The Employment Effects of Taxes and Government Expenditures in Mexico

Timothy J. Kehoe and Jaime Serra-Puche

In this paper a computational general equilibrium model is used to analyze the effects of government taxes and spending on employment in Mexico. It is found that the recent switch to a value-added tax system results in a reduction in the unemployment rate when government expenditures are unchanged. If, however, government expenditure declines by the same amount as tax revenue, so that the government deficit is fixed, the unemployment rate rises. Also examined are the effects of the two policy changes on prices and production of various goods and on income distribution and economic welfare.

Introduction

In Mexico the public sector has played a large and growing role in the economy during the past decade. Government expenditure, which was 22 percent of gross national product in the early 1970s, reached 38 percent by 1980. This increasing share has made government spending the primary tool of economic policy. Its impact on such macroeconomic variables as inflation and unemployment has been studied widely, but the impact on income distribution and the sectoral allocation of resources have received little attention. In a developing economy these considerations are, of course, essential in the analysis of economic policy.

In this paper, a general equilibrium model is used to analyze Mexico's recent switch to a value added tax (VAT) under two different assumptions about government spending. In the first, government spending is fixed. In the second, the government deficit is fixed so that government spending varies directly with tax revenues. The impact of VAT is quite different in the two cases. When spending is fixed, VAT—the introduction of which was, roughly speaking, a tax cut—has a favorable effect on urban employment. When the deficit is held constant unemployment rises.

The computational general equilibrium model of Kehoe and Serra-Puche (1981) provides a flexible tool for studying allocational effects of aggregate government policies. The model deals exclusively with real variables, but disequilibrium in one of the labor markets gives it a Keynesian flavor. In a manner analogous to the sticky wage story of macroeconomics textbooks, the wage of urban workers is downwardly rigid relative to an index of consumer prices. At this real wage floor the demand for urban labor falls short of its supply; the difference is unemployment. The wage of rural workers is free to change, so in this sense we have a dual economy. The wage rigidity in this model is similar to that studied by Dreze (1976), although his rationing scheme is different from ours.

Although the Mexican economy has experienced double digit inflation in recent years, there are reasons for believing that the urban real wage is downwardly rigid. The most obvious is the existence of a government minimum wage policy, which is

The authors are Assistant Professor of Economics of the Massachusetts Institute of Technology and Professor of Economics at El Colegio de México, respectively. This work is part of an ongoing project, MEGAMEX (Modelo de Equilibrio General Aplicado a la Economía Mexicana) sponsored by the Banco de México. We are grateful to David Backus and Leopoldo Solís, who provided helpful encouragement and suggestions, and to Sanjay Srivastava, who assisted us with the computer simulations.

revised annually. Strong urban labor unions may also play a role, although their overall impact is not clear. Although it is not necessary to specify the distribution of unemployment within any one consumer group since the demand functions are linearly homogeneous in income, it is useful to think of individual consumers as being unemployed at the same rate. It is, of course, possible to think of each individual being either fully employed with probability (1-u) or unemployed with probability u, where u is the unemployment rate, if we assume consumers are risk neutral.

The model also captures, to some extent, the real crowding-out effect of expansionary fiscal policies. It is assumed that the government can increase its expenditure by borrowing from domestic and foreign sources, that is, by issuing bonds. When tax revenue decreases, as was the case with VAT, the government can adjust its debt position to keep expenditure constant. When the deficit is constant, the debt is exogenously given. The crowding out effect is reflected in changes in the level of investment by the private sector.

The model is divided into a production side (activities) and a demand side (consumers). The latter includes an investment sector, a government sector, and a foreign sector. In the next sections we describe the model following this division. We then characterize the equilibrium and analyze the results of the introduction of the consumption value added tax in Mexico in January of 1980. The methodology of this study is that of comparative statics. The model is initially calibrated to replicate the Mexican economy in 1977, the latest year for which a complete set of data could be assembled. We then change the indirect tax system that existed in 1977 to a value added tax system and compare the equilibria. The results reported represent part of an ongoing effort to develop a flexible general equilibrium framework for analyzing the impact of policy decisions on the Mexican economy. This model extends the type of analysis pioneered by Shoven and Whalley (1972) to include considerations of unemployment and government deficits.

The Model

The model has 35 different goods: 14 sectors of production, three sectors of nonconsumption demand (government, foreign, and investment sectors), 15 final consumption goods, and three factors of production.

Production

Each of the 32 produced goods is generated by a constant-returns-to-scale production function that employs the other produced goods as intermediate inputs and 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 three factors of production with the possibility of substitution governed by a Cobb-Douglas production function. The advantage of this specification is that it allows us to use an input-output matrix for Mexico to describe intermediate transactions in production. We view the input-output matrix as an activity analysis matrix with 32 activities where the final 15 activities do not add any value; in other words, they do not employ factors of production. The submatrix formed by these 15 activities converts demand for final consumption goods (sectors 18 through 32) into demand for production goods (sectors 1 through 17).

More precisely, the production function for a sector depends on the intermediate

Table 1. List of Sectors

Production

1. Agriculture
2. Mining
3. Petroleum and petro-chemicals
4. Food products
5. Textiles
6. Wood products
7. Chemical products
8. Non-metal production
9. Machinery and automobiles
10. Electric energy
11. Commerce
12. Transportation
13. Services
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
19. Milk and eggs
20. Other groceries
21. Fresh fruits and vegetables
22. Meat
23. Fish
24. Beverages
25. Clothing
26. Furniture
27. Electronic products
28. Medical products
29. Transportation
30. Education articles
31. Articles for personal care
32. Services

Factors of Production

33. Rural labor
34. Urban labor
35. Capital and other factors

inputs for that sector, which enter with fixed coefficients, and on the three primary factors of production (rural labor, urban labor, and capital) used in the sector, which substitute for one another in the Cobb-Douglas form.

To summarize, we assume that production in the model is represented by an input-output matrix that does not permit joint production and Cobb-Douglas production functions that allow for substitution among the primary factors. Not all the activities add value. For production to be feasible, the input-output matrix must be a productive Leontief matrix, in the sense that there exists a set of positive activity levels for which gross production of produced goods is strictly positive.

Consumers

There are 12 consumer groups in the model. Two of them, the government and the rest of the world, are discussed in subsequent sections. The remaining ten groups represent aggregates of households and are divided into five different income groups in both the urban and the rural sectors. Prior to production each consumer group owns capital and labor that, when evaluated at market prices, represent the group's income. Urban labor and rural labor are considered to be separate factors of production. Following the usual economic paradigm of household behavior, the consumer groups are assumed to maximize their utility functions subject to their respective income constraints. (For the reader unfamiliar with this procedure, it is noted

Table 2. List of Consumers

1. Urban poor (0–1800) pesos per month net income)
2. Rural poor (0–1800)
3. Urban low income (1800–3150)
4. Rural low income (1800–3150)
5. Urban low-middle income (3150–5725)
6. Rural low-middle income (3150–5725)
7. Urban middle income (5725–13400)
8. Rural middle income (5725–13400)
9. Urban upper income (13400–)
10. Rural upper income (13400–)
11. Government
12. Foreign sector

that this maximization paradigm generates sets of consumer demand functions which are price- and income-responsive and which obey certain adding-up properties.)

The net income of each group is the value of the endowments of factors of production net of income taxes, the unemployment rate in the urban labor market, and government transfers received by the group. Only urban consumer groups have positive endowments of rural labor. We assume, due to data constraints, that the utility function of each group is Cobb-Douglas. The demand functions therefore lead to constant proportions of net income being spent on each good. These proportions are observed in household surveys.

In this model 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 consumers also save by purchasing government bonds, which they regard as perfect substitutions for physical investment. We shall often refer to this composite good, which is good 17 in our model, as "capital tomorrow."

To summarize, we assume that consumer groups maximize Cobb-Douglas utility functions subject to their respective income constraints. Saving enters their utility function in the form of demand for capital tomorrow. The different consumer groups have different utility functions.

Government

The government in this model taxes production, consumer income, and sales of consumption goods. It also earns revenue on physical capital that it owns and pays interest on its debt. It then uses the revenue to purchase goods and services, including capital tomorrow.

It is useful to think of the government as a consumer. The government differs from other consumers in that it purchases various commodities in fixed physical proportions. Given this structure of demand, we found it easier to interpret the government as purchasing a composite good, government services, and capital tomorrow. Government services are then produced by a fixed-coefficients production activity from the other goods in the model. When the government demands these services it is actually demanding, through the intermediate input requirements of this and other activities, goods from every sector in the economy. Factors of production, however, are not purchased in fixed physical proportions. Their use is governed by a Cobb-Douglas production function.

Each consumer group faces a constant income tax rate. The group is taxed on the value of its factor endowments, net of unemployment. Each group faces a different

rate according to the group's income. The sum over all the consumer groups' payments constitutes the total income tax revenue received by the government.

Prior to the introduction of the value added tax, the Mexican tax system had, in addition to having a general turnover tax rate (*impuesto sobre ingresos mercantiles*), a large number of special taxes applied to specific sectors. Our computation of the original equilibrium takes full account of this tax system, and so does the specification. The *ad valorem* tax rates imposed on the purchase of final and intermediate goods are weighted sums of all the tax rates that apply to each good. The total revenue collected from this tax is the sum of the tax revenue over all consumer and intermediate demands. 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.

Finally, the government is assumed to tax imports. As we shall describe below, imports are non-competitive and are assumed to be a homogeneous good. This good is produced by the foreign trade activity in the activity analysis matrix. The model has an aggregate tariff that applies to this good when it is used as an input. All those activities that use imports as inputs to the production process face this aggregate tariff. Therefore, the government's total revenue is the sum of the income tax revenue, the sales tax revenue, and the revenue from taxing imports.

Tax rates used in the model are effective average tax rates. Tax evasion is considered to be neutral in the sense that the rates of tax evasion are independent of the source and level of income as well as of the type of good. The lack of information about evasion and its distribution makes it impossible to look for non-neutral criteria to distribute the effect of evasion when computing the effective tax rates.

An interesting feature of the model is that the government may spend more or less than it receives. A deficit on current expenditures appears as a positive endowment of capital tomorrow in the government's budget constraint. A surplus appears as a requirement for capital tomorrow that represents government debt to be retired. Implicitly, the government issues bonds that are purchased by consumers in place of physical capital.

To summarize, we assume that the government taxes income and domestic and foreign transactions. The tax revenue, plus the government's capital endowment and the endowment of bonds (capital tomorrow), constrains the maximization of its utility function. This 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. The government endowment of bonds is equal to the current government deficit.

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 non-competitive; that is, they are not produced within the economy. They are defined as a homogeneous good that is demanded as an intermediate input in the production process. We assume that the physical composition of exports is fixed, although this can easily be varied in simulations.

The relationships between exports and imports is given by a column and a row of the activity analysis matrix. A coefficient in this column represents the total exports of a specific sector, where exports are aggregated using base-year prices. A coefficient in the row represents the physical input of the non-competitive import per unit of output in the sector. This convention allows the economy to produce imports by exporting goods in fixed proportions. Implicitly, we are assuming that the economy generates foreign exchange that it uses to finance imports. The tax or subsidy rates on the elements of this column represent export taxes or subsidies. The tax rates on the elements of the row represent tariff rates.

We also 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 exports column in the activity analysis matrix represent his demand function. In return for these exports he provides (produces) 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 also represented as a column of the activity analysis matrix. Total physical investment is given by the total savings of consumers plus government investment plus the difference between the trade deficit and the government deficit.

Original Equilibrium and Simulations

The application of this model to the Mexican economy reveals that the unemployment rate is sensitive to the level of government expenditure. In particular, the introduction of the value added tax is analyzed under two different scenarios. First, the tax is introduced without adjustments in the government deficit, resulting in a decrease in expenditure, since tax revenue goes down. In this case, the unemployment rate goes up. Second, fixing government expenditure (allowing an increase in the deficit), we find that the introduction of the value added tax results in a decrease of the unemployment rate.

An equilibrium to this model is defined to be a vector of endogenous variables—prices, activity levels, an unemployment rate, and a level of government expenditure—that satisfy five conditions: First, prices are such that no production plan makes positive after-tax profits and plans that are actually used to make zero profits. This condition is, of course, the familiar requirement that perfectly competitive producers operating constant-returns technologies earn zero profits. Second, the consumers' demand, derived under the assumption of utility maximization, is equal to the producers' supply, except possibly in the urban labor market.

Third, the unemployment rate that goes into the consumers' budget constraints is the same as that which emerges from the difference of supply and demand in the urban labor market. This unemployment rate is positive only if the wage constraint is binding. Otherwise it is zero. Fourth, the government satisfies the budget constraint that its expenditure is equal to its tax revenue plus its bond issue. Fifth, since only relative prices matter in this model, the equilibrium prices can be normalized by using the urban wage as numeraire, setting it equal to one and scaling other prices accordingly.

Once the model has been calibrated, we check it by computing its equilibrium using a computational procedure based on an algorithm developed by Scarf (1973). Later this procedure is used to compute the equilibrium after the model's tax parameters have been changed.

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. Quantity units are chosen so as to have all prices and activity levels equal to one. As we shall see, all the endogenously determined prices and activity levels are indeed identical to one, ensuring that all the economic variables computed by the model are equal to the actual values.

This equilibrium is given historically. Although uniqueness cannot be ensured, we presume that the original equilibrium is locally stable for changes in the parameters of the model (see Kehoe, 1980). We have made an effort to ensure that the equilibrium we compute after changing the tax parameters is one that can be obtained by continuously deforming the original parameters. Unfortunately, this is as much as can be said to justify our comparative statics analysis.

The production side of the economy has been specified using the input-output matrix of Mexico for 1970 and, using the RAS method, it has been updated 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 earlier. Results of sensitivity tests on these elasticities are given in Serra-Puche (1979). The distribution parameters are derived from the first order conditions by assuming all prices to be equal to one, their equilibrium value in the benchmark simulation. The efficiency parameter is subject to calibration, 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 are obtained from the shares of expenditures on each good by each consumer group, 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 national accounts.

The information on the government activity is taken from the input-output matrix, including the value added parameters. To obtain tax information 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. In this case we are assuming 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 since we are dealing with aggregate income tax rates which yield the correct revenue value.

The tariff and the export taxes are computed simply by finding the rates that yield the actual revenues, without too many complications since imports are one homogeneous good and all exports face the same tax rate. The foreign sector information only requires the trade deficit of Mexico for 1977, which is consistent with the rest of the variables. Finally, we take into account the government's deficit in 1977, which, as mentioned, is included in the government's vector of endowments in the entry that corresponds to capital tomorrow.

The introduction of the VAT in Mexico responded to the belief that this tax system, as opposed to the turnover tax system, is a more efficient and transparent tool of fiscal policy. In the first place, under a consumption value added tax regime, the fiscal authorities can formulate discriminatory policies with more accuracy than with the cascade system. Under VAT, the exemption of particular goods or sectors from the payment of the tax follows more directly than under the turnover regime. From the authorities' point of view, ignoring the general equilibrium effects, policy making is more transparent under a regime where the tax does not accumulate through the stages of production and commercialization. It is often claimed that income distribution targets can be reached more easily under the VAT system than under the turnover system, since in the latter case it is more difficult to obtain complete exemption of specific goods. This argument, of course, ignores factor price adjustment.

It is also argued that the VAT system may facilitate, for the same reason as mentioned above, export promotion policies. Exports are easily exempted, so as to improve their competitiveness with respect to the rest of the world, under the VAT regime. This was not the case under the previous system where the tax had a cascade effect. On the other hand, a small open economy must choose a tariff structure equivalent to the domestic indirect tax structure. The VAT system allows for these optimal adjustments better than the turnover regime. Finally, the fractional payment system introduced with the VAT (any VAT refund requires the receipts of payment of the tax), makes tax evasion less likely to occur, since agents are under mutual surveillance.

The substitution of VAT for the turnover tax was accompanied by the elimination of several special taxes. The VAT was not introduced with a uniform rate; some sectors and regions were treated differently. In particular, the agriculture sector was exempted from tax payments, as were some final non-processed food stuffs. Several professional services were also exempted. Furthermore, all border transactions were taxed at a 6 percent rate instead of the 10 percent rate imposed on the rest of the regions and non-exempted sectors. The VAT also replaced export taxes and import tariffs for all the in bond industries' demand for imports (temporary imports).

The original equilibrium prices are all identical to one, as are the activity levels, as shown in Table 3.

Table 3. Activity Levels and Indirect Tax Revenue
Original Equilibrium

Sector	Level	Revenues (Indirect Taxes) (Billions of 1977 pesos)
1	1.000000	0.33632
2	1.000000	1.25072
3	1.000000	9.09806
4	1.000000	9.25871
5	1.000000	3.81015
6	1.000000	2.20945
7	1.000000	5.74886
8	1.000000	1.53543
9	1.000000	12.06850
10	1.000000	1.34623
11	1.000000	0.0
12	1.000000	1.10808
13	1.000000	5.38648
14	1.000000	3.46925
15	1.000000	0.07775
16	1.000000	15.50500
17	1.000000	3.98452
18	1.000000	0.63780
19	1.000000	0.12850
20	1.000000	6.40540
21	1.000000	0.0
22	1.000000	0.61460
23	0.999998	0.03060
24	1.000000	10.46590
25	1.000000	3.54060
26	1.000000	2.66450
27	1.000000	3.61810
28	1.000000	0.89100
29	1.000000	0.82500
30	1.000001	0.12520
31	0.999999	0.49590
32	1.000000	6.79340

The revenue from indirect taxation, sales taxes, and import tariffs is identical to the actual revenue observed in Mexico in 1977 (123.430 billion 1977 pesos). Income tax revenue is also identical to the actual revenue for 1977 (93.386 billion 1977 pesos). Thus, total government revenue from taxation computed by the model (216.816 billion 1977 pesos) is identical to the total tax revenue actually observed in 1977, as can be verified by comparing these figures with the ones presented in the appendix. The perfect fit obtained by the model should not be construed as a demonstration that the Mexican economy was, in fact, in a state of competitive equilibrium in 1977. Rather we have calibrated our model to replicate the values of key economic variables in Mexico in that year. The usefulness of the model depends on the extent to which our simplifying assumptions allow us to capture, in a tractable manner, how these variables shift in response to policy changes.

The analysis of size distribution concentrates on the final allocation of production among the different consumers. For this purpose we compute utility indices for each consumer group, which are given in Table 4. These indices are computed using

Table 4. Utility Indices for Consumer Groups Original Equilibrium

Consumer Group (h)	Utility index (u^h)
1	0.17283
2	0.86888
3	0.52879
4	0.73341
5	1.36285
6	0.75917
7	3.45047
8	1.35929
9	4.30986
10	0.64317

Cobb-Douglas utility functions whose exponents are the shares of expenditure by consumers on goods 17 through 32.

These indices will be compared to the indices obtained with the introduction of the tax reform. Within an ordinal utility framework interequilibrium comparisons are allowed only within each consumer group. We view these indices as welfare measures, however, and will also allow comparisons of percentage changes across consumer groups. This comparison sheds light on the income distribution effects of the tax reform.

Finally, in the computation of the original equilibrium, the total original endowment of urban labor is calibrated so that the model yields a 7.5 percent unemployment rate, which is the official estimate of unemployment for 1977. The original equilibrium constitutes an accurate representative of our aggregate version of the Mexican economy. It serves, as we mentioned above, as the benchmark for the tax reform simulation.

The fiscal reform in 1980 consisted mostly of converting a turnover tax system into a consumption value added tax system. A detailed description of how this reform was introduced is given by Serra-Puche (1981), where it is argued that, if wage adjustments had been sluggish, this reform would have had negative effects on unemployment. We shall verify this conjecture by introducing this reform into the present model.

The impact of this reform is reflected in the changes in the relative prices in both scenarios: constant government deficit and constant government expenditure.

The effects on prices seem to be quite similar under both scenarios. Although we impose constraints on the allocation of resources by fixing government expenditure, relative prices are very similar after the introduction of the value added tax. These changes in relative prices are associated with changes in the allocation of resources and those in the activity levels.

The most noteworthy differences in the activity levels are in government services and investment. Since the introduction of the value added tax resulted in a net tax cut, activity level 15 (government services) decreases substantially in the constant deficit case; in other words, the provision of public services is considerably reduced in this scenario. On the other hand, the level of production of public services remains unchanged in the constant expenditure case as imposed in this version of the model. In this latter case, it is assumed that the deficit adjusts through increases in actual debt so as to keep real government expenditure constant. This constraint on activity level 15 causes different price, distribution, allocation, and unemployment

Table 5. Market Prices (urban labor-numeraire)

Sector	Constant Deficit Solution	Constant Expenditure Solution
1	1.02417	1.02629
2	0.96858	0.96970
3	0.85917	0.85874
4	0.97757	0.97807
5	0.98442	0.98424
6	0.96413	0.96429
7	0.91337	0.91292
8	0.95991	0.96040
9	0.92695	0.92675
10	0.94896	0.94934
11	1.03211	1.03103
12	0.97738	0.97748
13	1.00079	1.00046
14	0.97239	0.97374
15	0.99990	1.00230
16	0.85644	0.85683
17	0.95835	0.95900
18	0.99522	0.99547
19	1.01283	1.01339
20	0.93305	0.93326
21	1.02692	1.02793
22	0.99028	0.99031
23	1.00522	1.00580
24	1.05082	1.05080
25	1.07146	1.07085
26	1.02842	1.02789
27	1.00021	0.99961
28	1.00915	1.00839
29	0.91530	0.91511
30	0.97914	0.97877
31	1.03087	1.03022
32	1.00459	1.00431

Note: All prices were equal to 1.0 in the original equilibrium solution.

effects. There is also a significant difference between activity levels for the investment sector, activity 17. The distortion introduced by VAT seems to favor the investment level as shown by the 2 percent increase in the activity level under the constant deficit scenario. When public debt is issued to finance public expenditure, however, the model predicts a real crowding out by decreasing the investment level by 6.2 percent.

The value added tax was originally designed to encourage production in the agriculture and foodstuffs sectors (1 and 18 through 23) by exempting them from the payment of the tax. This goal is rather plausible, given the results of the model under both scenarios. When the government expenditure is held constant all the levels of production of foodstuffs increase more than with a constant deficit. This might be explained by the demand impulse of the expenditure through the reduction of urban unemployment, as we shall see below.

The changes in relative factor prices indicate that the rural wage increases more,

Table 6. Activity Levels

Sector	Constant Deficit Solution	Constant Expenditure Solution
1	1.02657	1.02576
2	1.01950	0.97894
3	1.03466	1.02963
4	1.03771	1.04327
5	0.97628	0.97728
6	1.01290	0.99981
7	1.01098	1.00469
8	1.01530	0.96159
9	1.02538	0.99244
10	1.00904	1.01299
11	1.01290	1.00834
12	1.07732	1.07672
13	1.00072	1.02810
14	1.01917	0.93822
15	0.82342	1.00000
16	1.01876	0.97735
17	1.01917	0.93822
18	1.03414	1.04530
19	1.01305	1.02599
20	1.10169	1.11463
21	1.00050	1.01183
22	1.03634	1.04996
23	1.02106	1.03385
24	0.97788	0.99023
25	0.95844	0.97118
26	0.99894	1.01186
27	1.02634	1.04031
28	1.01837	1.03153
29	1.12187	1.13699
30	1.04845	1.06245
31	0.99535	1.00925
32	1.02173	1.03542

Note: These activity levels may be read as indexes of production levels, and all indexes had a value of 1.0 in the original equilibrium solution.

with respect to the urban wage, when government expenditure is unchanged than when government deficit is held constant. The price of capital rises more in relative terms under the constant deficit scenario than with constant expenditure.

The unemployment effects of the tax reform are opposite in the two scenarios. When the deficit is fixed, the unemployment rate increases from 7.5 percent to 8.5 percent. In contrast, when expenditure remains unchanged, the unemployment rate goes down to 4.8 percent. In the first case, the relative increase of prices with higher weights in the utility function of the urban low-middle income groups, requires the urban wage to increase in order to satisfy the real wage constraint. This increase, together with the reduction of real government expenditure, which has important direct and indirect effects in the demand for urban labor, leads to a higher unemployment rate in the urban labor market. This result is not surprising since the tax exemptions were aimed at improving productivity and income in the rural sector.

When real government expenditure is constant, the unemployment rate decreases. This is purely an allocational effect which arises because those goods

Table 7. Factor Prices
(urban labor-numeraire)

	Constant Deficit Solution	Constant Expenditure Solution
Rural Labor	1.01586	1.03533
Urban Labor	1.00000	1.00000
Capital	1.04969	1.04690

whose production increases under the new set of relative prices happen to be the more employment-intensive goods. The direct and indirect price effects of government taxes and expenditure lead to these employment results. The change in relative prices introduced by VAT, and its allocational consequences, act in favor of employment.

The negative distribution effects of the increase in unemployment in the constant deficit scenario might be offset, however, by the decline in the differential between the urban and rural sector induced by VAT. As shown in Table 8, all the utility indices of the consumer groups increase due to the net cut in the tax burden. Here we assume that the cut in the provision of government services, which was necessary to keep the government deficit constant, equally affects all consumer groups. Since we have no way of computing the incidence of government services, we have left it out of the consumer utility indices. This omission should be kept in mind when interpreting our results. Nevertheless, the utility levels of rural groups tend to increase more than those of the urban groups. Except for the poorest and the richest groups, the increase in the utility index is higher for rural groups. There is a clear tendency to reduce the negative and distorting differential between rural and urban sectors. The welfare increases in the rural sector are less under this scenario, however, than in the model that assumes full employment. The rigid wage allows the urban sector to maintain its differential over the rural sector (see Kehoe and Serra-Puche 1981).

The distributional effects in the case of constant real expenditures are better in terms of the overall improvement (changes are always higher) but worse in terms of the differential between rural and urban groups. The overall improvement is understated in comparison to the constant deficit case because there is no decrease in the provision of public services although the tax burden goes down. The reduction in the rural-urban differential is smaller due to the positive effects of government expenditure on urban employment, that is, due to the reduction of the urban unemployment rate. That the constant expenditure scenario yields to an allocation that is Pareto superior to that of the constant deficit scenario is explained by the increase in the economy's net wealth caused by the additional government bonds.

Concluding Remarks

The results suggest that the introduction of the consumption value added tax encourages a reallocation of resources in favor of the target sectors, agriculture and foodstuffs. The tax change results in a net decline of the tax burden, reducing government revenues. When the government issues extra bonds to finance its expenditure, the level of investment decreases as a result of a real crowding out. Since crowding out is not complete, however, and since government bonds absorb savings, extra bonds increase the net wealth of the economy. This is, of course, the traditional Keynesian story.

Table 8. Utility Indices
Percentage Increase in Utility Index

Consumer Groups	Constant Deficit Solution	Constant Expenditure Solution
1	4.96	5.65
2	4.62	4.95
3	3.24	4.80
4	3.65	4.23
5	1.73	3.79
6	3.46	4.11
7	2.28	4.16
8	5.21	5.69
9	4.13	5.36
10	3.74	4.10

The unemployment rate seems to be very sensitive to changes in the level of real government expenditure. The unemployment rate is reduced with the switch to the VAT system when government expenditure is unchanged in real terms. If, however, government expenditure declines by the same amount as the tax revenue (so that the government deficit is fixed) the unemployment rate rises. Of course, in this kind of framework we ignore the inflationary impact of government expenditure, since there is not an endogenously determined price level. We also ignore the long-run effect that crowding out has on capital accumulation. Because our model fails to capture such monetary and dynamic phenomena its results should be interpreted with care.

The model is ideally suited, however, to capturing the impact of changes in relative prices and the unemployment rate on income distribution. With a declining real expenditure, the negative distributional effects of the rising unemployment rate of urban labor may be offset by a substantial reduction of the differential between the rural and urban groups. If, however, the real expenditure is kept constant, the reduction in the unemployment rate of urban labor has positive distributional effects but the urban-rural differential does not have a tendency to decrease.

SINTESIS

En el desarrollo de este artículo se ha utilizado un modelo de equilibrio general con el fin de analizar los efectos de los impuestos y el gasto del gobierno sobre el nivel de empleo en México. Se ha determinado que el cambio reciente hacia un sistema de impuestos sobre el valor agregado trae como consecuencia una reducción en la tasa de desempleo, siempre que no se afecten los niveles del gasto público. Sin embargo, si el gasto público disminuye en el mismo monto en que los impuestos, de modo que el déficit del gobierno se mantenga fijo, la tasa de desempleo subiría. En este artículo también se examinan los efectos de cambios hipotéticos de la política económica sobre la distribución del ingreso y el bienestar económico.

Appendix. Mexican Macroeconomic Variables and Model Tax Rates

In this appendix we present the values of the major macroeconomic variables in the Mexican economy for 1977 and the original and new tax rates. For a complete description of the parameters of the model see Serra-Puche (1981). The principal sources of data for the model are listed below.

Banco de México, 1980. *Información económica: producto interno bruto y gasto, 1970–1979.* México, D.F.

Secretaría de Programación y Presupuesto, 1976. *Matriz de insumo-producto de México, año 1970,* vol. 1. México, D.F.

———, 1980. *Encuesta nacional de ingresos y gastos familiares en 1977.* México, D.F.
Secretaría de Programación y Presupuesto and Banco de México, S.A., 1980. *Submatriz de consumo privado por objeto del gasto y rama de actividad de origen, año 1970.* México, D.F.

Major Macroeconomic Variables in Mexico, 1977
(Billions of 1977 Pesos)

Wages and salaries	638.318
Returns to capital and other factors	755.534
Capital consumption allowance	157.418
Indirect taxes	123.430
Gross national product	1,674.700
Private consumption	1,101.127
Government consumption	195.552
Gross investment	379.550
Exports	176.062
Imports	-177.591
Gross national product	1,674.700
Import taxes	10.735
Export taxes	15.505
Indirect taxes paid by producers	49.953
Indirect taxes paid by consumers	47.236
Total indirect taxes	123.430
Indirect taxes	123.430
Income taxes	93.386
Income from capital and other factors	14.00
Total government revenues	230.816
Government consumption	195.552
Government investment	98.750
Total government expenditures	294.302
Government expenditures	294.302
Government revenues	-230.816
Government deficit	63.486
Wages and salaries	638.318
Returns to capital and other factors	755.534
Government capital income	-14.000
Capital consumption allowance	157.418
Private income	1,537.270
Private income	1,537.270
Private consumption	-1,101.127
Income taxes	-93.386
Gross savings	342.757
Imports	177.591
Exports	-176.062
Trade deficit	1.529
Gross savings	342.757
Trade deficit	1.529
Government deficit	-63.486
Private investment	280.800
Private investment	280.800
Government investment	98.750
Total investment	379.550

Fixed investment	399.100
Inventory accumulation	40.450
Total investment	379.550

Aggregate Tax Rates

Consumer Group	Income Tax Rates	Good	Turnover Tax	VAT	Tariff	Export Tax
1	0.0	1	0.001242		0.084263	
2	0.0	2	0.043060		0.084263	
3	0.0	3	0.148888		0.084263	
4	0.0	4	0.038307		0.084263	
5	0.0	5	0.028568		0.084263	
6	0.0	6	0.038372		0.084263	
7	0.071448	7	0.052949		0.084263	
8	0.071448	8	0.034241		0.084263	
9	0.113141	9	0.056383		0.084263	
10	0.113141	10	0.039964		0.084263	
		11	0.0		0.084263	
		12	0.014384		0.084263	
		13	0.017821		0.084263	
		14	0.015467		0.084263	
		15	0.0		0.084263	
		16	0.0			0.123184
		17	0.0		0.084263	
		18	0.006769	0.0	0.084263	
		19	0.003064	0.0	0.084263	
		20	0.067218	0.0	0.084263	
		21	0.0	0.0	0.084263	
		22	0.007870	0.0	0.084263	
		23	0.004591	0.0	0.084263	
		24	0.116736	0.179158	0.084263	
		25	0.022132	0.090158	0.084263	
		26	0.037095	0.090158	0.084263	
		27	0.058173	0.090158	0.084263	
		28	0.043289	0.090158	0.084263	
		29	0.126742	0.090158	0.084263	
		30	0.014508	0.0	0.084263	
		31	0.032796	0.090158	0.084263	
		32	0.031694	0.041923	0.084263	

REFERENCES

Dreze, J. H., 1976. Existence of an exchange equilibrium under price rigidities. *International Economic Review*, vol. 16, pp. 301–320.

Kehoe, T. J., 1980. Uniqueness of equilibrium in production economies. Working Paper no. 271, Department of Economics, Masachusetts Institute of Technology, Cambridge.

Kehoe, T. J., and J. Serra-Puche, 1981. The impact of the 1980 fiscal reform on unemployment in Mexico. Unpublished manuscript.

Scarf, H. E. (in collaboration with T. Hansen), 1973. *The Computation of Economic Equilibria.* Yale University Press, New Haven.

Serra-Puche, J., 1979. A computational general equilibrium model for the Mexican economy: An analysis of fiscal policies. Ph.D. dissertation, Yale University, New Haven.

———, 1981 (forthcoming). A general equilibrium model of the Mexican economy. In *Applied General Equilibrium*, eds. H. E. Scharf and J. B. Shoven. University of Chicago Press, Chicago.

Shoven, T. B., and J. Whalley, 1972. A general equilibrium calculation of the effects of differential taxation on income from capital in the U.S. *Journal of Political Economics*, vol. 1, p. 281–321.