0.22 (0.10), -0.59 (0.07), and -0.55 (0.07) respectively, with standard errors in parentheses. The estimated value of θ is -0.47 with a standard error of 0.26. Thus, there is complementarity between public and private consumption, yet this effect is not very precisely estimated.

VI. Concluding Remarks

This paper develops, estimates, and simulates an intertemporal model of external balance dynamics in a small open economy. Despite the complexity of the full-blown optimizing model, it is transformed into a relatively small scale set of reduced form relations, capable of delivering a potentially rich set of macroeconomic simulations. By virtue of the optimizing nature of the analysis, these relations embody the structural, or policy invariant, parameters of preferences, policy, and technology. The analysis of the model demonstrates the notion that there is no simple relation between output growth, current account behavior, and changes in national wealth.

It is commonplace in policy discussions to assume that the policy maker targets the current account. This assumption can however be questioned. In effect, the current account measures the rate of accumulation or depletion of external assets. This is only a subset of the assets owned by the country, as there is also domestic physical and human capital. Thus, a broader measure of changes in national wealth ought to include the latter, and our analysis indeed proceeded in this direction.

The present analysis and results can be used to assess the effects of alternative structural adjustment policy scenarios on the economy's external position. One such scenario entails the following ingredients: (i) an increase in public investment in infrastructure, incentives to research and development, and budget allocations to enhance investment in human capital. These measures are likely to result in an increase in productivity. (ii) a decrease in public sector employment as part of an attempt to reduce the size of the government sector. This, coupled with at least unchanged private sector demand for labor, implies an increase in the size of the labor input in the production of the private sector. Our analysis and simulations indicate that both these changes have similar effects on the import surplus and the broader measure of change in national wealth. That is, on the one hand they tend to stimulate investment and to accelerate output growth and thereby to temporarily worsen the current account position despite their positive effect on saving. On the other hand, however, they result in an increase in national wealth (i.e., the increase in the value of the domestic capital stock exceeds the deterioration and the current account position). Thus, this secenario confronts the policy maker with a tradeoff between the prospects of enhanced economic growth and capital accumulation at the expense of an increase in external debt.

Other policy measures may be targeted to exert a direct impact on saving. Our analysis shows an important degree of sensitivity of saving to changes in the rate of return. Thus, incentives that effectively raise this return can be predicted to result in an increase in saving. This would contribute toward improvement in both external balance and national wealth. If this scenario includes an increase in tax revenues from other sources in order to compensate for the loss of revenue from enhanced saving incentives, then our analysis indicates that by themselves these additional taxes have only a negligible impact on the saving-investment balance.

The framework may be extended in several useful directions. First, a major extension consists of incorporating the nominal (monetary) side of the economy into the analysis thus allowing a role for nominal exchange rate and monetary policies in current-account dynamics. Second, it would be interesting to analyze the impact of changes in the fundamental factors that operate on long-term growth, in the context of the recent enogenous growth literature (see Romer (1986)). Although these extensions and refinements are beyond the scope of the present study, the model and approach developed in this paper can be extended and usefully applied in pursuing them.

APPENDIX

In this appendix we present the details of the complete general-equilibrium model.

(A.1) Production and Investment

The first-order (Euler) condition for maximization of the expected discounted sum of profits with respect to investment is

$$(A.1) \qquad E_t R^{-1}[\alpha a_0 K_t^{\alpha-1} L_{t+1}^{1-\alpha}\epsilon'_{t+1} + \tfrac{1}{2}g(\frac{I_{t+1}}{K_t})^2 (1-d)q_{t+1}] = q_t,$$

where $q_t = 1 + g \frac{I_t}{K_{t-1}}$ is the market value of the firm per unit of capital (the Tobin-q measure).

As usual, the firm's demand for labor is derived from the maximization of expected profits with respect to L. This yields:

$$(A.2) \qquad (1-\alpha)a_0 K_{t-1}^{\alpha} L_t^{-\alpha}\epsilon'_t - S_t = 0.$$

To obtain explicit solutions for the path of the (economy-wide) capital stock we linearize the Euler condition, equation (A.1), around steady state as follows

$$(A.3) \qquad k_{t-1} + a_0 k_t + a_1 E_t k_{t+1} = b_L E_t \ell_{t+1} + b_\epsilon E_t \epsilon_{t+1},$$

where $\bar{K}$, $\bar{L}$, and $\bar{\epsilon}'$ denote the steady state values of capital, labor and productivity, and $k_t \equiv (K_t - \bar{K})$, $\ell_t \equiv (L_t - \bar{L})$, and $\epsilon_t \equiv \epsilon'_t - \bar{\epsilon}'_t$ denote deviations from steady-state levels of capital, labor and productivity, respectively. The a and b coefficients, given in Table 8, depend on steady-state values of the marginal productivities of capital and labor, on the steady-state productivity level, and on the cost-of-adjustment coefficient, the rate of interest, and the depreciation factor.

The solution for k_t is given by (see Sargent (1987), 197-204)

(A.4) $$k_t = \lambda_1 k_{t-1} - \lambda_1 \sum_{i=0}^{\infty} (\frac{1}{\lambda_2})^i E_t(b_L \ell_{t+1+i} + b_\epsilon \epsilon_{t+1+i}),$$

where $\lambda_1 < 1$ and $\lambda_2 > 1$ are the roots of the quadratic equation $1 + a_0\lambda + a_1\lambda^2 = 0$. Equation (A.4) expresses capital stock in period t as a function of the capital stock in period t-1 and the expected future path of employment and productivity. Since b_L and b_ϵ are negative coefficients, increases in expected future levels of labor and factor productivity raise firms' current demand for capital.

The assumed productivity and labor supply processes, discussed in the text, are used to calculate the expected future values appearing in eq.(A.4). Substituting these calculations into (A.4) yields

(A.5) $$k_t = \lambda_1 k_{t-1} - m_L \ell_t - m_\epsilon \epsilon_t - m_e e_t - m_1 \ell_0 - m_2 e_0,$$

where $e_t \equiv \epsilon_t - \epsilon_{t-1}$, and the m-coefficients are specified in Table 8.

(A.2) Consumption

The consumer is assumed to face a given risk-free interest factor R (where R = (1+r) and r denotes the rate of interest). Yet, due to lifetime uncertainty the effective (risk-adjusted) interest factor is R/γ, where γ is the probability of survival from one period to the next; see Blanchard (1985) and Frenkel and Razin (1987). Disposable income is stochastic and is denoted by y^d. Consumer's utility from his stock of consumption goods during period $t + \tau$, $c_{t+\tau}$, viewed from the standpoint of period t, is given by $\delta^\tau U(c_{t+\tau})$, where δ is the subjective discount factor. The probability of survival from period t through period $t + \tau$ is γ^τ, and therefore expected lifetime utility as of period t is

(A.6) $$E_t \sum_{\tau=0}^{\infty} (\gamma\delta)^{\tau} U(c_{t+\tau}),$$

where E_t is the conditional expectations operator. Individuals are assumed to maximize (A.6) subject to

(A.7) $$c_t = (1-\omega)c_{t-1} + x_t,$$

(A.8) $$x_t = a_t + y_t^d - \left(\frac{R}{\gamma}\right) a_{t-1},$$

and the solvency condition $\lim_{t\to\infty} (\gamma/R)^t a_t = 0$. The variable x_t denotes the flow of consumption purchases, c_t denotes the stock of consumer goods, and ω denotes the rate of depreciation of this stock. The variable a_t is the one-period debt issued in period t. Consolidating eqs. (A.7) and (A.8), the expected value of the lifetime budget constraint is given by

(A.9) $$\left[1 - \left(\frac{\gamma}{R}\right)(1-\omega)\right] E_t \sum_{\tau=0}^{\infty} \left(\frac{\gamma}{R}\right)^{\tau} c_{t+\tau} = E_t \sum_{\tau=0}^{\infty} \left(\frac{\gamma}{R}\right)^{\tau} y_{t+\tau}^d -$$

$$- \left(\frac{R}{\gamma}\right) a_{t-1} + (1-\omega)c_{t-1} \equiv E_t w_t,$$

where $E_t w_t$ is expected wealth, adjusted for consumer goods' durability.

We specify utility as a quadratic function, that is,

(A.10) $$U(c_t) = hc_t - \frac{1}{2} c_t^2,$$

where $h > 0$ and $c_t < h$, where $c_t/(h-c_t)$ is the measure of relative risk aversion.

The solution to the consumer optimization problem is:

(A.11) $$c_t = \beta_0 + \beta_1 E_t w_t,$$

where

$$\beta_0 = \gamma h \frac{1-\delta R}{\delta R(R-\gamma)},$$

and

$$\beta_1 = \left[1 - \frac{\gamma}{\delta R^2}\right] \left[1 - (\tfrac{\gamma}{R})(1-\omega)\right]^{-1}.$$

The economy consists of overlapping generations. The size of each cohort is normalized to 1, there are γ^a individuals of age a, and the size of population is constant at the level $1/(1-\gamma)$. Aggregating consumption across cohorts yields the following expression for the total stock of consumption:

(A.12)
$$C_t = \gamma h(R-1) \frac{\delta R-1}{\delta R(R-\gamma)} + (1-\gamma)(1 - \frac{\gamma}{\delta R^2}) \left[1-(\tfrac{\gamma}{R})(1-\omega)\right]^{-1} [E_{t-1}\sum_{\tau=0}^{\infty}(\tfrac{\gamma}{R})^{\tau} (Y_{t+\tau} - Z_{t+\tau} - T_{t+\tau})] + \Gamma C_{t-1} + v_t$$

where
$$\Gamma = \left[\frac{\gamma}{\delta R} + \gamma(1-\omega)\right] \left[1-\gamma(1 + \frac{1}{\delta R^2})\right] \left[1 - (\tfrac{\gamma}{R})(1-\omega)\right]^{-1},$$

and where Y is gross domestic output, T is the level of taxes, and v is a zero-mean, finite-variance, error term. Expressed in terms of observed consumer purchases the consumption equation which is estimated is given by

(A.13)
$$X_t = \gamma h(R-1) \frac{\delta R-1}{\delta R(R-\gamma)} + (1-\gamma)(1 - \frac{\gamma}{\delta R^2}) \left[1 - (\tfrac{\gamma}{R}) \cdot (1-\omega)\right]^{-1} E_{t-1} \sum_{\tau=0}^{\infty}(\tfrac{\gamma}{R})^{\tau}(Y_{t+\tau} - Z_{t+\tau} - T_{t+\tau}) + (\Gamma - \gamma(1-\omega)) \cdot \sum_{\tau=0}^{\infty}\gamma^{\tau}(1-\omega)^{\tau}X_{t-\tau-1} + v_t,$$

where X is the per capita value of consumer purchases.

(A.3) The Reduced-Form Coefficients

Define the quadratic equation $1 + a_0\lambda + a_1\lambda^2 = 0$ where

$$a_0 = -(1 + \frac{1}{R} + \frac{K}{gR}\left[\alpha(1-\alpha)\alpha_0 K^{\alpha-2}L^{1-\alpha}\epsilon'\right]),$$

$$a_1 = R^{-1}$$

Then, λ_1 and λ_2 are the roots of this equation. Define

$$b_L = -\frac{1}{g\bar{R}}\, a a_0 (1-a)(\bar{K})^{a} (\bar{L})^{-a} \bar{\epsilon}',$$

$$b_\epsilon = -\frac{1}{g\bar{R}}\, a a_0\, (\bar{K})^{a} (\bar{L})^{(1-a)}.$$

Accordingly, the m coefficients in eq. (S.1) of Table 5 are:

$$m_L = \frac{-\lambda_1 b_L \phi \lambda_2}{\lambda_2 - \phi},$$

$$m_\epsilon = -\frac{\lambda_1 b_\epsilon \lambda_2}{\lambda_2 - 1},$$

$$m_e = -\lambda_1 b_\epsilon \frac{\rho}{(1-\rho)} \left[\frac{\lambda_2}{\lambda_2 - 1} - \frac{\lambda_2 \rho}{\lambda_2 - \rho}\right].$$

The h and s coefficients in (S.2) and (S.3) are:

$$h_k = a a_0 (\bar{K})^{a-1} (\bar{L})^{1-a} \bar{\epsilon}', \qquad s_k = (1-a) a_0 a (\bar{K})^{a-1} (\bar{L})^{1-a} \bar{\epsilon}',$$

$$h_\ell = (1-a)\, a_0 (\bar{K})^{a} (\bar{L})^{-a} \bar{\epsilon}', \qquad s_\ell = -(1-a) a_0 a (\bar{K})^{a} (\bar{L})^{-a-1} \bar{\epsilon}',$$

$$h_\epsilon = a_0 (\bar{K})^{a} (\bar{L})^{1-a} \qquad s_\epsilon = (1-a) a_0 (\bar{K})^{a} (\bar{L})^{-a} \bar{\epsilon}'.$$

The β-coefficients in (S.5) are:

$$\beta_0 = \gamma h \frac{1-\delta R}{\delta R (R-\gamma)}, \quad \text{and}$$

$$\beta_1 = \left[1 - \frac{\gamma}{\delta R^2}\right]\left[1 - \left(\frac{\gamma}{R}\right)(1-\omega)\right]^{-1}.$$

The n coefficients in (S.5) are

$$n_0 = \left(\frac{R}{R-\gamma}\right) Y - \left[\left(h_k \left(1 - \frac{R}{\gamma h_k}\right) + 1\right)\left(m_\ell \left(\frac{R}{R-\gamma\lambda_1}\right)\left(\frac{\gamma}{R-\gamma\phi}\right)\right.\right.$$

$$- m_\ell \left(\frac{\gamma^2}{1-\phi}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)$$

$$\cdot\left(\frac{1}{R-\gamma} - \frac{1}{R-\gamma\phi}\right) - \lambda_1 b_L \left(\frac{1}{1-\phi}\right)\left(\frac{\lambda_2}{\lambda_2 - 1} - \frac{\phi\lambda_2}{\lambda_2 - \phi}\right)\left(\frac{\gamma R}{\rho - \gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)\Big) +$$

$$\left. + h_\ell \left(\frac{R}{R-\gamma\phi}\right) + h_\ell \left(\frac{R}{1-\phi}\right)\left(\frac{1}{R-\gamma} - \frac{1}{R-\gamma\phi}\right)\right] \ell_0 +$$

$$+ \left\{-\left(h_k \left(1 - \frac{R}{\gamma h_k}\right) + 1\right)\left(m_\epsilon \left[\left(\frac{1}{\lambda_1}\right)\left(\frac{R}{R-\gamma\lambda_1}\right) + \left(\frac{\gamma}{\lambda_1}\right)^2 \left(\frac{1}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right) +\right.\right.\right.$$

$$+ \left(\frac{R}{1-\rho}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)\left(\frac{\gamma^2}{R\lambda_1-\gamma}\right) - \frac{\rho}{(1-\rho)^2}\left(\frac{\gamma}{\lambda_1}\right)^2\left(\frac{1}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)$$

$$+ \left(\frac{\gamma\rho}{1-\rho}\right)^2\left(\frac{1}{R-\gamma\rho}\right)\left(\frac{1}{R-\gamma\lambda_1}\right) + \left(\frac{\rho}{1-\rho}\right)\left(\frac{\gamma}{\lambda_1}\right)^2\left(\frac{1}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right) -$$

$$\left(\frac{\gamma^2\rho^2}{1-\rho}\right)\left(\frac{1}{R-\gamma\rho}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)\Bigg] - \left(\frac{\lambda_1 b_\epsilon}{1-\rho}\right)\Bigg[\left(\frac{1}{\lambda_2}\right)\left(\frac{\lambda_2}{\tau_2-1}\right)^2\left(\frac{1-2\rho}{1-\rho}\right)\left(\frac{\lambda_2}{\lambda_2-1}\right)$$

$$+ \left(\frac{\rho^2}{1-\rho}\right)\left(\frac{\lambda_2}{\lambda_2-\rho}\right)\Bigg]\left(\frac{\gamma R}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)\Big) + h_\epsilon\Bigg[\left(\frac{R}{R-\gamma}\right) + \left(\frac{\gamma R}{1-\rho}\right)\left(\frac{1}{R-\gamma}\right)^2$$

$$- \frac{\rho}{(1-\rho)^2}\left(\frac{\gamma}{R-\gamma}\right) + \left(\frac{\rho}{1-\rho}\right)^2\left(\frac{\gamma}{R-\gamma\rho}\right) + \left(\frac{\rho}{1-\rho}\right)\left(\frac{\gamma}{R-\gamma}\right) - \left(\frac{\rho}{1-\rho}\right)\left(\frac{\gamma\rho}{R-\gamma\rho}\right)\Bigg]$$

$$- \left(h_k\left(1-\frac{R}{\gamma h_k}\right)+1\right) m_e\Bigg[\left(\frac{\gamma R}{R-\gamma\rho}\right)\left(\frac{1}{R-\gamma\lambda_1}\right) + \left(\frac{\gamma^2}{1-\rho}\right)\left(\frac{R}{R-\gamma\lambda_1}\right)\left(\frac{1}{R-\gamma}\right)$$

$$- \left(\frac{1}{1-\rho}\right)\left(\frac{\gamma}{R}\right)^2\left(\frac{\rho R}{R-\gamma\rho}\right)\Bigg]\Bigg\}e_0$$

$$n_k = \left(h_k\left(1-\frac{R}{\gamma h_k}\right)+1\right)\left(\frac{R}{R-\gamma\lambda_1}\right) + \frac{R}{\gamma}$$

$$n_\ell = -\left(h_k\left(1-\frac{R}{\gamma h_k}\right)+1\right)\phi m_L\left(\frac{R}{R-\gamma\lambda_1}\right)\left(\frac{\gamma}{R-\gamma\phi}\right) + h_L\left(\frac{\phi R}{R-\gamma\phi}\right)$$

$$n_\epsilon = -\left(h_k\left(1-\frac{R}{\gamma h_k}\right)+1\right) m_\epsilon\left[\left(\frac{1}{\lambda_1}\right)\left(\frac{R}{R-\gamma\lambda_1}\right) + \left(\frac{\gamma}{\lambda_1}\right)^2\left(\frac{1}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)\right] + h_\epsilon\left(\frac{R}{R-\gamma}\right)$$

$$n_e = -\left(h_k\left(1-\frac{R}{\gamma h_k}\right)+1\right)\rho\Bigg\{m_\epsilon\Bigg[\left(\frac{1}{\lambda_1}\right)\left(\frac{R}{R-\gamma\lambda_1}\right) + \left(\frac{\gamma}{\lambda_1}\right)\left(\frac{1}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)$$

$$\setminus\left(\frac{\rho}{1-\rho}\right)\left(\frac{\gamma}{\lambda_1}\right)^2\left(\frac{1}{R-\gamma}\right)\left(\frac{1}{R-\gamma\lambda_1}\right) - \left(\frac{\gamma^2\rho^2}{1-\rho}\right)\left(\frac{1}{R-\gamma\rho}\right)\left(\frac{R}{R-\gamma\lambda_1}\right)\Bigg]$$

$$+ m_e\left(\frac{\gamma R}{R-\gamma\rho}\right)\left(\frac{1}{R-\gamma\lambda_1}\right)\Bigg\} + h_\epsilon\rho\left[\left(\frac{R}{R-\gamma}\right) + \left(\frac{\rho}{1-\rho}\right)\left(\frac{\gamma}{R-\gamma}\right) - \left(\frac{\rho}{1-\rho}\right)\left(\frac{\gamma\rho}{R-\gamma\rho}\right)\right].$$

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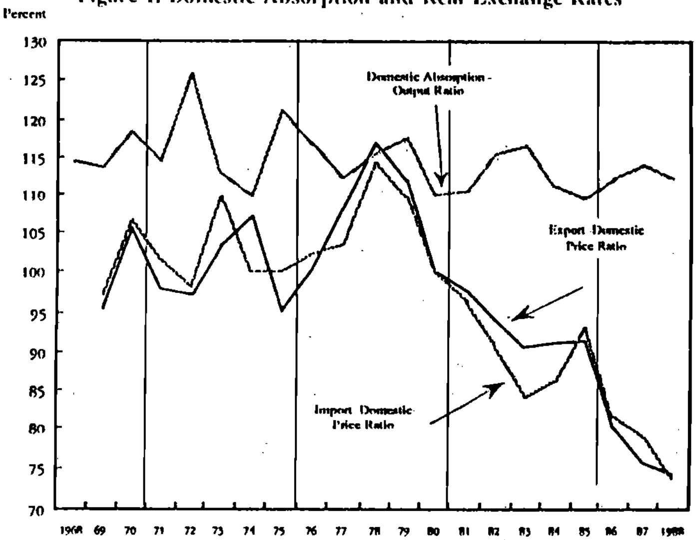
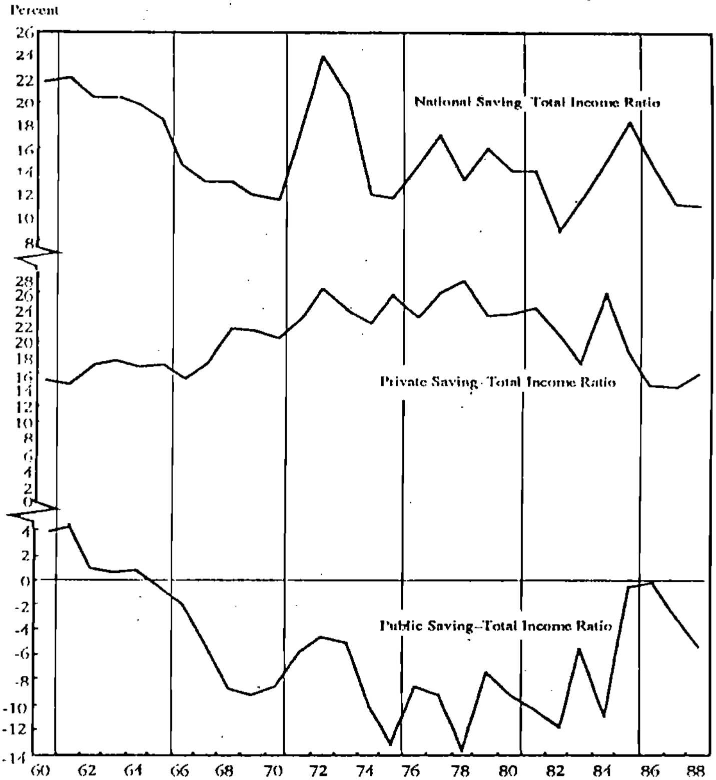
Figure 1. Domestic Absorption and Real Exchange Rates



Source: Bank of Israel. Annual Report 1988, diagram G-1.

Figure 2. National Saving and its Private and Public Components



Source: Bank of Israel, Annual Report 1988, diagram B-3.

Figure 3. Net Private Investment
(Percent of Business Sector Output)

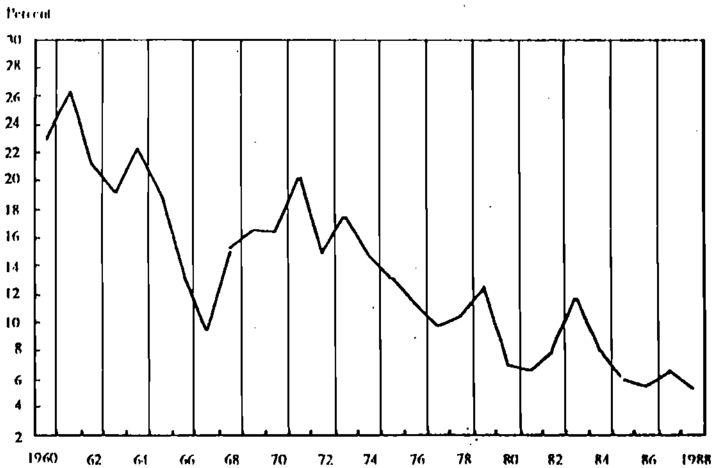


Figure 4. The Capital Stock, Predicted and Actual

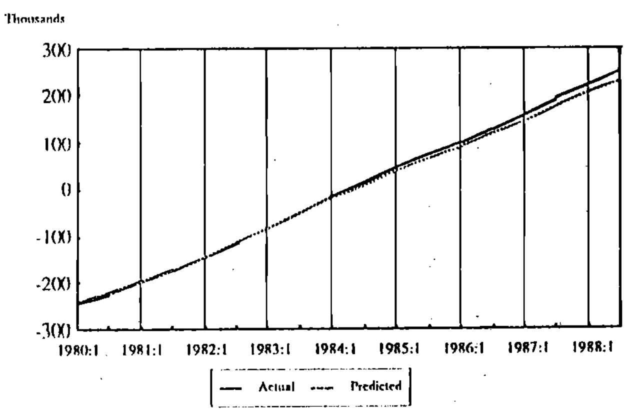
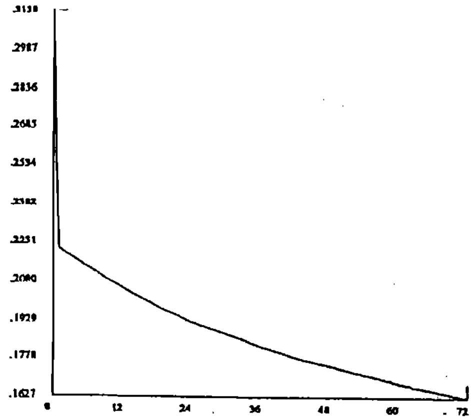
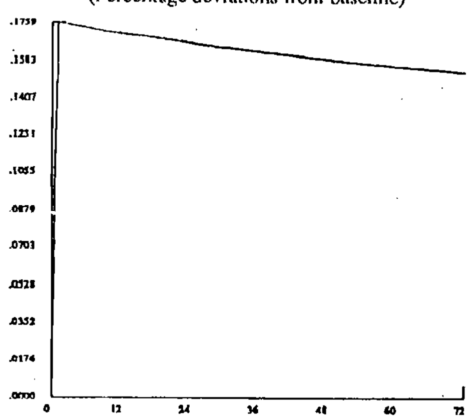


Figure 5a. Effects of a Permanent Productivity Change on the Current Account/GDP Ratio
(Percentage deviation from baseline)



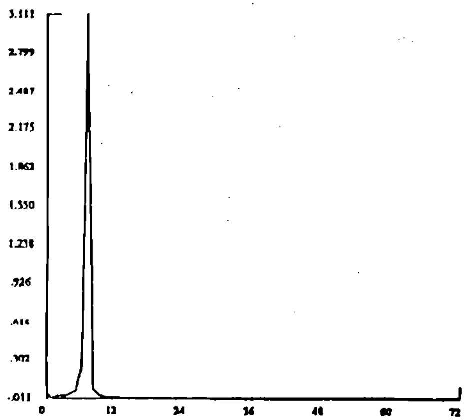
Note: Effects of a ten percent rise in α_0.

Figure 5b. Effects of a Permanent Productivity Change on the Wealth Accumulation/GDP Ratio
(Percentage deviations from baseline)



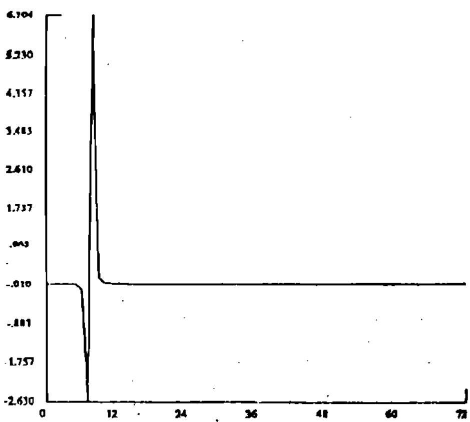
Note: Effects of a ten percent rise in α_0.

Figure 6a. Effects of Altering the Productivity Change Process on the Current Account/GDP Ratio
(Percentage deviations from baseline)



Note: Effects of lowering the persistence parameter [see equation (2)] by 10 percent, starting from $\varepsilon_{-2} = 0.5$ and $\varepsilon_{-1} = 0.75$.

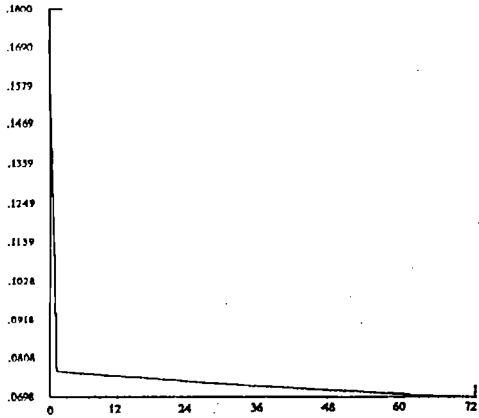
Figure 6b. Effects of Alterning the Productivity Change Process on the Wealth Accumulation/GDP Ratio
(Percentage deviations from baseline)



Note: Effects of lowering the persistence parameter [see equation (2)] by 10 percent, starting from $\varepsilon_{-2} = 0.5$ and $\varepsilon_{-1} = 0.75$.

Figre 7a. Effects of a Permanent Rise in the Level of Taxes on the Current Account/GFP Ratio

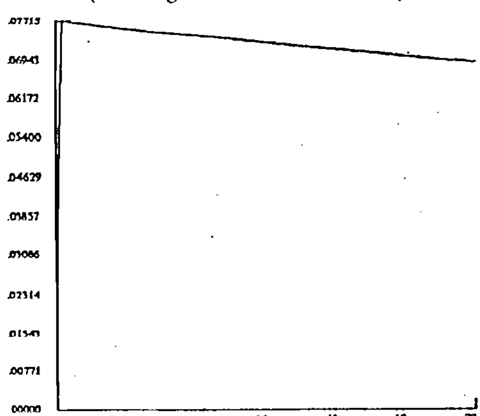
(Percentage deviations from baseline)



Note: Effects of increasing T_{-1} and T_{-2} by 1247.

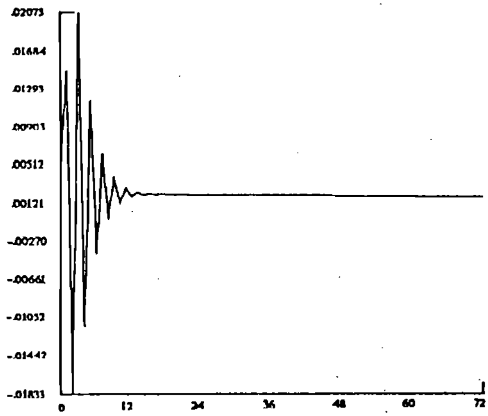
Figure 7b. Effects of a Permanent Rise in the Level of Taxes on the Wealth Accumulation/GFP Ratio

(Percentage deviations from baseline)



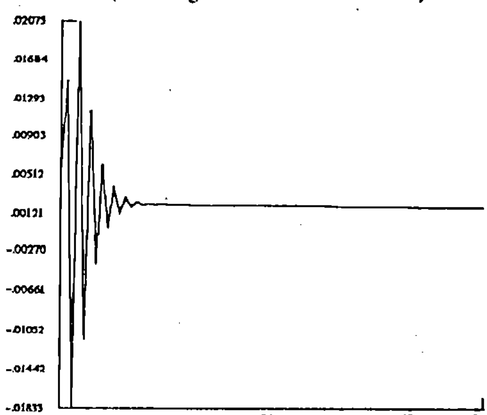
Note: Effects of increasing T_{-1} and T_{-2} by 1247.

Figure 8 a. Effects of Altering the Tax Policy Process onthe Current Account/GDP Ratio
(Percentage deviations from baseline)



Note: Effects of raising κ from –.57 to –.50 (see equation [10], with $T_{-2} = 0$, $T_{-1} = 1247$.

Figure 8b. Effects of Altering theTax Policy Process on the Wealth Accumulation/GDP Ratio
(Percentage deviations from baseline)



Note: Effects of raising κ from –.57 to –.50 (see equation [10]), with $T_{-2} = 0$, $T_{-1} = 1247$.