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Foreign Borrowing and Macroeconomic Adjustment to External Shocks

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We would like to thank A. Brooke and A. Drud for assistance in the use of their non-linear optimization algorithm, CONOPT.

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ABSTRACT

This paper analyzes the robustness of the traditional foreign borrowing maxim: "borrow to finance a temporary shock, adjust to a permanent one". Dynamic optimizing simulations are used to illustrate the benefits of foreign borrowing and to trace out the evolution of macroeconomic variables, particularly foreign debt, in response to external disturbances.

We find that, as real world disturbances often involve complex intertemporal correlations, any rules of thumb must be qualified according to the characteristics of the shock under consideration. In some cases, borrowing increases substantially in the face of a permanent shock. In others, higher borrowing may not be an appropriate response to a temporary shock. We show orders of magnitude of adjustment for several shocks that have recently hit developing countries. The results indicate that calculations of the impact effect of an external shock on the balance of payments is insufficient to determine the magnitude of desired adjustment. A normative analysis also indicates that failure to anticipate shocks may eliminate the gains from intertemporal trade nd leave a country worse off than under financial autarchy.

I. INTRODUCTION

In both the development and international economics literature, emphasis has been placed on gains from trade arising from the intertemporal reallocation of consumption. Countries may shift the distribution of welfare in their favor by running current account imbalances (which have zero net present value). The first-order condition for maximizing welfare with respect to external borrowing, is derived, for example, in Obstfeld (1982), Svensson and Razin (1983), Dornbusch (1983), Sachs (1984) and Cooper and Sachs (1985). Except for special cases, these studies confirm the traditional rules of thumb governing the management of country external borrowing, summarized by the maxim: "borrow to finance a temporary shock, adjust to a permanent one (Laursen-Metzler effect)". They also provide the welfare underpinnings of numerous empirical analyses of adjustment to oil price rises (e.g., Marion [1984]; Martin and Selowsky [1984]) and to other external shocks, (e.g. Balassa [1984]). Both the theoretical and empirical work, however, sacrifice generality in order to maintain analytical tractability. In particular, external disturbances are treated as abstract phenomena -- temporary or permanent in impact, anticipated or unanticipated.

In the real world, disturbances rarely take such a pure form. For example, a fall in commodity prices associated with recession in the OECD may be "unanticipated" in the sense that the price decline was not foreseen, but additional future low prices may also be anticipated if the recession is expected to follow the normal business

cycle. Alternatively, it may be that the precise timing of a downturn in prices was unanticipated, but the likelihood of one occurring at some time had been incorporated into decision-making such that the impact of the shock would be mitigated when it actually occurred. Similarly, "temporary" disturbances are rarely of such short duration that their impact on wealth is negligible (as is the presumption in analytical work); most often, they bear sizeable intertemporal correlation. In evaluating by how much consumption should be reduced, the net present value of the shock must be calculated. As Dornbusch (1983) emphasizes, however, the appropriate discount rate in home goods terms depends on the change over time in the prices of home goods relative to traded goods. But this last depends on the extent to which external borrowing is used to cushion adjustment.

Closed-form solutions for problems along the above lines are not easily derived from an analytical framework. The point is that the information conveyed by a disturbance may result in a complex reevaluation of intertemporal expectations. A simulation model is a more flexible tool for such an analysis. In the following section, we construct a simple, non-linear, neoclassical general equilibrium model which is solved as a single, dynamic optimization problem. 1/ The model focuses on the endogenous accumulation of physical capital and external

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1/ Non-linear optimizing models have not been extensively used in economic analysis because of their high cost and the unavailability of suitable algorithms. We are fortunate to have had access to the GAMS and CONOPT packages developed by A. Brooke and A. Drud, that permit solutions to small-scale models at reasonable rates.

debt in a framework that combines the key features of (i) non-traded and traded goods sectors with endogenous relative prices: (ii) imperfect specialization in the production of consumption and investment goods, and (iii) saving and foreign borrowing behavior determined by the optimization of an intertemporal social welfare function. Such a framework is necessary to treat a variety of intertemporal disturbances in a consistent fashion.

Section III looks at the impact on foreign borrowing and macroeconomic adjustment of the three principal shocks affecting developing countries in the late 1970s; a fall in the growth rate of the volume of commodity trade; a fall in world prices for commodity exports, and the rise in the real interest rate. The qualitative difference between "temporary " and "permanent" shocks is shown to be critical only for price shocks, not for the others. At the same time, the simulations show the relative quantitative impact of the alternative shocks on optimal borrowing and adjustment. We show that existing methodologies (e.g. Balassa (1984)) that treat all shocks similarly in terms of their static accounting impact on the balance of payments may be misleading if used for normative analysis of desired adjustment. Much of the latter is dominated by the revision of expectations about the future typically associated with unanticipated shocks.

Section IV considers anticipated versus unanticipated disturbances. We demonstrate that much of the welfare gain from foreign borrowing may be dissipated if future expectations do not materialize. In particular, autarchy may be preferable to foreign borrowing if large,

anticipated interest rate changes occur. This suggests that the mutual benefits expected from expanded cross-border capital flows may be severely squeezed in a highly volatile world environment.

II. THE MODEL AND INITIAL PLAN

In this section we illustrate the potential gains from intertemporal trade for a hypothetical economy, Harappa, whose productive structure (commodities, manufactures, services) approximates a 'typical' developing country. 1/ We present a small, three-sector model that may have been used by the Ministry of Planning. Then we describe the ten-year evolution of the economy, particularly of capital and external debt, that results from an intertemporal optimizing methodology, based on explicit forecasts of exogenous world parameters.

A. The Model

Harappa is a small open economy. It produces a traded and non-traded good (Q_{Tt} and Q_{Nt} respectively) with factors of production, labor and capital, mobile between sectors. The availability of factors is initially determined by a historical endowment (TL_1, TK_1) and grows over time via an exogenous growth of the labor force and an endogenous increase in the capital stock through investment. Only the traded good is used for investment. The country also produces a primary commodity, Q_{pt}, with sector-specific factors, which is entirely exported at the world price, p^*. Output of this commodity is demand driven. It therefore grows over time at the exogenous world-market growth rate, q_p.

1/ As is generally the case in intertemporal models, many of the results presented here are sensitive to the assumptions on factor intensities, numbers of goods and factors, number of time-priods, etc. Such a loss of generality is inevitable in a simulation exercise.

The planners' problem 1/ is to maximize the discounted flow of the utility of a representative household, U_t, in each period. Utility is represented as a function of the consumption of the non-traded and traded good, with an elasticity of substitution of one. The intertemporal elasticity of substitution, 1/b, is also constant. When b = 0, consumption is perfectly substitutable intertemporally, whereas as b tends to infinity the desire for consumption smoothing rises. (Table 1, eqs. 1-1a).

The planners' choice variables are the levels of capital investment and new borrowing, B_t, in each period. The former, together with the domestic production functions (eqs. 2-4), determines the production possibilities for each good in each time period. Borrowing is used to smooth consumption intertemporally. Given the total consumption in any period, consumers choose between traded and non-traded goods to maximize utility. The price of non-traded goods, relative to the numeraire, the price of manufactured traded goods, adjusts to clear the goods markets. The market-clearing equations (5) and (6) also depend on the international price of the primary commodity export.

Real fixed capital formation J_t, is linked to investment expenditures, I_t, by a quadratic function (eq. 7). This implies that

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1/ A small country assumption is made -- unlimited borrowing at a parametrically determined world interest rate. Recent theoretical work (Sachs [1983]) shows that this will only hold up to a given credit constraint. We assume this is not binding, and not enforceable (see Hellwig [1978]). An upward sloping supply of capital could be easily incorporated into the analysis. There is little theoretical or empirical support for such a formulation, however.

there are costs of installation which rise as the level of investment relative to the total capital stock rises. Such a formulation is analytically consistent with a Tobin's-q theory of investment (see Lucas, 1967; Hayashi, 1979; Lipton and Sachs, 1983).

The accumulation of the total capital stock and the level of debt outstanding are determined by the choices of investment and new borrowing levels (eqs. 8 and 9). Labor force growth is exogenous (eq. 10), up until the end of the ten-year plan, at which time a steady-state population would have been reached. Full employment of factors (eqs. 11 and 12) is guaranteed by flexible wage and rental rates which are equated across sectors (eqs. 13 and 14). Equation 15 represents the consumer choice axiom that the relative price of the non-traded good should be equated to the marginal utility of its consumption relative to the marginal utility of consumption of the traded manufactured good.

The initial conditions for the economy are given, (eq. 16), but the terminal conditions on the value of capital and debt at the end of the Plan require additional assumptions. It is clear that one available option is to have zero net investment and net borrowing at the end of the Plan (eq. 17). This would be appropriate if the steady-state had been reached. Thus, the minimum utility of the terminal capital and debt stocks can be assessed by their contribution to the future consumption stream that would result without further borrowing or investment. This permits calculation of terminal shadow values for the

Table 1: THE BASIC MODEL

Equation

$$W = \sum_{t=1}^{10} U_t/(1+\delta)^{t-1} + U_{11}/\delta(1+\delta)^{10} \quad (1)$$

where $U_t = (C_{Tt}^{a} C_{Nt}^{1-a})^{1-b}/(1-b)$ (1a)

$$Q_{Tt} = q_{Tt} K_{Tt}^{\alpha T} L_{Tt}^{1-\alpha T} \quad (2)$$

$$Q_{Nt} = q_{Nt} K_{Nt}^{\alpha N} L_{Nt}^{1-\alpha N} \quad (3)$$

$$Q_{Pt} = Q_{P_1} (1+q_p)^{t-1} \quad (4)$$

$$P_t^* Q_{Pt} + Q_{Tt} = C_{Tt} + I_t + rD_t - B_t \quad (5)$$

$$Q_{Nt} = C_{Nt} \quad (6)$$

$$I_t = \left(1 + \frac{v}{2}\frac{J_t}{TK_t}\right) J_t \quad (7)$$

$$TK_{t+1} = TK_t + J_t \quad (8)$$

$$D_{t+1} = D_t + B_t \quad (9)$$

$$TL_t = TL_1 (1+g)^{t-1} \quad (10)$$

$$TK_t = K_{Tt} + K_{Nt} \quad (11)$$

Table 1: THE BASIC MODEL (Cont'd)

$$TL_t = L_{Tt} + L_{Nt} \tag{12}$$

$$\partial Q_{Tt} / \partial L_{Tt} = P_{NT}\, \partial Q_{Nt} / \partial L_{Nt} = W \tag{13}$$

$$\partial Q_{Tt} / \partial K_{Tt} = P_{NT}\, \partial Q_{NT} / \partial K_{NT} = \pi \tag{14}$$

$$(\partial U_t / \partial C_{Nt}) / (\partial U_t / \partial C_{Tt}) = P_{Nt} \tag{15}$$

$$TK_1 = \overline{TK}_1;\ TL_1 = \overline{TL}_1;\ D_1 = \overline{D}_1;\ Q_{P_1} = \overline{Q}_{P_1} \tag{16}$$

$$I_{11} = 0;\ B_{11} = 0 \tag{17}$$

Parameter values

δ	=	pure rate of time preference = 0.03
b	=	inverse intertemporal elasticity of substitution = 0.8
a	=	share of traded goods in aggregate consumption = 0.45
αT	=	share of profits in traded sector = 0.535
αN	=	share of profits in non-traded sector = 0.35
q_T	=	efficiency parameter in traded sector = .3
q_N	=	efficiency parameter in non-traded sector = 1
q_P	=	growth rate of primary sector = 0.025
P_t	=	international price of primary sector = 1
r	=	world interest rate = 0.042
v	=	investment adjustment cost parameter = 5
g	=	labor force growth rate = 0.02

Note: The price of the manufactured traded good is taken as the numeraire.

Parameter values were chosen so as to replicate the characteristics of a typical developing country, in terms of economic structure, consumption/savings behavior, labor force growth and world interest rates.

B. The Initial Plan [1/]

The immediate prospects for the economy were for moderate growth. The exogenous primary producing sector was expected to grow by 2.5 percent per annum. In addition, there were positive net present value projects in the tradeable manufacturing sector. The intention of the planners was to use foreign borrowing to transform this potentially rising income stream into a smoother, higher utility, consumption stream. To this end, investment and external borrowing would be raised in each period until the expected marginal return on investment and the real social discount rate were equated to the marginal cost of foreign funds.

To implement the simple rules of thumb above for determining optimal borrowing and investment, a full intertemporal optimization procedure was required. The intertemporal nature of the decision-making process stemmed from three features. First, expectations about future income were crucial in establishing the current level and growth rate of consumption. Second, the economic costs of raising the capital stock through investment changed over time as the total absorption capacity of

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1/ We have used a non-linear optimizing algorithm, CONOPT, developed by A. Drud for the solutions. This permits economically interesting non-linearities to be preserved at reasonable cost.

the economy increased. Third, and most fundamentally the expected return on investment and the marginal cost of borrowing in each period depended on the expected rate of change of the real exchange rate. This, in turn, was a function of the relative supply and demand for each good, which was directly influenced by future borrowing and investment decisions.

The solution to the optimization problem is characterized as follows (Table 2). Overall GDP growth would average 3.1 percent during the Plan (1.1 percent per capita). This would be based on a relatively strong performance in manufacturing, with annual growth of 5.1 percent. The share of manufacturing in output would rise from 36 to 43 percent. Meanwhile, the primary sector, agriculture, would decline in importance. The slowest sectoral growth, in non-traded output, would be just 1.2 percent, reflecting a much smaller growth in domestic consumption demand than in output, due to the smoothing of consumption over time. Relative to the zero borrowing counterfactual, there is considerably more structural change in sectoral output.

A major portion of output growth is attributable to substantial gross fixed capital formation. The marginal return to capital in the economy in the first period is 5.8 percent, significantly above the pure rate of time preference (3 percent) and the real interest on foreign borrowing (4.2 percent). As a result, initial investment expenditure is 36 percent of GDP. This falls over time as capital accumulation drives down the marginal product of capital. By the final period, the profit rate is 5.4 percent, still above the opportunity cost

of foreign funds, indicating that a steady-state had not quite been reached.

The high levels of investment are financed by domestic savings and foreign borrowing in approximately equal proportions initially. High starting consumption, however, is only sustainable by a growth rate over time (1.3 percent) substantially below that of income (2.8 percent). Thus, domestic savings rise over the Plan period from 18.8 percent to 26.9 percent. In the meantime, new borrowing (the current account deficit) falls sharply from 17 to 1 percent of GDP over the Plan, as the demand for foreign funds for consumption smoothing starts to decline.

The large capital inflows are associated with a steady rise in the external debt/GDP ratio. The economy initially had outstanding debt of 40 percent of GDP. Debt grows, however, at an average rate of over 14 percent over the Plan, far in excess of real GDP growth. Thus, the debt/GDP ratio doubles to 88 percent by the fifth year and grows further to over 100 percent by the last year. It is only in the final year of the plan that the combination of a high stock of debt and low levels of new capital inflows combine to give a growth rate of debt marginally below that of GDP. Final year interest payments on the debt amount to 4.2 percent of GDP. The growth in interest payments implies that the country starts to transfer real resources to the rest of the world in years eight and thereafter.

Table 2: Structural Change Along the Optimal Borrowing Path and in Autarchy
(Percent of GDP)

Variable	Year 1		Year 5		Year 10		Avg. Gr. 1/ 1-10 (%)	
GDP	100		100		100		3.1	(2.9)
Agricultural output	20.0	(20.1)	19.4	(19.8)	19.0	(19.4)	2.5	(2.5)
Manufacturing output	36.2	(40.0)	40.1	(40.8)	43.1	(42.1)	5.1	(3.5)
Non-traded output	43.8	(39.9)	40.5	(39.4)	37.9	(38.5)	1.2	(2.2)
Investment	36.2	(25.8)	31.9	(26.9)	27.8	(28.7)	0.0	(4.2)
Consumption	79.5	(72.5)	73.7	(71.6)	68.9	(70.0)	1.3	(2.5)
Income	98.3	(98.3)	96.3	(98.5)	95.8	(98.7)	2.8	(3.0)
New borrowing	17.4	(0.0)	9.2	(0.0)	0.9	(0.0)	n.a.	(0.0)
Capital stock	600.8	(600.8)	640.9	(626.1)	678.1	(657.4)	4.5	(3.9)
Total debt	40.1	(40.1)	88.3	(35.8)	100.6	(31.0)	14.2	(0.0)
Interest payments	1.7	(1.7)	3.7	(1.5)	4.2	(1.3)	14.2	(0.0)
Memo items:								
Relative price of non-tradeable	0.420	(0.418)	0.427	(0.423)	0.433	(0.430)	0.3	(0.3)
Profit rate	0.058	(0.059)	0.056	(0.057)	0.054	(0.055)	-0.8	(-0.8)
Wage rate	0.452	(0.444)	0.473	(0.460)	0.493	(0.481)	1.0	(0.9)

1/ Average real growth of numerator.

Figures in parentheses represent a zero borrowing (financial autarchy) simulation.

Borrowing and investment have a substantial impact on the evolution of prices in the economy. At constant relative prices, capital accumulation would result in a decrease in non-traded output as this sector is labour-intensive by assumption (the Rybczynski effect). Aggregate consumption, however, rises over time As consumers allocate a constant fraction of their expenditure to non-traded goods, demand in this sector increases. Thus, at constant relative prices, demand for non-traded goods would exceed supply by growing amounts over time. The price rises to clear the market.

The influence of foreign borrowing is to reduce this incipient upward pressure on non-traded goods prices caused by investment. By helping to smoothe consumption over time, borrowing reduces the increase in demand for the non-traded good. On the other hand, by raising initial consumption of non-traded goods, the level of the price of non-traded goods in the initial periods is raised. The net result is a gradual rise over time in the price of non-traded relative to traded goods, starting from a level higher than would have been the case under autarchy.

The high initial relative price of the non-traded good leads to a real wage rate greater than in autarchy (Stolper - Samuelson). As capital accumulation takes place and the relative price of home goods rises further over time, real wages increase, faster than in autarchy.

The results of the intertemporal optimization provided policy-makers with some crucial insights as to how the economy would evolve over the plan. First, with the opening up of financial trade, quite dramatic consumption reallocation was possible, leading to considerable welfare gains. Second, they were relieved to discover that over a relatively long, ten-year period, it was acceptable (indeed optimal) to have a growth rate of outstanding debt and interest payments exceeding that of GDP and tradeable output. Third, they recognized that the productive structure of the economy would have to change significantly to provide the traded goods necessary to service debt when foreign borrowing was no longer available after the end of the Plan. This would imply devoting the bulk of investment to increasing capital in the

traded goods sector, with minimal increases in the non-traded sector. Fourth, it was evident that it would be necessary to mobilize greater national savings over time, increasing the domestic contribution to investment. This would be reflected in a current account deficit which would grow smaller in absolute terms at an increasing speed. Finally, the appreciation of the relative price of the home good would imply that the equilibrium domestic interest rate denominated in local currency terms, should be below the foreign interest rate. By contrast, in autarchy the domestic interest rate would have been greater than that in the rest of the world.

III. THE IMPACT OF UNANTICIPATED EXTERNAL SHOCKS 1/

In the sixth year of the Plan three major unforeseen events occurred. First, the world interest rate at which the country could borrow increased from 4.2 percent to 8.0 percent. Second, the price of the agricultural export good fell by twenty percent. Third, activity in the rest of the world stagnated and resulted in a zero volume growth for the agricultural export. These adverse developments necessitated a reassessment of the optimal borrowing and investment programme. As it was unclear whether the shocks were temporary or permanent, two alternative scenarios were calculated. In one, the shocks were expected to persist for five years (the remaining length of the Plan) but to

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1/ We analyze the impact of shocks through comparative dynamic results, rather than through the introduction of explicit stochastic elements in order to preserve the important economic non-linearities in production and consumption. Non-linear stochastic optimization cannot be numerically solved.

revert back to the original levels in the post-plan steady-state. In the other scenario, the shocks were modelled as if they were permanent changes.

Adjustment to an adverse shock will occur through changes in aggregate consumption and investment (and hence borrowing) and through switching of demand and supply as relative prices adjust. In general, even a temporary shock will have some expected intertemporal correlation. For example, developing countries were faced in the recent past with falls in the price and quantity of commodity exports, associated with recession in the OECD. It could have been anticipated that a recovery in the value of commodity exports was contingent on an upswing in the business cycle, typically after three to four years. For simplicity, we have modelled the temporary shocks below as continuing for five years at a uniform level, before reverting back to previous levels in the final period steady-state.

The intertemporal nature of disturbances is of critical concern in determining optimal adjustment and is at the heart of the usual distinction between temporary and permanent shocks. The loss of wealth associated with an external shock, in home goods terms, depends both on the magnitude of the shock and on the appropriate discount rate. 1/ This latter, however, is an endogenous variable, affected by

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1/ As defined here, the real social discount rate consists of two terms. One, the pure rate of time preference, is constant over time. The other term reflects the diminishing marginal utility of consumption, which in turn depends on the level of consumption in each period.

the nature of adjustment undertaken. Thus. one can conceptually divide "adjustment" into two components. First, demand must change to accommodate the loss in wealth. Second, the composition of demand and output must adjust to mitigate the impact on welfare of the expected future disturbance linked with the shock. This last will be associated with changes in relative prices over time. The second component becomes increasingly important as the expected duration of the disturbance increases.

The three shocks analyzed below have different intertemporal characteristics. Higher interest rates have an effect on wealth through their impact on raising the costs of servicing the existing stock of debt (assumed here to be a line of credit at a floating rate). They also have an impact on the desired extent of consumption smoothing over time. Permanently lower commodity prices, on the other hand, instantaneously reduce the level of output value, but leave the growth rate essentially unchanged (although there are indirect effects that follow from the resulting changes in relative prices). Finally. lower export volume growth has only a minor impact on the current value of output, and a more substantial impact on its future value.

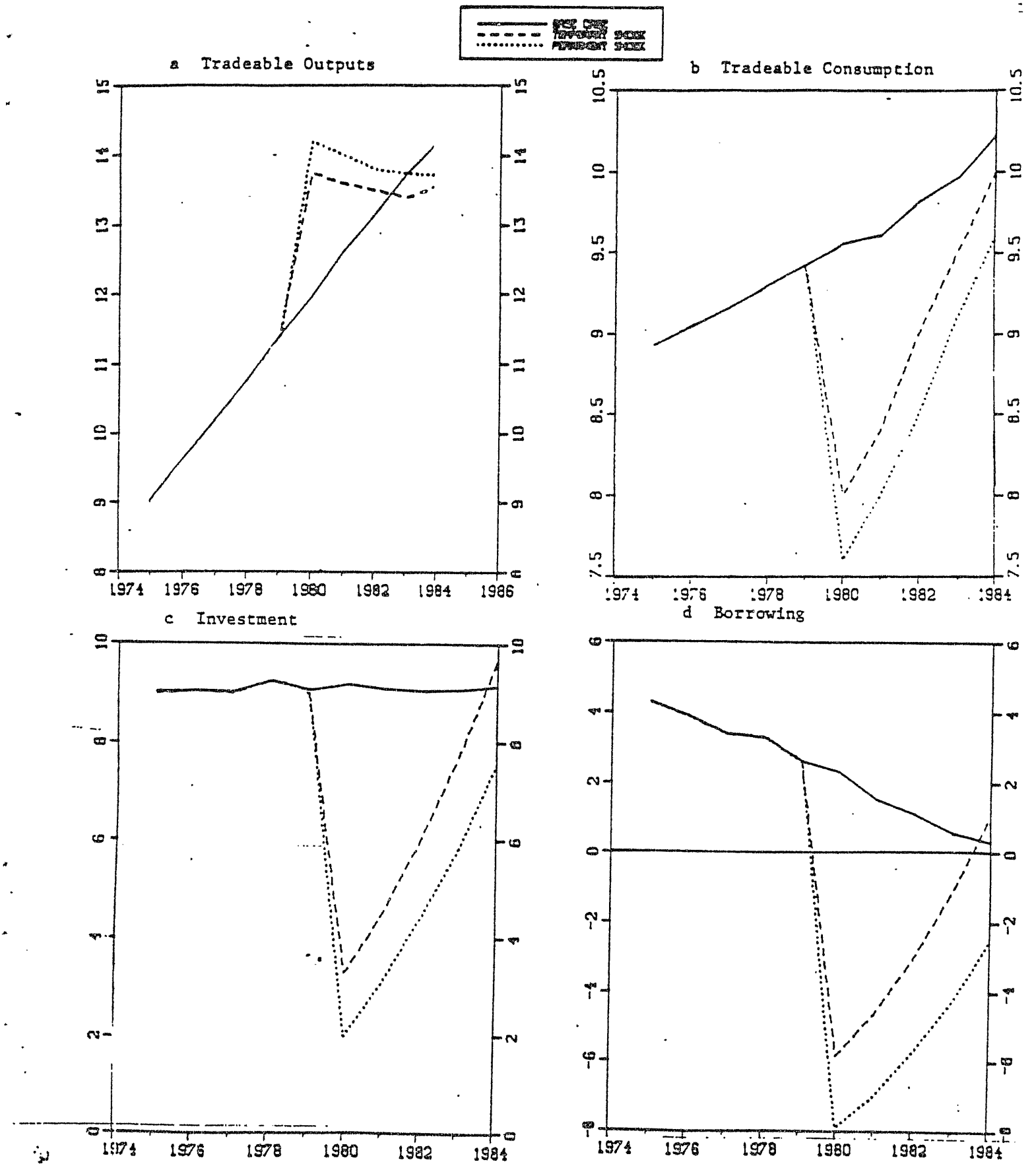
Interest rate increase

Consider first the case of temporary shocks. We assume that real interest rates rise from 4.2 percent to 8 percent in years 5 to 10 and then revert back to 4.2 percent. The additional debt service costs in year 6 amount to 3.7 percent of the previous year's GDP. Figures

1(a) through 1(d) illustrate the evolution of the key components of the balance of payments relative to the base case. Adjustment occurs as follows. The consumption of tradeables falls by 16 percent, partly due to the loss in wealth, partly due to a depreciation of the real exchange rate and partly in response to a desire for changing the profile of consumption as a consequences of the rise in the social discount rate. The savings of foreign exchange amount to 1.55 units. Investment expenditure, meanwhile, plummets as domestic profit rates fall temporarily below the world interest rate. Expectation of the fall back in interest rates keeps investment positive, however. In year 6, the savings from reduced investment account for 5.84 units. Additional foreign exchange savings of 1.77 units come from a higher output of tradeables in response to the currency depreciation. These sharp changes are required because desired net new borrowing turns sharply negative, reducing available foreign exchange by 8.11 units.

Over time, the future horizon over which high interest rates are expected to prevail is shortened. The impact on investment is correspondingly reduced. Even before interest rates fall again, investment expenditure starts to pick up. Immediate rates of return below the world interest rate are compensated by the increase in absorptive capacity that allows the economy to expand rapidly as soon as the high interest period is over. The revival of investment is closely linked with a decrease in the rate of net capital outflows. By the tenth period, new borrowing is positive again, traded goods consumption is only slightly below that in the base case and traded goods

Figure 1. Unanticipated Rise in Interest Rate



manufacturing, which had initially increased sharply, falls below the base case level due to the reduction in the rate of investment.

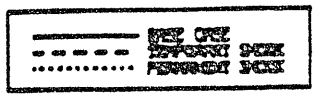
The pattern of adjustment that occurs if the shock is believed to be permanent is somewhat different. Initial adjustment is accentuated: a greater depreciation leads to higher output and lower consumption of tradeables. Investment is also reduced. But whereas investment recovers if the shock is temporary, when it is perceived to be permanent it is sharply lower throughout. Thus, increasing domestic absorptive capacity to permit sharply higher investment in anticipation of a fall in interest rates, becomes unprofitable. Furthermore, the expectation of permanently high interest rates makes it desirable to eliminate all outstanding debt before the end of the plan.

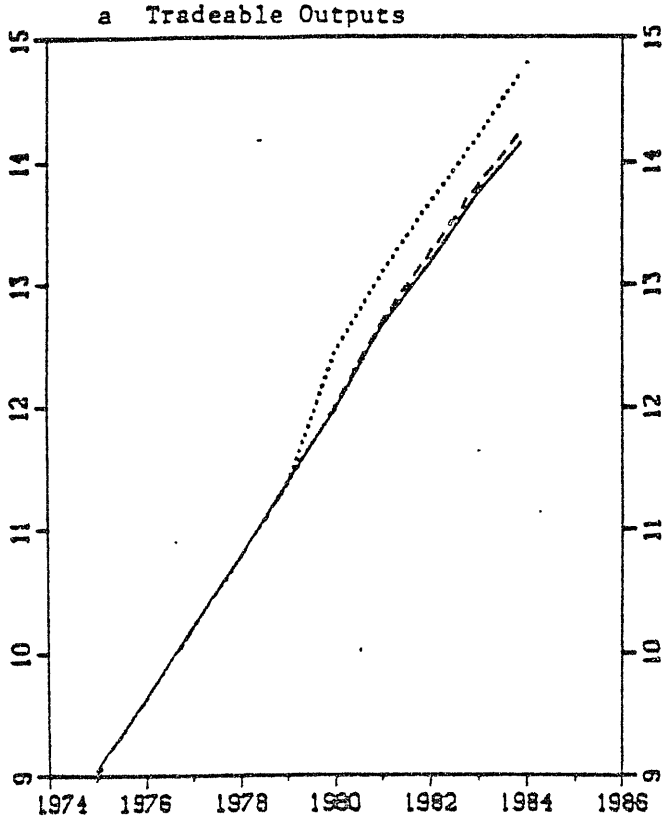
Fall in export commodity price

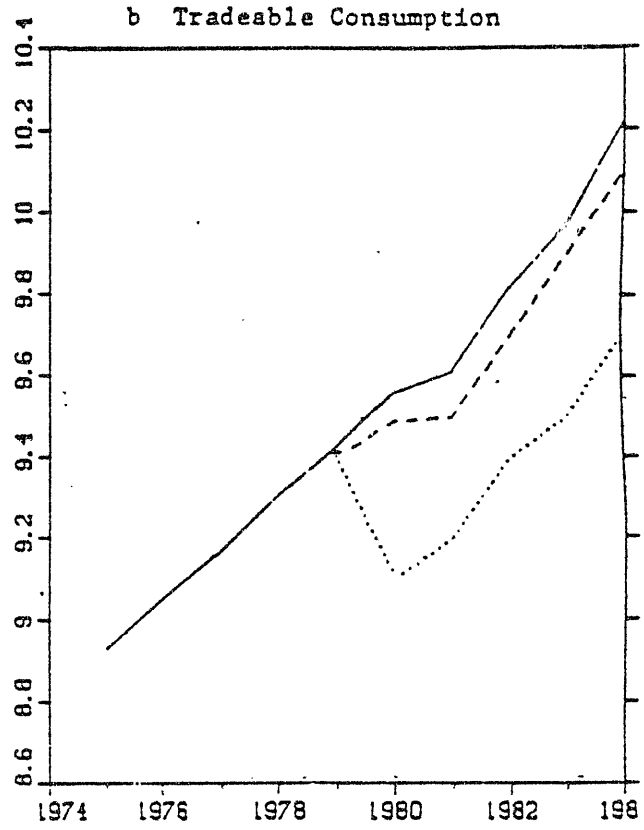
Adjustment to a fall in the price of the exported commodity good stands in sharp constrast. Figures 2(a) through 2(d)). We simulate a twenty percent fall, which leads immediately to a loss of foreign exchange of 1.13 units, slightly greater than the loss due to higher interest rates. When the fall is temporary, almost all the adjustment takes the form of greater borrowing (+1.04). The excess demand for foreign exchange leads to a depreciation of the currency. Output of tradeables expands slightly and consumption falls. At the same time, profitability is raised, so investment rises. The magnitude of these changes, however, is minor.

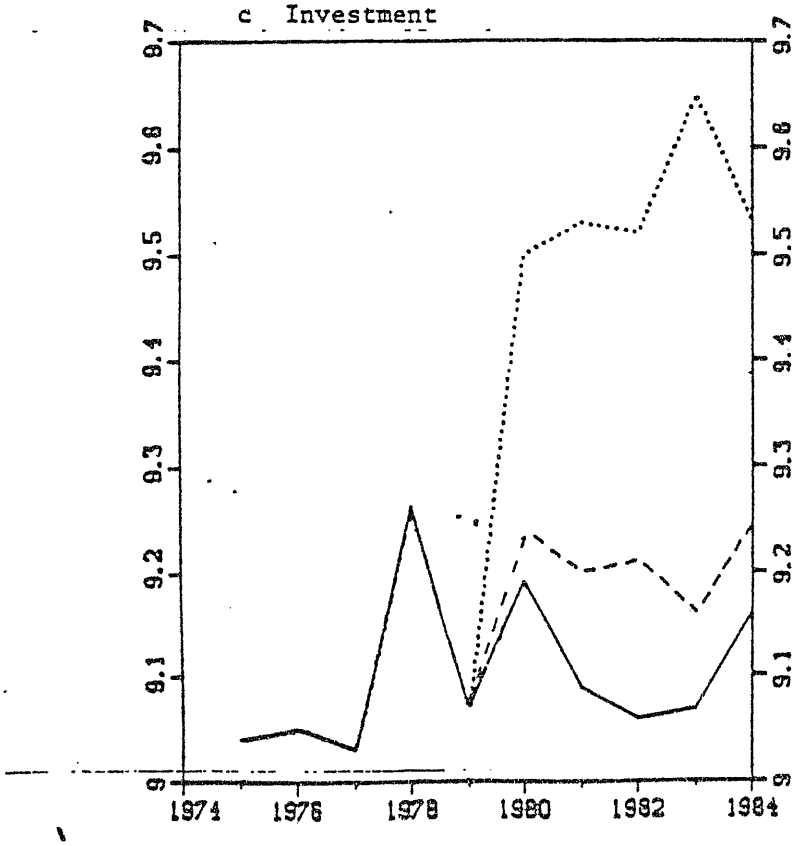
On the other hand, when the fall in commodity prices is expected to be permanent, changes are much sharper. There is a larger

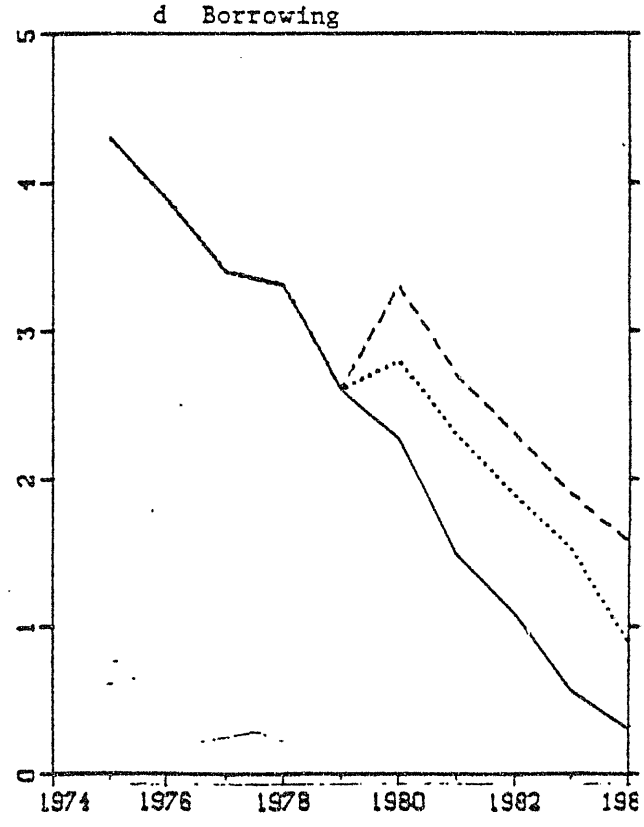
Figure 2. Unanticipated Fall in Export Price









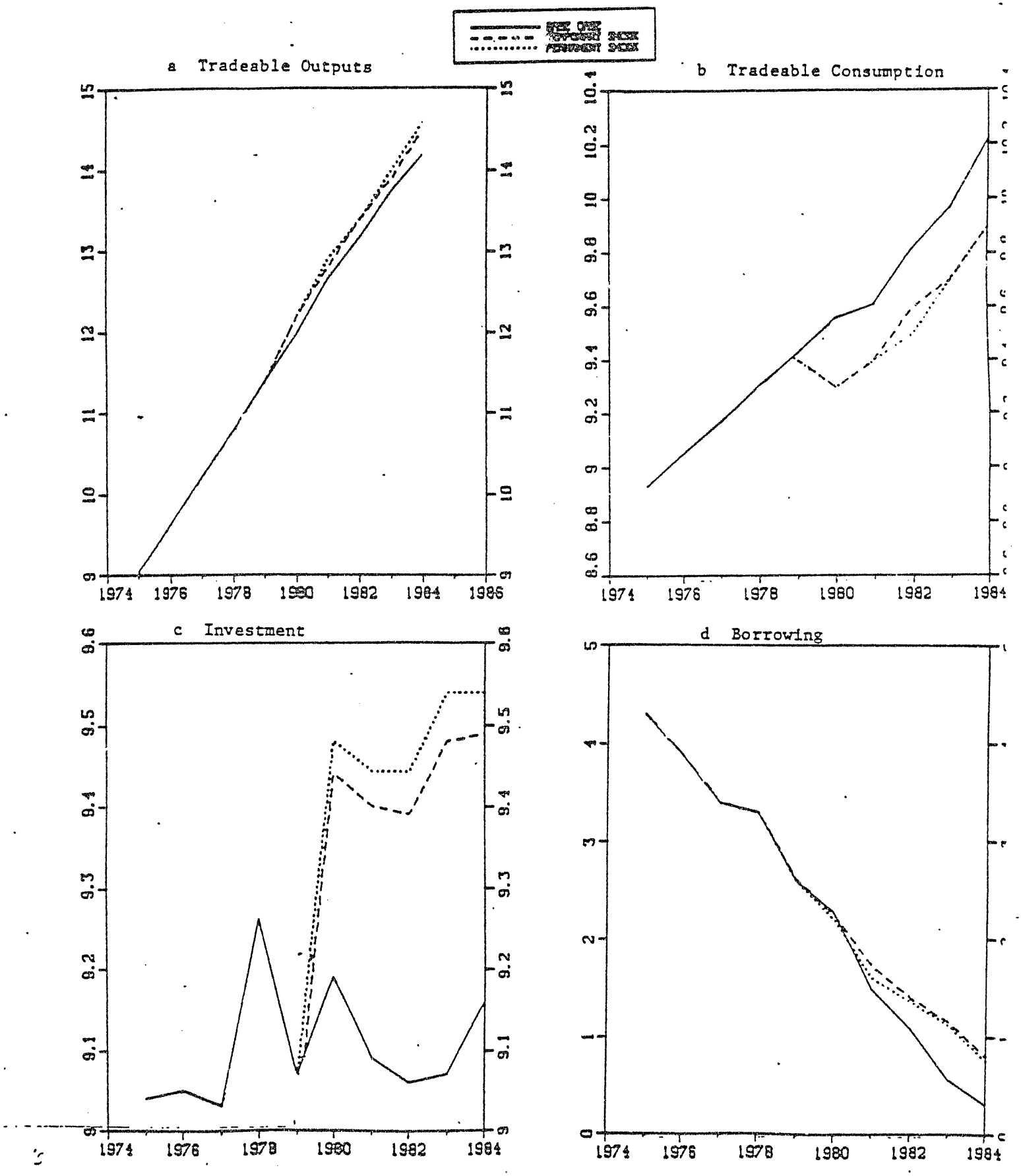


immediate depreciation. The rise in profitability is now expected to continue over a longer period, so investment expenditures rise sharply. Although this is offset by a fall in consumption, overall demand for tradeables remains almost unchanged relative to the base case. Thus, external borrowing still rises to help finance the investment.

Fall in export demand

If the growth rate of the quantity of exports falls to zero in the sixth year, there is only a minor impact on the immediate availability of foreign exchange (-0.14 units) -- about one-eighth of the decrease associated with the commodity price fall, for example. Because of the expected future losses, however, the adjustment in the economy is much sharper. Even a temporary recession inspires a currency depreciation, with higher output and investment and lower consumption than in the base case. In this case, however, new borrowing is actually lower initially than in the base case. This is due to the nature of the shock. With expected zero growth, the magnitude of the foreign exchange losses mounts over time. Borrowing is used to smooth the adjustment intertemporally. Therefore, it rises over time after its initial fall. This pattern is accentuated when the shock is considered permanent. The fall in borrowing is greater initially, but, relative to the base case, total debt in the steady-state ends up higher. (Figures 3a through 3d).

Figure 3. Unanticipated Fall in Export Volume



Impact effects

All the shocks considered below have an adverse impact on the availability of foreign exchange. Although it is difficult, because of the endogenous real social discount rate, to evaluate the net present value of each of the shocks, we can readily calculate the impact effect. Table 3 shows the loss of foreign resources in year 6, as a percent of the preceding year's GDP, associated with each shock. From the balance of payments identity, it is simple to associate changes in endogenous variables (the left-hand side of equation (18)), termed "adjustment", with changes in exogenous variables (the shocks).

$$(C_t + I_t - Q_t - B_t) \qquad (P^*_t Q_{pt} - rD_t) \quad (18)$$

The optimal adjustment in the first year is shown in Table 3 for both temporary and permanent shocks.

The numerical values in Table 3 illustrate several general points. First, even when a shock is considered to be temporary, it can generate large adjustments in real variables. Only in the case of a temporary fall in export prices does foreign borrowing initially increase so as to cushion the burden of the shock. In the case of an interest rate rise, the desired sharp fall in foreign borrowing exacerbates the need for adjustment. After a fall in export volume growth, borrowing also declines slightly, primarily to permit higher borrowing in the future when the impact of the shock is greater. Second, a permanent shock will not leave the desired current account deficit unchanged. For higher interest rates, this is a trivial result. But after a permanent fall in export prices, higher borrowing

Table 3: Adjustment to Unanticipated External Shocks
(Year 6: arbitrary "dollar" units)

	Rise in Interest Rate	Fall in Export price	Fall in Export Volume Growth
A. Size of Shock 1/	-1.05 (-3.7)	-1.13 (-4.0)	-0.14 (-0.5)
B. Adjustment	-1.05	-1.13	-0.14
1. Temporary			
Consumption of Tradeables	-1.55	-0.07	-0.19
Investment	-5.84	0.05	0.25
Production of Tradeables	1.77	0.08	0.22
External Borrowing	-8.11	1.04	-0.03
2. Permanent			
Consumption of Tradeables	-1.95	-0.41	-0.24
Investment	-7.14	0.33	0.30
Production of Tradeables	2.24	0.47	0.27
External Borrowing	-10.27	0.58	-0.07

1/ Impact on interest payments and export revenues. Figures in parentheses express the shock as a percentage of the preceding year's GDP.

is desirable to finance additional investments to produce trade goods. Only in the case of a permanent slow-down in export volume growth (perhaps associated with a land frontier constraint), is borrowing unaffected. Here, the rise in desired investment is fully financed by higher domestic savings. Third, it appears that quantifying the impact effect of a shock yields little insight into the magnitude of the required adjustment. Different shocks have different

characteristics that must be taken into account. Each shock has three separate effects: an impact effect on wealth, an indirect effect on wealth stemming from the change in investment opportunities as endogenous relative prices adjust, and a change in the relevant real social discount rate that influences the net present value of the future disturbances correlated with a shock. This suggests that methodologies that treat all shocks in a similar manner, (e.g., Balassa [1984]) focusing on their accounting impact on the balance of payments, rather than on the behavioral impact associated with intertemporal effects, are likely to yield misleading normative results.

IV. THE WELFARE IMPACT OF DISTURBANCES

A major feature of the profile of adjustment to an unanticipated shock is an immediate cut-back in aggregate consumption that is substantially greater than the decline in consumption in the steady state. Given the risk-aversion of the utility function, this is costly in welfare terms. When the disturbances are anticipated from the beginning of the plan, there is extended scope for adjustment smoothing and for altering the structure of the economy to mitigate the impact of the shock. The resulting consumption and investment profiles are much smoother. Table 4 shows the effects of anticipated and unanticipated shocks on the terminal values of debt and capital stock as percentage deviations from the base case.

When a future temporary rise in the interest rate is anticipated, borrowing, investment and the real exchange rate adjust to smooth consumption. This is initially lower than in the base case, but

Table 4: Effects of Anticipated (A) and Unanticipated (U) Disturbances
(percent deviation from base case)

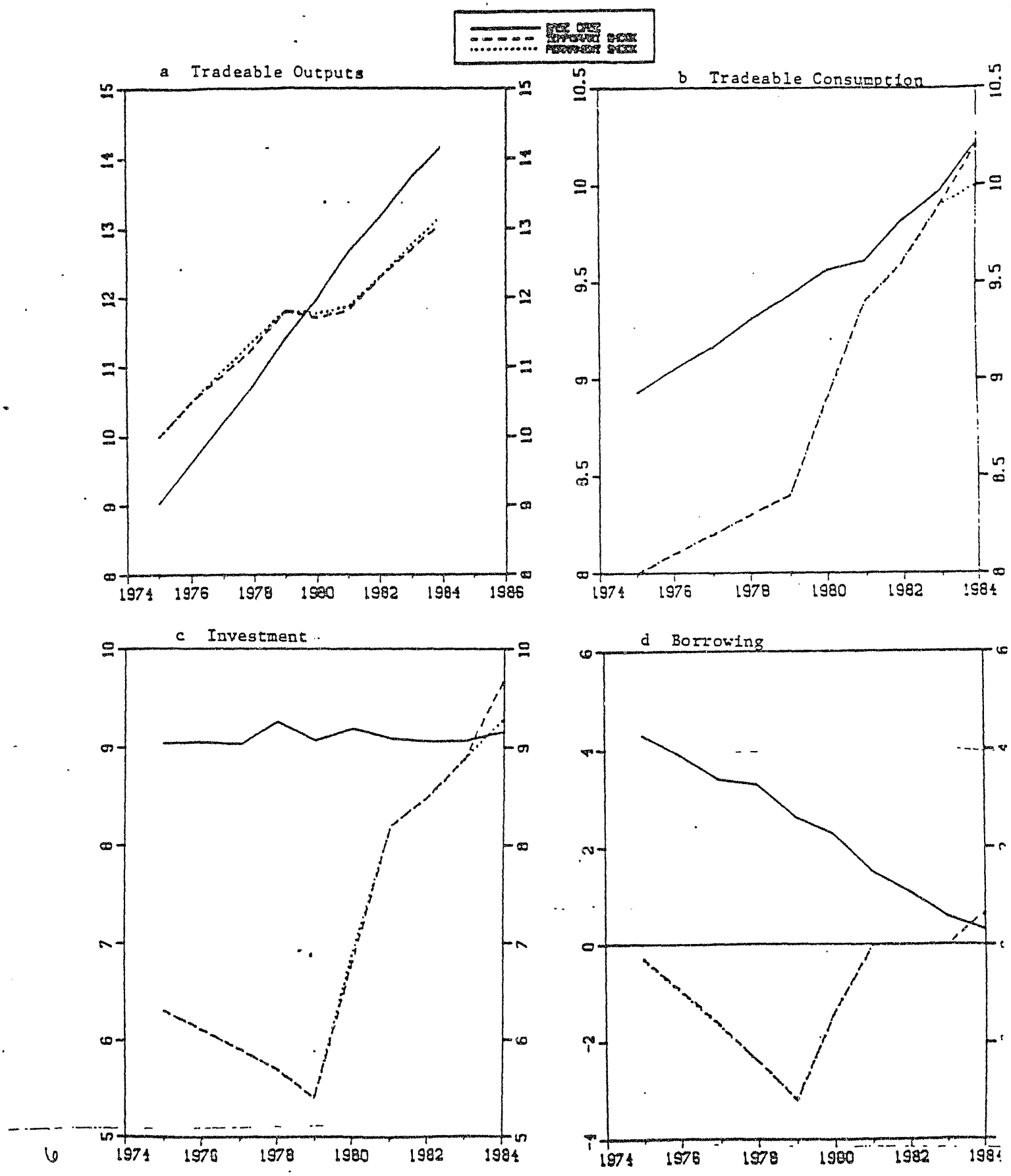
	Interest rate rise		Export price fall		Export volume growth fall	
	U	A	U	A	U	A
A. Temporary shock						
Debt 1/	-57.8	-98.0	18.4	15.4	4.8	-2.6
Capital Stock 1/	-5.3	-7.0	0.2	0.1	0.6	0.6
B. Permanent shock						
Debt 1/	-100.0	-100.0	11.2	1.0	4.2	-4.9
Capital Stock 1/	-8.5	-7.1	0.8	1.1	0.7	0.7

1/ Impact on terminal values of debt and capital stock.

rises faster, ending at a steady-state level higher than in the absence of a shock (Figure 4a through 4d). The immediate decline in consumption permits the entire existing stock of debt to be repaid before higher interest rates arise. 1/ By contrast, when the shock is unanticipated, only a portion of the debt is repaid. Investment is reduced in the presence of an anticipated shock, freeing up resources to pay off debt. But the negative required net borrowing leads to a depreciation of the real exchange rate and an increase in traded output. The growth rate of this last is, of course, constrained by the lack of investment; the capital stock ends up 7 percent below that in the base case in the

1/ The stock of debt is constrained to be positive. We do not allow the country to be a net creditor at the same terms as it borrows.

Figure 4. Anticipated Rise in Interest Rate

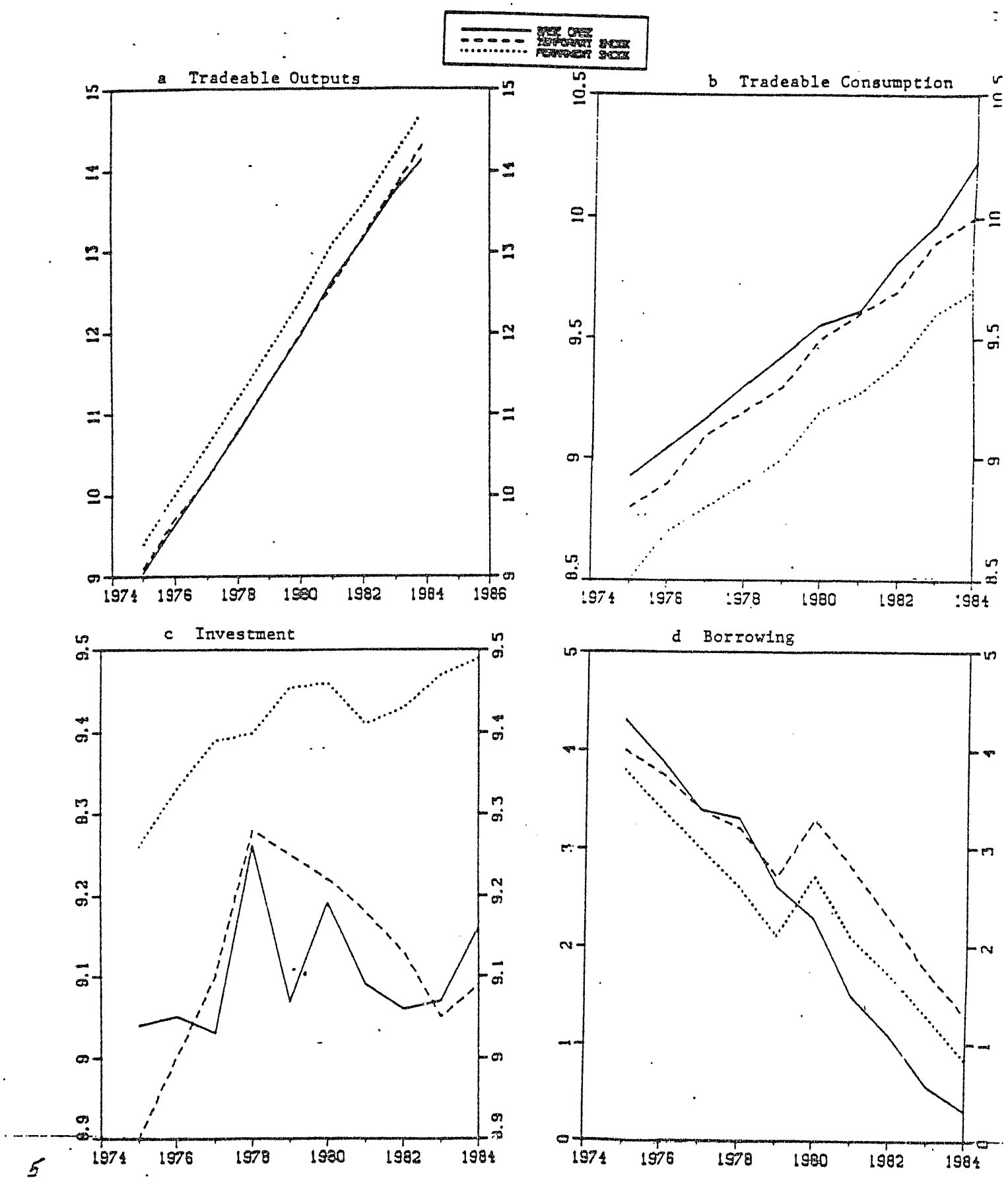


steady-state. Because interest payments on external debt are lower with the anticipated disturbance, steady-state income is higher than in the base case. Thus, the main impact of the interest rate rise is to alter the profile of consumption, shifting it into the future. With a permanent interest rate rise, the pattern is very similar, essentially because debt had already been reduced to zero and hence there is no additional shock from high steady-state interest rates.

Consider next the case of an anticipated fall in agricultural prices (Figure 5a through 5d). When the disturbance is temporary, the evolution of the economy looks much like in the base case. The adjustment process is smoothed over the whole plan period and over all the variables. Traded goods consumption, investment expenditure and initial borrowing are all fractionally below their levels in the base case. When the shock hits, borrowing rises to accommodate a smooth increase in consumption and a maintenance of investment. By the time the steady-state is reached, debt is greater than in the base case by 15.4 percent, while the total capital stock is unchanged. The terminal values of capital and debt are almost the same whether the temporary shock is anticipated or not. Of course, welfare is greater in the former because of the longer time horizon over which adjustment is smoothed.

When the shock turns out to be permanent, however, there is a more substantial difference between the anticipated and unanticipated results. In the former case, the expected loss of wealth leads to an immediate currency depreciation, and a cut-back in consumption and new external borrowing. Traded goods output expands in response to its greater profitability and investment expenditures rise. Again,

Figure 5. Anticipated Fall in Export Price

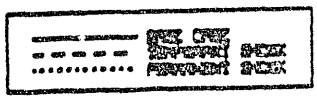


adjustment is smoothed over the whole period. In this case, the end-period debt stock is almost unchanged from the no-shock base case, as is the terminal capital stock. The profile of new borrowing, however, is different: lower initially and greater in the later periods when lower foreign exchange inflows from agriculture are forthcoming. By contrast, when the permanent shock was unanticipated, steady-state debt rises markedly, without a corresponding increase in the capital stock.

The final disturbance that is considered is a fall in the volume growth of the primary commodity export (Figure 6a through 6d). We observe that in both cases, where the anticipated fall is temporary and where it is permanent, adjustment is borne predominantly by a fall in consumption. The profiles of debt accumulation and investment are very similar to those in the base case. Steady-state debt ends up very close to the no-shock situation, although somewhat below in both cases. This is because the profile of the shock leads to a slightly slower rate of appreciation of the currency. Hence, foreign borrowing is made somewhat more expensive in home goods terms and the level declines correspondingly. Profitability, on the other hand, edges up and the capital stock ends fractionally higher. Again, these results stand in contrast to the cases with unanticipated shocks where borrowing expands to finance the extra capital accumulation desired after the shock. Foresight of the shock permits this process of capital accumulation to be initiated earlier.

The impact on welfare of the disturbance is shown in Table 5 in terms of deviations from welfare in autarchy. The higher levels of

Figure 6. Anticipated Fall in Export Volume



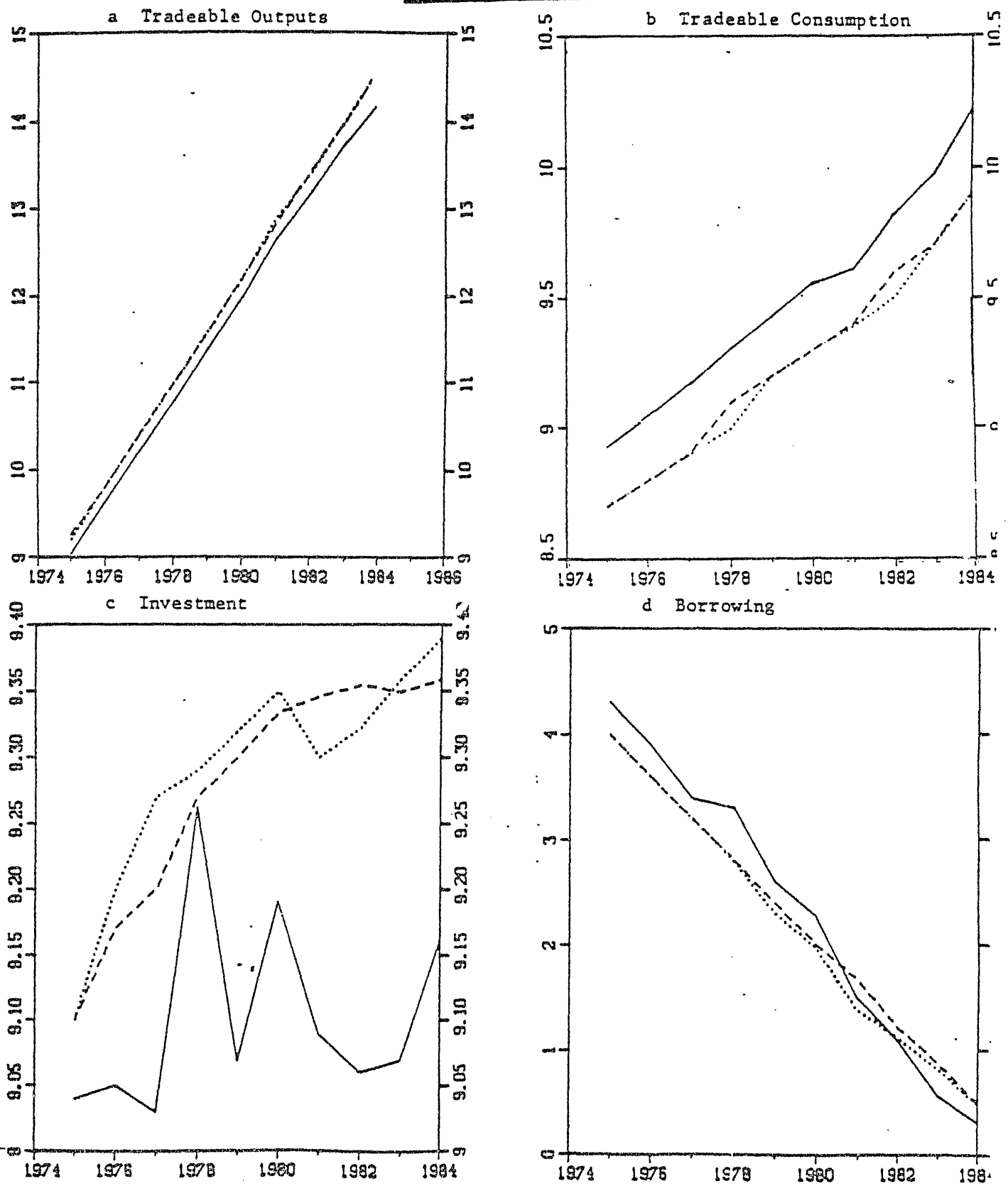


Table 5. Welfare Implications of External Shocks
(Utils)

	Anticipated Disturbance		Unanticipated Disturbance	
	Autarchy	With Borrowing	Autarchy	With Borrowing
Base	0	+0.47	0	+0.47
Temporary Interest Rise	-0.56	-0.56	-1.23	-3.09
Permanent Interest Rise	-0.56	-0.56	-1.23	-3.27
Temporary Price Fall	-4.03	-3.47	-4.35	-3.79
Permanent Price Fall	-22.76	-22.34	-23.08	-22.66
Temporary Volume Growth Fall	-12.36	-11.95	-12.50	-12.08
Permanent Volume Growth Fall	-14.38	-13.98	-14.52	-14.12

welfare associated with undertaking foreign borrowing are clear, both for the base case and for all anticipated disturbances. When there are unanticipated shocks, however, this is no longer the case. With borrowing, a substantial volume of debt is accumulated, which makes the impact of an interest rate increase particularly strong. Even though borrowing leads to some gains over autarchy in the pre-shock years, this is more than wiped out in the post-shock years. The result that autarchy may be preferable to optimal borrowing when there exist unanticipated interest shocks has widespread policy implications. It suggests that the expected welfare gains from foreign borrowing may be

very small (or even negative) in an environment characterized by floating-rate debt in the presence of volatile interest rates. Interest volatility has increased markedly after the 1979 decision by the Federal Reserve Board to stop targetting monetary policy towards interest rates. Thus, desired levels of developing country debt should have fallen both because of higher real interest rates and greater volatility in the early 1980s, compounding the need for real economic adjustment. 1/

V. CONCLUSION

In this paper, we have traced out the evolution of the main macroeconomic variables when there is access to foreign borrowing in the context of a small, neoclassical economy with intertemporal optimizing behavior. Substantial intertemporal reallocation of consumption takes place. Rapid structural change in production towards traded goods is required to finance the interest due on accumulated debt. This scenario serves as a base reference from which the impact of external disturbances can be measured. We have considered three of the most important external shocks from which developing countries have suffered since 1978: interest rate increases, commodity price falls, stagnant quantities of commodity export trade. Alternative optimal adjustment

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1/ Several authors, e.g. Sachs (1983), have argued that repudiation is more likely to occur when the benefits outweigh the costs. The latter are often modelled in terms of exclusion from future world capital markets. If the benefits from participating in such markets falls as a result of higher interest variability, then the penalty that lenders can impose on borrowers declines and repudiations or reschedulings become more likely.

paths are simulated for cases when unanticipated disturbances occur and when information about future disturbances becomes available.

The results indicate that external disturbances have important intertemporal substitution effects, in addition to the effect on wealth, that determine the evolution of the current account over time. This is related to the complex intertemporal correlations that are likely to be associated with real world disturbances. The true loss of wealth connected with an external shock cannot be estimated independently of the mode of adjustment. This is because the appropriate rate at which to discount the future losses of foreign exchange back to the present includes a term reflecting the marginal utility of consumption, which is an endogenous variable. Thus, the structure of the economy becomes an important factor in assessing the impact of shocks. In particular, when the impact effect of the shock depends on a state variable (for example, the effect of higher interest rates depends on the stock of outstanding debt), the ability to influence the path of the state variable must be incorporated into any evaluation of the costs associated with the shock.

The link between shocks and adjustment implies that dynamic programming of the optimal adjustment path is critical in determining the impact of any shock. Traditionally, analytical models have only considered 'pure' shocks, without major intertemporal substitution effects. They lose, thereby, the ability to consider the dynamic opportunities for smoothing. Hence, the resulting rules of thumb "borrow to finance a temporary shock, adjust to a permanent one", are not robust when applied to real world shocks. We present several

counter-examples. A temporary fall in the growth rate of the volume of commodity exports may lead to a fall in desired external borrowing, not a rise. A permanent fall in the price of commodity exports may lead to higher borrowing levels. And, not surprisingly, the impact of interest rate shocks is dominated by an intertemporal reallocation of consumption, rather than by the loss of wealth associated with higher debt service obligations.

Our results emphasize that the structure of an economy and the intertemporal nature of disturbances are key determinants of the impact of external shocks. By constrast, present empirical analysis often compares adjustment across countries with different structures that have suffered from different shocks. The results of such an analysis are likely to yield misleading normative conclusions.

The specific results of our simulations clearly depend on the underlying parameter assumptions -- which good is used for investment, relative factor intensities, substitutability between goods in consumption and production, etc. In addition, there are severe limiting features of the small-economy model used: full employment, flexible prices, mobile factors, elastic supply of capital, instantaneous adjustment and optimizing behavior, to name a few. We feel nevertheless that some aspects of reality are captured. In considering the welfare implications of borrowing, we have shown that financial autarchy may be preferable to optimal borrowing in the face of potential interest rate shocks. We also show that optimal desired adjustment of consumption is by far the largest in the face of the interest rate shock. This

provides a speculative explanation for recent debt crises. Recognizing that recourse to future financial markets would not yield major welfare gains, in constrast to the past, because of higher interest rate volatility, countries may have preferred to forego this access and reschedule their debt obligations rather than take the drastic 'optimal' adjustment path.

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