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Current Account Dynamics: The Role Of Real Shocks

Prepared by Leonardo Leiderman and Assaf Razin 1/

Authorized for Distribution by Jacob A. Frenkel

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Abstract

This paper demonstrates how a full-blown optimizing model of the dynamics of the current account can be reduced to a small-scale collection of reduced-form relations capable of implementing a rich set of macro-economic simulations. Emphasizing the role of shocks to productivity, labor employment, world rate of interest, and tax revenues the analysis can account for movements in trade imbalances, and the decline in private saving and investment observed recently in developed open economies.

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1/ This paper was written while the authors were visiting scholars in the Research Department, the International Monetary Fund.

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Summary

This paper provides an empirically based simulation analysis of current account imbalances arising from shocks to productivity, labor supply (or wages), world rate of interest, and tax revenues. The analysis demonstrates how a full-blown optimizing model can be reduced into a relatively small-scale set of reduced-form relations capable of accounting for observed changes in trade imbalances in the world economy.

The paper finds that changes in productivity, labor supply, world rate of interest, and tax revenue exert relatively strong influences on private saving. Through the use of these interactions, the observed decline in the saving/GDP ratio, which has been recently noted in developed open economies, can be accounted for by declines in productivity and in employment growth. The model shows a substantial offset by private-sector saving of a change in public-sector saving arising from an increase in tax revenue. The offsetting effect implies that while an increase in tax revenue raises national saving, the outcome is relatively small.

The results of the analysis also reveal that movements in investment depend strongly on movements in productivity, labor supply, and the world rate of interest. Taken together, the time-varying patterns of saving and investment in response to the real shocks give rise to alternating periods of improvements and worsenings in the current account position. While most policy discussions focus on the current account, this paper also analyzes the evolution of the market value of the economy's capital stock in order to highlight key determinants of changes in national wealth.

I. Introduction

In recent years there has been a notable change in approach concerning the analysis of current account dynamics. Traditionally, current-account analysis has been based on postulating behavioral rules for imports and exports (or for saving and investment). These rules have been usually considered to be invariant under changes in policies. However, it is accepted now that they are in fact sensitive to policy changes.

In contrast, the modern intertemporal approach derives behavioral relationships from explicit optimization. It thus provides a more meaningful framework for the analysis of alternative policy interventions. That is, since such an approach is capable of identifying the fundamental parameters that characterize the underlying preferences, technology, and policy, it can consistently account for how agent decision rules respond to changes in policy. ^{1/}

The behavior of the "twin deficits" can be used to illustrate the difference in predictions of the approaches. Consider, for example, the effects of a rise in the government-budget deficit due to a current-period cut in taxes. According to the traditional approach, the tax cut should, generally, raise both deficits. The modern approach, which allows for an endogenously-determined offset of private saving to the decline in public saving, considers explicitly the change in private sector's expectations concerning the implied future path of fiscal variables. In particular, it takes account of expected changes in future fiscal policies required for intertemporal public-sector solvency. The implications of the tax cut for the current account (according to the intertemporal approach) critically depend on the private-sector expectations about future fiscal-policy adjustments.

Despite the large body of literature on the theoretical aspects of the intertemporal-international approach, relatively little attention has been given to date to its empirical implications. This may reflect the methodological difficulties and complexities in attempting to implement models based on this approach. In a recent paper (Leiderman and Razin (1989)) we developed and tested a dynamic optimizing model of the current account which is consistent with the intertemporal approach. Following this work, the present paper provides an empirically-based simulation analysis of how the current-account dynamics are affected by key macro-economic variables, such as productivity, supply of labor, taxes, and the world rate of interest.

Empirical studies on the saving-investment balance have recently uncovered some interesting stylized facts. The first, documented by Barro (1989), is a substantial private-sector offset to changes in

^{1/} See, for example, an exposition in Frenkel and Razin (1987).

public-sector savings (arising from changes in tax revenues). The second, due to Feldstein and Horioka (1980), is a strong correlation between domestic saving and domestic investment. Our approach which allows for rich patterns of correlations between public and private saving and between private saving and investment, depending on the kind and on the persistence of real shocks, can shed light on the economic mechanisms underlying these facts.

The paper is organized as follows. Section II describes briefly the theoretical model. Dynamic simulations are presented in Section III, and Section IV concludes the paper with a summary and extensions.

II. A Dynamic Model of the Current Account

We 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 , and the capital, K , i.e., $Y_t = \alpha_0 K_{t-1}^\alpha L_t^{(1-\alpha)} \varepsilon_t$, where ε_t measures the level of productivity and α denotes the capital distributive share. Changes in labor (supplied to the private sector) and productivity are specified as exogenous stochastic processes. ^{1/}

These processes are:

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

$$(2) \quad \varepsilon_t - \varepsilon_{t-1} = \zeta(\varepsilon_{t-1} - \varepsilon_{t-2}) + \xi_{\varepsilon t}$$

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

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

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

where g is a cost-of-adjustment coefficient. Thus, in order to effectively augment the capital stock by the amount $K_t - K_{t-1}$ firms have to invest an amount Z_t of resources. Evidently, in the absence of costs

^{1/} 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 whose behavior is specified in equation (1).

of adjustment (i.e., if $g = 0$), $Z_t = K_t - K_{t-1}$. When these costs are present, however, gross investment exceeds net capital formation and some output is lost.

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

$$(4) \quad K_t = \bar{K} + \lambda_1(K_{t-1} - \bar{K}) + m_L(L_t - \bar{L}) + m_\varepsilon(\varepsilon_t - \bar{\varepsilon}) + m_e(\varepsilon_t - \varepsilon_{t-1}),$$

$$(5) \quad Y_t = \bar{Y} + h_K(K_{t-1} - \bar{K}) + h_L(L_t - \bar{L}) + h_\varepsilon(\varepsilon_t - \bar{\varepsilon}),$$

where \bar{K} , \bar{Y} , \bar{L} and $\bar{\varepsilon}$ are the steady-state levels of output, capital labor and productivity, respectively and λ_1 , m_L , m_ε , m_e , h_K , h_L and h_ε are reduced-form fixed coefficients. Linearizing the condition which equates the wage to the marginal productivity of labor (as in equation (1)) yields the real wage equation:

$$(6) \quad S_t = \bar{S} + s_K(K_{t-1} - \bar{K}) + s_L(L_t - \bar{L}) + s_\varepsilon(\varepsilon_t - \bar{\varepsilon}),$$

where S_t denotes period t real wage, and \bar{S} , s_K , s_L , and s_ε are reduced-form coefficients. Observe that 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 (see the Appendix). 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:

$$\begin{aligned} \bar{K} &= \bar{L} [(R-1)/\alpha\alpha_0]^{\frac{1}{\alpha-1}}, \\ (7) \quad \bar{Y} &= \alpha_0(\bar{K})^\alpha(\bar{L})^{1-\alpha}, \\ \bar{S} &= (1-\alpha)\alpha_0(\bar{K}/\bar{L})^\alpha. \end{aligned}$$

As usual, \bar{K} is derived from the equality between the rate of interest and the marginal productivity of capital, \bar{Y} is obtained upon substituting the resulting value of K and the amount \bar{L} in the production function, and \bar{S} is equal to the implied value of the marginal

productivity of labor. Investment in the steady state amounts to what is required in order to maintain a fixed stock of capital.

To illustrate the economic behavior implied by the model, consider the impact of the following changes. First, a transitory rise in labor employment (a positive realization of ξ_{Lt}) generates a transitory increase in domestic investment (see equation (4)), a transitory increase in output (see equation (5)), and a transitory decrease in the real wage (see equation (6)). Since the persistence parameter in the process governing labor employment is positive but less than one, these effects have some persistence but they must diminish through time. Second, consider an increase in the persistence parameter of the process governing productivity changes (ζ). It can be seen that this change alters the coefficients of the productivity variables in the reduced form for capital accumulation, i.e., m_ξ and m_e in equation (4) (see the Appendix). In particular, both m_ξ and m_e must increase with an increase in ζ . Thus, in this case the sensitivity of the capital formation process to productivity shocks increases. The response of the reduced-form coefficients to a change in a structural (or fundamental) parameter captures the reasoning of the Lucas critique (see Lucas (1976)).

We turn now to the consumption side of the model. The basic setup, which draws on Leiderman and Razin (1988), allows for real effects of intertemporal tax shifts and incorporates consumer good durability. The stock of consumer goods which generates a flow of consumption services is the argument in the utility function. This stock, C_t , subject to depreciation, is augmented every period by purchases of consumer goods, X_t , according to the relation:

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

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. Assuming a quadratic utility function, the maximization of expected lifetime utility yields the consumption function:

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

where $E_t W_t$ denotes 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 on the rate of depreciation of the consumption stock (see Appendix). Assuming rational expectations, the 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, by using equations (1)-(5).

The path of taxes is assumed to be governed by an exogenous stochastic process, as follows:

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

where κ is a fixed coefficient and ξ is a zero-mean finite-variance random term. Using equations (1)-(5) and equation (10), the expected value of the discounted sum of disposable income is given by:

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

where the n coefficients (reported in the Appendix) depend on the parameters of the production function and the investment technology as well as on the parameters of the driving variables, labor, productivity, and taxes. Substituting equation (11) into equation (9) yields a relationship between the stock of consumption goods and lagged values of the capital stock, labor employment, productivity, taxes, consumption stock, and debt. Given this relationship, the implications of the model for the flow of consumption purchases can be derived from equation (8). Notice that changes in the parameters that characterize the underlying preferences, technology, and tax policy alter the coefficients in the reduced form for consumption. This holds in particular for changes in the degree of persistence of the tax policy, employment and productivity shocks.

To determine the model's implications for the current account of the balance of payments, we combine the consumption side of the model with the production-investment side, and use the national-income accounts relation:

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

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 a unit of domestic capital is equal to

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

Accordingly (while abstracting from human wealth) a broader definition of changes in wealth is given by:

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

Summing up, in this section we develop a simulation-oriented and empirically-based model of saving and investment for a small open economy. In the next section, we use the model for dynamic simulations of the response of the current account, wealth accumulation, and other macro-economic variables, to real shocks.

III. Current Account Dynamics

The simulations reported in this section are based on the parameter estimates obtained from implementing the model on monthly time series for Israel, 1980-88, (see Leiderman and Razin (1989)). The parameter values are given in Table 1. The ϕ parameter indicates a relatively high degree of persistence of the labor employment shocks. A different pattern holds for shocks to productivity increments. The first difference follows an AR1 process with a negative coefficient, implying the presence of converging cycles in productivity changes. In a level form, however productivity changes have positive persistence. The coefficient g implies that at the sample mean 2.8 percent of gross investment is accounted for by cost of adjustments. 1/ The capital share in production costs is set at 0.25, and the monthly depreciation rate for the consumption stock is 0.43. The finite-horizon parameter is estimated at 0.998. The estimated coefficients of the consumption function, β_0 and β_1 , imply an intertemporal elasticity of substitution of about 10. Lastly, changes in taxes follow an AR1 process with a negative coefficient. This implies one-period cycles of tax changes and positive persistence for shocks to the level of taxes.

Using a set of initial values, 2/ and the abovementioned parameters, we simulate a baseline case and focus on the deviations of the dynamic equilibrium path from the baseline in response to changes in the

1/ A similar order of magnitude for costs of adjustment (2.4 percent of gross investment) is estimated for quarterly U.S. data by Shapiro (1986).

2/ The steady-state and initial values are as follows: $\bar{K} = 7456586$, $\bar{L} = 1220$, $\bar{Y} = 59653$, $\bar{S} = 37$, $K_{-1} - \bar{K} = -223552$, $X_{-1} = 15000$, $A_{-1} = L_{-1} - L = \varepsilon_{-1} - \varepsilon = \varepsilon_{-2} - \varepsilon = T_{-1} = T_{-2} = 0$.

Table 1. Parameter Values

ϕ	=	0.94
ζ	=	-0.35
g	=	3.00
R	=	1.002
α_0	=	1.71
α	=	0.25
ω	=	0.43
γ	=	0.998
β_0	=	39948.71 <u>1/</u>
β_1	=	0.007 <u>1/</u>
κ	=	-0.57

1/ These parameters depend on units of consumption and wealth. To provide orders of magnitude, note that the mean consumption over the sample is 14141, and the mean output is 24061.

underlying parameters. The basic simulation model consists of the production function in an exact form (see page 3), the exogenous stochastic processes for labor, production, and taxes (equations (1), (2), (10)), the cost-of-adjustment-investment relation in an exact form (equation (3)), and the optimal investment rule

$$R^{-1} \left[\alpha \alpha_0 K_t^{\alpha-1} L_{t+1}^{1-\alpha} + \frac{1}{2} g \left(\frac{I_{t+1}}{K_t} \right)^2 + (1+g) \frac{I_{t+1}}{K_t} \right] = (1+g) \frac{I_t}{K_{t-1}}$$

In addition, the simulation model includes the consumption function (equations (9) and (11)).

The simulations are reported in Table 2. Each entry in the table consists of two figures. The first gives the approximate percentage deviation from the baseline case on impact; the second gives this deviation after 72 periods. Figures 1-8 plot the simulated deviations from the baseline case of the current account surplus and the wealth accumulation, as ratios of GDP. We consider the following set of changes.

1. Productivity

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

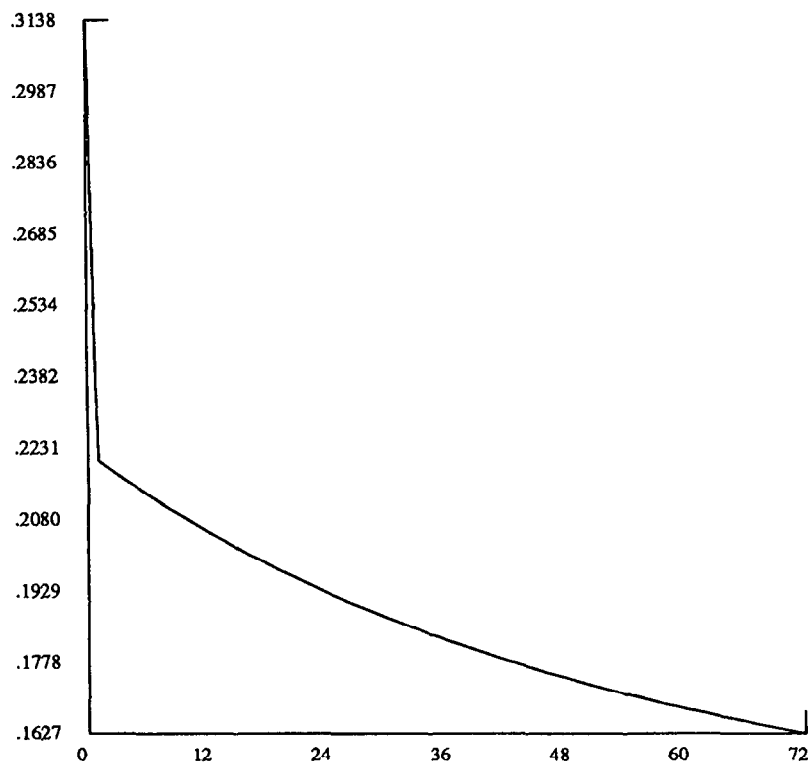
$$(14) \quad CA_t = (Y_t - Y_t^p) - (X_t - X_t^p) - (Z_t - Z_t^p),$$

where a superscript p denotes permanent values. ^{1/} In equation (14) we use the fact that $CA_t^p = 0$ and assume for simplicity that government spending does not deviate from its permanent level. 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 the latter, i.e., $Y_t < Y_t^p$, this factor contributes toward worsening of the current account position. An effect in the same direction arises from investment behavior. That is, the changes in current investment arising from the shock must exceed the change in the permanent level of investment (i.e., $Z_t > Z_t^p$) since the latter is just the amount of resources required to maintain the permanent stock of capital. Thus, this component of the macro-economic response to the shock worsens the current account position.

^{1/} For any variable y_t , we define a permanent value y_t^p by

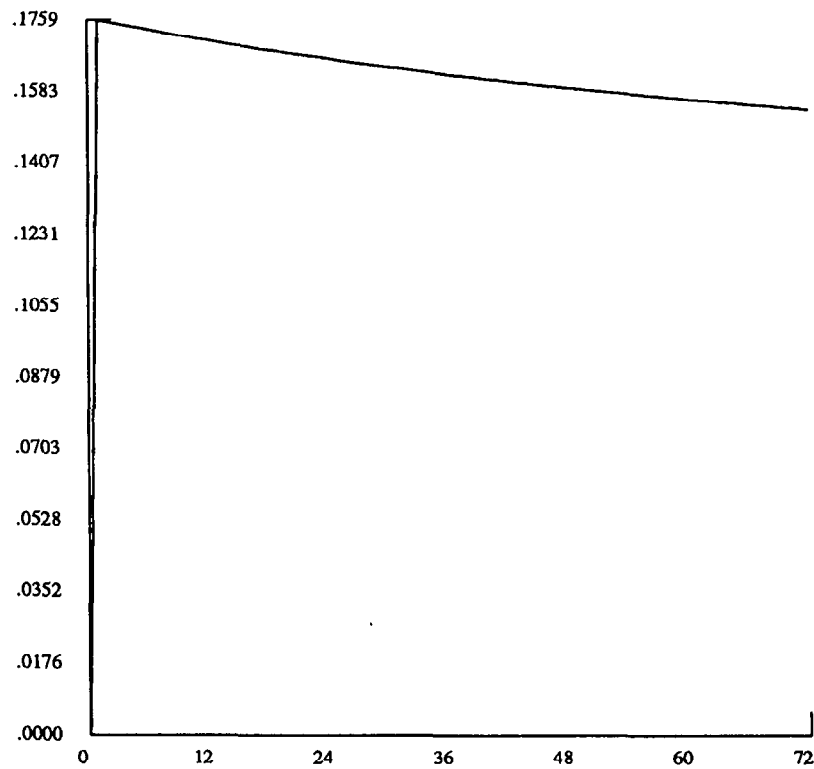
$$\sum_{\tau=0}^{\infty} d_{\tau} y_{t+\tau} = y_t^p \sum_{\tau=0}^{\infty} d_{\tau}, \text{ where } d_{\tau} \text{ is the present value factor.}$$

FIGURE 1A.
EFFECTS OF A PERMANENT PRODUCTIVITY-CHANGE
ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



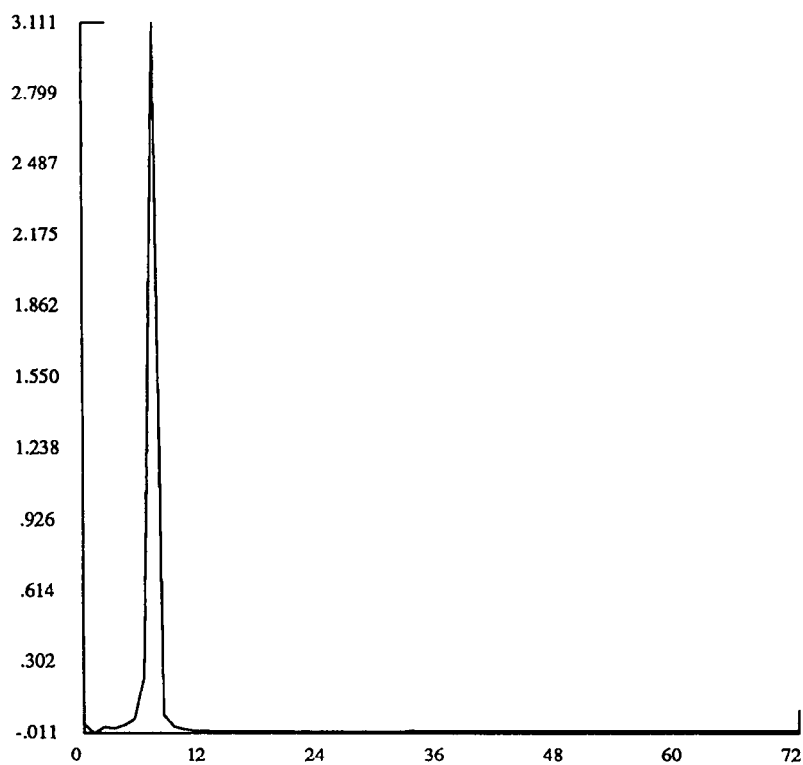
Note. Effects of a ten percent rise in α_n on the private-sector current account as a ratio to GDP

FIGURE 1B.
EFFECTS OF A PERMANENT PRODUCTIVITY-CHANGE
ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



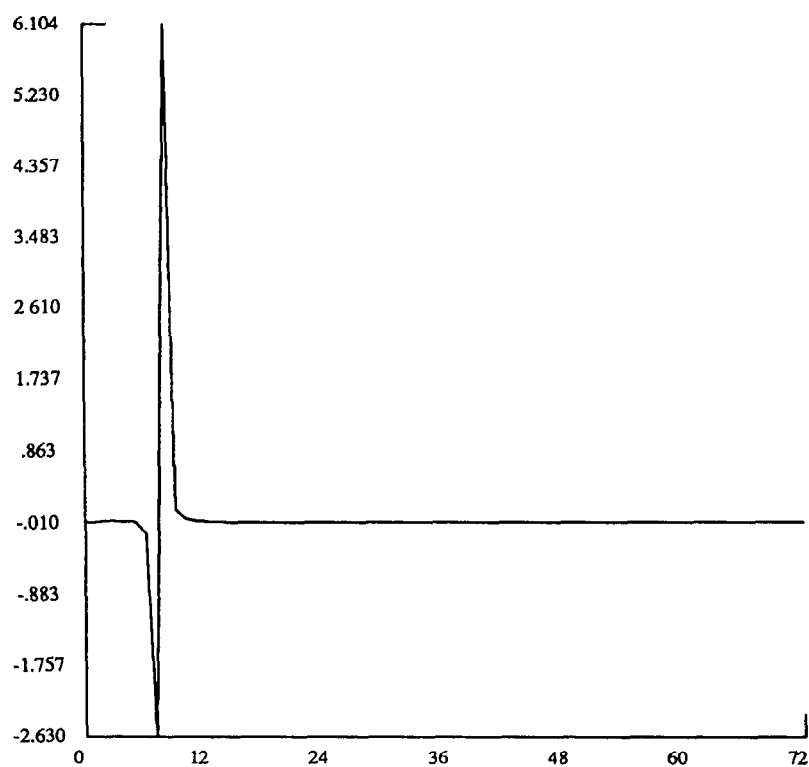
Note. Effects of a ten percent rise in α_0 .

FIGURE 2A.
EFFECTS OF ALTERING THE PROCESS OF PRODUCTIVITY CHANGE
ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



Note: Effects of lowering the persistence parameter (see Equations (2)) by 10 percent, starting from $\epsilon_{-2} = 0.5$ and $\epsilon_{-1} = 0.75$, on the private-sector current account as a ratio to GDP.

FIGURE 2B.
EFFECTS OF ALTERING THE PROCESS OF PRODUCTIVITY CHANGE
ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



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

Table 2. Simulations 1/
(Percentage deviations from baseline)

Change in Parameter	Response of				
	Output	Investment	Consumption	External <u>2/</u> Balance	Wealth <u>3/</u> Accumulation
(1) α_0 <u>4/</u>	[14.1,13.7]	*,*	[6.3,5.9]	[.31,.16]	[.18,.15]
(2) \bar{L}	[10.4,10.1]	*,*	[4.6,4.3]	[.24,.12]	[.13,.12]
(3) ϕ <u>5/</u>	[0.3,.12]	[7.8,-4.8]	[.07,.07]	[-.01,*]	[.13,*]
(4) g	*, -0.1]	[-4.9,-2.4]	[.02,.01]	[.018,-.003]	*,*
(5) R <u>6/</u>	[5.3,4.6]	[-5.9,3.5]	[25.5,20.9]	[-.7,-.30]	[-.29,-.30]
(6) $T_1=T_2$ <u>7/</u>	[0,0]	[0,0]	[-4.6,-3.2]	[.18,.070]	[.08,.07]
(7) κ <u>8/</u>	[0,0]	[0,0]	[0,0]	[.05,.05]	[.01,*]

1/ The simulations are based on the model described in the text and the Appendix. Each entry consists of two figures. The first is the approximate percentage deviation from the baseline case on impact; the second gives the deviation after 72 periods. An asterisk indicates figures smaller than .01 in absolute value.

2/ Private-sector current account to output ratio.

3/ Wealth accumulation (that is, the current account surplus plus the change in the value of domestic capital) expressed as ratio to output.

4/ The parameter is increased by 10 percent.

5/ The parameter is decreased from 0.94 to 0.90 and L_1 is set to -122.

6/ The rate of interest is reduced from .20 to .175 basis points.

7/ Taxes are raised from 0 to 10 percent of GDP.

8/ The parameter is changed from -.57 to -.50. The initial values of T_1 and T_2 are set equal to 1247.

The consumption response to the shock, however, tends to improve the current account since current consumption increases by less than permanent consumption (i.e., $X_t < X_t^P$). The reason is that in a growing economy future generations have larger permanent income than current generations and therefore consume more. The changes in the components of the current account are summarized in the first line of Table 2.

Despite the worsening of the current account position, there is an improvement in the current account surplus and the wealth accumulation when expressed as ratios to output, as seen in Figures 1a-1b. Because the rise in the level of output following the productivity shock combined with a deficit position in the baseline leads to a decrease in the current account deficit relative to GDP. The productivity shock causes increases in both investment and in the market value of the capital stock. The shock also results in a rise in the ratio of wealth accumulation to output, see Figure 1b. Thus, the positive capital-stock effects dominate the negative effect on wealth accumulation arising from the worsening of the current account.

Figures 2a and 2b display the effects of a different productivity change, namely a change in the persistence parameter ζ (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 significant lag.

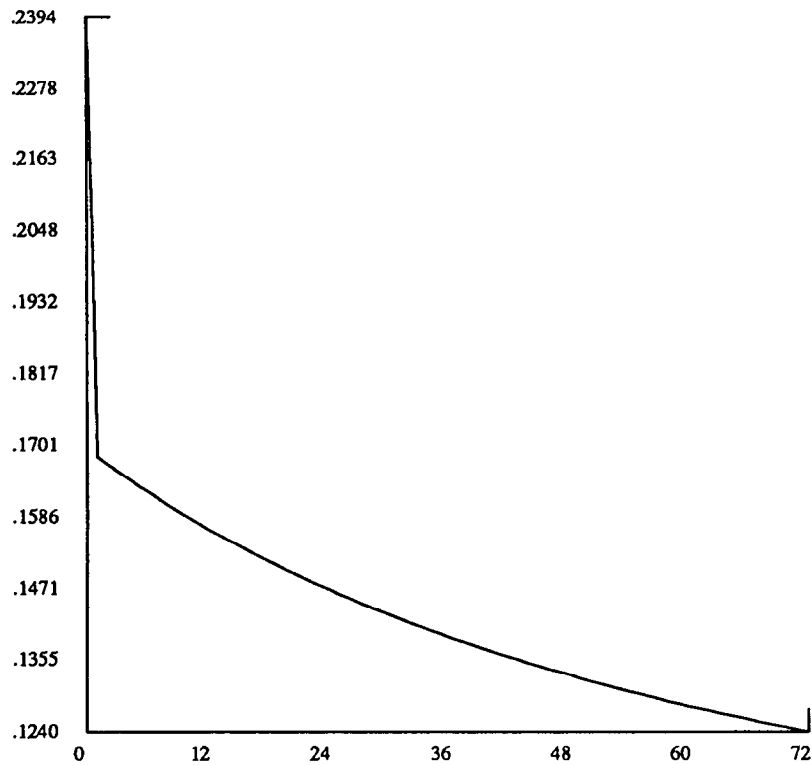
2. Labor Employment

We consider first a permanent (10 percent) rise in labor supply. This change has similar effects as the permanent productivity increase. As in that case, the simulations show an improvement in the current account and in wealth accumulation when measured as ratios of output; see Figures 3a-3b. ^{1/}

We simulated also the effects of lowering the persistence parameter ϕ which governs the evolution of labor employment. The results depend on the initial position of the economy relative to the steady state. In a growing economy (i.e., an economy which is initially below the steady state), the decrease in ϕ noticeably stimulates investment; see Table 2. This parameter change leads to a deterioration in the external balance position in the first few periods but to an increase in wealth accumulation. In both cases the dynamic responses reach peaks in the medium run (periods 12 to 24) and subside later on, see Figures 4a and 4b. This pattern is reversed if the initial labor employment exceeds the steady state level.

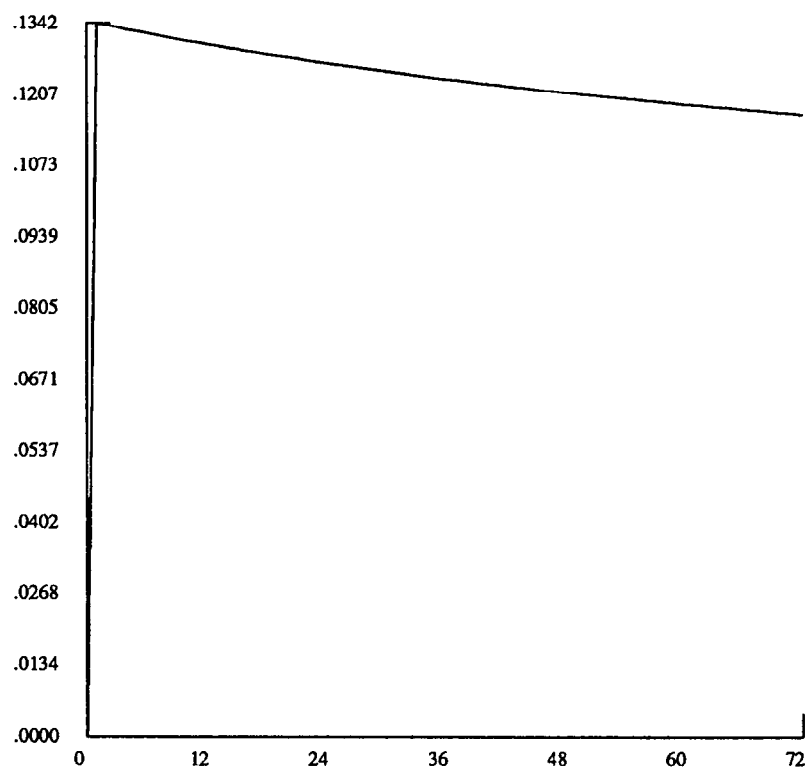
^{1/} Evidently, one difference is that this shock leads to a decrease in the real wage while the productivity shock leads to an increase in the real wage.

FIGURE 3A.
EFFECTS OF A PERMANENT CHANGE IN THE PRIVATE-SECTOR
LABOR EMPLOYMENT ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



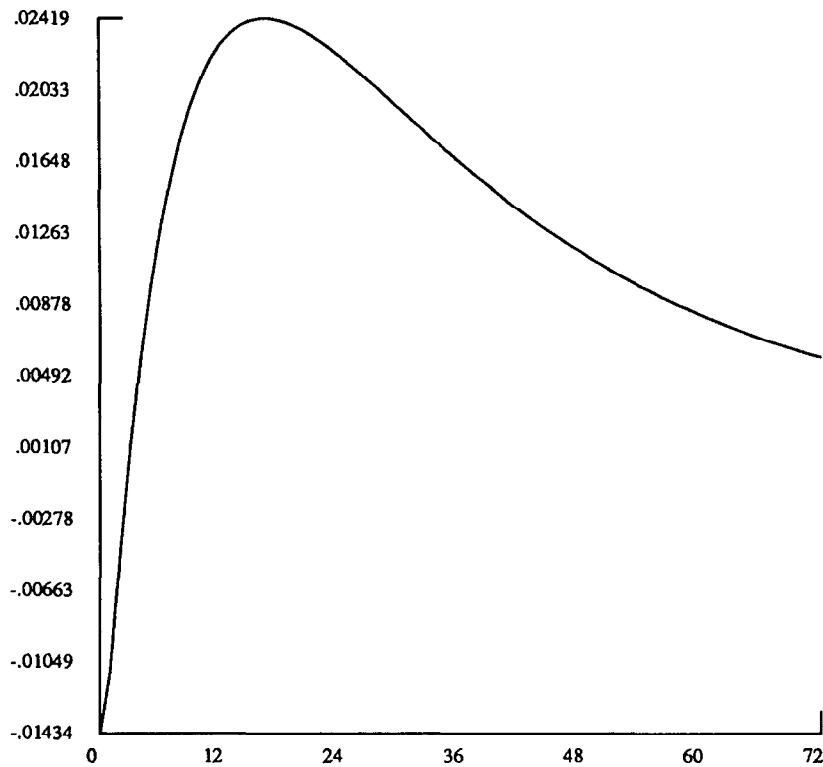
Note: Effects of a 10 percent rise in ζ on the private-sector current account as a ratio to GDP

FIGURE 3B.
EFFECTS OF A PERMANENT CHANGE IN THE PRIVATE-SECTOR
LABOR EMPLOYMENT ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



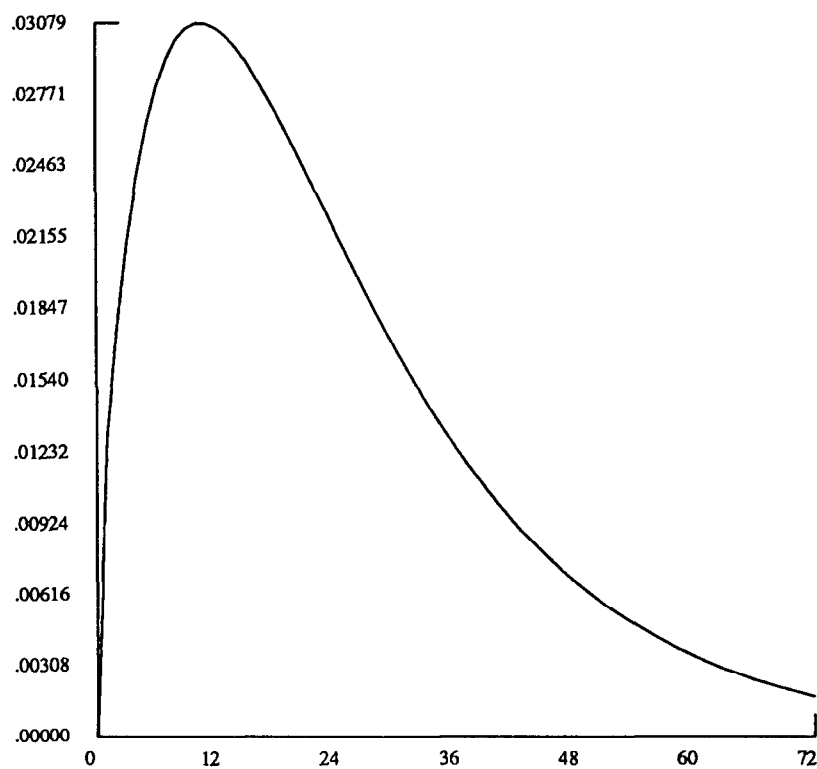
Note: Effects of a 10 percent rise in ζ

FIGURE 4A.
EFFECTS OF ALTERING THE PROCESS OF PRIVATE-SECTOR
LABOR EMPLOYMENT ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



Note Effects of lowering ϕ from 0.94 to 0.90, with $L_{-1} = -122$ as an initial value on the private-sector current account as a ratio to GDP

FIGURE 4B.
EFFECTS OF ALTERING THE PROCESS OF PRIVATE-SECTOR
LABOR EMPLOYMENT ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



Note Effects of lowering ϕ from 0.94 to 0.90, with $l_{-1} = -122$ as an initial value

3. Cost of Adjustment

Line 4 of Table 2 reports the results of a 10 percent increase in the cost-of-adjustment parameter. As expected, this change has a negative impact on investment. It turns out that this negative effect lasts for about 50 periods after the shock, and thereafter investment rises. The eventual rise must compensate for the initial period decline effect since the steady state level of capital remains intact. Consumption purchases respond positively on impact to the increase in g , reflecting an increase in output net of investment in the current period. Obviously, the positive response weakens through time since there is no change in the steady state level of consumption. ^{1/} Wealth accumulation falls in response to the shock, reflecting the fall in the market value of the capital stock. Accordingly, the depreciation in the market value more than offsets the positive effect on wealth accumulation arising from the improvement in the current account position. As time progresses and investment picks up, these effects are reversed; see Figures 5a-5b.

4. World Rate of Interest

When the world rate of interest permanently falls by 0.025 base points (per month) there is an increase in investment, and an increase in consumption on impact. As a result, the current account (as a ratio of output) worsens. In principle, the decrease in the rate of interest has ambiguous impact on wealth accumulation. On the one hand, the worsening the current account due to the rise in consumption and investment tend to lower wealth accumulation. On the other hand, there is a positive capital valuation effect. For the present set of parameters the first effect dominates. In the long run, the lower interest rate leads to a higher capital stock and output and therefore to a rise in consumption.

Overall, our simulations indicate a relatively high degree of sensitivity of the external balance arising mainly from a strong interest-rate effect on consumption (see Figures 6a-6b).

5. Taxes

A rise in the initial value of taxes by 10 percentage points of output (with a continuing increase through the tax-evolution equation) lowers the level of consumption by about 3-4 percent, relative to the baseline, but improves only slightly the current account. This improvement results in a small increase in wealth accumulation.

Another simulation experiment consists of changing the κ -parameter in the stochastic process which governs the evolution of taxes. In Table 2 and 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

^{1/} A positive capital depreciation coefficient (i.e., $d > 0$) would, however, imply a fall in steady-state consumption.

the tax burden on current generations. Notice from Figure 8a and 8b that the current account and the wealth accumulation (in ratios to output) exhibit cyclical responses to the shock 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 an alternating sequence of high and low tax burdens which generate the cyclical behavior of consumption.

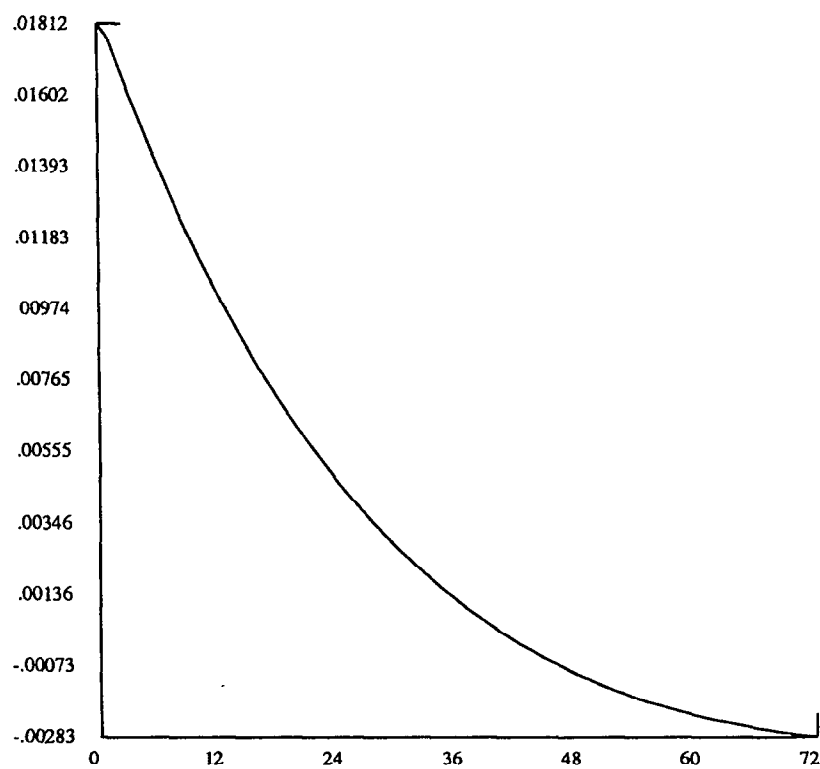
IV. Conclusions and Policy Implications

In this paper, we present an empirically-based simulation analysis of the dynamics of the current account and the wealth accumulation under a variety of potentially important macroeconomic real shocks. ^{1/} In particular we emphasize the role of changes in production, labor employment, taxes, and the real rate of interest. A key distinguishing feature of our simulation model is that it is based on an explicit intertemporal framework of optimization. Despite the complexity of the full-blown optimization the model reduces to a relatively small-scale set of reduced form relations which is 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 that describe preferences and technology.

In our analysis, movements in the current account are decomposed into movements in its two main components: saving and investment. We find that changes in productivity, labor employment, world rate of interest, and tax revenues exert relatively strong effects on private saving. In attempting to account for the decline in the private saving/GDP ratio that has been observed in Israel in the 1980s, and in other open economies (see Leiderman and Razin (1989) for details on the sample on which our model parameters are estimated) there are three potential factors that stand out: First, the observed decline in productivity growth; second, the observed decline in employment growth (in the private sector); and third, the observed rise in tax revenues. Related to these developments is the fiscal stance of the government; i.e., public sector saving. Based on parameter values estimated for our sample, we find a substantial offset by private sector saving to changes in public sector saving. This implies that while a rise in government's tax revenue also raises national saving, the latter is only small. Thus, this fiscal instrument is relatively ineffective in achieving such an objective.

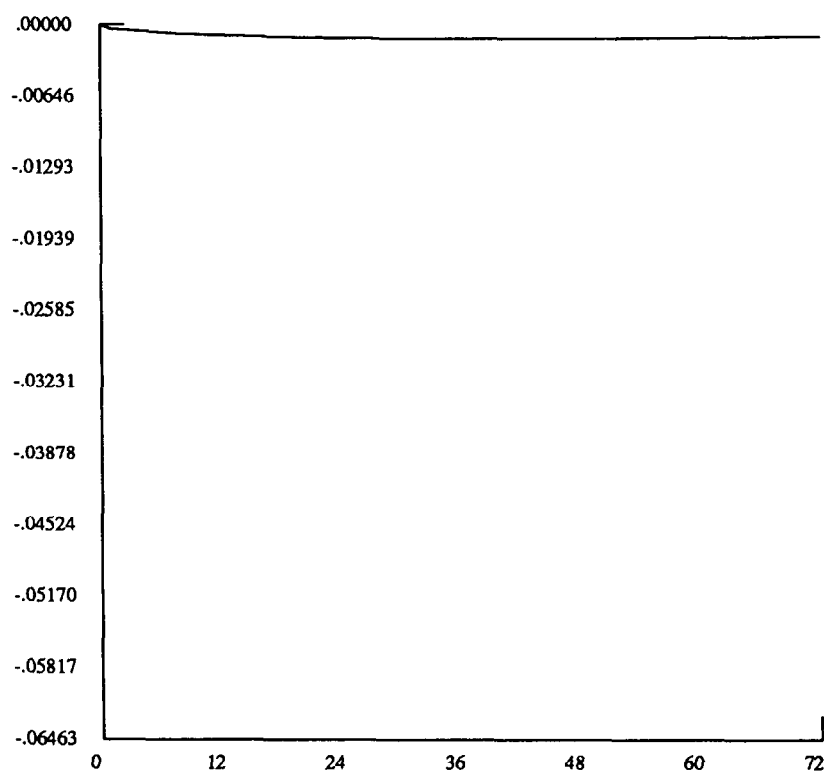
^{1/} Though the parameter values that we use are based on estimating the model for Israel in the 1980s, the model is applicable to many small open economies.

FIGURE 5A.
EFFECTS OF A CHANGE IN INVESTMENT COST OF ADJUSTMENT
ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



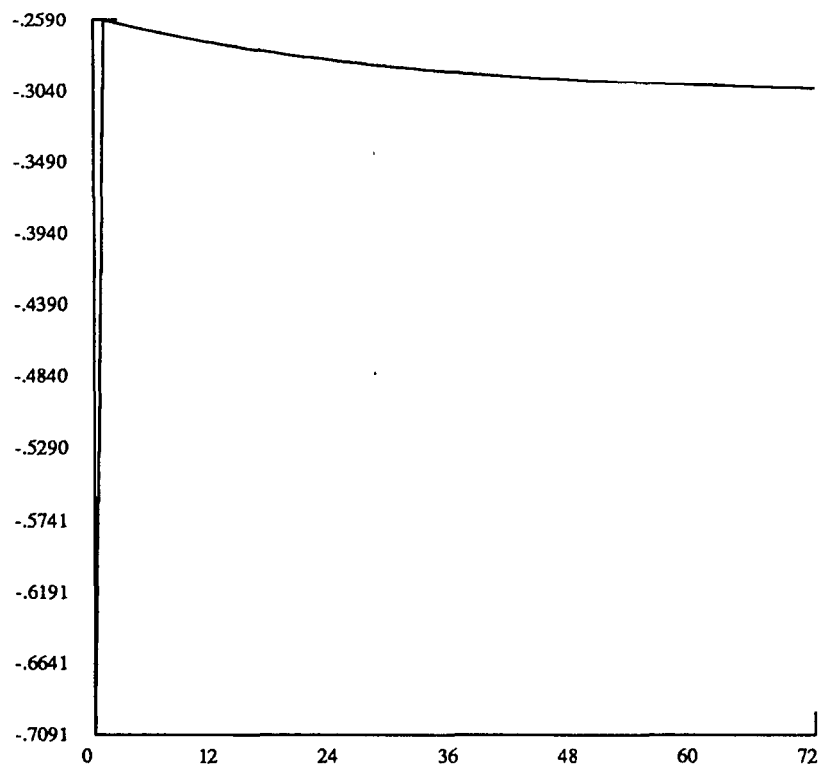
Note Effects of a 10 percent rise in g (see equation (3)) on the private-sector current account as a ratio to GDP

FIGURE 5B.
EFFECTS OF A CHANGE IN INVESTMENT COST OF ADJUSTMENT
ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



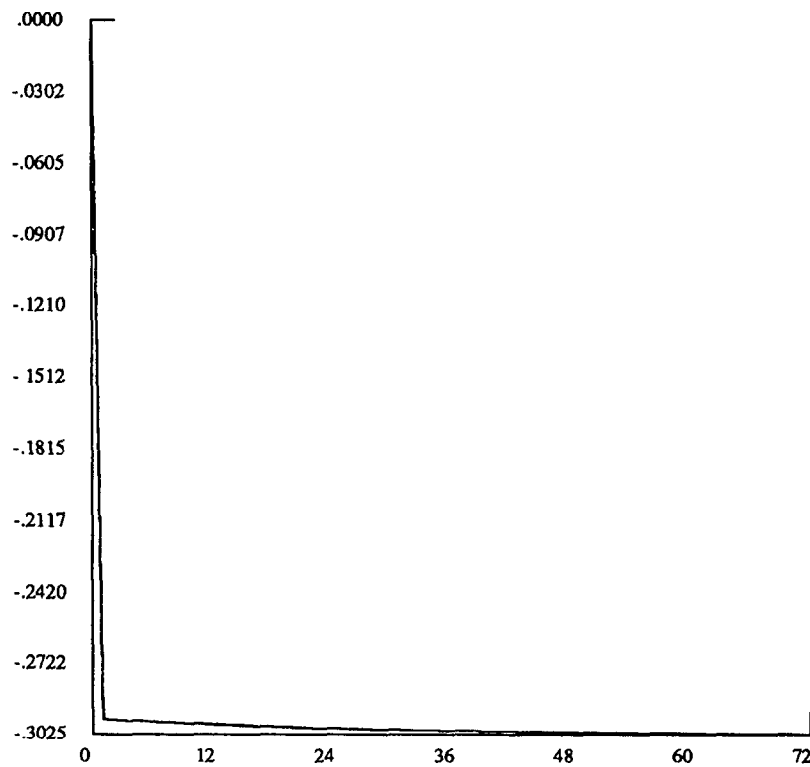
Note. Effects of a 10 percent rise in g (see equation (3))

FIGURE 6A.
EFFECTS OF A PERMANENT DECLINE IN THE REAL RATE OF INTEREST
ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



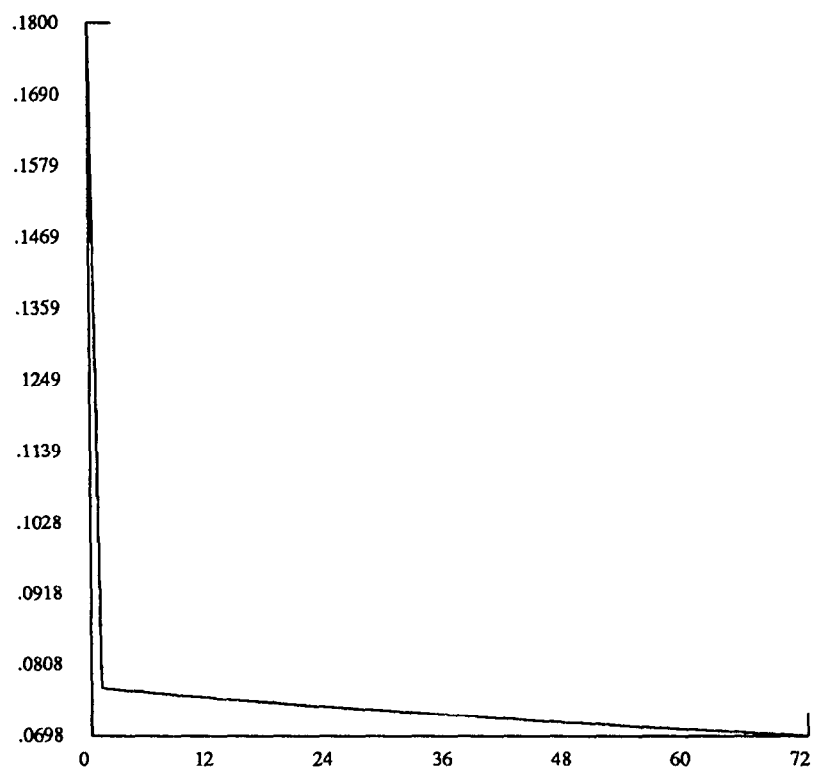
Note. Effects of lowering the real interest rate from 0.2 percent per month to 0.175 percent per month, on the private-sector current account as a ratio to GDP

FIGURE 6B.
EFFECTS OF A PERMANENT DECLINE IN THE REAL RATE OF INTEREST
ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



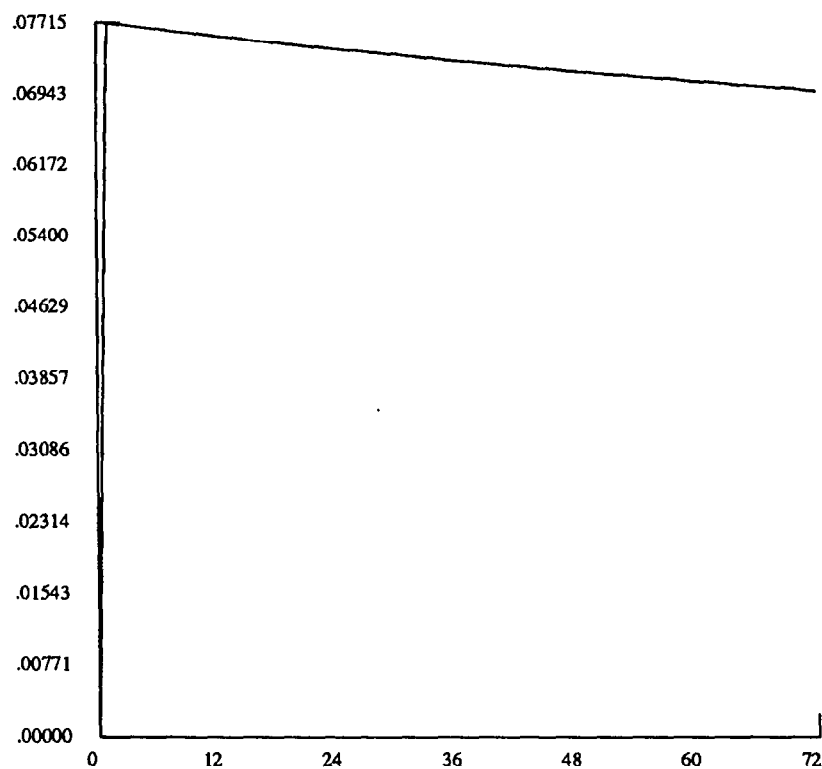
Note Effects of lowering the real interest rate from 0.2 percent per month to 0.175 percent per month

FIGURE 7A.
EFFECTS OF A PERMANENT RISE IN THE LEVEL OF TAXES
ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



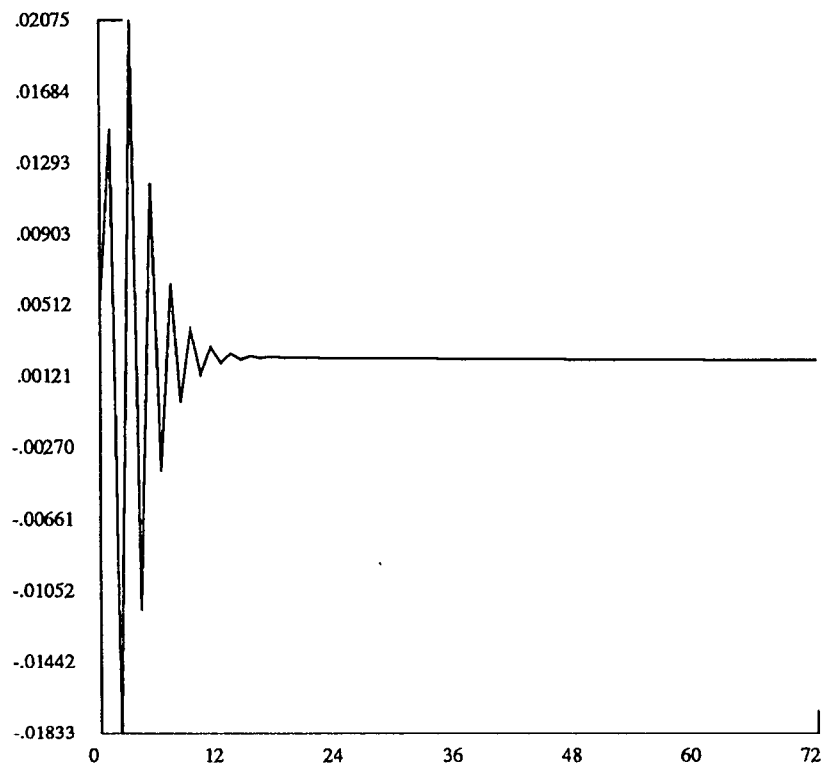
Note. Effects of increasing T_{-1} and T_{-2} by 1247 on the total (private plus public) current account as a ratio to GDP

FIGURE 7B.
EFFECTS OF A PERMANENT RISE IN THE LEVEL OF TAXES
ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



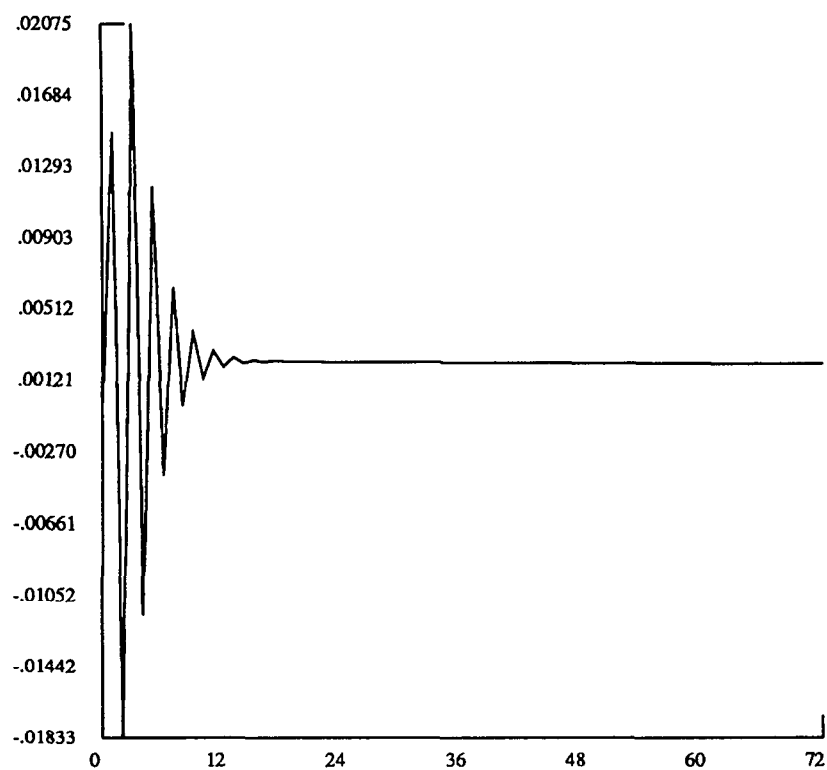
Note Effects of increasing T_{-1} and T_{-2} by 1247

FIGURE 8A.
EFFECTS OF ALTERING THE TAX POLICY PROCESS
ON THE CURRENT ACCOUNT — GDP RATIO
(Percentage deviations from baseline)



Note: Effects of raising κ from -0.57 to -0.50 (see Equation (10)), with $T_{-2} = 0$ and $T_{-1} = 1247$, on the total (private plus public) current account as a ratio to GDP

FIGURE 8B.
EFFECTS OF ALTERING THE TAX POLICY PROCESS
ON THE WEALTH ACCUMULATION — GDP RATIO
(Percentage deviations from baseline)



Note. Effects of raising κ from -0.57 to -0.50 (see Equation (10)), with $T_{-2} = 0$ and $T_{-1} = 1247$

Our results reveal that movements in investment strongly depend on movements in productivity, labor employment, and the real rate of interest. The declining trend of investment (observed in our sample) can be associated with a persistent decline in the growth rates of both productivity and (private sector) labor employment 1/ and with a marked rise in the real rate of interest.

Taken together, these time-varying patterns of saving and investment give rise to alternating periods of improvements and worsenings in the current account. While most policy discussions focus on the current account, our model analyzes also the evolution of the market value of the capital stock and has thus implications for changes in wealth (i.e., the change in the value of domestic capital plus the surplus on current account). The observed slowdown in the growth of wealth during our sample can be explained by the above-mentioned declining trends in productivity and labor employment.

An important extension of the present analysis consists of attempting to incorporate in the model a richer set of macroeconomic channels through which government policies may affect productivity, labor employment in the private sector, tax revenues, and the rate of interest. These factors were treated here as exogenous and would become endogenous in the more complete analysis. To endogenize changes in productivity, the model would specify the mechanism linking the latter to public investment and investment in human capital. Similarly, it may be desirable to specify how policies which determine wages and employment in the public sector impact on employment and wages in the private sector. Another extension is to explicitly specify in the model an endogenous behavior of government which targets some key variables. As is evident this extension would result in a set of derived policy rules. Accordingly, changes in the parameters governing these rules would be reflected in changes in the model reduced-form coefficients, a relation to be taken into account when simulating the model. An important issue in this context is to determine which variables should serve as policy targets. It is commonplace to use the current account as one such variable. However, other variables which are more closely linked to welfare criteria are perhaps more appropriate to serve as policy targets: (i) A broader measure of asset accumulation than the current account, which incorporates changes in the market value of the capital stock and (ii) the separate components of the current account, namely saving and investment.

1/ Evidently, this implies that the scale effect on investment of the labor input dominates the substitution effect.

APPENDIX - THE REDUCED FORMS' COEFFICIENTS IN TERMS OF FUNDAMENTAL PARAMETERS

I. Coefficients for Equations (4)-(6)

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

$$a_0 = 1 - \frac{(1-d)}{R} + \frac{K}{gR} \left[a(1-a)a_0K^{a-2}L^{1-a}\epsilon' \right],$$

$$a_1 = (1-d)R^{-1}$$

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

$$b_L = -\frac{1}{gR} aa_0(1-a)(K)^a(L)^{-a}\epsilon',$$

$$b_{\epsilon} = -\frac{1}{gR} aa_0(K)^a(L)^{(1-a)}$$

Accordingly, the m coefficients in eq.(4) 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 (5) and (6) are:

$$\begin{aligned} h_k &= a a_0 (\bar{K})^{a-1} (\bar{L})^{1-a} \bar{\epsilon}', & s_k &= (1-a) a_0 a (\bar{K})^{a-1} (\bar{L})^{1-a}, \\ h_\ell &= (1-a) a_0 (\bar{K})^a (\bar{L})^{-a} \bar{\epsilon}', & s_\ell &= -(1-a) a_0 a (\bar{K})^a (\bar{L})^{-a-1}, \\ h_\epsilon &= a_0 (\bar{K})^a (\bar{L})^{1-a} & s_\epsilon &= (1-a) a_0 (\bar{K})^a (\bar{L})^{-a}. \end{aligned}$$

II. Coefficients for Equation (9)

The β -coefficients in (9) are:

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

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

where the intertemporal elasticity of substitution is $(h-C)/C$, δ is the subjective discount factor, R is one plus the rate of interest, γ is the survival probability, and ω is the rate of depreciation of the stock of consumption.

III. Coefficients for Equation (11)

The n coefficients are given by

$$\begin{aligned}
 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. \\
 &\quad \left. \left. - m_\ell \left(\frac{\gamma}{1-\phi} \right) \left(\frac{1}{R-\gamma \lambda_1} \right) \right) \right. \\
 &\quad \left. \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) \right. \\
 &\quad \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 + \\
 &\quad + \left\{ - \left(h_k \left(1 - \frac{R}{\gamma h_k} \right) + 1 \right) \left(m_\ell \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. \\
 &\quad \left. \left. + \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) \right. \right. \\
 &\quad \left. \left. + \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) - \right. \right. \\
 &\quad \left. \left. \left(\frac{\gamma^2 \rho^2}{1-\rho} \right) \left(\frac{1}{R-\gamma \rho} \right) \left(\frac{1}{R-\gamma \lambda_1} \right) \right] - \left(\frac{\lambda_1 b_\ell}{1-\rho} \right) \left[\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) \right. \right.
 \end{aligned}$$

$$\begin{aligned}
& + \left(\frac{\rho^2}{1-\rho} \right) \left(\frac{\lambda_2}{\lambda_2 - \rho} \right) \left[\left(\frac{\gamma R}{R-\gamma} \right) \left(\frac{1}{R-\gamma\lambda_1} \right) \right] + h_\epsilon \left[\left(\frac{R}{R-\gamma} \right) + \left(\frac{\gamma R}{1-\rho} \right) \left(\frac{1}{R-\gamma} \right)^2 \right. \\
& - \left. \frac{\rho}{(1-\rho)^2} \left(\frac{\gamma}{R-\gamma} \right) + \left(\frac{\rho}{1-\rho} \right)^2 \left(\frac{\gamma}{R-\gamma\rho} \right) + \left(\frac{\rho}{1-\rho} \right) \left(\frac{\gamma}{R-\gamma} \right) - \left(\frac{\rho}{1-\rho} \right) \left(\frac{\gamma\rho}{R-\gamma\rho} \right) \right] \\
& - \left(h_k \left(1 - \frac{R}{\gamma h_k} \right) + 1 \right) m_e \left[\left(\frac{\gamma R}{R-\gamma\rho} \right) \left(\frac{1}{R-\gamma\lambda_1} \right) + \left(\frac{\gamma^2}{1-\rho} \right) \left(\frac{R}{R-\gamma\lambda_1} \right) \left(\frac{1}{R-\gamma} \right) \right. \\
& - \left. \left(\frac{1}{1-\rho} \right) \left(\frac{\gamma}{R} \right)^2 \left(\frac{\rho R}{R-\gamma\rho} \right) \right] \} e_0
\end{aligned}$$

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

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

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

$$\begin{aligned}
n_e = - \left(h_k \left(1 - \frac{R}{\gamma h_k} \right) + 1 \right) \rho \left\{ m_\epsilon \left[\left(\frac{1}{\lambda_1} \right) \left(\frac{R}{R-\gamma\lambda_1} \right) + \left(\frac{\gamma}{\lambda_1} \right) \left(\frac{1}{R-\gamma} \right) \left(\frac{1}{R-\gamma\lambda_1} \right) \right. \right. \\
\left. \left. + \left(\frac{\rho}{1-\rho} \right) \left(\frac{\gamma}{\lambda_1} \right)^2 \left(\frac{1}{R-\gamma} \right) \left(\frac{1}{R-\gamma\lambda_1} \right) - \left(\frac{\gamma^2 \rho^2}{1-\rho} \right) \left(\frac{1}{R-\gamma\rho} \right) \left(\frac{R}{R-\gamma\lambda_1} \right) \right] \right.
\end{aligned}$$

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

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