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A COMPUTATIONAL GENERAL EQUILIBRIUM MODEL WITH ENDOGENOUS UNEMPLOYMENT

An analysis of the 1980 fiscal reform in Mexico

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In this paper we develop a general equilibrium model of the Mexican economy in which unemployment and government deficits play important roles. The unemployment rate depends on a downwardly rigid real wage in the urban sector. The government runs a deficit simply by selling bonds that consumers consider perfect substitutes for physical capital as savings instruments. The model is used to analyze the impact of the 1980 fiscal reform. The presence of the rigid real wage and alternative specifications of government policies regarding the size of the deficit are found to have significant effects on the comparative statics results. Whether or not the reform improves the welfare of rural households compared to urban households, for example, depends on whether government policy is to keep the deficit constant or keep expenditures constant in response to changes in tax revenues.

1. Introduction

Over the past twenty years economists have used general equilibrium models to analyze the incidence of government expenditure and tax policies. Models like those developed by Harberger (1962) and Shoven and Whalley (1972) are ideally suited to analysis of pure incidence. Unfortunately, the models that have been developed thus far do less well analyzing situations where such macro phenomena as capital accumulation, inflation, unemployment of resources, and government deficits play important roles. In this paper we develop a general equilibrium model of the Mexican economy that allows for unemployment and government deficits. The model is then

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used to analyze the impact of the 1980 fiscal reform. The principal concerns in this analysis are not macro phenomena, however, but rather income distribution and allocation of resources among different sectors of the economy. Nevertheless, our simulations indicate that these issues are so closely intertwined with such macro phenomena as unemployment and deficits that to neglect these phenomena might seriously bias the analysis. The model does not, however, deal with monetary and dynamic issues. There are two reasons for this approach. First, it is possible to include unemployment and the impact of deficits in a static real model. Second, providing a realistic, yet tractable, role for money in a dynamic general equilibrium model is a difficult task. The strategy of this paper is to tackle the less difficult problems first in tying macro phenomena into a general equilibrium framework.

Unemployment in this model depends on a downwardly rigid real wage in the urban sector. Urban labor is unemployed only if the wage constraint is binding. Any unemployment is distributed evenly across consumer groups. The unemployment aspect of this model is similar to that studied by Drèze (1976), although our rationing scheme is different from his. Even though the Mexican economy has experienced double digit inflation in recent years, there are reasons to believe that the urban real wage is downwardly rigid. The most obvious is the government minimum wage policy, which is revised annually. Strong urban labor unions may also play a role, although their overall impact is not clear. It should be stressed, however, that this model does not attempt to provide a behavioral theory of rigid wages and unemployment. Although this is an interesting and important issue, our emphasis is on a different question. Suppose that wages are rigid for some combination of economic, political, and sociological reasons. What effect does the possibility of unemployment have on the analysis of tax incidence? Changes in the economic environment that affect the urban labor market do so through quantity adjustments rather than price adjustments. The general equilibrium spillover effects are, of course, quite different depending on what the adjustment mechanism is. Since we believe that unemployment is an important phenomenon in the Mexican economy, we are compelled to introduce it into the model even without a detailed behavioral analysis of the urban labor market itself. A more detailed analysis would probably allow for a hierarchy of labor types and a non-zero elasticity of labor supply. It would further distinguish between unemployment and underemployment and disguised unemployment. It would also integrate the model of the urban labor market with a model of migration from rural to urban areas, a significant phenomenon in Mexico.

Another interesting feature of this model is the presence of a government deficit. Models of the Harberger and Shoven–Whalley type usually avoid issues raised by the presence of government deficits and changes in the level of government expenditures. These models deal with situations either where there is no government and all tax revenues are redistributed to consumers, or where the government budget is always balanced and different tax schemes yield the same revenue. In this model the government can run a deficit simply by selling bonds that consumers consider perfect substitutes for physical capital as savings instruments. There is, of course, a close relationship between policies governing the size of the deficits and the unemployment rate.

In the next four sections we describe the model. We then tie the components of the model together by defining the concept of an equilibrium and describing the computational procedure used to compute such an equilibrium for the Mexican economy. The computational procedure is a fixed-point algorithm, of the type developed by Scarf (1973), modified to compute an endogenously determined unemployment rate. Finally, we analyze the unemployment and distribution effects of the introduction of the consumption value added tax in Mexico in January 1980. The methodology of this study is that of comparative statics: the model was initially calibrated to replicate the Mexican economy in 1977. (The base year 1977 is used because it is the latest for which a complete set of data could be assembled.) We then change the indirect tax system that existed in 1977 to the value-added tax system and compute new equilibria using different sets of assumptions about unemployment and government deficits. The real wage is rigid and the unemployment rate varies or the unemployment rate is fixed and the real wages varies; the government deficit is fixed and the level of expenditures varies or the level of expenditures is fixed and the deficit varies. Not surprisingly, we find that an evaluation of the fiscal reform depends crucially on the set of assumptions used. Some of the most interesting results of our analysis are the questions that it raises. We discuss these questions and directions for possible future research in the concluding section.

2. Production

The model includes 35 goods: 14 production goods, 3 sectors of non-consumption demand (government, foreign sector, and investment), 15 final consumption goods, and 3 factors of production. Each of the first 32 goods is produced by a constant-returns production function that employs the other produced goods as intermediate inputs and the final 3 goods, rural labor, urban labor, and capital, as factors of production. The first 32 goods enter the specification of the production function in fixed coefficients form. Value added is produced by the 3 factors of production with the possibility of substitution governed by a Cobb–Douglas production function, which differs from sector to sector. The advantage of this specification is that it allows us to use an input–output matrix to describe the intermediate transactions in production (table 1).

Table 1
List of sectors.

Production	
1. Agriculture	8. Non-metal production
2. Mining	9. Machinery and automobiles
3. Petroleum and petrochemicals	10. Electric energy
4. Food products	11. Commerce
5. Textiles	12. Transportation
6. Wood products	13. Services
7. Chemical products	14. Construction
Non-consumption demand	
15. Government services	
16. Imports–exports	
17. Fixed investment and inventory accumulation (capital tomorrow)	
Consumption demand	
18. Bread and cereals	25. Clothing
19. Milk and eggs	26. Furniture
20. Other groceries	27. Electronic products
21. Fresh fruits and vegetables	28. Medical products
22. Meat	29. Transportation
23. Fish	30. Educational articles
24. Beverages	31. Articles for personal care
	32. Services
Factors of production	
33. Rural labor	
34. Urban labor	
35. Capital and other factors	

The input–output matrix includes 32 activities of which the final 15 activities do not add any value; in other words, they do not employ the factors of production. The 32×32 input–output matrix is of the form

$$B = \begin{bmatrix} A & -Z \\ 0 & D \end{bmatrix}, \tag{1}$$

where A is a 17×17 input–output matrix that gives intermediate transactions for the 14 production sectors and the 3 non-consumption demand sectors, Z is a 17×15 matrix that converts demand for final consumption goods into demand for production goods, and D is a 15×15 matrix with total consumption of the consumption goods on the diagonal and zeros elsewhere. The only function of Z and D is to transform the aggregation of outputs from production in the first 17 sectors into a 15 good aggregation of consumption goods. When a consumer buys bread and cereals, for example, she is actually buying outputs of the agriculture, food products, and commerce sectors in some fixed proportions. Z and D just keep track of these proportions; all of the production is done in the first 17 sectors.

The production function for sector j is:

$$Q_j = \min(A_j, VA_j), \qquad j = 1,\dots,17. \tag{2}$$

Here A_j aggregates the intermediate inputs for sector j:

$$A_j = \min_{i \neq j} \left(\frac{a_{jj} x_{ij}}{|a_{ij}|} \right), \qquad j = 1,\dots,17, \tag{3}$$

where x_{ij} represents the physical quantities of input i used in the production of j, and a_{ij} is a non-positive number that represents the minimal input of input i per a_{jj} units of output of j. VA_j represents the value added in sector j, which is produced from the three factors according to a Cobb–Douglas production function:

$$VA_j = c_j \prod_{k=1}^{3} x_{kj}^{\delta_{kj}} \qquad j = 1,\dots,17. \tag{4}$$

The parameters c_j and δ_{kj} satisfy the properties $c_j > 0$, $\delta_{kj} \geqq 0$, $\sum_{k=1}^{3} \delta_{kj} = 1$.

3. Consumers

There are 12 consumer groups. Two of them, the government and the rest of the world, are discussed in subsequent sections. The remaining 10 groups represent aggregates of households and are divided into 5 different income groups in both the urban and the rural sectors. Each consumer group is endowed with capital and labor that generate its income. Urban labor and rural labor are separate factors of production (table 2).

Let $w_k^h \geqq 0$ be group h's endowment of factor k. Letting $q_k \geqq 0$ denote the prevailing market price of the factor k, we calculate the income of group h as:

$$Y_h = (q_1 w_1^h + q_2 w_2^h (1-u) + q_3 w_3^h)(1 - i_h) + R_h. \tag{5}$$

Here $0 \leqq u \leqq 1$ is the unemployment rate of urban labor, $0 \leqq i_h < 1$ is the income tax rate faced by group h, and R_h is the total of transfer payments received from the government by group h. Only urban consumers have positive endowments of urban labor, only rural consumers have positive endowments of rural labor. We assume, due to data constraints, that the

Table 2
List of consumers. Net household income in pesos per month ($23 1977 Mex. = $1 1977 U.S.).

1.	Urban poor ($0–1800)
2.	Rural poor ($0–1800)
3.	Urban low income ($1801–3150)
4.	Rural low income ($1801–3150)
5.	Urban low-middle income ($3151–5725)
6.	Rural low-middle income ($3151–5725)
7.	Urban middle-income ($5726–13,400)
8.	Rural middle-income ($5726–13,400)
9.	Urban upper income ($13,401–)
10.	Rural upper income ($13,401–)
11.	Government
12.	Foreign sector

utility function of group h has the form

$$u_h = \prod_{i=15}^{32} (x_i^h)^{b_i^h}. \tag{6}$$

The parameters b_i^h satisfy the properties $b_i^h \geqq 0$, $\sum_{i=15}^{32} b_i^h = 1$. The consumer's demand functions can be derived by maximizing the utility function (6) subject to the budget constraint:

$$\sum_{i=15}^{32} p_i(1+cf_i)x_i^h = Y_h, \tag{7}$$

where p_i, $i = 15, \ldots, 32$, are the prices the goods purchased by consumers and cf_i are ad valorem tax rates imposed on purchases.

Consumer savings are translated directly into demand for the investment good, which could be thought of as being an increment to the consumer's endowment of physical capital in the next period. The consumer can also save by purchasing government bonds, which are a perfect substitute for physical investment. We often refer to this composite good, which is good 17, as capital tomorrow.

4. Government

The government taxes production, imports, consumer income, and sales. It also earns a return on some of the physical capital that it owns. It uses this revenue to purchase goods and services and to invest in physical capital. Government policy can be modified to include such transfer schemes as income supplements, social security payments, and unemployment compensation. Since there are no significant transfer schemes currently in use in Mexico, however, they are not present in the original specification of the model.

The tax rates used in the model are the effective average tax rates. Any tax evasion is assumed to be neutral; in other words, independent of the source and level of income as well as of the type of the good. The lack of information about evasion and its distribution makes it difficult to look for non-neutral criteria to distribute the effect of evasion when computing the effective tax rates.

The government differs from other consumers in the model in that it issues exogenously determined debt. In addition, the government acts as a producer in producing a public good, government services, using the 15th column of the activity analysis matrix B. These services are bought by the government in its capacity as a consumer. When the government demands these services, it actually demands, through the intermediate requirements of this activity, from every sector of the economy.

Each consumer group h, with income Y_h, faces an income tax rate i_h. The income tax revenue received by the government is:

$$I=\sum_{h=1}^{12} i_h Y_h. \tag{8}$$

Prior to the introduction of the value added tax, in addition to having a general turnover tax rate (*impuesto sobre ingresos mercantiles*), the Mexican tax system had a large number of special taxes applied to specific sectors. Our specification takes full account of this tax system. Let ci_i be the ad valorem tax rate paid by the producer of good i, $i=1,\dots,17$, on sales. Similarly, let cf_i be the ad valorem tax rate paid by consumers of good i, $i=15,\dots,32$, on purchases. (We sometimes let the indices of both ci_i and cf_i run from 1 to 32, setting $ci_i=0$, $i=18,\dots,32$, for example.) These tax rates are computed as the weighted sums of taxes on all goods aggregated into good i in the model. The total revenue collected from these taxes is:

$$C=\sum_{i=1}^{17} p_i ci_i a_{ii} y_i+\sum_{i=15}^{32} p_i cf_i \sum_{h=1}^{10} x_i^h. \tag{9}$$

This specification takes account of the 'cascade' effect of the turnover tax system: the total tax is reflected in the final price of the good after going through all the stages of production and commercialization. The more stages the good goes through, the larger is the cascade effect of the tax.

Imports are assumed to be a single homogeneous good. This good is obtained from the export column of the input–output matrix A, denoted (a_M). The model has an aggregate tariff that applies to this good when used as an input. All those activities that use imports as inputs to the production process face this aggregate tariff. The revenue from taxing imports is:

$$T = p_M t \sum_{j=1}^{17} |a_{Mj}| y_j, \qquad (10)$$

where a_{Mj} is the non-positive number that denotes use of imports by activity j, $j \neq M$, p_M is the price index for the aggregate import good, and t is the tariff rate. The government's total revenue R is the sum:

$$R = I + C + T. \qquad (11)$$

In addition to tax collections, the model can also incorporate transfers and tax rebates by giving each consumer group, in lump-sum form, a fraction of government revenue:

$$R_h = \alpha_h R, \qquad (12)$$

where $\sum_{h=1}^{10} \alpha_h = 1 - \alpha_G$, and α_G is the share of the total revenue that the government retains (α_h and $\alpha_G \geqq 0$). For the computation of the original equilibrium we assume that $\alpha_G = 1$.

The composition of government expenditure is viewed as an independent policy decision. In the absence of a simulated change in this composition, our behavioral assumption is that it stays fixed in real terms. The government can be thought of as maximizing a fixed proportions utility function constrained by a budget constraint of the form:

$$Y_G = q_3 w_3^G + p_V w_V^G + \alpha_G R, \qquad (13)$$

where p_V and w_V^G are the price and the endowment of capital tomorrow in the hands of the government and w_3^G is the government's initial endowment of physical capital. The utility function has only two non-zero fixed coefficients: demand for government services and demand for capital tomorrow (investment). Government services are produced by combining commodities in fixed proportions and factors with a Cobb–Douglas technology.

An interesting feature of the model is that the government may spend more than it receives in revenues. Such a deficit on current expenditures appears in (13) as a positive endowment of capital tomorrow in the government's budget constraint. In the computation of the original equilibrium this endowment is equal to the actual government deficit evaluated in 1977 prices. Implicitly, the government issues bonds that are purchased by consumers in place of physical capital.

5. Foreign sector and investment

The specification of the foreign sector in this model is very simplistic. Nevertheless, it captures the structure of the balance of trade and the corresponding capital flow. Imports are a non-competitive, homogeneous good that is demanded as an intermediate input in the production process. Final consumption of imports is, of course, accounted for within the fixed coefficient structure of the input–output matrix. Likewise, the physical composition of exports is fixed, although this can easily be varied in simulations.

The relationship between exports and imports is given in the 16th column and row of the matrix B. A coefficient in this row, a_{Mj}, represents the physical input of the non-competitive import per a_{jj} units of output in sector j. A coefficient in the column, a_{iM}, represents the total exports done by sector i where exports are aggregated within sectors using base year prices. This convention allows the economy to produce imports by exporting goods in fixed proportions. Implicitly, the economy generates foreign exchange that it uses to finance imports. The tax or subsidy rates on the elements of the 16th column represent export taxes or subsidies. The tax rates on the elements of the 16th row represent tariff rates.

We define one more consumer, the rest of the world, who exists only to allow us to explain what happens to the flows that make up the balance of trade. This consumer can be thought of as demanding exports in fixed proportions, so that the coefficients of the 16th column of the matrix B represent his demand function. In return for these exports he provides an amount of the import good given by the diagonal element of the export column. This consumer is also endowed with an amount of imports that is equal to the actual trade deficit when evaluated in 1977 prices. With this income he purchases capital tomorrow. Thus, any deficit on the trade account has a corresponding surplus on the capital account.

The trade deficit is determined exogenously. To make it endogenous we would have to specify the foreign sector in much more detail. Nonetheless, it is possible to use the model to examine the effects of shocks in the foreign sector by simulating changes in the coefficients of the import row and export column of the activity analysis matrix, as well as changes in the exogenous trade deficit.

Although our model is static, we must account for the investment that takes place during the period of analysis. We introduce an investment activity that produces capital tomorrow. This activity is represented as the 17th column, a_V, of the matrix B, where a_{iV}, $i \neq V$, is a non-positive number that represents the investment purchases from sector i per a_{VV} units of total investment. Total physical investment in the economy is given by:

$$V = S + GI + TD - GD, \qquad (14)$$

where S is total savings by consumers, GI is government investment, TD is the trade deficit, and GD is the government deficit.

6. Definition of equilibrium

There is a constraint on the real wage of urban labor of the form

$$q_2 \geqq \sum_{i=15}^{32} \gamma_i p_i(1+cf_i). \tag{15}$$

The weights γ_i convert the market prices $p_i(1+cf_i)$ into a price index. In our simulations the weights γ_i are the coefficients b_i^5 of the urban low-middle income consumer group's utility function. This index may therefore be interpreted as a cost of living index for this consumer group. If this constraint is not binding, then we require demand to be equal to supply of labor in the urban sector. If it is binding, then demand may fall short of supply, which results in unemployment. The consumption weights for the fifth consumer group have been chosen for the price index because it is this group that faces the official minimum wage income in the urban sector. An alternative would be to use a cost of living index for all consumer groups in the urban sector (table 3).

To prove the existence of equilibrium for this type of model we must allow the wage constraint to be violated if $u=1$. In other words, the real wage can fall if all urban labor is unemployed. This is a technical condition that plays no substantive role in our model; complete unemployment is possible only for implausible parameter values.

Consumer demands depend on incomes which in turn depend on the unemployment rate. Since demand functions are linearly homogeneous in income, it makes no difference whether we think of every individual within each consumer group as being underemployed at the same rate u, or think of a proportion $1-u$ of the group as being fully employed and u as being

Table 3
Weights in price index.

15. 0.0	24. 0.07510
16. 0.0	25. 0.10894
17. 0.15165	26. 0.05736
18. 0.08444	27. 0.03951
19. 0.04476	28. 0.01380
20. 0.07718	29. 0.04255
21. 0.05386	30. 0.00571
22. 0.08633	31. 0.01239
23. 0.00561	32. 0.14081

unemployed. Let π denote the price vector (p,q) and $\xi_i(\pi,R,u)$ the excess demand for commodity i. $\xi_i(\pi,R,u)$ is continuous for positive price vectors and homogeneous of degree zero in π and R. It also satisfies the following version of Walras's law:

$$\sum_{i=1}^{35} \pi_i(1+cf_i)\xi_i(\pi,R,u)+\sum_{h=1}^{12} i_h(q_1w_1^h+q_2w_2^h(1-u)+q_3w_3^h) + uq_2\sum_{h=1}^{12} w_2^h \equiv R, \tag{16}$$

for all vectors π, R, and u.

Let $E(q)$ denote the activity analysis matrix formed by input–output matrix B and by the factor matrix $F(q)$ with Cobb–Douglas coefficients for rural labor, urban labor, and capital:

$$E(q)=\begin{bmatrix} B \\ F(q)\end{bmatrix}. \tag{17}$$

Define the matrix $\bar{E}$ by the rule:

$$\bar{e}_{ij}=e_{ij}-s_{ij}|e_{ij}|, \qquad i=1,\ldots,35; \quad j=1,\ldots,32. \tag{18}$$

Here s_{ij} denotes the tax on the sales or purchases of good i by sector j; in other words, the tax rates s_{ij} include the taxes ci_i and tariff t discussed previously. In this notation $\pi\bar{E}(q)y$ represents the after-tax profitability of the production plan $E(q)y$. The total tax revenue accruing from such a production plan is $\pi(E(q)-\bar{E}(q))y$.

A vector of prices $\pi^*=(p^*,q^*)$, a total revenue R^*, a non-negative vector of activity levels y^*, and an unemployment rate u^* are an equilibrium of our model if they satisfy the following conditions:

$$\pi^*\bar{E}(q^*)=0, \tag{19}$$

$$0\leq u^*\leq 1, \tag{20}$$

$$q_2^*\geq \sum_{i=15}^{32} \gamma_i p_i^*(1+cf_i), \quad \text{if } u^*=0,$$

$$q_2^*= \sum_{i=15}^{32} \gamma_i p_i^*(1+cf_i), \quad \text{if } 1>u^*>0, \tag{21}$$

and

$$q_2^* \leqq \sum_{i=15}^{32} \gamma_i p_i^*(1+cf_i), \quad \text{if } u^*=1,$$

$$E(q^*)y^* = \xi(\pi^*, R^*, u^*) + u^* w_2 e^{34}. \tag{22}$$

Here $w = \sum_{h=1}^{12} w^h$ and e^{34} is the vector with unity in the 34th place and zeros elsewhere.

$$R^* = \pi^*(E(q) - E(q))y^* + \sum_{i=1}^{35} \pi_i^* cf_i \xi_i(\pi^*, R^*, u^*)$$

$$+ \sum_{h=1}^{12} i_h(q_1^* w_1^h + q_2^* w_2^h(1-u^*) + q_3^* w_3^h). \tag{23}$$

Condition (19) requires that all activities make zero profits after payment of taxes; (20) restricts the rate of unemployment; (21) characterizes the constraint in the real wage of urban labor explained above; (22) is the condition of supply equal to demand with the possibility of unemployment in the urban labor market; and (23) is the condition that the government revenue that enters the demand functions is equal to what it actually takes in.

7. Existence of equilibrium and a computational algorithm

We can exploit the structure of our model to reduce the search for equilibria to a search over the five variables q_1, q_2, q_3, R, and u. We develop a fixed point algorithm that carries out this search systematically and is guaranteed to find an approximate solution that is accurate to any specified level. An argument dealing with the limit of a sequence of approximate equilibria is then used to demonstrate the existence of equilibrium.

We can rewrite (19) as:

$$p^*\bar{B} = -q^*\bar{F}(q^*), \tag{24}$$

where p^* is a vector of commodity prices and q^* a vector of factor prices. This implies that we can express p^* as a function of q^*:

$$p^* = -q^*\bar{F}(q^*)\bar{B}^{-1}. \tag{25}$$

Since $\bar{B}$, like B, is a productive input–output matrix, $\bar{B}^{-1}$ is non-negative. $\bar{F}(q^*)$ is non-positive. Consequently, p^* must be non-negative if q^* is. If we know the equilibrium factor prices, we can therefore use the zero net-profit condition (19) to uniquely determine a vector of non-negative commodity prices.

Equilibrium condition (22) can be rewritten as:

$$By^* = \xi^1(\pi^*, R^*, u^*), \tag{26}$$

$$F(q^*)y^* = \xi^2(\pi^*, R^*, u^*) + u^* w_2 e^2. \tag{27}$$

Here we have partitioned ξ into ξ^1, which is 32×1, and $\xi 2$, which is 3×1; e^2 is, of course, $(0, 1, 0)$. We can solve for y^* by inverting B:

$$y^* = B^{-1}\xi^1(\pi^*, R^*, u^*). \tag{28}$$

To carry out the dimension reduction, we need to be sure that the y^* computed in (28) is non-negative. Since B^{-1} is non-negative this would obviously be true if $\xi^1(\pi^*, R^*, u^*)$ were also non-negative. This is not the case in our model, however, because of the trade deficit and, possibly, the government deficit. With the parameters we are using there is no problem since these deficits are far smaller, at any (π, R, u), than total demand for imports and investment. It is possible, however, that, if the foreign sector were willing to absorb a large enough trade deficit, the export activity would not operate and we could not use that column in going from (24) to (25) or from (26) to (28). Similarly, if the government ran a large deficit, it could completely crowd out investment. In such a case, however, although we could not use the dimension reduction, we could still compute an equilibrium. Since this is only a problem for implausible values of the parameters, however, we shall ignore it.

Using (25) to define p as a function of q and (28) to define y as a function of (q, R, u), we set $f(q, R, u) = \xi^2(p(q), q, R, u) - F(q)y(q, R, u)$. It is easy to verify that f is continuous for strictly positive prices and homogeneous of degree zero in q and R. We can therefore again rewrite (22) as:

$$f(q^*, R^*, u^*) + u^* w_2 e^2 = 0. \tag{29}$$

Recall that production taxes are $p(B - \bar{B})y + q(F(q) - \bar{F}(q))y$. It is natural, therefore, to define a total tax function

$$\begin{aligned} TR(q, R, u) = {} & p(q)(B - B)y(q, R, u) + q(F(q) - F(q))y(q, R, u) \\ & + \sum_{i=1}^{35} \pi_i(q) cf_i \xi_i(p(q), q, R, u) \\ & + \sum_{i=1}^{12} i_h(q_1 w_1^h + q_2 w_2^h(1 - u) + q_3 w_3^h). \end{aligned} \tag{30}$$

Equilibrium condition (23) can be rewritten as:

$$R^* = TR(q^*, R^*, u^*). \tag{31}$$

With a little work we can show that $f(q,R,u)$ satisfies the following version of Walras's law:

$$\sum_{k=1}^{3} q_k f_k(q,R,u) + q_2 u w_2 + TR(q,R,u) = R. \tag{32}$$

We have reduced our search for an equilibrium to a search for a vector (q^*, R^*, u^*) that satisfies (29), (31), and the constraints on the unemployment rate and urban wage (20) and (21). Since ξ is homogeneous of degree zero in π and R, and F is homogeneous of degree zero in q, we can easily verify that f is homogeneous of degree zero in q and R and that TR is homogeneous of degree one. Consequently, if (q^*, R^*, u^*) satisfies our equilibrium conditions so does $(\lambda q^*, \lambda R^*, u^*)$ for any $\lambda > 0$. Define $\zeta = 1/2u$. For the moment we normalize prices so that $\sum_{k=1}^{3} q_k + R + \zeta = 1$. An equilibrium is now a point on the unit simplex in R^5. We have set $\zeta = 1/2u$ to stay away from situations where $u = 1$ and q and R are undefined.

We give this simplex an extremely fine subdivision. The vertices of this subdivision form a grid of points that we search over. Suppose that we label these vertices using the following rules.

1. If the ith element of the vertex (q, R, ζ) is zero, set the label $b(q,R,\zeta)$ equal to $e^i \in R^5$. Here e^i is the vector with one in the ith place and zeros elsewhere. If more than one coordinate is zero, let i be the first.

2. Otherwise, if $q_2 < \sum_{i=15}^{32} \gamma_i p_i (1 + c_{if})$, where p is determined by the rule $p = p(q)$, and if $\zeta < 1/2$, set

$$b(q,R,\zeta) = \begin{bmatrix} 0 \\ w_2 \\ 0 \\ 0 \\ 1 \end{bmatrix}.$$

3. Otherwise, if $\zeta \geqq 1/2$, set

$$b(q,R,\zeta) = \begin{bmatrix} f_1(q,R,1) + \theta \\ f_2(q,R,1) + \theta \\ f_3(q,R,1) + \theta \\ TR(q,R,1) - R + \lambda \\ -1 + \mu \end{bmatrix}.$$

4. Otherwise set

$$b(q,R,\zeta)=\begin{bmatrix} f_1(q,R,2\zeta)+\theta \\ f_2(q,R,2\zeta)+\theta \\ f_3(q,R,2\zeta)+\theta \\ TR(q,R,2\zeta)-R+\lambda \\ -2\zeta+\mu \end{bmatrix}.$$

Here θ, λ, and μ are small positive constants that satisfy conditions that we describe below.

Scarf's algorithm locates a subsimplex whose five vertices have labels that satisfy

$$\sum_{j=1}^{5} b_j x_j = c, \tag{33}$$

for some $x_j \geqq 0$ and any $c > 0$. The idea behind the algorithm is to choose the labelling rules and the vector c so that (33) looks like the equilibrium conditions. If we set

$$c=\begin{bmatrix} \theta \\ \theta \\ \theta \\ \lambda \\ \mu \end{bmatrix},$$

then it can be demonstrated that any vector in this subsimplex would serve as an approximate equilibrium. An example of this type of argument can be found in Shoven and Whalley (1973). The argument supposes that we have used the algorithm to locate a subsimplex whose vertices are very close to each other and whose labels satisfy (33). We then use Walras' law (34) to demonstrate that the weights x_j associated with the labels of vertices that were labelled using rules 3 and 4 must sum approximately to one. It is then easy to check that this implies that any point in this subsimplex would serve as an approximate equilibrium.

As we take finer and finer subdivisions of the simplex we get a sequence of approximate equilibria. Since all of these solutions lie in the simplex, which is compact, this sequence has a convergent subsequence. The continuity of f and TR imply that any limit of this sequence is an equilibrium. Consequently, an equilibrium exists. To see that such a point is indeed an equilibrium, suppose that we have found a limit point of the sequence of subsimplices that satisfy (33). Supposing for the moment that $\zeta < 1/2$ at this point, we can rewrite (33) as:

$$\beta_1\begin{bmatrix}1\\0\\0\\0\\0\end{bmatrix}+\beta_2\begin{bmatrix}0\\1\\0\\0\\0\end{bmatrix}+\beta_3\begin{bmatrix}0\\0\\1\\0\\0\end{bmatrix}+\beta_4\begin{bmatrix}0\\0\\0\\1\\0\end{bmatrix}+\beta_5\begin{bmatrix}0\\0\\0\\0\\1\end{bmatrix}$$

$$+\beta_6\begin{bmatrix}f_1+\theta\\f_2+\theta\\f_3+\theta\\TR-R+\lambda\\-2\zeta+\mu\end{bmatrix}+\beta_7\begin{bmatrix}0\\w_2\\0\\0\\1\end{bmatrix}=\begin{bmatrix}\theta\\\theta\\\theta\\\lambda\\\mu\end{bmatrix} \tag{34}$$

Observe first that an equilibrium would satisfy these conditions if $\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=0$, $\beta_6=1$, and $\beta_7=u^*$. Suppose for the moment that the first five weights are zero. Then by multiplying the first three equations by the respective q_k, adding them to the fourth equation, and adding the result to the fifth equation multiplied by $-q_2w_2$, we can use Walras' law (32) to obtain:

$$\beta_6(\theta(q_1+q_2+q_3)+\lambda-q_2w_2\mu)=\theta(q_1+q_2+q_3)+\lambda-q_2w_2\mu. \tag{35}$$

If the coefficient of β_6 is not zero, this would imply that $\beta_6=1$. Walras' law can also be used to demonstrate that $\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=0$ if θ, λ, and μ satisfy the conditions $1>\lambda>\theta>2w_2\mu>0$. $\theta>2w_2\mu$ then implies that $\beta_6=1$. This implies that $\beta_7=u^*$. Notice that rule 2 implies that $\beta_7>0$ only if $q_2^*\leqq\sum_{i=15}^{32}\lambda_ip_i^*(1+cf_i)$ and $u^*\leqq 1$. If $u^*<1$, then $\beta_6>0$ implies that this constraint is satisfied with equality since the conditions of rule 4 are met.

In our model it is easy to demonstrate that $f_2(q,R,u)>0$ if $u=1$ and $q_2\leqq\sum_{i=15}^{32}\gamma_ip_i(q)(1+cf_i)$; in other words, there is positive excess demand for labor if all of it is unemployed. This rules out the possibility of $u^*=1$ and implies that the wage constraint is satisfied with equality if $u^*>0$. In a more general setting we could demonstrate that, whenever $\zeta\geqq 1/2$ at a limit point of a sequence of solutions to the algorithm, $u^*=1$ and $q_2^*\leqq\sum_{i=15}^{32}\gamma_ip_i^*(1+cf_i)$. The reasoning is analogous to that above.

Notice that the limiting argument used to prove existence of an equilibrium is non-constructive; it relies on finding a convergent subsequence of an infinite sequence that would be impossible to compute. In practice, however, it is usually enough to know that a solution to the problem exists and that we can find a numerical solution that satisfies the equilibrium conditions to any level of approximation that is desired. In fact, variants of Scarf's algorithm, such as that developed by Merrill (1972), which we use in our computation, easily compute solutions that are accurate to the limits of double precision on a digital computer.

8. Calibration and computation of original equilibrium

The computation of the original equilibrium constitutes the benchmark for the comparative statics exercise used in this work. It represents a faithful replica of the Mexican economy in 1977. For a complete description of the parameters of the model see Serra-Puche (1981).

The production side of the economy has been specified using the input–output matrix of Mexico for 1970. Using the RAS method, we have updated it to 1977. The intermediate demands are derived from the interindustry transactions of the input–output table. The value-added parameters, required for the computation of the demand for primary factors, have been computed under the assumption of profit maximization. The elasticity of substitution between factors has been assumed to be one in every sector, due to the lack of reliable estimates. This leads to the Cobb–Douglas specification for all the production functions described above. Results of sensitivity tests on these elasticities in a similar model are given in Serra-Puche (1979). The distribution parameters δ_{kj} are derived from the first-order conditions for profit maximization. The efficiency parameters c_j are calibrated to ensure that the model's total production per sector is identical to the actual values.

The demand side of the economy has been obtained from the household survey of Mexico for 1977. The demand parameters b_i^h are obtained from the shares of expenditure on good i by consumer group h, and adjusted so as to have the market demands equal to the final private consumption column in the input–output matrix. The initial endowments of the consumer groups have also been adjusted to match value added in the activity analysis matrix. The original endowment of urban labor is adjusted so that the model yields a 7.5 percent unemployment rate, which is the official estimate of urban unemployment in 1977.

The information on the government activity is taken from the input–output matrix, including the value-added parameters. To obtain tax information, which is very important in this work, we have carefully aggregated the actual tax rates so as to match our aggregation. For indirect taxes, our original specification includes the turnover tax and the special taxes specific to particular goods. The tax that each good in our model faces is a weighted average of effective rates. Once the correct aggregation has been done, we compute effective tax rates by finding the turnover tax and the special tax rates that yield the actual government revenue in 1977. We assume neutrality of tax evasion within the sector or aggregate good.

The income tax rates are effective rates derived while keeping the whole income tax structure unchanged. Here evasion is again assumed to be neutral across consumers and independent of the income source. The tariff and the export taxes are computed by finding the rates that yield the actual revenues. The foreign sector information only requires the trade deficit of Mexico for 1977, which is consistent with the rest of the variables. We also take into account the goverment deficit in 1977 which, as mentioned, is included in the government's vector of endowments in the entry that corresponds to capital tomorrow.

Units have been normalized so that all market prices and activity levels should be one. The equilibrium has been computed in under 20 seconds of computing time on an IBM 370/168. All the elements of the price vector and all activity levels are exactly equal to one to six significant digits. The model has been calibrated so that the values of all major macroeconomic variables coincide exactly with those actually observed.

9. Impact of the fiscal reform

The fiscal reform of 1980 converted a turnover tax system into a consumption value-added tax system. We introduce this reform into the model by setting $ci_i = 0$ in eq. (11) and adjusting the cf_i. A value-added tax rate of 10 percent is applied to final purchases of all commodities with several notable exceptions: all purchases of agricultural produce and food are exempt. Similarly, purchases of educational materials and professional services are exempt. Transactions that occur on the border are taxed at a rate of 6 percent; we take this into account by averaging the two tax rates using 1977 weights. Finally, some special taxes, particularly those on purchases of alcoholic beverages, remain in effect. Most other special taxes, particularly those on exports, have been abolished (table 4).

Once these changes have been made, a new equilibrium is computed and the results compared with the benchmark. In general, it is difficult to ensure that this type of model has a unique equilibrium [see Kehoe (1982)]. Using a technique described by Kehoe and Whalley (1982), however, we have carried out an exhaustive search to verify that the equilibrium is indeed unique. We can therefore do comparative statics without worrying about non-uniqueness (table 5).

The impact of the reform is reflected in changes in all the relative prices and production levels in the system. Four different equilibria have been calculated: in the first two the urban real wage remains constant and the unemployment rate adjusts; in the second two the real wage adjusts so that the unemployment rate remains constant; in the first and the third the

Table 4
Aggregate tax rates.

Sector	Turnover tax	Value-added tax	Tariff
1	0.001243		0.084263
2	0.043061		0.084263
3	0.148888		0.084263
4	0.038307		0.084263
5	0.028569		0.084263
6	0.038372		0.084263
7	0.052950		0.084263
8	0.034242		0.084263
9	0.056383		0.084263
10	0.039964		0.084263
11	0.0		0.084263
12	0.014384		0.084263
13	0.017822		0.084263
14	0.015468		0.084263
15	0.0		0.084263
16	0.123184		0.0
17	0.0	0.0	0.084263
18	0.006815	0.0	
19	0.003073	0.0	
20	0.072062	0.0	
21	0.0	0.0	
22	0.007932	0.0	
23	0.004612	0.0	
24	0.132164	0.179158	
25	0.022633	0.090158	
26	0.038524	0.090158	
27	0.061766	0.090158	
28	0.045248	0.090158	
29	0.145137	0.090158	
30	0.014722	0.0	
31	0.033908	0.090158	
32	0.032731	0.041923	

government deficit remains constant and the level of government expenditure adjusts; and in the second and fourth expenditures remain constant and the deficit adjusts (table 6).

The changes in relative prices are associated with changes in the allocation of resources and in activity levels. The fiscal reform results in a fall in indirect taxes of about 45 percent in all four scenarios. In the two where the government deficit stays fixed the most significant decline in activity level is in government services (15), which is due to the cut in tax revenue. In contrast, in the two scenarios where government expenditure remains constant there is a significant decline in investment (17), the result of crowding out by the increased government deficit.

Consumption of both groceries (20) and transportation (29) increase substantially in all four cases as a result of decreases in taxes on purchases

Table 5
Market prices (urban wage = numeraire).

Sector	Constant deficit/ wage	Constant expenditure/ wage	Constant deficit/ unemployment	Constant expenditure/ unemployment
1	1.02417	1.02629	1.03564	0.99265
2	0.96858	0.96970	0.97810	0.94164
3	0.85917	0.85874	0.86440	0.84314
4	0.97757	0.97807	0.98736	0.94916
5	0.98442	0.98424	0.99262	0.95992
6	0.96413	0.96429	0.99232	0.94004
7	0.91337	0.91292	0.92111	0.88992
8	0.95991	0.96040	0.96846	0.93513
9	0.92695	0.92675	0.93466	0.90387
10	0.94896	0.94934	0.95619	0.92792
11	1.03211	1.03103	1.04240	1.00052
12	0.97738	0.97748	0.98512	0.95452
13	1.00079	1.00046	1.00926	0.97533
14	0.97239	0.97374	0.98002	0.95124
15	0.99990	1.00230	1.00346	0.99194
16	0.85644	0.85683	0.86454	0.83288
17	0.95835	0.95900	0.96652	0.93485
18	0.99522	0.99547	1.00536	0.96553
19	1.01283	1.01339	1.02344	0.98213
20	0.93305	0.93326	0.94253	0.90527
21	1.02692	1.02793	1.03798	0.99537
22	0.99028	0.99031	1.00024	0.96089
23	1.00522	1.00580	1.01569	0.97494
24	1.05082	1.05040	1.06132	1.01933
25	1.07146	1.07085	1.08118	1.04203
26	1.02842	1.02789	1.03781	1.00003
27	1.00021	0.99961	1.00929	0.97268
28	1.00915	1.00839	1.01844	0.98084
29	0.91530	0.91511	0.92273	0.89307
30	0.97914	0.97877	0.98811	0.95220
31	1.03087	1.03022	1.04011	1.00279
32	1.00459	1.00431	1.01304	0.97920
33	1.01586	1.03533	1.02795	1.00120
34	1.00000	1.00000	1.00000	1.00000
35	1.04969	1.04690	1.06269	1.00861

and in prices of such intermediate goods as food products (4) and petroleum and petrochemicals (3). One goal of the fiscal reform was to stimulate activity in agriculture (1) and foodstuffs (3 and 18 through 23) by exempting these sectors from payment of the tax. This goal is plausible, given the results of the model.

Table 7 reports changes in major macroeconomic variables. Notice that unemployment rises if the deficit remains constant but falls if the deficit rises and expenditure stays constant. We think that the second scenario, constant expenditure and a rigid real wage, is the most realistic. Subsequent evidence

Table 6
Activity levels.

Sector	Constant deficit/ wage	Constant expenditure/ wage	Constant deficit/ unemployment	Constant expenditure/ unemployment
1	1.02657	1.02576	1.02874	1.01927
2	1.01950	0.97894	1.02339	0.96328
3	1.03466	1.02963	1.03821	1.01842
4	1.03771	1.04327	1.03978	1.03771
5	0.97628	0.97728	0.97920	0.96867
6	1.01290	0.99981	1.01623	0.98850
7	1.01098	1.00469	1.01418	0.99447
8	1.01530	0.96159	1.01932	0.94428
9	1.02538	0.99244	1.02920	0.97775
10	1.00904	1.01299	1.01237	1.00329
11	1.01290	1.00834	1.01564	0.99972
12	1.07732	1.07672	1.08127	1.06482
13	1.00072	1.02810	1.00427	1.01988
14	1.01917	0.93822	1.02366	0.91687
15	0.82342	1.00000	0.82827	1.00000
16	1.02150	0.97735	1.02268	0.96152
17	1.01917	0.93822	1.02366	0.91687
18	1.03340	1.04530	1.03592	1.04115
19	1.03634	1.02599	1.01442	1.02327
20	1.10169	1.11463	1.10358	1.11035
21	1.00050	1.01183	1.00159	1.00978
22	1.03634	1.04996	1.03817	1.04591
23	1.02106	1.03385	1.02251	1.03089
24	0.97788	0.99023	0.97971	0.98606
25	0.95844	0.97118	0.96109	0.96456
26	0.99894	1.01186	1.00164	1.00514
27	1.02634	1.04031	1.02915	1.03333
28	1.01837	1.03153	1.02107	1.02480
29	1.12187	1.13649	1.12603	1.12551
30	1.04845	1.06245	1.05124	1.05553
31	0.99535	1.00925	0.99818	1.00221
32	1.02173	1.03542	1.02519	1.02645

supports this contention. The government deficit rose by 11.1 percent in real terms from 1979 to 1980 and 109.5 percent (preliminary estimate) from 1980 to 1981, the year in which the final stages of the fiscal reform were put into effect. The urban unemployment rate fell from 6.1 percent in 1979 to 4.3 percent in 1980 to about 4 percent in 1981. Of course, this model would need to be modified substantially before it could be used for forecasting. If nothing else, we would need to account for growth and major exogenous shocks, such as the changes in the international price of petroleum between 1977 and the present. Nevertheless, the results of the model seem to fare well when confronted with empirical evidence. The figures in table 7 should, however, be viewed with care: the scaling is sensitive to the choice of the urban wage as numeraire.

Table 7
Major macroeconomic variables (billions of pesos market prices).

	Benchmark	Constant deficit/ wage	Constant expenditure/ wage	Constant deficit/ unemployment	Constant expenditure/ unemployment
Unemployment rate	7.5%	8.5%	4.82%	7.5%	7.5%
Indirect taxes	123,430	67,469	67,833	68,283	65,467
Total government revenue	230,816	178,091	179,625	180,223	173,467
Government expenditure	294,302	238,931	290,703	241,584	286,292
Government deficit	63,486	60,840	111,078	61,361	112,825
Gross private investment	280,800	292,789	246,800	296,469	233,010
Consumption	1,101,127	1,131,134	1,143,909	1,144,598	1,106,913
Trade deficit	1,529	1,465	1,466	1,478	1,429
Gross national product	1,674,700	1,661,389	1,681,412	1,681,173	1,624,786

One way to analyze the distributional impact of the reform is to calculate the changes in utility levels. Percentage changes in the values of the utility functions can be interpreted as percentage changes in real income: the Cobb–Douglas functions are weighted geometric means of consumption of the different goods. A 5 percent change in utility, for example, corresponds to a 5 percent increase in income if prices remain constant. Notice that, in table 8, the reform helps the poor and two upper income groups more than the two groups in the middle in all four scenarios. This is easily explained by changes in relative prices: the fall in the price of food has a favorable impact on the poor since food is such a major item in their budgets. The increase in the return on capital helps the upper income groups, who own most of the capital. The reform was intended to redistribute income toward the rural households. Notice that whether or not this occurs depends crucially on what happens to government expenditure. If expenditure falls so that the deficit stays constant, the rural consumers are helped more by the reform than the urban consumers. If expenditure remains constant and the deficit rises, however, this effect disappears. That the government is the major employer of urban labor explains much of this result.

Although the assumption of a rigid real wage has a noticeable impact on the prices and activity levels reported in tables 5 and 6, its significance is

Table 8
Percentage changes in utility indices (not including government expenditure).

Sector	Constant deficit/ wage	Constant expenditure/ wage	Constant deficit/ unemployment	Constant expenditure/ unemployment
1	4.96	5.65	5.24	4.89
2	4.62	4.95	4.90	4.16
3	3.24	4.80	3.48	4.22
4	3.65	4.23	3.93	3.47
5	1.73	3.79	1.95	3.34
6	3.46	4.11	3.75	3.33
7	2.28	4.16	2.54	3.59
8	5.21	5.69	5.54	4.77
9	4.13	5.36	4.44	4.57
10	3.74	4.10	4.08	3.11
Urban	3.11	4.69	3.39	4.04
Rural	4.31	4.79	4.61	3.93

most evident in the utility indices of table 8. Notice that all consumers, not just the urban ones, are better off with a flexible urban wage than with a rigid one when the deficit remains constant. All consumers are worse off, however, with a flexible urban wage when expenditure remains constant.

There are two problems with the results presented in table 8. First, the impact on consumers' utility levels of government expenditures is not taken into account. Second, the potential effect on future utility levels of the government deficit is also ignored. It is easy to explain why the scenarios with constant expenditure result in Pareto improvements: the increase in the government deficit is associated with an increase in government bonds, which is an increase in net wealth in this model. In the first and third scenarios the drop in government expenditures undoubtedly affects the consumers. Lack of information makes it difficult to analyze the incidence of changes in government expenditure. To examine the importance of the problem of how government expenditures affect utility levels, let us drastically simplify the issue by assuming that government expenditure affects all consumers equally and that utility functions are of the form:

$$u_h = \left(\prod_{i=15}^{32} (x_i^h)^{b_i^h} \right) x_G^{0.21296}. \tag{36}$$

Here x_G represents the level of provision of the public good government services and investment and 0.21296 is the ratio of government expenditures to total private domestic expenditures in 1977. The results of including government expenditures in consumers' utility functions are reported in table 9. Notice that the figures for the second and fourth scenarios do not

Table 9
Percentage changes in utility indices (including government expenditure).

Sector	Constant deficit/ wage	Constant expenditure/ wage	Constant deficit/ unemployment	Constant expenditure/ unemployment
1	0.71	5.65	1.10	4.89
2	0.38	4.95	0.77	4.16
3	−0.94	4.80	−0.59	4.22
4	−0.55	4.23	−0.16	3.47
5	−2.39	3.79	−2.06	3.34
6	−0.73	4.11	−0.33	3.33
7	−1.87	4.16	−1.49	3.59
8	0.95	5.69	1.39	4.77
9	−0.09	5.36	0.33	4.57
10	−0.46	4.10	−0.01	3.11
Urban	−1.07	4.69	−0.68	4.04
Rural	0.08	4.79	0.50	3.93

change since expenditure stays constant. Notice too that neither the first nor the third scenario now results in a Pareto improvement. It is even more difficult to address the problem of how the government deficit affects utility levels over time. The static nature of the model makes it impossible to account for these effects.

10. Concluding remarks

We have developed a general equilibrium model that determines an endogenous unemployment rate and allows for government deficits. The model is then used to analyze the impact of the 1980 fiscal reform on resource allocation and income distribution in Mexico. Many of the results presented in the previous section do not depend crucially on the assumptions made about macro phenomena. Consumption of groceries, for example, goes up because the price goes down as a result of a fall in taxes on purchases and in the costs of inputs. Answers to the most important distributional questions, however, do depend crucially on macro phenomena. Whether or not the fiscal reform improves the welfare of rural households compared to that of urban households, for example, depends on whether or not the deficit remains constant.

Although our results make sense in the light of recent experience in Mexico, much is left out of our analysis and as many questions are raised as are answered. Much of the increase in government deficits over the past two years, for example, has been financed by an increase in the money supply. This has resulted in inflation, a phenomenon not captured in our model. For example, the model predicts an improvement in the exchange rate due to the abolition of export taxes. In reality, however, the large differential in inflation between Mexico and its trading partners has caused the exchange rate to deteriorate.

Inflation and other monetary phenomena can only be handled adequately in an intertemporal framework. Such a framework is also needed to investigate the impact of deficits on investment and growth. Answers to such questions as how much of government debt is perceived as net wealth by households, how are investment decisions made, and how does crowding out occur are crucial to any analysis of a major policy decision. Our model assumes these questions away in simple, and perhaps unrealistic, ways. The challenge is to construct an intertemporal model to give these issues a more realistic treatment.

We are also left with problems that can be handled within a purely static framework. The aggregation of labor, for example, prevents us from making statements about the distribution of unemployment. A model with a hierarchy of labor types, the possibility of underemployment, and elasticity of labor supply would undoubtedly be more attractive. Similarly the aggregation of all factors of production except labor into one capital good is a glaring weakness of the model. These issues, more than the previous set, are closely related to lack of data. There would be few problems knowing what changes in the model to make if the data were available. An issue that not only involves lack of data but also raises interesting theoretical questions is how to analyze the incidence of changes in government expenditure.

In spite of its weaknesses, however, the model produces results that are both plausible and interesting. The 1980 fiscal reform causes a significant drop in tax revenues. The unemployment rate falls and the deficit rises if expenditure remains constant. Although the prices of agricultural goods and foodstuffs fall, the welfare of the rural sector does not improve compared to that of the urban sector, again assuming that expenditure remains constant. The welfare of the poor and the upper income groups improve more than that of the middle income groups.

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