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A General Equilibrium Analysis of the Indirect Tax Reform in Spain*

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1. Introduction

Spain's recent entry into the European Economic Community (EEC) is to be accompanied by a number of economic reforms needed to comply with requirements imposed on all member countries. Fiscal policies in general, and tax reforms in particular, play a crucial role in the new economic programs and strategies of the government. A key ingredient of these reforms is the introduction of a value-added tax on consumption (VAT) in substitution of a complex range of indirect taxes, including a turnover tax applied at every stage of all production processes. The VAT has been the primary source of government revenues accruing from indirect taxation since entry into the EEC on January 1, 1986.

Another important component of the new fiscal package is the removal of trade barriers on commercial transactions between member nations. During the last three decades, the Spanish economy has become increasingly open: the ratio of exports to Gross National Product, only 5.6% in 1959, reached 23.6% in 1984. The integration of Spain to the EEC is bound to have an important impact not only on the volume of trade but also on trade patterns, and, given the importance of the foreign sector, a considerable effect on the Spanish economy as a whole. As a full member of the EEC, the government must completely dismantle its protectionist legislation on imports from other EEC countries within the next seven years. Moreover, legislation regulating commerce with ROW countries must be adapted to community regulations. In contrast with the immediate application of the VAT following Spain's entry in the EEC, the dismantling

of the system of protectionist tariffs, as well as the removal of other trade restrictions, is to be gradually carried out over a period ending in 1993.

The fiscal reform has posed a series of interesting policy questions. For instance, one common criticism of the new package is that the VAT rates chosen are too high and will further depress the economy, whose official unemployment rate during 1985 was 22%. On the other hand, government officials are primarily concerned with the effect on public revenues and, in turn, on the substantial deficit of the public sector (around 8% of GDP in 1985). Another current debate in Spanish economic forums centers on whether the new tax structure has a detrimental impact on the capital-labor ratio due to the retention of social security taxes, which are taxes on the use of labor.

A few studies have been carried out to asses the effects of the fiscal reform. Calatrava and Martinez [1984] and Raymond and Castellano [1984] have studied the impact on the inflation rate using standard input-output techniques, while Melo and Galí [1985] have simulated the economic and financial effects of the reform on the behavior of a single firm. Undoubtedly of great value as a first approximation, these studies are nonetheless inappropriate to capture the effects of economy-wide structural changes such as those implied by the recent tax reform. The VAT applies to all the transactions that take place in the Peninsular territory and its adoption will change the cost structure of firms and modify the patterns of consumption demand. To assess the full scope of the new tax system, a general equilibrium framework that fully takes into

account market interdependencies is the natural analytical tool.

The objective of this paper is to develop an applied general equilibrium model of the Spanish economy to analyze the impact of the indirect tax reform on relative prices, resource allocation, and income distribution, using the information contained in the Social Accounting Matrix constructed by Kehoe *et al.* [1985]. The model follows in the tradition of Shoven and Whalley [1973]. The Shoven-Whalley framework has been the source of inspiration for many recent large-scale numerical models. (See Shoven and Whalley [1984] for a survey of multisectorial tax models.) Although the model we present here is closely related to Kehoe and Serra-Puche's [1983] model of the Mexican economy, the model that we have constructed is sensitive to the characteristics of the new fiscal structure in Spain. In particular, we emphasize the special treatment that we give to the foreign sector, labor markets and the government fiscal budget, three aspects of the Spanish economy that are of vital interest in the context of entry into the EEC.

The foreign sector has been segmented into the EEC and the "rest of the world" (ROW), to account for the different tax treatment given to imports and exports from each of the two trading areas. Moreover, we incorporate the well-known Armington assumption (Armington [1969]) to differentiate similar products by country of origin. Thus, we specify production functions in which domestic and imported products are imperfect substitutes.

Another feature of the model is the specification of two endogenous unemployment rates, which are meant to capture the effects

of rigidities on the wage rates of two types of labor, skilled and unskilled. This characteristic of the model becomes important in the light of the high unemployment rates experienced by the Spanish economy in the last decade.

With regard to the government's budget, we present a fine disaggregation of the system of social transfers that characterizes the Spanish social security system. These transfers to households, whose value depend on prices and unemployment rates, are therefore endogenously determined within the model. As a consequence of this and other factors, the government deficit also becomes endogenous.

The paper is organized along the following lines: the analytical structure of the model is outlined in Section II. There, we briefly describe the basic components of the model, placing emphasis on its novel features. In Section III, we define the equilibrium concept used and comment on the main characteristics of the benchmark equilibrium that allows us to complete the numerical specification of the parameters of the model. We exploit, in Section IV, the comparative statics properties of the model to simulate the introduction of the VAT and analyze its effects on the performance of the economy. In addition, we appraise three alternative policy scenarios that incorporate some of the most debated aspects of the tax reform. In particular, we consider a reduction of the VAT rates, a reduction of the social security taxes paid by employers, and the introduction of flexible wage rates. We conclude in Section V with a summary of the main results and a discussion of other possible applications and extensions of the model.

II. The Model

Our model includes four types of different agents: producers, households, the government and the foreign sector. We distinguish 12 production sectors, 8 household units, and 2 foreign agents: the EEC and the rest of the world ROW. In the tradition of neoclassical theory, each agent is characterized by the maximizing behavior of an objective function subject to market or technological constraints. The model includes 27 different goods: 12 production goods (encompassing 11 that are produced privately and 1 public good), 3 goods representing non-consumption demand (investment and 2 export goods, "commerce with the EEC" and "commerce with the ROW"), 9 final consumption goods and 3 primary factors (2 types of labor, skilled and unskilled, and capital). The sectors in the model are listed in Table 1.

[Table 1]

2.1 Producers

Each of the 12 productive sectors produces an homogeneous good using a constant-returns-to-scale technology represented by a nested production function. Inputs to production for each sector j are domestic output x_{Dj}, imports from the EEC x_{Ej}, and imports from the ROW, x_{Rj}. The technology of sector j is represented by a Cobb-Douglas

production function:

$$Q_j = \delta_j \prod_{k=D,E,R} x_{kj}^{\sigma_{kj}} , \qquad j=1, 2, \ldots, 12$$

It would have been desirable to use less restrictive assumptions to represent the technology, but lack of adequate data makes it difficult to use more flexible functional forms.

Domestic output is produced by using intermediate inputs x_{ij} and value-added VA_j in fixed proportions:

$$x_{Dj} = \min\{ x_{1j}/a_{1j}, x_{2j}/a_{2j}, \ldots, x_{12,j}/a_{12,j}, VA_j/v_j \} , \quad j=1, 2, \ldots, 12,$$

where the a_{ij} and v_j represent non-negative input-output technical coefficients. Value-added is produced by combining the 3 primary factors through a Cobb-Douglas production function :

$$VA_j = \mu_j \prod_{\ell=25}^{27} x_{\ell j}^{\alpha_{\ell j}} , \qquad j=1, 2, \ldots, 12.$$

All production parameters must satisfy the usual properties corresponding to a linearly homogeneous technology.

Since households demand goods whose "label" is different from the "label" of the goods supplied by the production sectors, it becomes

necessary to transform households' demand for consumption goods into demand for production goods. This is accomplished through the use of a fixed-coefficients *conversion matrix*. The need to distinguish between consumption and production goods arises because of the different statistical classifications used in official data sources.

It is worth emphasizing that total output Q_j is a mix of three types of supply. This Armington specification of total output allows for a more flexible representation of how total output is obtained. Imports are neither perfectly complementary inputs to production nor perfectly substitutable outputs to domestic supply. We therefore contemplate substitution in the output mix in response to changes in relative prices. By staying away from polar cases, we are able to model the very realistic feature that, in a given economy, most goods are at the same time imported and exported.

Producers are assumed to maximize after-tax profits subject to their technological constraints. With a constant-returns-to-scale technology, profits must be zero at the optimum of the firm. Hence, input demands are defined for given output levels and depend upon prices, tax rates and output level.

2.2 Households

The model includes 6 representative consumers who are classified according to their income level, their age, and the skill of the

household head; skilled and unskilled labor are two distinct factors of production. The disaggregation by age allows us to incorporate into the model those social security transfers, such as retirement pensions, that depend on age. "Old" and "young" consumers are distinguished exclusively by their income level; they are either "poor" or "rich". "Adult" households (those between 25 and 65 years old) are divided by both income level and skill into four types. Since this class of consumers encompasses, by far, the majority of households and potentially active working people in Spain, it seems reasonable to establish a finer dissagregation of labor endowments. The list of households types is presented in Table 2.

[Table 2]

Consumers derive income from selling their endowments of labor, skilled or unskilled, and capital. Since a proportion of consumers are unemployed at a rate u_h, the level of income of a representative consumer of type h includes the factor income accruing from sales of labor services by the fraction $1-u_h$ of consumers employed and from the sale of capital services. The fraction of consumers unemployed receives unemployment benefits UB_h, which amount to a proportion b_h of the income that they would obtain were they employed. Consumers also obtain income from retirement pensions V_h, capital and other income transfers from the government K_h, in-kind health coverage S_h, and net transfers

N_h to residents from the EEC and the ROW.

If we denote the endowment and market price of factor ℓ by $\omega_{h\ell}$ and q_ℓ, respectively, and the weighted income tax rate by m_h, then disposable income DI_h for consumer h can be written as follows:

$$DI_h = (1-m_h)\left(\sum_{\ell=25}^{26} q_\ell\, \omega_{h\ell}\,(1-u_\ell) + UB_h + q_{27}\,(\omega_{h,27} + K_h) + V_h\, p_X + S_h p_{21} + N_h\right)$$

where unemployment benefits are defined as

$$UB_h = b_h \sum_{\ell=25}^{26} q_\ell\, \omega_{h\ell}\, u_\ell .$$

and net transfers from abroad are

$$N_h = p^E\, \omega_{hE} + p^R\, \omega_{hR} .$$

These foreign transfers, which appear as an endowment of foreign goods for consumers, reflect the fact that part of household income is not generated domestically. For the Spanish economy, these net transfers amount to about 3.2% of total disposable income. Although this proportion is not substantial, it is nonetheless important to include these transfers to have a more complete model as well as to obtain internal consistency of the data base. We value these sources of income by using the prices for imported goods from the two trade areas. Notice that

retirement pensions are valued according to a consumer price index p_x, whereas we value health coverage at the price of the medical services consumption good.

We assume that consumers' preferences, defined for the 9 consumption goods and savings are described by a Cobb-Douglas utility index. Households maximize their utility subject to the budget constraint:

$$\sum_{j=16}^{24} p_j(1+s_j)\, C_{hj} + p_{13}\, C_{h,13} \leq DI_h ,$$

where s_j represents the *ad valorem* sales tax on the consumption C_{hj} of good j by consumer h.- It is well known that the demand functions derived from this utility maximization problem are continuous for positive prices and homogeneous of degree zero in prices.

2.3 Government

The government acts both as a producer and as a consumer. As a producer, the government supplies a public good that is produced by the government services sector. This sector's output is also bought by the government, in its role as a consumer. In doing so, the government is actually demanding goods, through the intermediate requirements of the public sector's activity, from every one of the private productive sectors of the economy. Demand for the public good, as well as for government

investment, is derived from a utility function with fixed coefficients. This way of modelling government demand may appear simplistic, but it serves to capture the structural and bureaucratic features of government institutions that make the composition of government demand rigid.

Government income includes returns on its ownership of physical capital plus income accruing from taxation. Tax revenues are obtained from a variety of sources: taxes on production and imports, taxes on consumer income, and sales taxes.

Purchases of intermediate goods from sector i are taxed at a rate t_i. Hence, total tax collection on intermediate transactions is

$$R_1 = \sum_{j=1}^{12} \sum_{i=1}^{12} t_i p_i a_{ij} x_{Dj} .$$

Imported goods by sector j are taxed with tariff rates t_j^E and t_j^R. Thus, total tariff revenues are

$$R_2 = p^E \sum_{j=1}^{12} t_j^E x_{Ej} + p^R \sum_{j=1}^{12} t_j^R x_{Rj} .$$

The government also collects production taxes from the use of labor by firms. If we denote these labor tax rates by $t_{\ell j}$, total revenue collected from the factor taxes is

$$R_3 = \sum_{\ell=25}^{26} \sum_{j=1}^{12} t_{\ell j} \, q_\ell \, x_{\ell j} .$$

Total collection R_4 accruing to the government from sales taxes on consumption is

$$R_4 = \sum_{j=16}^{24} s_j P_j \sum_{h=1}^{8} C_{hj} .$$

Finally, revenue accruing from income taxes is

$$R_5 = \sum_{h=1}^{8} m_h \, DI_h / (1-m_h) .$$

Here, gross personal income $DI_h/(1-m_h)$ of consumer group h is taxed at a rate m_h. Adding up, we obtain total government revenue from all types of taxes

$$R = \sum_{k=1}^{5} R_k .$$

In our model, we use effective average tax rates computed

from the information supplied by the underlying Social Accounting Matrix. In performing simulations, however, we use tax rates that have been obtained from official rather than effective tax rates. We may therefore overestimate tax receipts from the VAT. With regard to tax evasion, we assume neutrality across economic agents and sectors due to the lack of information on alternatives.

A novel aspect of our model is that government transfers to consumers are endogenously determined. As mentioned above, households receive different types of income transfers from the government. Total transfers from the government are

$$T_G = \sum_{h=1}^{8} (UB_h + q_{27} K_h + V_h p_x + p_{22} S_h) .$$

Total income transfers are determined within the model because the unemployment rates and relative prices needed to compute these transfers are endogenous variables. This specification gives us a flexible way to analyze, for instance, possible reforms of the Spanish social security system and its implications on the government deficit.

The budget constraint of the government can be written as

$$p_{12} C_{G,12} + p_{13} C_{G,13} + T_G = R + p_{13} \omega_{G,13} + q_{27} \omega_{G,27} .$$

The left-hand side of the budget summarizes total government outlays. It

includes, in addition to total transfers T_G, expenditures $C_{G,12}$ on the public good and $C_{G,13}$ on real investment. In the right-hand side of the budget constraint we have government income R generated by taxes plus income accruing from the endowment $\omega_{G,27}$ of physical capital in the hands of the government. Since the model is constructed to allow the government to spend more than the revenues it obtains, the public deficit appears in the government budget constraint as a fictitious endowment $\omega_{G,13}$ of the investment good. Intuitively, we can think of the government borrowing from households by issuing bonds that are perfect substitutes in consumers demand for the investment good.

2.4 Foreign Sector

In our model, EEC and ROW countries are treated as two distinct agents, although the way imports and exports enter conceptually into the model is the same in both cases. The level of exports to each trading region is fixed exogenously. The particular menu of exports chosen by the EEC and ROW countries, however, is sensitive to the relative prices of exported goods and services. Each foreign region is assumed to maximize the "utility" provided by its imported goods subject to an income constraint, namely the value of the fixed level of exports. Due to limitations on data, we have chosen Cobb-Douglas utility indicators.

Goods produced in a particular sector are, to some extent, substitutes for imports of equivalent commodities produced abroad. Given

the level of aggregation of the production sectors, this seems an appropriate assumption. As mentioned above, we assume there is a production function that generates output out of domestic and imported commodities from the two trading regions. The mixture of domestic goods and imports chosen is obtained by minimizing the total cost of providing a fixed level of output. Notice that this selection is sensitive to relative prices and, of course, import taxes and allows us to derive demand for imported goods and services from both the EEC and the ROW.

The trade deficit is determined endogenously in the model, but at the cost of fixing exogenously the level of exports. We can justify this drastic simplification by considering the level of exports as an independent decision of the foreign agents.

2.5 Savings and Investment

In order to incorporate the flows of investment into our static model, we conceptualize them as capital goods available at the end of the economic period, or "capital tomorrow". Investment is a good produced with a fixed-coefficients technology, whose inputs are the sales of the productive sectors to the investment sector. The output level of the investment sector is determined by the level of total savings in the economy so as to satisfy the macroeconomic condition that total investment equals total savings.

Total investment is financed by domestic and foreign sector savings, net of the government deficit. Domestic savings include both

private and public savings, whereas the savings of the foreign sector is interpreted as the trade deficit. We have to discount the public sector deficit from the global savings figure because of the way we are modelling the financing of the government deficit.

III. Equilibrium and Calibration

The concept of equilibrium in our model is the standard Walrasian one, except that we allow positive excess supply in the labor markets. In equilibrium, producers maximize after-tax profits, consumers maximize utility, government tax revenues equal tax payments, and demand equals supply in all non-labor markets. More specifically, an equilibrium for the economy is defined as a vector of commodity and factor prices (p^*, q^*), a vector of output levels x^*, a vector of unemployment rates u^*, and a level of tax revenue R^*, such that, given a set of tax rates, the following conditions are satisfied:

1. *Consumers maximize utility subject to their budget constraints;*
2. *Producers maximize profits given the technology;*
3. *Government tax proceeds are precisely equal to the amount of taxes payed by all agents;*
4. *Non-labor markets clear;*
5. *Wage rates are downwardly rigid in real terms;*

6. *Supply is greater than or equal than demand in the labor markets;*
7. *If supply is strictly greater than demand in a labor market then the wage constraint is binding;*
8. *Export output levels are fixed;*
9. *Government services output is fixed.*

The first four conditions are the well-known equilibrium conditions of tax models (see Shoven and Whalley [1973]). It is the existence of endogenous unemployment rates and deficits that makes this specification different from the standard Shoven-Whalley model and gives rise to five additional equilibrium conditions. Since the purchasing power of nominal wages is fixed in terms of a consumers' price index (i.e. real wage rates are constant), adjustments in the labor markets take place on the quantity side. Thus, if the wage constraints are binding, which is the case for most plausible parameter values, then equilibrium unemployment rates are strictly positive. Wages, however, are only downwardly rigid and may rise in a full employment economy. Notice also that in this model the public sector deficit GD and the trade deficits TD are endogenous magnitudes. We obtain this property by fixing the activity level of the government sector and the level of exports to the EEC and the ROW.

The individual supply and demand schedules are derived from the optimization problems of producers and consumers. Given the properties of the individual demand and supply functions, the market excess demand function for sector j, $\zeta_j(p,q,u,R,GD,TD)$, is continuous for

positive prices and homogeneous of degree zero in prices and revenue. In turn, taxes collected from consumers, R_4 and R_5, are homogeneous of degree one in prices. Together, $\zeta_j(p,q,u,R,GD,TD)$, R_4, and R_5 satisfy Walras's Law:

$$\sum_{j=1}^{12} p_j \zeta_j(p,q,u,R,GD,TD) + R_4 + R_5 = R .$$

Kehoe and Serra-Puche [1983] provide a proof of existence of an equilibrium for this type of model. For the sake of brevity, here we omit a discussion on this subject. We also assume that the equilibrium is unique. (See Kehoe and Whalley [1985] for a discussion of uniqueness in large-scale models.)

To make the model presented in Section III operational, numerical values must be assigned to all the parameters. The numerical specification requires the construction of a microconsistent data set that fully describes all economic transactions among all agents for a given period. Here we use the microconsistent data base assembled by Kehoe *et al.* [1986] for 1980 to calibrate the model. This procedure, described by Mansur and Whalley [1984], makes the crucial assumption that the economy is in equilibrium in the base year. The values of some parameters are easily obtained from the data base and the restrictions imposed on the functional forms. The remaining parameters are calibrated so that the model replicates, as an equilibrium, the data observed in the benchmark

year.

To normalize the relative prices and activity levels associated with the benchmark equilibrium, it is a common practice in the literature to rescale the units of measurement so that they are all unitary. In other words, the magnitudes in the data set reflect quantities and value simultaneously, and demand equals supply at unitary levels of production. Once the model replicates the benchmark equilibrium, it is possible to perform comparative statics exercises by modifying some of the exogenous parameters.

IV. Simulations

In this section, we simulate the introduction of the VAT and complement the analysis by perturbing the new equilibrium in several different ways. As we explain below, the results of the VAT simulation suggest that the new rates have, relative to the old tax system, a detrimental effect on the economy and, particularly, on consumer welfare. We assess the causes of this result first by analyzing a reduction of the official VAT rates. We then consider two alternative scenarios in which we take into account policy proposals that have been, in connection with the introduction of the VAT, subjects of debate among trade unions, business, and the government: What would be the impact of the new indirect tax system on the economy were the labor markets more flexible? Would a reduction of the taxes on labor use (social security taxes) have positive effects on the economy, without at the same time worsening too

much the government budget?

As mentioned in Section II, we keep fixed the level of the activity of the public sector and the two foreign sectors in all the simulations. This procedure allows us to make endogeneous the government deficit and the trade deficits.

4.1. The effects of the introduction of the VAT in Spain

To simulate the change in the fiscal system we completely eliminate the turnover tax on production as well as other indirect taxes, and modify the taxes on foreign trade to account for the substantially different tariff structure ensuing from integration. Following the non-uniform system used in most EEC countries, the Spanish government has selected three different rates: "low" (6%), "standard" (12%) and "high" (33%). Except for a handful of exempt commodities, every consumption good is taxed at one of these rates.

The VAT rates corresponding to our 9 consumption goods are reported in Table 3. These rates are obtained as weighted averages of individual rates levied on the commodities included in each composite consumption good. Remember, however, that we do not take into account any possible tax evasion. Notice that the rates differ substantially among commodities. This leads us to suspect that the introduction of the VAT will have a noticeable effect on the relative prices of consumption goods in particular and on resource allocation in general.

[Table 3]

The main results of this simulation are summarized in Tables 4 to 7 under the heading "VAT". It is interesting to study the impact on relative prices since this illustrates the distortions with regard to the benchmark equilibrium prices (see Table 4). As expected, the VAT results in a reduction of production prices and an increase of consumption prices. The percentage changes in production prices, however, are fairly uniform (-2% approximately). Thus, the price ratios of all production sectors remain constant. On the other hand, the impact on consumption prices is fairly variable and we observe that, whereas the price of medical services drops by 4%, the price of tobacco and alcoholic beverages goes up by 12%. These results suggest that price distortions are mostly reflected on the consumption side. We can say that, on average, consumption prices increase by 2.7%, since this is the increase in the consumer price index when all prices are scaled up by the factor prices' index.

The changes in factor prices are also revealing. In particular, notice the reduction in the price of capital relative to wages. This is largely due to the fact that real wages are fixed. This reduction has important consequences on the optimal choice of factors, labor unemployment, and income distribution, as we discuss below.

[Table 4]

The levels of output for the production and non-consumption

demand sectors appear in Table 5. The activity levels of eight of the production sectors fall with respect to the base case. These falls in the activity levels are explained by market conditions: the price increases in consumption goods and the fall in disposable income reduce the amounts demanded by households and result in lower production. We should also stress, however, the 4% increase in the activity level of the investment sector due to the smaller price of the investment good, which stimulates households' savings, and the reduction in the government deficit.

[Table 5]

The aggregate indicators in Table 6 summarize the changes in the economy as a whole. The most noticeable impact is on unemployment, which rises sharply. Of course, this result is due to the fall in the price of capital relative to those of labor, combined with the substitutability of these factors of production in the value-added function. On the other hand, the impact on government revenues is positive and, given that the level of government expenditures is fixed at the benchmark level, the public deficit falls. Notice that the increase in net indirect tax revenues more than offsets the fall in net income tax revenues. The latter is explained by the increases in the unemployment rates, which reduce taxable income and raises unemployment benefits.

[Table 6]

The impact of the VAT on income distribution can be studied by analyzing the change in real income of each consumer group. This is given by the percentage changes in utility levels reported in Table 7. On average, consumer welfare decreases between 2 and 3%. This should be, and is, approximately equivalent to the fall in real output (GDP) reported in table 6. The reduction in welfare is explained by the increases in consumption prices and unemployment. The rise in the unemployment rates result in a net reduction of disposable income, since unemployment benefits do not match wage income. Likewise, the increase in most consumption prices gives also rise to a fall in consumers real income. Notice that as consumption goods become more expensive relative to the price of investment, households tend to save more. Although the raise in savings is not enough to compensate for the fall in real income, it is nevertheless conceivable that rising levels of investment could lead to higher levels of utility over time.

[Table 7]

We observe that rich consumers suffer greater percentage welfare reductions. In other words, although real income drops for all consumers, the welfare reduction may be described as progressive, since poor consumers experience smaller real income losses. This is explained by the additional negative impact that the drop of the price of capital has on disposable income of rich consumers since they own most of the capital endowment.

4.2 Simulations of Alternative Policies

The results of the VAT simulation motivate us to study the impact of alternative policies that could attenuate the negative effects on the economy, particularly those related to the reduction in consumer welfare. These drops in the real income of all consumer groups are explained either by increases in unemployment rates, by reductions in factor prices relative to consumption prices, or by combinations thereof.

The principal objective of the following analysis is to explain the reductions in consumers' purchasing power. Firstly, we contemplate the uniform reduction in the VAT rates (30%) that maintain, on average, consumption prices at the benckmark level. Hence, any welfare loss is explained by increases in unemployment rates. Secondly, we study a scenario in which wage rates adjust so as to keep unemployment rates fixed at the benchmark level. Therefore, any welfare loss is explained by increases in consumption prices relative to factor prices. These two scenarios allow us to single out the role that the VAT rates and the rigidities in the labor market play in resource allocation. Thirdly, to help us better understand the importance of unemployment on the economy, we analyze a measure that is aimed at stimulating more labor-intensive production processes. To this effect, we simulate a 30% reduction in social security contributions paid by employers while maintaining the original VAT rates.

Reduction in the VAT rates

The results of this simulation appear under the heading "Reduced VAT 30%" in Tables 4-7. As one would expect, production prices are similar and consumption prices substantially lower than in the previous simulation. Notice, moreover, that the price of capital relative to those of labor is now approximately equal to 1, the benchmark value.

The activity levels of the production sectors are evenly distributed around one, with seven sectors in which activity levels are above the benchmark values. Notice too the increase in the activity level of the investment sector.

Unemployment rates are approximately equal to the original values. Therefore, a 30% reduction of the VAT rates is an alternative way to maintain unemployment constant. Not surprisingly, the lower rates reduce government revenues as a percentage of GDP, and, since the percentage of expenditures remain constant, the public deficit amounts to 1.76% of GDP, greater than in the VAT simulation, but still below the benchmark equilibrium value. We can conclude that the policy we consider here does not increase the public deficit. Likewise, the percentages of private consumption and investment are similar to those in the original equilibrium.

The utility changes with respect to the original equilibrium are minor: some are positive and some are negative. The rich consumer groups experience the greatest gains in comparison to the VAT simulation. This is not surprising since GDP remains basically unchanged, as do the activity

levels, unemployment rates, government expenditures, and private consumption and investment.

Since, in terms of aggregate indicators, the overall picture that emerges from this simulation is very similar to the original equilibrium, one could argue that, according to the model, the VAT rates selected by the government are about 30% above those that would have maintained the benchmark values of the aggregate indicators of the economy as well as its consumers' welfare levels. Of course, our results also indicate that these benchmmark values could be maintained if evasion of VAT is about 30%, at least if such evasion is evenly distributed across sectors and consumers.

Flexible Wages with Fixed Unemployment Rates

The results of this simulation appear under the heading "Flexible Wages" in Tables 4-7. An inspection of Table 4 shows that the structure of production, consumption and non-consumption demand prices is very similar to the one obtained in the VAT simulation. The only difference lies in that the prices of labor relative to that of capital fall by approximately 2% compared to the VAT simulation. Notice though that, in comparison with the benchmark case, the price of capital is still lower than those of labor.

The activity levels of the production sectors improve relative to those reported in the VAT simulation, although some remain below the benchmark levels. For most industrial sectors, the activity levels increase

by 1 or 2%. For the other sectors, the most significant change is in construction, whose activity level increases by 9%; this sector is particularly sensitive to the reduction in wages given that its production process is labor intensive. Investment, for the same reason as in the VAT simulation, also experiences a great upward surge (13.4%).

Consumers suffer smaller welfare losses than in the VAT scenario. The most positive welfare change is on the four rich consumer groups. This can be explained by the fact that capital income, which is mostly owned by these consumer groups, grows as a result of the rise in the price of capital. Nevertheless, consumers' welfare is still below the benchmark levels. It can be shown, by working out with the macroeconomic indicators, that aggregate disposable income indexed by factor prices is about the same as in the benchmark case. Hence, the drop in utility levels is explained by the rise in consumption prices induced by the new value-added tax. This reinforces our view that the chosen VAT rates are too high, even when unemployment rates are fixed.

Although GDP does not change noticeably relative to the benchmark level, private consumption falls and the government deficit shrinks. Both phenomena are explained by the large increase in net indirect taxes.

Reduction in Social Security Taxes

In this final simulation, we analyze the effects of a 30% reduction in social security contributions by employers. The information

contained in Table 4 tells us that production prices undergo a significant change for the first time and, even though the VAT rates are the original ones, the impact on consumption prices is noteworthy: their levels are 1-3% below the levels in the "VAT" and "Flexible Wages" simulations. We observe that production prices fall, but not uniformly. This is because the production sectors have different labor intensities and they bear different labor tax burdens.

The improvement in the economy following this policy measure is remarkable. Most sectors see their activity levels to go up and unemployment rates are sharply reduced. As a percentage of GDP, tax revenues are greater than in the original equilibrium as well as in the "VAT" and "Reduced VAT" simulations. The public deficit is 0.6% of GDP, well below the 2.01% in the base year. Although private consumption and private investment shares of GDP are slightly lower and greater respectively than in the original equilibrium, they expand in absolute values with respect to all simulations.

Finally, all consumers but one are better off than in the original equilibrium, and all of them are better off than in the three previous simulations. The level of utility of consumer type 7 does not improve, relative to the benchmark level, because its main source of income are retirement pensions which depend only on a consumption price index.

The results of this last exercise support a policy of reduction of the labor taxes paid by employers. The fear that such a policy would further promote a raise of the public deficit is not confirmed by the model.

To the contrary, the reduction in unemployment and the increase in the activity levels of production sectors increases net revenues of the government derived from direct taxes.

V. Concluding Remarks

We have presented an applied general equilibrium model to analyze the effects of the important tax reform implemented in Spain to comply with EEC legislation for country members. The model has been used to evaluate the introduction of the VAT in substitution of a turnover tax on production and other taxes on production, consumption, and foreign trade.

The results of the VAT simulation indicate that the tax reform reduces the levels of activity in most production sectors and the welfare of all consumers. In order to measure the sensitivity of the model to the specification of the VAT rates, we have reduced the original VAT rates by 30%. The results show that the negative impacts detected in the first simulation are somewhat dampened. This provides support for the idea that, unless there is significant tax evasion, the original VAT rates may be too high and all agents would be better off with lower rates.

The results of allowing real wage rates to adjust, so as to maintain fixed levels of unemployment, indicate that consumers' welfare increases with respect to the VAT simulation, but are still below the benchmark levels. Finally, we have addressed a controversial policy issue: the reduction of social security taxes paid by employers. The simulation carried out under the hypothesis of a 30% reduction in social security tax

rates shows that unemployment levels fall sharply whereas consumers' welfare improves noticeably. It is also worth mentioning that, under this policy, the government deficit shrinks considerably. This result reinforces the belief that the tax on labor is a major cause of the high unemployment rates registered by the Spanish economy during the past decade.

The model can be improved on several respects. The functional forms used in the model could be replaced by more flexible ones as new econometric studies of the Spanish economy provide reliable estimates of the exogenous parameters. The modelling of the public sector could also be improved to address issues related to optimal tax policy. The results of the last simulation suggest that a more detailed analysis of the social security system and the labor market deserves a good deal of attention, since these issues seem to play a determinant role in the working of the economy. In particular, we would like to analyze the optimal design of transfers and receipts taking into account the changing composition of the population. The natural framework to analyze this type of question is a dynamic intertemporal model.

Needless to say, the static nature of the model advises us to be cautious in the interpretion of the results. Indeed, our comparative statics exercises should not be used to draw strong conclusions on macro phenomena such as investment or savings, which have a clear dynamic and intertemporal dimension. For instance, the model tells us that investment will increase after introducing the VAT. From this, we could argue that a higher rate of investment could induce a higher growth rate that would lead to higher real income levels over time. These results are consistent

with economic intuition since capital goods are VAT free, yet these remarks would be more appealing were investment decisions modelled explicitly. Building a dynamic general equilibrium model is, however, a task well beyond the scope of this study.

In spite of its limitations, the model provides the analyst with a flexible policy tool that is sensitive to market interdependencies and general equilibrium feedbacks. Essentially, the model may be viewed as a bridge that links neoclassical economic theory with the instrumental needs for the design of sound economic policy.

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Table 1

List of Sectors

Production Sectors

1. Agriculture and Fishing
2. Energy
3. Basic Industry
4. Machinery and Transportation Equipment
5. Automobile Industry
6. Food Products
7. Other Manufactures
8. Construction
9. Commerce
10. Transportation Services
11. Commercial Services
12. Government Services

Non-Consumption Demand Sectors

13. Investment
14. Commerce with the EEC
15. Commerce with the ROW

Consumption Demand Sectors

16. Food and Non-alcoholic Beverages
17. Tobacco and Alcoholic Beverages
18. Clothing
19. Housing Services
20. Household Articles
21. Medical Services
22. Transportation Services
23. Recreational Services
24. Other Services

Factors of Production

25. Unskilled Labor
26. Skilled Labor
27. Capital and other factors

Table 2

Consumer Groups
(household heads)

1. Young, poor	5. Adult, poor, skilled
2. Young, rich	6. Adult, rich, skilled
3. Adult, poor, unskilled	7. Old, poor
4. Adult, rich, unskilled	8. Old, rich

Table 3

Value-Added Tax Rates

Food and Non-alcoholic bev.	0.0608	Medical Services	0.0279
Tobacco and Alcoholic Bev.	0.2800	Transportation Services	0.1800
Clothing	0.1236	Recreational Services	0.0611
Housing Services	0.0465	Other Services	0.0780
Household Articles	0.1076		

Table 4

Market Prices*

(Benchmark = 1)

Sector	VAT	Reduced VAT (30%)	Flexible Wages	Reduced SS Tax Rates (30%)
		Production Prices		
Agriculture and Fishing	0.9856	0.9913	0.9901	0.9745
Energy	0.9811	0.9627	0.9824	0.9549
Basic Industry	0.9873	0.9864	0.9866	0.9523
Mach. and Transp. Equip.	0.9807	0.9765	0.9775	0.9357
Automobile Industry	0.9927	0.9876	0.9888	0.9442
Food Products	0.9875	0.9900	0.9895	0.9658
Other Manufactures	0.9804	0.9804	0.9805	0.9472
Construction	0.9860	0.9801	0.9815	0.9424
Commerce	0.9876	0.9894	0.9891	0.9691
Transportation Serv.	0.9924	0.9934	0.9932	0.9708
Commercial Services	0.9814	0.9828	0.9825	0.9667
Government Services	1.0149	0.9999	1.0031	0.9434
		Non-Consumption Demand Prices		
Investment	0.9850	0.9800	0.9812	0.9424
Commerce with the EEC	0.9848	0.9840	0.9842	0.9519
Commerce with the ROW	0.9842	0.9836	0.9838	0.9523
		Consumption Prices		
Food and Non-alcoh. bev.	1.0433	1.0280	1.0455	1.0230
Tobacco and Alcoh. bev.	1.1183	1.0473	1.1203	1.0943
Clothing	1.1023	1.0663	1.1027	1.0679
Housing Services	1.0218	1.0093	1.0227	1.0043
Household Articles	1.0826	1.0504	1.0822	1.0472
Medical Services	1.0105	1.0025	1.0107	0.9859
Transportation Services	0.9554	0.9109	0.9548	0.9268
Recreational Services	0.9882	0.9704	0.9877	0.9578
Other Services	1.0240	1.0031	1.0251	1.0027
		Factor Prices		
Unskilled labor	1.0273	1.0055	1.0105	1.0012
Skilled Labor	1.0260	1.0024	1.0043	1.0004
Capital Services	0.9716	0.9943	0.9892	0.9987

* $0.5038\, p_{25} + 0.0124\, p_{26} + 0.4838\, p_{27} = 1$

Table 5

Activity Levels

(Benchmark = 1)

Sector	VAT	Reduced VAT (30%)	Flexible Wages	Reduced SS Tax Rates (30%)
Production Sectors				
Agriculture and Fishing	0.9588	0.9775	0.9644	0.9937
Energy	0.9801	1.0019	0.9995	1.0327
Basic Industry	0.9904	1.0118	1.0302	1.0704
Mach. and Transp. Equip.	1.0028	1.0252	1.0437	1.0835
Automobile Industry	1.0280	1.0671	1.0443	1.0817
Food Products	0.9562	0.9766	0.9610	0.9910
Other Manufactures	0.9576	0.9822	0.9735	1.0093
Construction	1.0291	1.0553	1.1167	1.1780
Commerce	0.9717	0.9969	0.9835	1.0195
Transportation Serv.	0.9872	1.0129	1.0026	1.0364
Commercial Services	0.9799	0.9977	0.9906	1.0212
Government Services	1.0000	1.0000	1.0000	1.0000
Non-consumption Demand Sectors				
Investment	1.0355	1.0632	1.1355	1.1996
Trade with the EEC	1.0000	1.0000	1.0000	1.0000
Trade with the ROW	1.0000	1.0000	1.0000	1.0000

Table 6

Aggregate Indicators

Indicator	Benchmark	VAT	Reduced VAT (30%)	Flexible Wages	Reduced SS Tax Rates (30%)
Unemployment %					
unskilled	10.00	12.94	9.95	10.00	3.41
skilled	5.00	7.11	4.97	5.00	2.39
Tax. Revenues/GDP %	9.58	10.24	9.86	11.27	10.66
net indirect	14.15	15.87	14.42	16.05	13.33
net direct	-4.57	-5.63	-4.56	-4.78	-2.67
Gov. Expenditures/GDP %	13.40	13.71	13.41	13.42	13.47
Gov. Deficit/GDP %	2.01	1.44	1.76	0.26	0.60
Priv. Consumption/GDP %	72.58	71.86	72.37	70.89	71.69
Priv. Investment/GDP %	19.34	20.19	20.26	21.78	21.64
GDP (billions of pesetas*)	15.18	14.86	15.16	15.14	15.52
% GDP change		-2.13	-0.16	-0.27	+2.22

* $0.5038\, p_{25} + 0.0124\, p_{26} + 0.4838\, p_{27} = 1$

Table 7

Percentage Changes in Households' Utility Index

Consumer Group	VAT	Reduced VAT (30%)	Flexible Wages	Reduced SS Tax Rates (30%)
Poor young	-2.1039	-0.0168	-1.9036	+2.9622
Rich young	-2.6312	+0.4687	-1.4924	+3.2272
Unskilled poor adults	-2.1968	-0.2668	-1.9839	+2.4536
Unskilled rich adults	-2.6616	+0.2744	-1.5433	+2.6820
Skilled poor adults	-2.8155	-0.2284	-2.5782	+0.8389
Skilled rich adults	-3.4742	+0.0977	-2.0229	+1.3630
Poor old	-1.2136	-0.9255	-1.0325	-0.5325
Rich old	-2.0183	-0.0200	-1.0337	+1.2287