DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS
DIVISION OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF CALIFORNIA

Working Paper No. 473

OPTIMAL ADJUSTMENT TO TRADE SHOCKS UNDER ALTERNATIVE DEVELOPMENT STRATEGIES

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May 1988

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I. Introduction

The relationships between trade policy, industrial and agricultural policies and adjustment to shocks arising from unforeseen changes in the international environment are still not well understood. The analytic literature on trade under uncertainty (see Adelman and Sarris 1982 and Sarris 1987) indicates that policy insights derived from the analysis of economic dynamics under certainty do not necessarily carry over to the case of uncertainty. Thus, while formal analyses of trade under certainty show that open development strategies are superior to closed ones, models of trade under uncertainty show that uncertainty in international markets may make it optimal for a risk-averse country to move towards autarky (Ruffin 1974 and Cheng 1987). Under uncertainty, import substitution strategies may therefore well be superior to strategies of export led growth. The literature also indicates that insights into optimal policies differ with the structure of the model (e.g. how much substitution has been built in), the timing of decisions (e.g. whether decisions must be taken before the uncertainty is revealed or can be postponed till after the uncertainty has manifested itself) and the modelling of the origin of the shock (e.g. whether uncertainty is additive or multiplicative, and whether there is a price or a quantity shock). Theoretical conclusions thus tend to be model and situation specific and to offer no general guidelines concerning optimal development strategies under uncertainty.

The empirical evidence concerning country adjustments to the 1973 and 1979 oil shocks and to the debt shocks of the 1980s also reveals no strong general uniformities. Actual country-adjustment patterns to shocks arising from import-price increases in the seventies have varied a great deal. The East Asian economies of South Korea, Taiwan and Japan reacted quite differently from the Latin American economies of Argentina, Brazil, Chile, Mexico and Uruguay.

As pointed out by Corbo and de Melo (1986), the Southern Cone countries, Argentina, Chile and Uruguay, entered the period of the first oil shock with import substitution policies, large inflation and acute balance of payments crises. They attempted to control the internal and external imbalances by a combination of: liberalization policies in commodity and credit markets; reductions in total absorption; and expenditure switching between domestic and foreign markets through real devaluation. Their initial success in controlling inflation and foreign exchange imbalances was followed by large increases in external debt, internal financial crises, and cycles in output and employment. Brazil and Mexico, on the other hand, delayed implementation of stabilization policies by relying on heavy external borrowing to sustain the growth of domestic demand. They both shifted towards inward-oriented trade strategies, relaxing their export drives, imposing tighter import controls, increasing tariffs and overvaluing their exchange rates. Neither the Southern Cone IMF-type adjustment nor the Brazil-Mexico debt-led growth were very successful in the medium run.

By contrast, as pointed out by Lin (1986), the East Asian economies continued their outward orientation after 1973 and relied on wage moderation and productivity increases to maintain international competitiveness. They did not cut real absorption; indeed, in each case, the rates of growth of domestic consumption rose subsequent to the impact of the external shocks, as did savings and real output. South Korea devalued in response to each oil-shock;

Taiwan did not; and Japan had a currency appreciation between the two oil shocks. Japan and Taiwan developed substantial foreign exchange surpluses and South Korea had large deficits during the impact periods of the shocks. The Korean deficits were quickly brought under control, however, by increasing export elasticities much faster than import elasticities.

The real world thus displays a substantial variety of stabilization and structural adjustment patterns in response to shocks arising in the external sector and very varied and changing relationships of policy-instrument adjustments to policy outcomes over time. While some economies have clearly adjusted more successfully than others, it is hard to disentangle from the empirical evidence how much of their relative success was due to differences in policy, how much was due to differences in economic structure, and how much was due to the fact that the same external shock impacts differently on economies that have been pursuing different development strategies and are of different size.

The present paper attempts to shed some light on these issues by modelling optimal adjustment to trade shocks in a single middle-income economy pursuing different development strategies. Using the methodology developed in Adelman and Sarris (1982) and Adelman, Sarris and Roland-Holst (1987), the techniques of stochastic control are applied to a CGE model of Turkey to compare the robustness of alternative development strategies to shocks like the 1979 oil shock. The use of policy instruments and the extent of deviation of state variables from their target values are compared under three different objective functions (growth; stabilization; or income distribution equalization) and three different development strategies (export expansion; agricultural development led industrialization; or import-substitution). We find that the results are sensitive to both development strategies and objectives. Nevertheless some interesting, strategy and objective specific, generalizations can be made.

II-1. The Turkish Economy Before the January 1980 Reform

During the 1960's and 70's Turkey undertook a very intensive import-substitution drive, which was implemented through quantitative restrictions and a deliberate policy of overvaluation of the domestic currency. Growth, while rapid (averaging close to 6.5% per annum), was not uniform and not short of problems. Indeed, after the possibilities of the first, "easy," stage of import-substitution were exhausted in the early 1960's and the replacement of imports of intermediates and capital goods became the dominant thrust of industrial development, the limited size of the domestic market and the faltering foreign trade performance of the economy imposed increasingly binding constraints inhibiting further growth.

One of the first symptoms of the emerging crisis was the acceleration of domestic inflation from a moderate rate of 5% in the 1960's, to 18% in the early 1970's and to 50% in 1977. In the absence of any major adjustment in the foreign currency value of the Lira, incentives significantly drifted against exports. According to Balassa's 1981 calculations, the real exchange rate between Turkey and its major trading partners appreciated by 13% between 1973 and 1977. The current-account deficit reached $3.8 billion in 1977.

In response to the growing crisis, the government undertook a series of stabilization measures in 1978, and then again in 1979, which met with only mixed success. While the current account deficit improved to $1.8 billion in 1979, the domestic inflation rate accelerated to 64%. In the meantime, possibilities for foreign capital inflows, especially commercial borrowing, were exhausted. Thus, the 1979 oil-shock hit Turkey under very adverse conditions. Consequently, intermediate and capital-goods imports dropped substantially and contributed to low capacity utilization in industry, which registered, on the average, a growth rate of 2.7% during 1978-1980. The rate of growth of the real GNP fell sharply, from 2.9% in 1978, to -0.4% in 1979 and again to -1.1% in 1980.

Finally, in January 1980, a new government introduced a set of extensive policy reforms and started implementing a change of focus in Turkey's development strategy from inward-looking import-substitution to an outward-oriented strategy of manufacturing export expansion.

II-2. The Turkish Economy After the January 1980 Reform

The 1980 reform aimed not only at short-run stabilization but also at changing the structure of the economy towards greater outward orientation and liberalization by providing an increased role to the private sector and to market forces. Further, a change in sectoral priorities occurred, with greater emphasis being given to export-oriented manufactures, such as processed food, textiles, wearing apparel and light intermediates, and to commercial services, especially overseas contracting.

These structural adjustments were pursued by a set of far-reaching policies:[1] The Turkish Lira was devalued by almost 50% against the U.S. dollar, with further daily adjustment being made to ensure that the effects of price increases on the real exchange rate are offset. Concurrently, an extensive scheme of export-promotion measures was introduced. Import restrictions were liberalized and the waiting period for import licenses was reduced considerably. Measures were also taken to introduce more flexibility and rationality into the state-enterprise system. Finally, in July of 1980, interest rates were freed from government ceilings.

The reform package yielded its first fruits by 1981. In that year, led by a 62% rise in the dollar value of merchandise exports, GNP grew by 4.1%, and industrial value added rose by 7.2%. The current-account deficit narrowed to $2.3 billion after its record high of $3.7 billion in 1980. The successful export performance continued and the value of exports expanded from $4.7 billion in 1981 to $7.9 billion in 1985, registering an average rate of growth of 22% per annum.

However, due to restrictive monetary policies and reductions in domestic absorption, business conditions have generally been sluggish, and domestic private investment remained stagnant in 1981, after its decline of 20% in 1980. Despite wage reductions[2] and repressive attitudes towards labor, unemployment increased from 14.8% in 1980 to 15.2% in 1981 and further to 16.7% in 1985. Indeed, as the 1982 World Bank Report (p. 50) states, the decline in private investment and the increase in unemployment seemed to be the two "concomitants" of the Turkish adjustment attempts in the 1980's.[3] Further, there was an observed imbalance between the structure of exports (in favor manufactured products) and the allocation of private funds (away from manufacturing industries), a phenomenon which was directly in conflict with the overall growth strategy of increasing manufactured exports.[4]

The mixed results of the 1980 reform package make it natural to ask whether alternative development and adjustment strategies in Turkey would have yielded better results under the external shocks of the seventies and the protectionist policies of the 1980s. More specifically, for a typical middle-income country like Turkey, what would constitute optimal policy responses to trade shocks imposed by an acceleration of imported producer-goods prices coupled with an unfavorable environment for exports? How would the economy have fared under alternative development strategies? It is these questions we seek to analyze in the present paper.

II-3. Seeking Out Alternatives

We start by noting that the export-led growth model does not exhaust the spectrum of "open" development strategies. In particular, a recently advocated strategy of "agricultural demand-led industrialization" (ADLI) (Adelman 1984 and Yeldan 1987) can be added to the familiar menu of import-substitution or export-led strategies of industrial development. The ADLI strategy calls for a reallocation of investment funds to agriculture within the context of an open development strategy[5] in order to increase agricultural productivity. The arguments in favor of such a strategy rest on the dynamic backward and forward linkages of growth in agricultural output and farmer incomes. These linkages create a mass market for domestic industrial products for use as inputs in agriculture and in rural consumption. The ADLI strategy is a "balanced" industrialization strategy, working through agriculture-industry linkages that expand internal demand for the intermediate and final consumption goods produced by the domestic manufacturing sectors. The advocacy of the ADLI strategy reflects a belief that agricultural and industrial growth can be restructured without departing from an open trade regime so that the primary source of the economy's dynamic resides in the domestic market rather than in the, cyclical and uncertain, foreign market.

Under conditions of perfect foresight, the superiority of the ADLI strategy over the export-led strategy has already been tested and confirmed by Adelman (1984) for S. Korea, and by Yeldan (1987, 1988) for Turkey. The task of the present paper is to check whether their results carry over to conditions of uncertainty arising from unexpected fluctuations in the external conditions faced by the domestic economy.

III-1. The CGE Model

To do this, we apply the techniques of stochastic control to an economy characterized by a computable general equilibrium model. The computable general equilibrium (CGE) model is in the Adelman-Robinson (1978) tradition in its characterization of the domestic economy and its dynamics, and in the Dervis-deMelo-Robinson (1982) tradition in its characterization of international trade. By using a Walrasian multi-sector, multi-agent apparatus,[6] the model simulates the optimizing behavior of economic agents in response to endogenous price signals in the commodity and factor markets. The model is composed of two stages. The first stage is a static general equilibrium construct which utilizes numerical methods to solve a system of non-linear simultaneous equations for the prices that are consistent with zero excess demands in both commodity and factor markets. In the second stage, a dynamic adjustment process is specified for capital accumulation; for population growth; for changes in technical productivity; and for other changes in the "behavior" of economic factors.

The model, as applied to Turkey, distinguishes four economic sectors, four types of labor, seven consumer groups and a government. Domestic output in each sector is given by a constant return Cobb-Douglas production function with capital and labor as primary inputs. Intermediate inputs are assumed to be used in fixed proportion to output. Sectoral physical capital stocks are treated as fixed in the static stage and profit rates are thus allowed to vary among sectors in equilibrium. In the dynamic stage, however, a behavioral submodel is provided to update the sectoral investment-allocation coefficients in response to the observed differences in sectoral profit rates. This behavioral submodel lurches the system towards a dynamic intertemporal equilibrium in which, in the absence of future shocks or policy changes, profit rates across sectors would tend to be equalized.

Labor is disaggregated into four categories: agricultural labor is employed only in agriculture, and is treated as separate and immobile within any period. However, between periods, the model specifies a Harris-Todaro (1970) migratory process in which rural-urban migration takes place in response to differences between the agricultural and the expected urban wage rates.

In the urban sectors, the real wage rate of organized/skilled labor is assumed fixed and varied only parametrically. The excess of organized labor is absorbed by the unorganized/unskilled labor market, in which the wage rate of unorganized labor adjusts freely to clear the urban labor market. Finally, service labor is employed only in the service sector which typifies small scale service enterprises and self employment.

On the trade side, the model adopts the Armington composite-commodity specification, in which domestic and imported goods are imperfect substitutes and are aggregated by a CES function with a given elasticity of substitution. Further, domestic output is allocated between exports and domestic use via a constant elasticity of transformation specification, due to Powell and Gruen (1968).

The elasticities of substitution and transformation are chosen to reflect differences in the quality and/or nature of the traded goods within each sector. The balance of foreign trade is maintained by exchange rate adjustments.

The model is closed on the macro side by using a "savings driven" closure rule in which the savings pool of the economy sets the limits to capital investment and which distinguishes between private and public savings decisions. Saving propensities set private savings as a fraction of private disposable income. The government is assumed to preselect a ratio of public savings to aggregate nominal GNP, with public consumption determined residually. The savings-driven closure was selected to make capital accumulation and economic growth maximally sensitive to fluctuations in the balance of payments accounts and to changes in private income levels.

The system is normalized around a numeraire consisting of an index of composite-goods prices and using sectoral output shares in the base-year as weights.

III-2. The Methodology

The methodology used in this paper is that formulated in Adelman and Sarris (1982) and applied in Adelman, Sarris, and Roland-Holst (1987) to the study of optimal adjustment to uncertainty of a small, low income, very open economy following an export-led growth strategy (South Korea). The presentation in this section follows Adelman, Sarris and Roland-Holst (1987).

III-2-1. The Control Problem

Assume that a target path of the endogenous variables $\bar{x}_t$ ($t = 1, \ldots, T$) exists which fulfills the objectives of the economic authority. Such a path, $\bar{x}_t$, corresponds to an average path, $\bar{z}_t$, of the uncontrollable exogenous variables. Let us now introduce uncertainty by letting it induce variations in the uncontrolled exogenous variables in the model. These variations will, in turn, induce variations in the endogenous variables, taking them away from their target paths. To move the endogenous variables back toward their target values a revision of the policy instruments would be necessary. It would be desirable to formulate adjustment rules for ex post revisions of the instruments ex ante, only once, and at the outset of the policy interval when alternative strategies can still be considered. These rules can be used to calculate how the policies instruments should be changed once the actual shocks are known. Such closed-loop adjustment rules will now be derived using stochastic optimal control theory.

The objective of the control problem is to minimize the deviations of the endogenous or state variables about their target paths, subject to the structural relationships imposed by the CGE model described in the previous section.

The most general characterization of an intertemporal CGE model is given by a set of nonlinear continuously differentiable functions

$$X_t = f(X_t, X_{t-1}, y_t, z_t), \qquad t = 1, \ldots, T. \tag{1}$$

The above expression defines a CGE by a set of structural equations for n contemporaneous endogenous variables, represented by the n element vector X_t, and is not in reduced form. The model equations f are functions of X_t, as well as of lagged values of the endogenous variables X_{t-1}, which reflect the structural dynamics of the model. The vector y_t denotes a set of m contemporaneous exogenous variables which are assumed to be controllable, that is at the complete and instantaneous discretion of economic policymakers. The last argument of the model's functional specification, z_t, is a k-element vector which represents those exogenous variables which are outside the control of policymakers. The components of z_t are random variables of the form

$$z_t = \bar{z}_t + e_t, \qquad t = 1, \ldots, T \tag{2}$$

where the elements of e_t are assumed to have mean zero and to be both serially and contemporaneously uncorrelated. The k-vector e_t, which accounts for the deviations of the uncontrolled exogenous variables about their means, represents the only uncertainty in the present analysis. It is assumed that the structural form (1) and its parameters provide an exact specification of the underlying economic reality.

The problem of optimal adjustment to shocks can be expressed as solving a quadratic stochastic control problem of the form

$$\text{Minimize } E \left\{ \sum_{t=1}^{T} (x_t - \bar{x}_t)' \, Q_t (x_t - \bar{x}_t) \right\} \tag{3}$$

subject to the state equations

$$x_t = F(x_t, x_{t-1}, y_t, z_t), \qquad t = 1, \ldots, T. \tag{4}$$

In general, only a subset of the variables X_t endogenous to the CGE model will be of direct interest to policymakers. The state variables, x_t, in (3) and (4) correspond to such a subset, and their respective state equations (4) represent an implicit reduced form of the CGE model (1) omitting the other endogenous variables as arguments. In (3) the minimization is evaluated over all reduced-form relationships for the instruments of the form $y_t = G(x_{t-1}, z_t)$, and the expectation is taken over the joint probability distribution of all random exogenous variables z_t. The matrix Q_t consists of diagonal elements representing policy weights on the acceptable degree of variation in the target state-variables; a larger weight implies that less variation will be tolerated.

Although the quadratic loss function (3) above is standard, the nonlinearity of the CGE constraint set (4) renders the control problem intractable in its present form. One way to contend with this difficulty is to linearize expression (4) around its deterministic target path. Consider the deterministic target path,

$$\bar{x}_t = F(\bar{x}_t, \bar{x}_{t-1}, \bar{y}_t, \bar{z}_t), \qquad t = 1, \ldots, T \tag{5}$$

and the total differential

$$dx_t = D_x dx_t + D_{x-1}\, dx_{t-1} + D_y dy_t + D_z dz_t. \tag{6}$$

The matrices D_x, D_{x-1}, D_y and D_z in (6) represent the Jacobians of the structural equation system, differentiated on the target path with respect to x_t, x_{t-1}, y_t, and z_t respectively. The differentiation is done at a fixed time, and the variable t is held constant for each expression (6).

Recasting the differential expression (6) in reduced form yields the linear approximation to the state equations

$$\Delta x_t = A_t \Delta x_{t-1} + B_t \Delta y_t + C_t \Delta z_t \tag{7}$$

where

$$A_t = (I - D_x)^{-1}\, D_{x-1} \tag{8}$$

$$B_t = (I - D_x)^{-1}\, D_y \tag{9}$$

$$C_t = (I - D_x)^{-1}\, D_z \tag{10}$$

and

$$\Delta x_t = x_t - \bar{x}_t;\ \Delta x_{t-1} = x_{t-1} - \bar{x}_{t-1};\ \Delta y_t = y_t - \bar{y}_t; \tag{11}$$

and $\Delta z_t = z_t - \bar{z}_{t-1}$.

III-2-2. The Bellman Recursion

Standard dynamic programming methods can now be applied to generate the desired closed-loop adjustment rule. Consider the one-period version of the quadratic expected loss function (3) written in recursive form. It can be defined as

$$V_t\ (\Delta x_{t-1}, \Delta z_t) = \min_{\Delta y_t} [\Delta x_t{}' Q_t \Delta x_t + E_t V_{t+1}\ (\Delta x_t, \Delta z_{t+1})] \tag{12}$$

where E_t denotes the conditional expectation given information up to and including period t. Since for the terminal period, $E_T\ V_{T+1} = 0$, for the terminal period (12) has the form

$$V_T(\Delta x_{T-1}, \Delta z_T) = \min_{\Delta y_T} [\Delta x_T{}' Q_T \Delta x_T]. \tag{13}$$

This expression can be evaluated by setting the partial derivative of V_T with respect to y_t equal to zero.

$$\frac{\delta V_T}{\delta y_T} = 2\ \frac{\delta(\Delta x_{T'})}{\delta y_T}\ Q_T \Delta x_T = 2\ B_T{}'\ Q_T \Delta x_T = 0. \tag{14}$$

After substituting for Δx_t in (14) and some minor algebra, this first-order condition yields the optimal terminal-period instrument-adjustment rule

$$\Delta y_T^* = -(B_T{}'\ Q_T B_T)^{-1}\ B_T{}'\ Q_T[A_T \Delta x_{T-1} + C_T \Delta z_T]. \tag{15}$$

Equation (15) gives the ex ante adjustment rule, applied ex post (as of the elapse of period T - 1), to revise instruments to y_T^* for the next period. The expected loss under optimal adjustment for period T then becomes

$$V_T(\Delta x_{T-1}, \Delta z_T) = \Delta x'_{T-1} M_T \Delta x_{T-1} \tag{16}$$

where

$$M_T = A_T'[Q_T - Q_T B_T(B_T' Q_T B_T)^{-1} B_T' Q_T] A_T. \tag{17}$$

This expression is obtained by substituting into (13) the minimal deviation of the state variable Δx^*_t resulting from implementing the optimal instrument adjustment rule (15) for Δy^*_t.

Now the recursion iterates back to period T - 1 and solves

$$\begin{aligned} V_{T-1}(\Delta x_{T-2}, 0) &= \min_{\Delta y_{T-1}} [\Delta x_{T-1}' Q_{T-1}\Delta x_{T-1} + V_T(\Delta x_{T-1}, 0)] \\ &= \min_{\Delta y_{T-1}} [\Delta x_{T-1}' (Q_{T-1} + M_T) \Delta x_{T-1}]. \end{aligned} \tag{18}$$

This expression is obtained by substituting the optimal expected loss for period T from (16) into (18). It differs from (16) in that it includes not only the expected loss for period (T - 1) but also the expected future loss for period T.

Using Bellman's Recursion, expression (15) is then applied iteratively backward from T to yield instrument-adjustments for all prior periods. For periods prior to the terminal one, however, the derivation of the adjustment matrices must take account of the accumulation of deviations from the target path during the recursion. These deviations will arise since the optimal adjustment only minimizes deviations and does not guarantee complete restoration of the policy trajectory. To generalize for all periods $t = \tau + 1, \ldots, T$ subsequent to the shock under consideration, the solution to the minimization problem in (18) takes the form

$$\Delta y_t^* = G_t \Delta x_{t-1} \tag{19}$$

where

$$G_t = -[B_t' (Q_t + M_{t+1}) B_t]^{-1} B_t' (Q_t + M_{t+1}) A_t \tag{20}$$

$$M_t = A_t'(Q_t + M_{t+1}) \{I - B_t[B_t' (Q_t + M_{t+1}) B_t]^{-1} B_t' (Q_t + M_{t+1})\} A_t \tag{21}$$

and, by convention, $M_{T+1} = 0$.

For the period of the shock (τ), the optimal adjustment takes the form

$$\Delta y_\tau^* = H_\tau \Delta z_\tau \tag{22}$$

where

$$H_\tau = -[B_\tau' (Q_\tau + M_{\tau+1}) B_\tau]^{-1} B_\tau' (Q_\tau + M_{\tau+1}) C_\tau \tag{23}$$

and M_τ is given by expression (21) above for $t = \tau$.

Adjustment rules (19) and (22) define the loss-minimizing adjustment rules for changing the discretionary policy instruments in response to the destabilizing forces to which the economy is exposed. Assuming the economy starts on a target path, exogenous forces which might drive the system away from its intended trajectory can be partially counteracted by taking the remedial actions dictated by the reduced-form instrument adjustment rules (19) and (22).

III-2-3. Instrument and state variable adjustments

The adjustment matrices G_t show how the policy instruments can be adjusted contemporaneously to minimize the induced deviations of the state variables, regardless of the source of the deviation. The matrices H_t give a complete characterization of the first-round optimal policy response to a contemporaneous perturbation by uncorrelated exogenous forces, regardless of what has happened before or happens afterwards. Computing these two groups of matrices is a simple matter once the underlying Jacobians Dx_t, Dx_{t-1}, D_y, and D_z are obtained, and a detailed inspection of them can be quite illuminating.

Although the matrix pairs (G_t, H_t) for $t = 1, \ldots, T$ give a complete characterization of optimal policies for a wide variety of adjustment problems, the present discussion examines only a specific family of possible disturbances. In particular, it is assumed that the exogenous shock occurs once only, in the τth period of the policy interval $t = 1, \ldots, T$. For a once only disturbance Δz_τ in period τ, the first-round adjustment follows equation (22) and the net effect on the contemporaneous state variables takes the form

$$\begin{aligned}\Delta x^*_\tau &= B_\tau \Delta y^*_\tau + C_\tau \Delta z_\tau \\ &= (B_\tau H_\tau + C_\tau)\, \Delta z_\tau. \end{aligned} \tag{24}$$

These deviations in the period τ state variables will, in turn, induce deviations in subsequent endogenous variables via the structural dynamics of the economy. In the next period, assuming no new exogenous shocks, the actual instrument adjustment will be given by

$$\begin{aligned}\Delta y_{\tau+1} &= G_{\tau+1} \Delta x^*_\tau \\ &= G_{\tau+1}(B_\tau H_\tau + C_\tau)\, \Delta z_\tau, \end{aligned} \tag{25}$$

and the contemporaneous state variables will vary according to

$$\begin{aligned}\Delta x_{\tau+1}^{*} &= A_{\tau+1}\, \Delta x_{\tau}^{*} + B_{\tau+1}\, \Delta y_{\tau+1}^{*} \\ &= A_{\tau+1}(B_{\tau}H_{\tau} + C_{\tau})\, \Delta z_{\tau} + B_{\tau+1}\, G_{\tau+1}\, (B_{\tau}H_{\tau} + C_{\tau})\, \Delta z_{\tau} \qquad (26) \\ &= (A_{\tau+1} + B_{\tau+1}\, G_{\tau+1})\, (B_{\tau}H_{\tau} + C_{\tau})\, \Delta z_{\tau}.\end{aligned}$$

In general, for all periods, $t = \tau + 1, \ldots, T$, subsequent to the once-only exogenous shock, the adjusted instruments and resulting state variable deviations take the form

$$\Delta y_{t}^{*} = N_{t}\Delta z_{\tau} \quad \text{and} \quad \Delta x_{t}^{*} = P_{t}\Delta z_{\tau} \tag{27}$$

where the matrices N_t and P_t follow a forward recursion given by

$$N_{t} = G_{t}P_{t-1} \quad \text{and} \quad P_{t} = (A_{t} + B_{t}G_{t})\, P_{t-1} \tag{28}$$

with initial conditions

$$N_{\tau} = H_{\tau} \quad \text{and} \quad P_{\tau} = B_{\tau}\, H_{\tau} + C_{\tau}. \tag{29}$$

The resulting sequence of matrix pairs (N_t, P_t) for $t = \tau, \ldots, T$ measure the optimal adjustments and trajectory deviations from the period of the shock to the terminal period in units of the exogenous shock variables Δz_{τ}. Thus, in addition to a complete ex ante derivation of explicit ex post adjustment rules of the form G_t and H_t, it is also possible to compute ex ante the actual optimal adjustments and induced target path deviation per unit change in the exogenous variables.

III-2-4. The Evaluation of the Jacobians

The evaluation of the Jacobians, D_x, D_y, D_z, and $D_{x_{t-1}}$, which make up the composite Jacobians A_t, B_t, and C_t, can be carried out in two ways. The most direct method would be to linearize the structural equations analytically, convert these to reduced form in the endogenous state variables, differentiate the reduced forms around $\bar{x}_t$, $\bar{x}_{t-1}$, $\bar{y}_t$, and $\bar{z}_t$, and then evaluate the differentials on each target path at (x_t, x_{t-1}, y_t, z_t) for each point of time. We use a different, more expedient and more accurate, method. We obtain numerical estimates for the D_x, D_y, D_z, and $D_{x_{t-1}}$ by perturbing the CGE model in its original nonlinear form around each target path in each period. The perturbations are carried out over x_t, x_{t-1}, y_t, and z_t one variable at a time. The differences in solutions for the target variables for each perturbation yield one column of the appropriate differential matrix D.

IV. The Optimal Adjustment Path Under Alternative Strategies

The optimal adjustment path of the domestic economy in response to trade shocks is computed with the aid of the above discussed CGE model and control methodology over the period 1986 through 1994. This period spans Turkey's Fifth and Sixth Five-Year Development Plans. The model and the associated stochastic control methodology are utilized as planning devices in order to analyze the expected behavior of the economy under shock under three alternative development strategies: (1) import-substitution industrialization (ISI); (2) export-led industrialization (XLI); and (3) Agricultural Demand-Led Industrialization (ADLI).

Under each development strategy, three distinct objectives are distinguished for the derivation of the adjustment paths. One objective function is a stabilization objective, in which the aim is to stabilize the state variables of (1) merchandise trade balance; (2) per capita private consumption; (3) organized labor employment; (4) migration; and (5) per capita food consumption around their target values. A second objective function is an income distribution objective, in which the focus is on minimizing the effect of shocks upon the state variables indicating the per capita income levels of the seven household classes, especially the poor. The seven households derive their respective incomes from their sectoral factor income earnings and also from the rest of the world as private borrowing and remittance inflows.[7] A third objective to be considered is that of a growth objective in which the optimal control methodology is employed to minimize the state variable deviations of: (1) output supplies and (2) physical capital stocks of all four sectors from their target values.

For all three objectives, the lagged values of the state variables (x_{t-1}) consist only of the lagged sectoral physical capital stocks and of the lagged values of the number of rural-urban migrants. This is because the dynamics of the model are restricted to the rate of capital accumulation, the rate of population growth (which is exogenous to the model), and to the reallocation of labor from rural to urban sectors via the migration submodel.

The CGE simulation experiment involves designing an optimal, dynamic adjustment package of sectoral public investment, commercial policy and exchange rate administration. The control variables (y_t) are chosen with this in mind and represent the standard structural-adjustment and commercial-policy instruments: the nominal exchange rate (the real exchange rate cannot be set unilaterally by the policymaker); the domestic-currency values of sectoral tariffs and export subsidies in each of the three sectors that engage in merchandise trade (agriculture, consumer manufacturing, capital goods manufacturing); the levels of sectoral public investment by destination; and the value of aggregate public investment. All variables are valued at real 1981 prices in Turkish Lira.

The vector (z_t) of shocks is designed to typify a highly adverse environment for the domestic economy, like that of the second oil shock of 1979. More explicitly, the world price of imports of producer goods is increased by 60% in the first period. On the export side, the world demand for the Turkish merchandise exports is reduced by half. Thus, the economy is subjected to a sizable shock from both the income (declining export revenues) and the cost (rising import costs of production) side in the initial year of the plan period.

The weighting matrix Q_t, of the expected quadratic loss function defined in the previous section, is devised to reflect the tolerance of the authority for deviations from the target path under each objective. For the stabilization objective, the weights are set equal to the derivatives of aggregate gross domestic product with respect to the relevant variable. For the income distribution objective, the variables were weighed according to a Samuelson-Bergson utility function of the form,

$$U = \sum_i YH_i^{\beta} N_i$$

where YH_i is the per capita household income of each household type, β is related to the marginal utility of income, and N_i is the number of households of type i. This weighting scheme is equivalent to weighting each household income by the utility of household income multiplied by the number of households receiving that income. For the parameter β, a value of 0.8 was chosen. This Q matrix gives considerably higher weights to the incomes of the poorer households.

For the variables of the growth objective, the weights on the sectoral output supplies were set equal to their respective shares in GNP. For the physical capital stocks, the respective output-capital stocks multiplied by the sectoral shares in GNP were used as the relevant weights.

Under each of the three objective functions identified, the weights were normalized around one to achieve comparability in relative terms.

The experiment is conducted in three steps. First, for each of the three alternative development strategies an intertemporal path of state variables and instruments is derived under conditions of perfect foresight. Next, utilizing the equilibrium values of the state variables from the CGE model under each development strategy as the designated target paths, the methods described in the previous section are applied to develop a set of dynamic ex ante rules for ex post adjustment in response to the trade shocks. Finally, the deviations from the target paths and the intensity of adjustment of the control instruments are contrasted across the alternative strategies to infer conclusions about the relative stability characteristics of the strategies themselves.

IV-1. Implementation of the Alternative Strategies

The XLI strategy is simulated by subsidizing manufacturing exports by 20%, with no subsidy being granted to agricultural exports. All subsidies are provided on an ad valorem basis and are paid directly out of the government's budget. Also, to eliminate the tariff-induced bias against exports, the tariff rates are decreased gradually from their 1985 levels, and are abolished completely in 1990. To further reflect the positive bias towards export-oriented manufactures, the public investment shares of these sectors are increased at the expense of agriculture.

The ADLI strategy is implemented by shifting the investment structure towards agriculture. In particular, agriculture's share of the government investment fund is gradually increased to 25% by the end of the Fifth Plan period. (Private investment behavior, on the other hand, is allowed to be determined endogenously, responding to sectoral deviations from the economy-wide average rate of return to capital, as is also the case for both the XLI and ISI simulations.) It is assumed that the increase in agricultural investment will allow the factor productivity of agriculture to grow at a rate twice as fast as the one assumed under the other alternative strategies (2.5% versus 1.2% during 1986-89, and 2% versus 1% during 1990-94), raising the growth of agricultural productivity towards the mean for less developed countries. Given the prolonged neglect of the Turkish agriculture, which reached especially severe proportions during the 1980's, and given the vast potential of unexploited resources in this sector, the assumed rates of agricultural productivity growth under ADLI should be considered modest. In fact, the assumed ADLI technological progress rates are 20% below the rate hypothesized by Adelman (1984, p. 941) in her own simulations for S. Korea, in which she took the average productivity growth rate of all developing countries during the 1970's as her estimate of the technical-progress rate achievable in S. Korea under ADLI during the next decade.

With respect to foreign trade, under the ADLI strategy direct export subsidies are gradually reduced and abolished altogether by 1989, the last year of the Fifth Plan. Further, all tariff rates are reduced to 10% and equalized across all sectors, so as to remove the anti-agriculture bias associated with having a differential system of incentives that grants higher levels of protection to industry. Thus, in contrast to the XLI's scheme of high export subsidies, the ADLI strategy calls for a redirection of trade incentives toward one in which domestic demand plays a leading role under the auspices of an undistorted, open, trade regime.

Lastly, the ISI strategy is simulated by increasing the tariff rate on imports of consumer goods to 40%, and that of producer goods to 60%. Further, to reflect the reduced substitution possibilities that result from the quantitative import restrictions often imposed in closed-economy, import-substitution strategies, the import share parameter and the substitution elasticity in the Armingtonian composite function are reduced by 2 percentage points for producer-goods industries. No subsidies are provided to exports. To account for the likely productivity-reducing effects of the inefficiency associated with the ISI strategies, technical productivity growth rates in manufacturing industries are reduced by one-third. Finally, public investment shares are shifted in favor of import substituting manufactures.

Common to all three strategies, the model's closure rule requires that the ratio of government-investment to GDP be specified exogenously. To ensure comparability among model runs, this ratio was fixed at the path projected by the Fifth Plan for all three strategies.

The simulations were carried out over the period 1986-1994 consisting of three 5-year subperiods. In devising the target paths, the data for various exogenous variables and parameters for the subperiod 1986-1989 was taken directly from the Fifth Plan's own projections. The Plan's trend values were used for the rest of the experimental period. The solution values for the state variables and instruments under each strategy are given in Tables 1 and 2, respectively.

TABLE 1

Target Levels of the State Variables ($\bar{X}$)

	1986			1990			1994		
	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
Real output[1]									
Agriculture	2467.9	2436.6	2436.6	3107.1	2760.4	2683.7	3932.9	3281.2	3091.9
Consumer mfr.	2710.7	2759.9	2570.4	3448.5	3631.2	3195.3	4394.3	4638.4	3913.5
Producer mfr.	3982.5	4033.5	3933.8	5375.1	5452.1	5147.1	6983.9	7030.7	6443.3
Services	6053.9	5968.8	6195.9	7647.8	7407.8	7689.0	9433.2	9152.3	9421.8
Real capital stock[1]									
Agriculture	3397.2	3397.2	3397.2	4600.9	4017.7	3780.1	6571.7	5379.1	4721.3
Consumer mfr.	1630.9	1630.9	1630.9	2178.1	2656.0	2444.1	2777.2	3850.2	3339.0
Producer mfr.	4596.5	4596.5	4596.5	6057.5	5913.4	5964.3	7842.8	7305.9	7387.0
Services	13023.1	13023.1	13023.1	14471.2	14928.9	14693.1	15909.8	17151.6	16648.7
Per capita real household income[2]									
Agricultural labor	0.175	0.176	0.158	0.208	0.225	0.195	0.253	0.273	0.231
Urban marginal labor	0.184	0.183	0.183	0.197	0.171	0.153	0.202	0.167	0.148
Organized labor	0.605	0.605	0.605	0.638	0.638	0.638	0.690	0.690	0.690
Services--labor	0.198	0.199	0.185	0.222	0.211	0.188	0.244	0.228	0.189
Agric. capitalists	2.617	2.645	2.373	3.156	3.377	2.911	3.398	4.008	3.465
Indus. capitalists	7.437	7.770	6.984	7.667	7.751	6.766	7.680	7.747	6.583
Commerc. capitalists	7.162	6.982	7.349	7.826	7.918	7.402	8.202	7.930	7.408
Merchandise trade deficit[1]	438.8	442.8	336.9	552.9	531.2	394.9	666.5	626.6	466.4
Per capita real private consumption[1]	0.344	0.344	0.331	0.387	0.377	0.353	0.437	0.415	0.381
Per capita real food consumption[1]	0.132	0.130	0.133	0.152	0.133	0.134	0.175	0.143	0.141
Organized labor emp.[3]	2919.0	2886.6	3010.3	3226.1	2908.9	3060.1	3603.7	3273.4	3211.8
Migration[3]	55.7	54.1	66.4	42.7	30.5	41.6	32.5	17.8	27.1

[1]Billion Turkish lira, 1981 prices.
[2]Million Turkish lira, 1981 prices.
[3]1,000 man-years.

TABLE 2

Levels of the Instruments in the Target Path[1]

	1986			1990			1994		
	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
Exchange rate[2]	582.7	592.0	480.5	1227.8	1193.7	940.3	2092.9	1981.9	1552.6
Value of tariffs									
Agriculture	2.891	1.298	0.000	3.031	0.000	0.000	3.274	0.000	0.000
Consumer manufacture	4.279	2.805	12.761	4.992	0.000	14.435	6.000	0.000	16.572
Producer manufacture	133.285	78.103	596.5	184.2	0.000	763.1	245.7	0.000	973.8
Value of export subsidies									
Agriculture	11.807	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Consumer manufacture	43.442	92.361	0.000	0.000	133.3	0.000	0.000	179.1	0.000
Producer manufacture	41.054	85.109	0.000	0.000	119.6	0.000	0.000	160.2	0.000
Government investment									
Agriculture	176.1	73.6	47.4	284.7	86.1	55.6	375.7	102.2	65.2
Consumer manufacture	83.9	148.2	133.5	45.8	173.5	156.1	55.9	206.6	183.1
Producer manufacture	260.8	231.3	286.1	365.8	271.2	334.7	502.6	322.7	392.6
Services	409.8	469.0	488.5	449.8	552.5	574.9	464.1	650.5	667.4
Total	930.6	922.1	955.6	1146.1	1083.4	1121.4	1398.4	1282.2	1308.3

[1] In billions of Turkish lira, 1981 prices.

[2] Nominal exchange rate, Turkish lira per dollar.

IV-2. The Instrument Adjustment Rules

The matrices of optimal adjustments, N_t, represent the government's optimal decision rules in response to a once-only exogenous shock in the first period, 1986, and are displayed in Tables 3, 4, and 5. In the period of the shock this matrix corresponds simply to the H matrix of the first round optimal adjustment. In consecutive periods, the N matrix is derived as a composite of optimal responses of the state variables as induced by the earlier adjustment rules.

A general overview of the results reported in Tables 3-5 reinforces the Adelman, Sarris, and Roland-Holst (1987) observation on the multi-faceted nature of the adjustment patterns, across periods and sectors regardless of the nature of the global strategies. In particular, it is observed that in no instance does the sector that is directly affected by the shock bear the major burden of adjustment. It can therefore be concluded that decision rules based on partial equilibrium analyses would never be optimal and would likely produce misleading results.

Second, we find that the optimal adjustment rules spread the adjustments over time. In general, subsequent-period adjustment of the instruments tends to be of the opposite sign and smaller in numerical value.

Third, the aggregate level of government investment proves to be one of the most intensively used instruments in bringing the economy back to its target path (except for the initial period response of the ISI strategy under the growth objective).

Fourth, the optimal policy response to the rising cost of imports of producer goods is generally a devaluation of the exchange rate. As for shocks on export demand, the optimal response of the exchange rate is mixed. In

TABLE 3

(N) Matrices of Optimal Instrument Adjustments, Growth Objective[1]

	Shocks[2]											
	To import price of producer goods[3]			To export demand of								
				Agriculture			Consumer goods			Producer goods		
Changes in:	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
1986												
Exchange rate	0.978	1.135	1.736	4.385	5.734	6.445	8.079	-2.034	7.871	0.132	1.555	10.121
Tariffs												
Agriculture	-0.994	0.102	0.258	1.231	5.821	7.952	-5.421	-1.474	8.480	-2.763	-1.679	23.645
Consumer mfr.	0.594	-0.710	-0.529	1.093	-3.606	-3.171	8.696	11.606	1.464	0.967	-2.674	14.337
Producer mfr.	1.281	-0.257	0.756	2.199	-1.233	-1.723	0.474	0.997	-3.532	15.636	16.759	3.074
Export subsidies												
Agriculture	0.554	-0.011	0.556	3.112	0.044	-0.358	2.391	0.009	-4.304	1.563	-0.008	-14.729
Consumer mfr.	-0.041	-0.175	0.674	-2.518	-0.135	0.075	-2.655	1.263	4.183	-2.216	1.539	16.233
Producer mfr.	0.000	-1.588	0.000	0.000	-0.099	0.000	0.000	-2.629	0.000	0.000	-2.150	0.000
Govt. investment												
Agriculture	0.586	0.566	0.629	2.442	2.792	2.298	4.286	-0.688	2.839	0.747	1.089	3.727
Consumer mfr	0.587	0.771	0.754	2.402	3.704	2.818	4.394	-0.783	3.484	0.358	1.533	4.604
Producer mfr.	0.650	0.121	1.764	2.691	1.313	4.935	4.747	0.112	5.567	0.838	1.037	6.379
Services	1.887	2.426	2.278	7.722	11.764	9.135	14.121	-2.426	11.243	1.596	4.981	14.678
Total	-3.618	-4.817	0.284	-16.056	-20.236	-0.615	-21.931	-5.606	-0.687	-16.176	-17.439	-1.705
1990												
Exchange rate	-0.032	0.007	-0.013	-0.068	0.035	-0.119	-0.025	-0.001	-0.098	-0.039	-0.013	-0.225
Tariffs												
Agriculture	0.000	0.004	0.004	0.000	0.018	-0.009	0.000	-0.008	-0.008	0.000	-0.011	-0.026
Consumer mfr.	0.015	-0.016	-0.011	0.032	-0.085	-0.106	0.011	0.001	-0.088	0.017	0.031	-0.202
Producer mfr.	0.002	-0.009	-0.002	0.004	-0.047	-0.063	0.001	0.007	-0.053	0.002	0.021	-0.127
Export subsidies												
Agriculture	0.004	-0.002	-0.010	0.009	-0.010	-0.072	0.003	0.006	-0.059	0.005	0.007	-0.133
Consumer mfr.	-0.008	-0.004	0.026	-0.016	-0.020	0.149	-0.006	-0.001	0.122	-0.009	0.006	0.266
Producer mfr.	-0.009	-0.006	-0.029	-0.022	-0.045	-0.359	-0.009	-0.022	-0.299	-0.012	0.002	-0.697
Govt. investment												
Agriculture	-0.015	0.000	-0.005	-0.031	0.000	-0.027	-0.011	-0.001	-0.022	-0.017	-0.001	-0.047
Consumer mfr.	-0.013	0.004	-0.004	-0.027	0.022	-0.045	-0.010	0.000	-0.037	-0.015	-0.008	-0.086
Producer mfr.	-0.016	0.005	-0.006	-0.033	0.025	-0.064	-0.013	0.000	-0.053	-0.019	-0.009	-0.123
Services	-0.030	0.007	-0.013	-0.063	0.038	-0.143	-0.023	0.000	-0.188	-0.035	-0.014	-0.274
Total	-0.009	-0.016	0.030	-0.022	-0.096	0.544	-0.010	-0.023	0.454	-0.012	0.019	1.075
1994												
Exchange rate	0.000	0.000	-0.001	0.000	0.000	-0.051	0.000	0.000	-0.043	0.000	0.000	-0.103
Tariffs												
Agriculture	0.000	0.000	0.001	0.000	0.000	0.057	0.000	0.000	0.048	0.000	0.000	0.116
Consumer mfr.	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001
Producer mfr.	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001
Export subsidies												
Agriculture	0.000	0.000	-0.002	0.000	0.000	-0.078	0.000	0.000	-0.065	0.000	0.000	-0.158
Consumer mfr.	0.000	0.000	0.014	0.000	0.000	0.047	0.000	0.000	0.399	0.000	0.000	0.962
Producer mfr.	0.000	0.000	-0.016	0.000	0.000	-0.516	0.000	0.000	-0.432	0.000	0.000	-0.104
Govt. investment												
Agriculture	0.000	0.000	0.000	0.000	0.000	-0.015	0.000	0.000	-0.013	0.000	0.000	-0.031
Consumer mfr.	0.000	0.000	0.000	0.000	0.000	-0.015	0.000	0.000	-0.013	0.000	0.000	-0.032
Producer mfr.	0.000	0.000	0.000	0.000	0.000	-0.012	0.000	0.000	-0.010	0.000	0.000	-0.025
Services	0.000	0.000	-0.001	0.000	0.000	-0.064	0.000	0.000	-0.054	0.000	0.000	-0.130
Total	0.000	0.000	-0.003	0.000	0.000	-0.108	0.000	0.000	-0.090	0.000	0.000	-0.217

[1]Entries are in billions of Turkish lira per billions of Turkish lira of shock.

[2]The shocks to export demand are calibrated to generate decreases in exports of 1 billion Turkish lira. For ease of interpretation, the signs of the elasticities are changed so that a positive sign means an increase in the relevant state variable in response to the decrease in exports.

[3]The shocks to import prices of producer goods are calibrated to generate a 1 billion Turkish lira increase in the import bill of producer goods.

TABLE 4

(N) Matrices of Optimal Instrument Adjustments, Stabilization Objective[1]

	Shocks[2]											
	To import price of producer goods[3]			To export demand of								
				Agriculture			Consumer goods			Producer goods		
Changes in:	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
1986												
Exchange rate	-0.067	1.784	2.398	2.857	8.019	1.179	3.004	-4.508	7.229	-0.669	0.583	1.860
Tariffs												
Agriculture	-0.205	-0.257	0.972	6.949	4.898	5.001	3.596	0.630	-1.161	0.062	-0.168	1.207
Consumer mfr.	0.772	-3.401	-1.561	-3.427	-14.048	0.550	8.447	18.844	5.086	-1.331	-0.891	-0.040
Producer mfr.	1.032	-1.988	0.389	-1.820	-8.613	1.638	-1.945	4.208	-1.089	13.821	15.670	13.977
Export subsidies												
Agriculture	0.595	-0.017	-0.927	0.882	0.014	0.558	3.913	0.006	0.616	0.514	-0.012	-3.601
Consumer mfr.	-0.079	0.535	0.198	2.226	2.450	3.837	-0.508	-0.729	1.573	0.213	-0.034	13.339
Producer mfr.	0.000	5.033	0.000	0.000	-12.941	0.000	0.000	7.779	0.000	0.000	1.160	0.000
Govt. investment												
Agriculture	0.010	0.908	0.874	1.416	3.983	0.379	1.507	-2.015	2.530	0.215	0.508	0.593
Consumer mfr.	-0.014	1.199	1.053	1.517	5.193	0.446	1.612	-2.474	3.055	-0.101	0.814	0.683
Producer mfr.	0.011	-0.114	0.951	1.578	0.350	1.669	1.671	0.582	5.711	0.261	0.992	2.989
Services	-0.034	3.833	4.237	4.959	16.656	1.510	5.165	-7.890	10.424	0.138	2.631	2.014
Total	-0.835	-6.012	-0.033	-5.181	-23.331	-0.016	-6.301	1.851	-0.096	-10.764	-13.040	-0.006
1990												
Exchange rate	0.996	1.394	1.194	-0.713	5.714	0.405	1.337	-2.685	0.419	-2.072	0.375	-0.463
Tariffs												
Agriculture	-0.002	0.049	-1.587	-0.001	0.201	-0.486	-0.003	-0.094	-1.039	0.005	0.013	0.042
Consumer mfr.	-0.414	-0.551	4.218	0.116	-2.262	1.261	-0.648	1.057	3.030	1.163	-0.145	0.206
Producer mfr.	0.698	1.729	1.290	-0.370	7.094	0.276	1.002	-3.327	1.925	-1.674	0.459	1.249
Export subsidies												
Agriculture	-0.614	-1.802	2.949	0.515	-7.385	0.895	-0.785	3.471	1.998	1.149	-0.487	0.001
Consumer mfr.	-0.138	0.393	-7.793	0.008	1.610	-2.347	-0.231	-0.758	-5.440	0.440	0.109	-0.192
Producer mfr.	0.282	-1.294	8.087	-0.784	-5.313	2.476	0.081	2.480	5.277	0.387	-0.340	-0.238
Govt. investment												
Agriculture	0.492	0.134	0.499	-0.312	0.548	0.170	0.681	-0.257	0.180	-1.089	0.035	-0.189
Consumer mfr.	0.358	0.752	0.638	-0.297	3.081	0.210	0.460	-1.450	0.283	-0.677	0.204	-0.177
Producer mfr.	0.581	0.994	0.986	-0.456	4.074	0.323	0.760	-1.914	0.454	-1.143	0.266	-0.254
Services	0.726	1.634	0.313	-0.492	6.699	0.124	0.989	-3.145	-0.050	-1.558	0.438	-0.311
Total	-1.374	-12.036	5.283	-0.653	-49.364	2.139	-2.674	23.144	-1.294	5.612	-3.212	-5.791
1994												
Exchange rate	-0.055	-0.250	0.449	0.061	-1.027	0.114	-0.065	0.481	0.506	0.076	-0.065	0.240
Tariffs												
Agriculture	0.022	0.446	-0.342	-0.031	1.831	-0.087	0.022	-0.858	-0.381	-0.019	0.119	-0.178
Consumer mfr.	0.094	-1.478	0.029	-0.051	-6.065	0.007	0.134	2.842	0.038	-0.222	-0.393	0.021
Producer mfr.	-0.094	-1.842	-2.077	0.063	-7.481	-0.528	-0.129	3.508	-2.334	0.202	-0.486	-1.102
Export subsidies												
Agriculture	-0.001	-0.456	0.795	0.033	-1.871	0.203	0.015	0.878	0.886	-0.056	-0.125	0.413
Consumer mfr.	0.072	1.198	0.684	-0.096	4.915	0.174	0.076	-2.305	0.769	-0.073	0.321	0.363
Producer mfr.	0.134	-0.353	-0.674	-0.041	-1.449	-0.174	0.207	0.679	-0.738	-0.373	-0.094	-0.334
Govt. investment												
Agriculture	-0.017	-0.158	0.187	0.024	-0.648	0.045	-0.017	0.305	0.232	0.012	-0.041	0.125
Consumer mfr.	-0.001	-0.099	0.101	0.002	-0.406	0.026	-0.001	0.189	0.112	0.001	-0.024	0.052
Producer mfr.	-0.040	0.160	-0.053	0.042	-0.658	0.014	-0.048	0.309	0.053	0.060	-0.043	0.021
Services	-0.030	0.143	0.335	0.033	-0.586	0.087	-0.036	0.275	0.364	0.043	-0.037	0.162
Total	0.501	3.137	6.503	-0.091	12.868	1.631	0.803	-6.029	7.526	-1.502	0.836	3.712

[1]Entries are in billions of Turkish lira per billions of Turkish lira of shock.

[2]The shocks to export demand are calibrated to generate decreases in exports of 1 billion Turkish lira. For ease of interpretation, the signs of the elasticities are changed so that a positive sign means an increase in the relevant state variable in response to the decrease in exports.

[3]The shocks to import prices of producer goods are calibrated to generate a 1 billion Turkish lira increase in the import bill of producer goods.

TABLE 5

(N) Matrices of Optimal Instrument Adjustments, Income Distribution Objective[1]

	Shocks[2]											
	To import price of producer goods[3]			To export demand of								
				Agriculture			Consumer goods			Producer goods		
Changes in:	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
1986												
Exchange rate	0.593	0.358	1.452	4.511	1.627	0.574	7.069	-1.528	0.793	0.669	0.758	-3.379
Tariffs												
Agriculture	0.308	0.677	11.837	6.952	8.930	7.844	-1.315	-1.466	18.111	0.395	0.103	12.448
Consumer mfr.	0.214	-0.554	-5.956	-4.310	-2.852	-0.692	4.958	13.057	-1.664	-2.513	0.076	-3.338
Producer mfr.	0.927	-0.489	3.314	-1.663	-3.401	1.692	-2.983	1.322	-3.820	13.068	16.425	14.608
Export subsidies												
Agriculture	0.020	-0.037	-6.477	0.028	-0.085	-1.398	0.674	0.045	-10.982	-0.353	0.008	-11.262
Consumer mfr.	0.331	0.650	6.972	1.998	3.321	6.520	1.202	-1.003	18.195	0.532	-0.518	25.570
Producer mfr.	0.000	-0.643	0.000	0.000	4.791	0.000	0.000	-1.306	0.000	0.000	2.550	0.000
Govt. investment												
Agriculture	0.351	0.178	0.620	2.270	0.688	0.154	3.576	-0.492	0.232	0.882	0.611	-1.257
Consumer mfr.	0.348	0.235	0.763	2.404	0.848	0.171	3.805	-0.456	0.273	0.613	0.945	-1.580
Producer mfr.	0.393	0.013	1.151	2.522	0.639	1.479	3.976	0.330	1.312	1.002	1.228	-0.899
Services	1.140	0.798	1.881	7.826	3.008	0.406	12.324	-1.548	0.543	2.481	3.006	-5.534
Total	-2.051	-1.188	0.069	-8.935	-0.978	0.062	-13.535	-8.518	0.163	-12.821	-13.829	0.178
1990												
Exchange rate	-0.576	0.003	0.167	-5.920	0.012	-0.044	-8.344	0.022	-0.086	4.369	0.003	-0.396
Tariffs												
Agriculture	0.000	1.171	-0.086	0.001	1.477	0.065	0.001	-0.196	0.123	-0.001	-1.036	0.362
Consumer mfr.	0.259	-0.172	0.015	2.665	-1.527	0.032	3.758	0.274	0.058	-1.968	1.105	0.099
Producer mfr.	-0.218	-0.315	-0.328	-2.211	-2.697	0.071	-3.096	0.341	0.140	1.642	1.884	0.718
Export subsidies												
Agriculture	0.233	-0.075	0.117	2.386	-0.621	-0.075	3.359	0.042	-0.143	-1.758	0.417	-0.444
Consumer mfr.	-0.067	0.004	-0.121	-0.694	0.035	0.061	-0.982	-0.003	0.123	0.505	-0.024	0.410
Producer mfr.	-0.026	0.489	0.199	-0.274	4.028	0.010	-0.389	-0.263	0.012	0.194	-2.697	-0.242
Govt. investment												
Agriculture	-0.277	0.010	0.105	-2.841	0.089	-0.060	-4.002	-0.023	-0.113	2.100	-0.068	-0.368
Consumer mfr.	-0.212	0.014	0.053	-2.179	0.095	-0.010	-3.072	0.033	-0.018	1.606	-0.045	-0.107
Producer mfr.	-0.276	-0.003	0.055	-2.840	-0.022	-0.006	-4.004	0.034	-0.013	2.096	0.030	-0.099
Services	-0.507	-0.021	0.131	-5.214	-0.175	-0.006	-7.352	0.018	-0.015	3.848	0.120	-0.203
Total	0.611	1.175	1.668	6.201	9.785	-0.845	8.690	-0.813	-1.603	-4.620	-6.632	-5.457
1994												
Exchange rate	-0.035	0.009	-0.054	-0.368	0.069	0.050	-0.519	0.005	0.093	0.272	-0.042	0.259
Tariffs												
Agriculture	-0.085	0.004	0.038	-0.870	0.030	-0.042	-1.227	-0.004	-0.078	0.642	-0.021	-0.209
Consumer mfr.	0.048	0.002	0.012	0.496	0.013	-0.009	0.699	0.004	-0.016	-0.366	-0.006	-0.048
Producer mfr.	-0.201	0.031	0.158	-2.065	0.252	-0.133	-2.913	-0.010	-0.250	1.525	-0.166	-0.716
Export subsidies												
Agriculture	0.172	-0.013	-0.072	1.772	-0.108	0.069	2.497	0.006	0.130	-1.308	0.072	0.359
Consumer mfr.	-0.046	-0.002	-0.032	-0.476	-0.013	0.022	-0.670	-0.002	0.041	0.351	0.007	0.126
Producer mfr.	-0.106	0.006	0.074	-1.090	0.047	-0.084	-1.536	-0.001	-0.158	0.804	-0.030	-0.416
Govt. investment												
Agriculture	-0.047	0.006	-0.036	-0.486	0.043	0.032	-0.685	0.007	0.060	0.358	-0.023	0.169
Consumer mfr.	-0.005	0.002	-0.010	-0.054	0.015	0.009	-0.076	+0.001	0.018	0.040	-0.009	0.050
Producer mfr.	0.000	0.004	-0.006	-0.001	0.030	0.007	-0.002	0.001	0.012	0.001	-0.019	0.033
Services	-0.006	0.007	-0.028	-0.062	0.057	0.026	-0.088	0.002	0.049	0.046	-0.035	0.136
Total	0.591	-0.091	-0.654	6.079	-0.762	-0.557	8.574	0.064	1.042	-4.491	0.517	2.977

[1]Entries are in billions of Turkish lira per billions of Turkish lira of shock.

[2]The shocks to export demand are calibrated to generate decreases in exports of 1 billion Turkish lira. For ease of interpretation, the signs of the elasticities are changed so that a positive sign means an increase in the relevant state variable in response to the decrease in exports.

[3]The shocks to import prices of producer goods are calibrated to generate a 1 billion Turkish lira increase in the import bill of producer goods.

general, under XLI and ISI, the exchange rate is used more intensively as a policy instrument with the growth and stabilization objectives than with the distribution objective. The ADLI strategy, on the other hand, utilizes the exchange rate more under the growth and the income distribution objectives as compared to its use under the stabilization objective.

Fifth, all three strategies tended to use the tariff instruments more intensively than the export-subsidy instruments. This tendency was especially pronounced for the growth objective.

Further, it is interesting to note that, in the period of the shock, the ADLI and ISI strategies do not make significant use of the export subsidy instrument to producer-goods manufacturing; by contrast, under the XLI strategy, producer-goods export subsidy is the most intensively used export-incentive instrument. In the subsequent periods, however, export subsidies on producer goods are widely used in all three strategies.

Sixth, optimal adjustment rules are sensitive to both objectives and strategies. More detailed observations of the N_t matrix under the stabilization objective indicates that the optimal commercial policy response to an increase in the cost of imports of producer goods is to increase both tariffs and export subsidies in that sector (save the third period reversals on tariffs) with the ADLI and ISI strategies. Under the XLI strategy, on the other hand, tariffs in the producer-goods sector are first decreased and then increased; and subsidies are first increased and then reduced.

As for the growth objective, we observe that the ISI strategy makes relatively little use of aggregate government investment as a policy variable. Instead, sectoral government investments and tariffs are more widely used.

Again, as compared to the alternative strategies, we observe that the ISI response to the trade shock is a relatively more intensive use of all instruments, especially when the shock is one of export demand to urban manufacturing.

A comparison of the two open-economy strategies reveals that ADLI generally resorts to less policy interventions as compared to XLI. The only exception is the case of the export-demand shock to consumer manufacturing.

Turning to the income distribution objective, we observe that the ISI economy displays the most sensitivity (and requires the most intensive adjustment) to demand shocks to producer goods under this objective. It is hard to make a similar observation for the ADLI and XLI strategies. However, very broadly, under these two open strategies, declines in agricultural and consumer-good export demand seem to require the most intensive adjustments.

IV-3. The Paths of Optimal State Variable Adjustments

The P matrices (Tables 6-8) display the path of induced deviations in the state variables which would result from the implementation of the optimal adjustment rules in response to the initial period shocks. These matrices describe the changes in the realized path of the economy under optimal adjustment and indicate how the burden of adjustment will be allocated across the state variables under the optimal policy rule for each objective and development strategy. The paths displayed in the P matrices can therefore be utilized to make inferences about the potential relative stability of each of the three global development strategies.

The general conclusions derived from an inspection of the path of the P matrices are similar to those observed for the paths of the N matrices. As

TABLE 6

(P) Matrices of Optimal State Variable Adjustments under Optimal Instrument Adjustments, Growth Objective[1]

	Shocks: To import price of producer goods			To export demand of: Agriculture			Consumer goods			Producer goods			Total optimal adjustment		
	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
1986															
Real output[2]															
Agriculture	0.003	0.075	0.855	0.004	0.037	-0.106	0.015	0.042	-0.478	0.007	-0.019	-1.363	0.107	0.500	-4.544
Consumer mfr.	0.421	-0.182	-0.295	0.059	-0.023	0.232	0.050	0.439	0.747	0.116	0.272	2.008	2.658	1.564	9.112
Producer mfr.	0.255	-0.016	-0.040	0.042	0.018	0.112	0.052	0.205	0.342	0.084	0.096	0.903	1.715	0.986	4.518
Services	-0.036	-0.026	0.039	-0.002	-0.015	0.161	0.005	-0.027	0.512	-0.003	0.003	1.268	-0.154	-0.230	3.265
Real capital stock[2]															
Agriculture	0.000	0.101	-0.195	-0.002	0.056	-0.610	-0.004	0.110	-1.913	-0.003	-0.013	-4.753	-0.030	0.891	-25.876
Consumer mfr.	0.377	-0.615	-0.319	0.059	-0.252	-0.244	0.066	0.092	-0.825	0.115	0.399	-1.981	2.436	-1.610	-11.710
Producer mfr.	0.123	-0.135	-0.154	0.030	-0.054	-0.140	0.052	0.025	-0.428	0.060	0.086	-1.037	1.011	-0.323	-6.192
Services	-0.018	0.044	-0.003	-0.002	0.020	-0.018	0.000	0.013	-0.057	-0.004	-0.019	-0.140	-0.102	0.215	-0.752
1990															
Real output[2]															
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Consumer mfr.	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.006	0.000	0.000	-0.034
Producer mfr.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.007
Services	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	-0.006
Real capital stock[2]															
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.009
Consumer mfr.	0.000	0.000	0.000	0.000	0.000	-0.003	0.000	0.000	-0.001	0.000	0.000	-0.027	0.000	0.000	-0.148
Producer mfr.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.003
Services	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.010
1994															
Real output[2]															
Agriculture	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.000	0.005	0.000	0.000	0.029
Consumer mfr.	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.005	0.000	0.000	-0.026
Producer mfr.	0.000	0.000	0.002	0.000	0.000	0.005	0.000	0.000	0.015	0.000	0.000	0.038	0.000	0.000	0.207
Services	0.000	0.000	0.002	0.000	0.000	0.005	0.000	0.000	0.018	0.000	0.000	0.044	0.000	0.000	0.239
Real capital stock[2]															
Agriculture	0.000	0.000	-0.002	0.000	0.000	-0.006	0.000	0.000	-0.018	0.000	0.000	-0.043	0.000	0.000	-0.244
Consumer mfr.	0.000	0.000	-0.002	0.000	0.000	-0.005	0.000	0.000	-0.016	0.000	0.000	-0.039	0.000	0.000	-0.624
Producer mfr.	0.000	0.000	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.008	0.000	0.000	-0.019	0.000	0.000	-0.103
Services	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	-0.002	0.000	0.000	-0.006	0.000	0.000	-0.031
Total value of objective function[2]													5.119	6.949	551.745

[1] In elasticity terms. Entries have been multiplied by 100.

[2] Billions of Turkish lira, in 1981 prices.

TABLE 7

(P) Matrices of Optimal State Variable Adjustments under Optimal Instrument Adjustments, Stabilization Objective[1]

	Shocks: To import price of producer goods			To export demand of: Agriculture			Consumer goods			Producer goods			Total optimal adjustment		
	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
1986															
Organized labor employment[2]	0.004	-0.008	0.001	0.003	-0.005	0.000	0.019	-0.004	0.001	-0.009	0.010	0.000	0.045	-0.013	0.002
Merchandise trade deficit[3]	0.007	0.806	0.000	0.006	0.486	0.000	0.037	-0.215	-0.001	-0.017	-1.060	-0.001	0.088	1.336	-0.001
Migration[2]	0.015	0.747	-0.058	0.028	0.254	-0.001	0.162	-0.469	-0.019	0.011	-0.034	-0.021	0.671	2.563	-0.291
Per capita real private consumption[3]	0.001	0.130	0.000	0.000	0.078	0.000	0.003	0.035	0.001	-0.001	-0.171	0.000	0.006	0.212	0.001
Per capita real food consumption[3]	0.000	-0.004	-0.002	-0.001	-0.003	0.000	-0.005	0.000	-0.001	0.000	0.003	0.000	-0.014	-0.023	-0.011
1990															
Organized labor employment[2]	0.000	0.018	-0.001	0.000	0.011	0.000	0.000	0.045	-0.001	0.000	-0.024	0.000	0.000	0.030	-0.001
Merchandise trade deficit[3]	0.000	-0.012	0.000	0.000	-0.007	0.000	0.000	-0.029	0.000	0.000	0.015	0.000	0.000	-0.020	0.000
Migration[2]	0.022	-0.089	-0.269	-0.003	0.003	-0.007	0.007	0.014	-0.044	-0.006	-0.181	0.017	0.086	-0.630	-1.191
Per capita real private consumption[3]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
Per capita real food consumption[3]	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.009
1994															
Organized labor employment[2]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Merchandise trade deficit[3]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Migration[2]	0.017	0.068	0.030	0.000	0.022	0.001	0.009	0.095	0.014	-0.006	-0.005	0.009	0.069	0.264	0.201
Per capita real private consumption[3]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Per capita real food consumption[3]	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total value of the objective function[3]													0.034	98.219	0.001

[1]In elasticity terms. Entries have been multiplied by 100.
[2]1,000 x man-year.
[3]Billions of Turkish lira, in 1981 prices.

TABLE 8

(P) Matrices of Optimal State Variable Adjustments under Optimal Instrument Adjustments, Income Distribution Objective[1]

Per capita household income	Shocks: To import price of producer goods			To export demand of: Agriculture			Consumer goods			Producer goods			Total optimal adjustment (in elasticity terms)		
	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI	ADLI	XLI	ISI
1986															
Agricultural labor	-8.093	-8.198	-1.502	-7.301	-10.301	-0.694	-37.811	-8.960	-4.830	8.316	9.770	-9.385	-93.795	-89.712	-57.023
Marginal labor	-9.488	78.885	-2.243	-8.559	46.680	-1.035	-44.333	32.207	-7.213	21.531	-99.385	-14.019	-109.954	177.542	-85.115
Organized labor	-0.091	-1.511	0.070	-0.083	-0.894	0.033	-0.427	-0.616	0.228	0.207	3.918	0.435	-1.054	-3.400	-17.134
Service labor	70.450	51.578	14.500	63.558	30.520	6.698	329.167	21.053	46.683	-159.966	-64.981	53.906	816.555	116.389	550.323
Agric. capitalist	-10.654	-21.140	-3.712	-9.677	-12.520	-1.749	-50.070	-8.398	-12.209	24.824	26.374	-23.604	-119.251	-47.970	-143.263
Indust. capitalist	-9.815	-41.268	-8.101	-11.544	-23.173	-1.928	-60.053	-6.933	-6.647	25.453	52.260	-6.043	-151.099	-89.280	-80.711
Commerc. capitalist	1.605	3.205	-29.286	1.077	0.171	0.231	6.189	-2.454	0.582	-0.040	7.393	-1.996	28.137	43.233	-110.546
1990															
Agricultural labor	-0.724	0.407	0.000	-0.071	0.182	0.000	-0.370	0.125	0.000	0.180	-0.387	0.000	-0.917	0.893	-0.001
Marginal labor	0.522	-0.716	-0.001	0.472	-4.240	-0.001	-2.443	-0.293	-0.002	-0.117	0.902	-0.004	6.053	-6.109	-0.026
Organized labor	-0.021	1.350	0.000	-0.019	0.799	0.000	-0.096	0.551	0.000	0.416	-1.701	0.000	-0.235	3.084	-0.001
Service labor	-0.410	-1.031	0.002	-0.370	-0.610	0.002	-1.917	-0.421	0.006	0.932	1.298	0.011	-4.752	-2.327	0.065
Agric. capitalist	-0.505	-4.223	0.049	-0.458	-2.671	-0.005	-2.384	-0.545	-0.032	1.166	6.276	-0.088	-5.835	-2.528	-0.293
Indust. capitalist	-1.976	-5.738	0.152	-1.811	-3.670	0.017	-9.419	-0.383	0.120	4.680	8.761	0.181	-22.763	-1.728	1.694
Commerc. capitalist	2.041	0.541	-0.599	1.860	0.208	0.057	9.659	1.019	0.402	-4.771	-0.029	1.085	23.505	5.772	2.898
1994															
Agricultural labor	0.000	0.002	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	-0.002	0.000	0.008	0.004	0.000
Marginal labor	-0.001	-0.040	0.000	-0.001	-0.023	0.000	-0.003	-0.016	0.000	0.002	0.050	0.000	-0.008	-0.089	0.001
Organized labor	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	-0.001	0.000
Service labor	-0.001	0.003	0.000	-0.001	0.002	0.000	-0.005	0.001	0.000	0.002	-0.004	0.000	-0.011	0.008	0.000
Agric. capitalist	0.000	-0.001	-0.003	0.000	-0.001	0.000	-0.001	0.002	0.002	0.001	0.003	0.005	-0.003	0.010	0.010
Indust. capitalist	0.089	0.027	-0.124	0.081	0.017	0.016	0.419	0.005	0.114	-0.208	-0.038	0.331	1.020	0.032	0.681
Commerc. capitalist	0.024	0.005	-0.015	0.022	0.004	0.001	0.114	-0.002	0.008	-0.057	-0.010	0.022	0.277	-0.010	0.047
Total value of the objective function[2]													6.177	3.622	1.239

[1]In elasticity terms. Entries have been multiplied by 100.

[2]In billions of Turkish lira, in 1981 prices.

expected, during the period of the shock, deviations from the target path of the growth state variables are greatest under the ISI strategy.

In the second period, deviations become smaller under all three strategies. In the third period, however, the state variables of the ISI economy once again move away from the target path (even though the deviations compared to the first period are much smaller); whereas, under the open-economy strategies of ADLI and XLI, adjustment is complete by the end of the first period.

Further, it is interesting to note that, under ISI, the elasticities of the growth state variables are usually of negative sign, that the realized path of the economy usually falls short of the level of the target path. This phenomenon can be explained, in part, by the "delayed" response of the ISI economy in increasing its level of domestic investment.

Comparison of the P matrices of the XLI with ADLI strategies reveals interesting results. At the individual sectoral level, the real output supplies of urban manufacturing sectors display more stability (in the sense that induced deviations are smaller) with the XLI strategy when the shock is one of import-cost of producer goods or that of export demand to agriculture. In all other cases, however, the individual state variable response of the growth objective is more stable with the ADLI strategy.

The relative stability of the ADLI strategy is more pronounced when the state variables of the stabilization objective are considered. In the ADLI economy, adjustment seems to be complete by the end of the first period (with the exception of the migration variable); whereas it continues through the second period under XLI.

Here, however, the ISI strategy reveals comparably the highest stability (with the exception of the migration variable) among the three stylized development models that are considered. This observation strikes an interesting contrast with the oscillating path of the growth state variable adjustment of the ISI strategy and suggests that the relative stability properties of alternative development strategies may depend upon the choice of the state variables that are focused upon as well as all other considerations concerning the size of the shock; level of development and size of the economy; etc.

As for the income distribution objective, the ADLI economy reveals itself to be the least stable, whereas the ISI economy proves to be the most stable one. Here, of particular importance is the fact that the elasticity of state variables with respect to the aggregate, combined shock is negative for both the agricultural and urban marginal labor categories, the poorest members of the society.

This phenomenon is actually a by-product of the movement of the relative prices against agriculture under the ADLI strategy. With the adoption of a pro-agricultural growth strategy, the rate of increase of agricultural production exceeds the rate of increase in agricultural prices. In the absence of negating market restrictions, the relative abundance of the agricultural good exerts downward pressure on its price and leaves the farmers' income levels more susceptible to exogenous shocks. Thus, what might be needed--along with the productivity-improving effects of the ADLI strategy--is a "terms of trade policy" which will guarantee that the fruits of the increased agricultural productivity will be shared by both farmers and the urban consumers.

Table 9 presents the levels of the state variables after optimal adjustment to the combined shock. It indicates that the ADLI strategy is superior

TABLE 9

riables after Optimal Adjustment in Period 1

ADLI	XLI	ISI
2468.1	2437.6	2438.5
2716.8	2763.5	2569.7
3988.3	4036.8	3933.6
6053.1	5967.7	6196.1
3397.1	3397.5	3396.6
1634.3	1630.1	1630.4
4600.4	4595.9	4595.8
13021.9	13023.5	13022.9
0.161	0.163	0.150
0.171	0.204	0.173
0.604	0.603	0.596
0.335	0.218	0.277
2.352	2.512	2.066
6.476	7.194	6.474
7.333	7.144	6.615
438.833	443.287	336.899
0.344	0.344	0.331
0.132	0.130	0.133
2919.111	2885.969	3010.010
55.699	53.998	66.399

TABLE 9

Variables after Optimal Adjustment in Period 1

	ADLI	XLI	ISI
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prices.

prices.

for service labor and for commercial capitalists; that it is essentially the same as XLI for agricultural and organized labor; and that XLI is preferable for marginal labor and agricultural and industrial capitalists. Real output is highest under the ADLI strategy. As for the stabilization variables, the trade balance is smallest and employment largest under the ISI strategy but at the cost of the smallest per capita real consumption and highest rural-urban migration.

V. Conclusions

Thus, in conclusion, the strategy comparisons presented above reveal that in the medium run ADLI offers a strategy that generates better results and a more stable environment for the purposes of "structural adjustment" and "sustainable growth" than XLI under the depressed conditions of the eighties. However, the model solutions indicate that to complement the above results with the objective of poverty alleviation an energetic social-incomes policy has to be followed that is designed to translate the productivity increases in agriculture into higher material incomes in both rural and urban areas.[8]

The detailed computations carried out in this paper also indicate that the choice of most active adjustment-instruments is shock and objective specific; that optimal adjustment patterns tend to spread the burden of adjustment across economic actors, sectors, and instruments; that under optimal adjustment the effects of shocks on the target variables tend to die down in five to ten years; and that an adjustment pattern of first overshooting and then correcting the adjustment is optimal under most strategies (the primary exception is ISI) and for most instruments and objectives.

FOOTNOTES

[1]See Milanovic (1986) and Yagci (1984) for a comprehensive evaluation of the protection and export-incentives schemes in Turkish manufacturing since 1980. For a detailed description of the 1980 Reform, see World Bank (1982).

[2]On an index scale of 100 in 1980, the real wages have fallen to 67.3 in 1985 (Yeldan, 1988).

[3]Some scholars have already pointed out that the success of the Turkish export drive was actually a result of the special favorable events, like the war conjuncture in the region, instead of the reform package itself (see, e.g. Berksoy, 1985; Kepenek, 1984).

[4]For a further discussion of this point, see Yeldan (1987).

[5]For the original statement and the description of the ADLI strategy see Adelman (1984); and Mellor (1976). For extensions and applications, see de Janvry (1984); Singer and Alizadeh (1986); Adelman, Bournieux and Waelbroeck (1986); and Yeldan (1987, 1988).

[6]A detailed description of the model is presented in Yeldan (1988).

[7]It is assumed that agricultural capitalists receive 15% of net private borrowing from the rest of the world and the rest is allocated between the urban capitalists. 40% of the remittance inflow is assumed to be channeled to the agricultural labor household, and the rest to the urban labor households. Further it is assumed that agricultural labor captures 25% of agricultural profits to highlight the size of the small scale production units in the Turkish rural structure. For details of the aggregation of the social accounting matrix see Yeldan (1988, chp. 4).

[8]The elements of this policy are discussed in Yeldan (1988, Chapter 5) and in Adelman (1984, pp. 945-946).

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