

**A Cost-Benefit Analysis of Cash Transfers Within A General
Equilibrium Framework:
Simulations Based On Mexico's PROGRESA Cash Transfers**

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Abstract: This paper combines computable general equilibrium modeling with disaggregated household data to evaluate the general equilibrium welfare impacts of cash transfer programs arising from the need to finance these transfers domestically. We separate the indirect welfare impact into three components: (i) the *redistribution effect* arising from the need to finance programs, (ii) the *reallocative effect* arising from the transfer of resources between households with different "tax propensities", and (iii) the *distortionary effect* arising from the need to use distortionary finance instruments. We show how all these effects can be subsumed within one parameter, namely, the *cost of public funds*. Using the Mexican cash transfer program as a basis for simulations, we show that the substantial welfare gains which result from the switch from universal food subsidies to targeted cash transfers reflect both the improved targeting efficiency of the latter as well as relaxing the need to trade-off equity objectives against efficiency when designing tax systems. More generally, the indirect costs of finance can be substantially lowered when such programs are combined with appropriate tax reforms.

Key Words: general equilibrium, poverty alleviation, social welfare, domestic finance, cost of public funds.

JEL Classification: D58, D61, E62,H2

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Section 1: Introduction

In response to budgetary pressures, many developing countries have recently moved (or are considering moving) to more targeted poverty alleviation programs.¹ A crucial component of these programs involves a cash transfer to poor households, often made conditional on households investing in their human capital.² In this paper we are concerned solely with the evaluation of the welfare impacts of the cash transfer component of such programs.

When evaluating the economic impact of such transfers, it is useful to separate these into direct and indirect income (or welfare) effects. The direct income effects reflect the design of the program (i.e. the rules for targeting transfers) and impact on what might be called the beneficiaries. These are often referred to as first-round effects and are captured by partial equilibrium approaches to policy evaluation. The indirect effects capture the second-round income changes brought about both by the impact of cash transfers and by their financing on the level and composition of demand and supply. In this paper we focus primarily on the indirect income effects, more particularly those that are a consequence of the need to finance the program domestically. We view this dimension of the program to be especially important since any credible poverty alleviation strategy must have underlying it a credible financing strategy. The latter can have important consequences for the level and distribution of household incomes and economic welfare.

¹ For example, the PROGRESA program in Mexico and the PRAF program in Honduras. Similar programs are being seriously considered by Nicaragua and Argentina.

² Particularly in the human capital of children, e.g. regular attendance at schools and health clinics.

There are a number of reasons why one should endeavor to evaluate the indirect effects of the program. Firstly, these may offset the first-round impact on beneficiaries and thus return to frustrate the achievement of objectives. Secondly, they affect individuals not included in the program but whose well-being enters into our measure of social welfare. This is particularly important in the presence of partial or imperfect targeting, e.g. when because of the design of a poverty-alleviation program some poor households (such as those in urban areas) have been excluded. Thirdly, in the presence of commodity taxes and subsidies, some of the indirect income effects emerge through changes in government revenues and expenditures thus impacting on the budgetary consequences of the transfer program, an outcome of particular importance to policy makers. Fourthly, the indirect effects on non-beneficiaries can have an important bearing on the political economy dimensions of the program: one may be willing to trade-off program effectiveness with program acceptability, although the two are obviously not unrelated.

In order to facilitate understanding of the sources of the indirect welfare effects we show how one can separate these effects into three components. Firstly, there is a *redistribution effect* due to the fact that someone must be taxed in order to pay for the cost of the transfer program. If high income households bear the brunt of this taxation, and if we attribute a social value to a more equal distribution of income, then the resulting welfare cost will be less than the direct welfare gain from the transfers. Secondly, there is a *reallocation effect* which results from the fact that the pattern of demand will change if those who finance the program have income elasticities of demand different from those who receive the transfers. The resulting demand changes can have important consequences for government revenues when taxes vary substantially across commodities. The welfare effects arise essentially because demand shifts away from (or towards) commodities for which demand was previously too low due to their inefficiently high tax rates. Thirdly, there is a *distortionary effect* because of the need to raise the revenue to finance the program through manipulating distortionary commodity taxes and subsidies. For example, if the program is financed by reducing distortionary subsidies,

then this effect is positive, but if financed by increasing distortionary taxes then it may be negative. We consider both of these alternatives. We show how all these effects can be subsumed within one parameter, namely, the *cost of public funds*.

In general, then, the indirect (or "multiplier") effects can be positive or negative and can accrue to both beneficiaries and non-beneficiaries. The sign and magnitude of these effects and how they work themselves through the economy (i.e. to whom they eventually accrue) depend both on the structure of economic activity (which determines how equilibrium is restored to commodity and factor markets) and on how the government budget is balanced in response to the transfers and the demand impacts they generate. Allowing for these "second round" effects is what essentially characterizes general equilibrium approaches to policy evaluation.

The layout of the report is as follows. In the next section we present the framework for our evaluation of the direct and indirect welfare impacts of the program. In Section 3 we discuss the structure of the computable general equilibrium model used to trace through the general equilibrium responses to the change in demand generated by the transfers. We describe the data and assumptions used to construct the model. We finish this section by discussing the different policy scenarios (or simulations) which we evaluate. The results of the simulations are presented and discussed in Section 4. In the final Section 5 we summarize our findings.

Section 2: Methodology

This paper focuses primarily on analyzing the level and distribution of indirect income effects. To trace through these indirect effects we need to specify the structure of the economy so as to identify how the changes in supply and demand which result from the transfers work themselves through the various commodity and factor markets. This includes specifying not only how equilibrium is restored in these markets but also specifying how equilibrium is restored to government finances as a result of both the

direct and indirect impacts on government revenues and expenditures.

With regard to commodities one can consider a number of alternative market structures, of which the following two are at different ends of the spectrum:

- (i) *Markets clear through production*: At one extreme we can assume that excess capacity exists throughout the economy so that the extra demand generated by the transfers absorbs some of these "surplus" resources thus generating Keynesian-type income multiplier effects (i.e. demand-led growth). This extra income gives rise to further rounds of increased demand and associated income effects, and so on through further rounds of expenditure. Such general equilibrium responses are captured by so-called social accounting matrix (SAM) multipliers with market prices being unaffected by changes in demand.
- (ii) *Markets clear through prices*: At the other end of the spectrum lies a view of the economy characterized by full capacity so that extra demands result in price increases which bring about an appropriate reallocation of resources between sectors and consequent supply changes but no further income effects. For given demand changes, the more mobile are factors in and out of a sector then the smaller the price change required to bring forth the necessary supply responses. An extreme case is where factors are sector specific and fixed in supply so that prices increase but quantities supplied remain unchanged.

In general, the first set of models generate much higher (and positive) indirect effects than the second set. In between (i) and (ii) one has an economy with surplus resources in some sectors but with other sectors characterized by full capacity. The existence of international trade provides another "leakage" which may reduce multiplier effects or result in general equilibrium being restored through changes in factor prices rather than through commodity prices.

Since we are concerned primarily with the indirect welfare effects arising from the need to domestically finance the transfer program, the model we use to identify these assumes

that markets clear through prices. Given the structure of the economy, the general equilibrium welfare impacts will also depend on (i) the existing structure of taxes and subsidies (including price controls) on commodities and factors, and (ii) how the transfers are financed (i.e. which combination of taxes or subsidies are changed). We simulate a number of alternative financing arrangements with the program being financed either by reducing existing subsidies or by increasing value-added tax (VAT) rates differently. In reality the program was delivered only to rural areas and financed by a reduction in subsidies.³

In order to identify the general equilibrium effects identified above, we use a computable general equilibrium model (CGE) for Mexico - the structure of this model is explained in detail later. We use a *two-step* approach. First, the transfers are fed into the model and we consider alternative market structures and budget-closure rules. Then the resulting direct and indirect income effects, as well as the price changes, are taken from the CGE and, together with disaggregated household data, are used to calculate the impact on social welfare within the standard theory of social welfare.⁴ In Appendix A we show that the welfare impact (dW) can be calculated as:

$$dW = \sum_h \hat{a}^h y^h [\tilde{a}^h + \ddot{o}^h - \sum_i \dot{e}_i \tilde{n}_i] \quad (1)$$

where y^h is total income of household h , \hat{a}^h is the social valuation of extra income to household h , \tilde{a}^h and \ddot{o}^h are the proportionate changes in household income brought about by the direct transfers and indirect income effects respectively, \tilde{n}_i the proportionate change

³ In order to address the issue of program expansion to urban areas, we also simulated an alternative program which is delivered to both rural and urban areas and is financed by both a reduction in subsidies and also by an increase in VAT rates. In order to save space we do not present these here, but see Coady and Harris (2000) for details.

⁴ See Drèze and Stern (1987) for a more detailed and complete description of such a model.

in the price of commodity i , \hat{e}_i^h is the share of expenditure on commodity i in the total expenditure of the household, and we use the condition $\mathbf{p} \cdot \mathbf{x}^h = y^h$. The term in brackets can be interpreted as the proportionate change in real incomes (i.e. nominal incomes minus a cost-of-living index). These proportionate changes are outputs from the CGE model and are then applied to household-level data.

In order to apply the above approach, one needs to specify the term \hat{a}^h . This can be calculated as:

$$\hat{a}^h = (y^k / y^h)^{\hat{a}}$$

where y^k is the income of a reference household (for which $\hat{a}^k=1$) and \hat{a} can be interpreted as an "inequality aversion" parameter with concern for inequality increasing with \hat{a} . For example, with $\hat{a}=0$ all welfare weights take the value unity so that extra income to all households is considered equally socially valuable. With $\hat{a}=1$, the social value of extra income to a household with twice the initial income of k is considered only as half as socially valuable as extra income to k . This welfare weight decreases to a quarter when $\hat{a}=2$ and so on.⁵

In Appendix A we also formally decompose the indirect welfare effects into three components: the redistribution, reallocation and distortionary effects. The latter two effects can be interpreted as efficiency effects. Here we present a very simple model which helps to bring out the main points and to motivate the results presented later.⁶ The welfare impact of the program can also be written as:

$$dW = \sum_h \hat{a}^h dm^h - \bar{e} \sum_h dm^h \quad (2)$$

⁵ See Myles (1995, pp114-5) for more discussion.

⁶ See Coady and Drèze (2000) for a more detailed discussion of the literature on optimal taxation.

where dm^h is the direct cash transfer to household h , $\sum_h dm^h$ is the program budget, \hat{a}^h the social valuation of this transfer, and \ddot{e} the social cost of raising the money to finance these transfers (or the so-called "cost of public funds"). The first term on the r.h.s. is then the direct welfare impact and the second is the indirect welfare impact of the program. The sign of the indirect effect is determined by the sign of \ddot{e} . If the government is unconcerned about income distribution (e.g. either because incomes are already equalized or $\hat{a}^h=0$) then $\hat{a}^h=1(=\hat{a})$ for all households. If, in addition, the transfers (and other government revenue needs) are financed by non-distortionary lump-sum taxes then we have $\hat{a}=\ddot{e}=1$. The program then results in no overall change in welfare.

However, if instead the transfers have to be financed by introducing distortionary taxes then we have $\hat{a}=1$ and $\ddot{e}>1$ so that the net welfare impact is negative due to an indirect distortionary effect capturing the so-called "deadweight losses" associated with taxes. If distortionary taxes already existed then the sign of \ddot{e} will depend on whether these were optimally set or not and which taxes (subsidies) are increased (decreased) to finance the program. If initially taxes were set optimally then $\ddot{e}>1$ and welfare decreases.⁷ If instead the program is financed by the removal of distortionary subsidies then $\ddot{e}<1$ and welfare increases. If initially taxes were not set optimally then $\ddot{e}>1$ ($\ddot{e}<1$) if the program is financed by raising taxes which were initially too high (low). In the presence of an inefficient tax structure one also gets reallocation effects if income elasticities differ across those receiving and financing the budget. For example, if the poor (who receive transfers) have a relatively high propensity to consume highly taxed commodities from extra income then this will decrease \ddot{e} since the net revenue costs of financing the program will be lower.

Even if the two efficiency effects are zero (e.g. due to the availability of lump-sum transfers), \ddot{e} can still differ from unity if income distribution is sub-optimal. If, in such a

⁷ Optimal taxation requires that, for all taxes under the control of the policy maker, the deadweight loss from raising extra revenue (i.e. \ddot{e}) is equalized across all tax instruments.

situation, the incidence of taxation falls on relatively low-income (high-income) households then $\ddot{e} > 1$ ($\ddot{e} < 1$) reflecting a higher (lower) social cost of raising revenue. The belief that $\ddot{e} < 1$ is obviously the central motivation for the program in the first place.

We are interested in determining the overall welfare impact of the actual transfer program but also in comparing across alternatives. The actual program is the transfer program financed by a reduction in food subsidies. The alternatives reflect alternative financing scenarios, namely, alternative reforms of the VAT system. In order to motivate the manner in which we present our results, it is useful to rearrange equation (2). Since the direct welfare impact is common across all (i.e. the actual and alternative) programs, one can equivalently compare the welfare impacts by comparing the benefit-cost ratios of programs defined as:

$$\dot{e}_j \equiv \frac{\sum_h \hat{a}^h dm^h}{\ddot{e}_j \sum_h dm^h} = \frac{\sum_h \hat{a}^h \acute{a}^h}{\ddot{e}_j} = \frac{\ddot{e}_D}{\ddot{e}_j}$$

where \ddot{e}_j is the social cost of raising the revenue to finance the program (i.e. one for each of the actual and alternative financing strategies, j), \acute{a}^h is the transfer received by household h as a proportion of the transfer budget, and \ddot{e}_D is a weighted average of household \hat{a} s since $\sum_h \acute{a} = 1$. One can also interpret \ddot{e}_D as the welfare impact of the direct transfers and \ddot{e}_j as the welfare cost of the indirect income effects.⁸ In principle one should choose the program with the highest $\dot{e}_j > 1$, i.e. conditional on benefits exceeding costs one chooses the program which exhibits the lowest social cost of delivering these benefits.

⁸ Strictly speaking these are marginal welfare effects so that the total welfare effects are derived as $(\ddot{e}_D - \ddot{e}_j)$ times the program budget. The term \ddot{e}_D is analogous to what is commonly referred to as the *distributional characteristic* of policy instruments or programs (Feldstein, 1972). In our case, as implicit in equation (1), we can also think of the direct and indirect income effects of the program as two separate programs (or program components) which can be evaluated separately. It is also straightforward to show that $\ddot{e}_T = \acute{a}\ddot{e}_D + (1-\acute{a})\ddot{e}_I$ where \ddot{e}_T is the welfare impact of the full program, \ddot{e}_I is the welfare impact (or distributional characteristic) of the indirect program component, and \acute{a} is the share of the direct income transfers in the total (i.e. direct plus indirect) income effect of the program. One can also easily show that $\dot{e}_I = \acute{a}\dot{e}_j$.

Or, in other words, $\bar{\epsilon}_j$ is the social return to every dollar raised to finance the program. Later we present results for $\bar{\epsilon}_D$, $\bar{\epsilon}_j$, and $\bar{\epsilon}_j$ across alternative financing scenarios and different degrees of aversion to inequality (i.e. values of $\bar{\alpha}$).

Section 3: The CGE Model

In this section we discuss the nature of the CGE model which is used to simulate the general equilibrium responses to the program.⁹ We start by describing the database which links the various sectors of the economy and determines the channels through which the general equilibrium effects work. We then discuss the way in which factor and product markets operate and interact to determine how equilibrium is restored after the program is implemented. This is followed by a brief discussion of the various policy simulations undertaken in the subsequent section, concentrating mainly on the nature and magnitude of the resulting sectoral and macroeconomic flows.

Section 3.1: The Database and SAM

The CGE model used in this analysis relies on a social accounting matrix (SAM) of Mexico, based on 1996 data.¹⁰ The SAM accounts for all income and expenditure transactions of all sectors and institutions in the national economy, and thus serves as the underlying data framework for the CGE model.¹¹ The data were first collected as a national SAM, which was then divided into 5 regions. The model is able to capture differences among the regions in terms of production and consumption patterns, in a “top-down” approach: rather than having complete regional SAMs, the model regionally

⁹ This model builds on the work of Harris (1999).

¹⁰The data used in constructing the SAM include: “Sistema de Cuentas Nacionales de México,” INEGI, 1996, for national accounts data and other macro data; Informe Anual, Banco de México, 1996 for macro data; SAGAR, 1996 for data on crop yields and land utilization; Encuesta Nacional de Ingresos y Gastos de Hogares, INEGI, 1994, for household income and expenditure data; GTAP database for import and export data. The input-output coefficients come from a 1985 input-output table.

¹¹For a detailed discussion of SAMs, see Pyatt and Round (1985).

disaggregates the national SAM only by production and factor markets as well as households.

The model includes four rural regions, North, Central, Southwest and Southeast, which produce only primary agricultural products. There is one “national” urban region, which comprises all of the urban areas of Mexico, regardless of geographical location. The urban area produces processed agricultural goods and other goods and services.

Appendix Table 1 shows which states are in each rural region. Generally, the North region produces more high-valued agriculture, in particular fruits and vegetables, much of which is exported. Agriculture production relies on more irrigated land use, and households are wealthier. The Southeast region is poorest, more of the land used is non-irrigated, and there is less commercial farming. The Central and Southwest regions are a mixture of the first two, with a range of subsistence and commercial farming and agricultural technology. These two areas also produce the largest amounts of basic grains and beans.¹²

The SAM and CGE model permit the regionalization of agriculture. Each rural region produces 6 agricultural activities: maize, wheat, other grains, beans, fruits and vegetables, and other crops. The models allows for multiple production activities to produce one national commodity. For example, all four rural regions produce the maize activity, which is supplied to a single national maize commodity market. Thus there are 24 agricultural *activities* but 6 agricultural *commodities*. A given sector’s production is differentiated among the regions according to output levels and technology (in terms of factor and input usage). The livestock/forestry/fishery sector is not regionalized, due to data limitations. The urban region produces all other goods, including processed agricultural goods. Appendix Table 2 lists the sectors used in the model.

¹² See Coady and Harris (2000) for an analysis of the regional distribution of welfare and poverty before and after the program.

There are 4 types of non-agricultural labor: professional, white-collar, blue-collar, and unskilled/informal (referred to in this paper as unskilled), and four agricultural labor categories, differentiated by region. The agricultural activities employ only agricultural labor and non-agricultural activities do not use any agricultural labor. Each rural region uses two types of land, irrigated and non-irrigated, for a total of 8 land types. There is one capital category, used by all sectors. The model may be thought of as medium-term in nature, since labor is mobile across sectors, but capital and land are not.

Each region has 3 households, defined as poor, medium or rich according to the income tercile into which they fall. The delineation among the categories comes from national data. In this way, distributional impacts of different scenarios can be observed among income groups as well as among the regions. The rural regions get labor income from all labor types, distributed according to national survey data. Poor rural households receive 45% of the agricultural returns to dry land in their region, while medium rural households receive 55% of dry land income. All of the irrigated land payments go to the rich households. The land returns (to dry land) for the livestock/forestry/fishery sector are split among the medium and rich rural households. Rural households also receive capital income indirectly through enterprises. This income is calculated as the residual between income and expenditure. Urban households do not receive any income from agricultural labor; the other labor categories distribute payments to the households according to shares given in the national survey. Urban households do not receive any land income and, like their rural counterparts, receive capital payments via the enterprise account.

Household consumption patterns also come from the survey data. Rural households have home consumption of the agricultural goods produced in their respective regions; all other goods are bought on the national market. All households save according to parameters estimated from household survey data.

The government and the enterprise account already alluded to are the other domestic

institutions in the SAM. The government, which is national, collects seven types of taxes: a value-added tax, a producer tax, an export tax, a sales tax, an import tariff, a payroll tax and an income tax. It receives transfers from the rest of the world and provides transfers to households and enterprises. The rest of the world account provides transfers to households, buys Mexico's exports, and sells its imports.

With the data for the SAM coming from so many disparate sources, it is not surprising that its initial construction was neither balanced nor consistent. The SAM was therefore balanced using maximum entropy techniques to incorporate prior knowledge in a consistent way.¹³ In Appendix Table 3 we present some useful summary statistics of the data used in the analysis.

Section 3.2: Description of the CGE Model

The computable general equilibrium model used in this study follows the sectoral and socio-economic structure of the SAM described above. The CGE model is neo-classical in spirit, with agents responding to price changes. The model is Walrasian, determining only relative prices. Product prices, factor prices and the equilibrium exchange rate are defined relative to the consumer price index, which serves as the price numeraire. The country is "small" in the sense that it takes world prices as given.

The production technology is a nested function of constant elasticity of substitution (CES) and Leontief functions. At the top level, domestic output is a linear combination of value added and intermediate inputs. Value added is a CES function of the primary factors of production (the land types, labor types and capital mentioned above) and intermediate input demand is determined according to fixed input-output coefficients. The commodity output is a composite of different activities, which are imperfectly substitutable: thus this framework allows multiple activities to produce one commodity, as discussed in the SAM description. Producers decide to supply their output to either the

¹³ For discussion on this technique, see Robinson *et al* (1998).

export or domestic market according to a constant elasticity of transformation (CET) function, which permits some degree of independence from international prices. The composite consumption good is a CES function of imported and domestically produced commodities. This aggregation, known as the Armington function, permits imperfect substitutability, and therefore, two-way trade, between imported and domestically produced goods.

Households receive income from factor payments (land, labor and capital payments) net of factor taxes, government transfers, and transfers from the rest of the world. They consume goods according to a linear expenditure function (LES), purchasing goods from the market as well as from home production (in rural areas only). They also pay taxes on their monetary income and save a share of their total income. Enterprises serve as the conduit between the capital factor account and the other institutions (households, government and rest of the world). They receive capital income minus capital payments to the rest of the world, as well as government transfers. Enterprises transfer that payment, net of depreciation and taxes, to households. Government income is the sum of all taxes: direct taxes on households and enterprises, value-added taxes, producer taxes, import tariffs, export taxes, social security taxes and sales taxes. The government consumes commodities according to fixed shares (given in the SAM) and also spends money on producer subsidies, transfers to domestic institutions, and transfers to the rest of the world.

Macro closure refers to the four macroeconomic accounts which must be balanced in the CGE model: the current account with the rest of the world, the government account, the savings-investment account, and the factor markets. In each condition, there are variables which serve to equilibrate the equation. The current account can be balanced by either the foreign savings variable or the exchange rate. This study chooses the latter, so that the welfare analysis is not based on changes in foreign inflows. The choice of government budget closure will depend on the simulation being performed; in all cases,

government savings (or dissavings, as the case may be), will be held fixed, as will real government spending. One of the tax instruments will be free to adjust to keep government savings at its base-line level. This will allow us to perform government budget-neutral experiments without having government purchases of goods and services affect the welfare analysis. Similarly, in the savings-investment balance, real investment will be held fixed, and the marginal propensity to save equilibrates the account. In the factor market equilibria, either a factor is immobile and the wage can vary across sectors or the factor is free to move and the wage fixed across sectors. Here, labor is mobile and capital is fixed. Land is mobile across the sectors within its region. Appendix B contains a complete listing of the CGE equations.

Section 3.3: General Equilibrium Simulations

In this section we briefly discuss the impact of each PROGRESA experiment on macroeconomic, sectoral and regional flows. Two different types of simulations are performed with the CGE model to experiment with different ways of raising the money needed to pay for the current PROGRESA transfer program. In the first, consumer subsidies are removed to finance the transfer. The second set of simulations experiments with different types of value-added tax (VAT) reforms.

In the base-run, the government deficit is \$12 billion.¹⁴ The CGE model is programmed to keep this number constant. In each simulation, the method of “closing” the budget must take into account the general equilibrium consequences of the transfer. For example, although the direct cost of the PROGRESA program is \$57 billion, it may be that increased (or decreased) tax revenues from the second-round effects of the transfer decrease (or increase) the amount of revenue the government needs in order to keep its budget constant. The model adjusts for this through one of the equilibrating tax variables, specified below. The results (i.e. proportional income and price changes), used for our following discussion of the channels through which general equilibrium effects flow

¹⁴Note that we will follow the convention of using "\$" to signify Mexican pesos.

under the various scenarios, are presented in Table 1.

Subsidies

In the base run of the model, subsidies on *Manufactured Maize*, *Manufactured Wheat* and *Dairy Manufacturing* imply a consumer subsidy on these goods of 25%, 20% and 20%, respectively.¹⁵ These subsidies cost about \$58 billion, so their removal can be used to finance the PROGRESA transfer. In the experiment, the income tax, which is modeled as a lump sum tax, serves as the equilibrating variable for the government budget and it falls slightly. Removing the distorting subsidies causes a slight improvement in the macroeconomic accounts, with consumption increasing three-quarters of a percent and GDP and absorption rising by one-half of one percent.

At the the micro level, the decreased subsidies directly lead to decreases in production of the formerly protected goods, and as a consequence, the output of their intermediate goods (raw *Maize*, *Wheat* and *Livestock*, in particular) also falls. This causes resources to shift to the other agricultural goods, and in fact, overall agricultural output increases because resources are now allocated more efficiently. As a result, there is downward pressure on most agricultural factors of production — the exceptions are agricultural labor in the Central region, where the labor-intensive *Beans* production experiences a large increase in output, and irrigated land in the Southeast region, where *Other Crops* has a relatively larger increase in output. The fact that most rural factors now receive lower payments explains in large part the decline in non-beneficiary rural household income as well as why beneficiary households end up receiving less than the full amount of the income transfer.

The urban area's production contracts by ½ percent point as a result of the policy. This is

¹⁵ In 1996, the base year of the model, most consumer subsidies had already been abolished. This model augments the subsidies on these three goods in an attempt to recreate the pre-reform environment and show the effects of removing those subsidies in order to pay for the PROGRESA transfer, as did occur in reality.

mainly due to the decrease in production of the processed foods which were formerly protected. Thus, all urban factors of production receive lower payments, which leads to a decline in urban household incomes. This also negatively impacts rural households due to their reliance on urban factor income.

Value-Added Taxes

The base data has three levels of the value added tax (VAT)¹⁶: all raw agricultural goods, processed agricultural goods, and food have a VAT rate of zero; the "middle" VAT rate is imposed on *Light Manufacturing, Intermediate Goods, and Professional Services* at 5%; and the "high" VAT rate is on *Capital Goods, Consumer Durables, Construction, and Commerce, Trade and Transportation*, equalling 10%. The VAT is adjusted in five ways to raise the revenue needed to fund the PROGRESA transfer. In the first experiment (PVAT), the VAT is raised proportionally on all goods, which causes the middle VAT rate to increase to 7.3% and the higher rate to increase to 14.6%. Next, the VAT is increased only for those goods with the upper rate, rising to 16.1% (HVAT). Thirdly, the VAT is increased and made uniform for the goods which initially had a VAT imposed on them, with the resulting new rate equal to 11.4% (TVAT). Then, the VAT is increased and made uniform for the goods which initially had either zero VAT or the middle rate, so that these goods are now subject to a 7.2% VAT, while the high VAT rate remains at 10% (BVAT). Finally, the VAT is adjusted so that it is uniform for *all* goods, including the ones which were previously exempt, for a single VAT rate of 8.3% (SVAT). See Table 2 for a summary of these experiments.

Two of the VAT experiments slightly improve the macroeconomic indicators, namely, the uniform increase of the zero and low VAT goods (i.e. BVAT), and the uniform increase of all goods (i.e. SVAT). The resulting VAT structures from these experiments

¹⁶ These data do not reflect actual VAT rates exactly because they are imposed on composite production goods, the individual components of which may have different rates and may include exports (which are zero-rated). Thus the rates must be interpreted as *average* VAT rates for these aggregated sectors.

are less distorting than the other experiments. On the other hand, because these two VAT changes increase the VAT rate on agricultural products, agricultural factors of production suffer from lower returns. For example, when the VAT is made uniform for all activities, agricultural wages fall by between 7.6% to 8.9%, and land returns fall by between 8.2% to 10.6%. This then dampens the income gains to recipient households, by about 5.5% to 6.5% percent in either experiment. The increase in the VAT for the sectors which originally had a low VAT decreases payments to the urban factors, which hurts both urban and rural household income.

The other three VAT experiments are more inefficient, as evidenced by the slight decline in macroeconomic indicators. However, since raw agricultural production and processed agriculture is not taxed, the increased demand for these products raises the agricultural wages in all three experiments. This does not imply that beneficiary household incomes increase beyond the transfer payment, because of their reliance on urban factor income. The VAT lowers urban wages by more in these scenarios, because urban sector production is harder hit, and this negatively impacts all rural households, including the beneficiaries. However, their income changes are still higher than in the two VAT simulations mentioned above. And, as expected, urban households see even greater decreases in their income with the more distorting VAT systems, since the VAT rates are now higher for the goods from which they receive factor income.

Section 4: Simulations and Results

In this section we very briefly describe our policy simulations and then evaluate their impacts on welfare. As mentioned earlier, this involves taking the indirect welfare impacts from the CGE analysis and superimposing them on the household-level data. The program is modeled as a poverty alleviation program which transfers income to "poor" households in rural areas, equivalent to a 30% increase in their nominal incomes and 2% of GDP. The total welfare impact of such a program will depend on how it is financed and we consider a number of alternatives. The actual source of finance is the

elimination of food subsidies. The other alternatives considered involve various reforms of the value-added tax (VAT) system. The present VAT system is modeled as having three rates: 0%, 5%, and 10% on agriculture/processed foods, light manufacturing/intermediate goods, and consumer durables/capital goods respectively. We consider the following alternatives to finance the program:

- (i) *Proportional Increase*(PVAT): in all VAT rates to 0%, 7.5% and 15% respectively.
- (ii) *Increase High Rate* (HVAT): from 10% to 16%.
- (iii) *Uniform Top Rate* (TVAT): with the top two rates made uniform at 11%.
- (iv) *Uniform Bottom Rate* (BVAT): with the bottom two rates made uniform at 7%.
- (v) *Uniform Single Rate* (SVAT): with an 8.3% rate on all goods.

The basic approach is to compare the social costs of raising the necessary revenue to finance the program (the "cost of public funds", \ddot{e}_j) with those of the actual financing instrument, i.e. the elimination of food subsidies, as well as with the program benefit (i.e. \ddot{e}_D).

The results of our simulations are presented in Table 3. We start by comparing the cost of public funds across alternative financing packages for $\alpha=0$, i.e. where we are concerned only with the efficiency aspects of the program and not with its impact on the distribution of income or poverty. It is clear that, from an efficiency perspective, financing the program by reducing subsidies dominates with the cost of raising \$100 being only \$62. In other words, every \$100 raised to finance the program increases welfare (and GDP) by \$38. These substantial welfare gains result from the elimination of a highly distortionary subsidy. This compares extremely favorably with the alternative forms of VAT financing.

Two of the VAT alternatives, i.e. SVAT and BVAT, also result in welfare gains, with the cost of raising \$100 being \$95 if financed by a move to a single uniform VAT rate or \$97 if financed by a move towards a uniform VAT rate in the place of the bottom two rates. These efficiency gains arise from the reform in the VAT structure. In general, the

inefficiency associated with a tax system is minimized by having relatively higher rates on commodities with relatively low own-price elasticities of demand.¹⁷ Since basic food items tend to have low price elasticities, shifting taxes towards these commodities will tend to increase welfare and this is what happens in both the case of SVAT and BVAT. Our results tell us that the gains resulting from thus reforming the VAT structure outweigh the welfare losses from the higher average rate required to finance the program.

The other VAT alternatives considered all have a cost of public funds greater than unity, ranging between \$105-\$107 per \$100 of revenue raised. All of these involve an increase in the VAT rates of one or both of the top two VAT rates and the commodities falling within these rates tend to be the most price elastic. These welfare losses mean that, in the absence of any social value being attached to any improvement in the income distribution, such a program would be welfare decreasing. However, not only are distributional concerns the motivating force for the program in the first place, but they also tend to be the motivation behind tax structures which exhibit high tax rates on low price-elastic luxuries typically consumed disproportionately by higher-income households. Therefore, any evaluation of the program should explicitly address this issue.

Introducing distributional concerns involves analyzing the results for values of $\alpha > 0$. The cost of public funds for a number of financing instruments is presented in Figure 1a: in order to avoid clutter we focus on only three of the VAT alternatives, i.e. the most inefficient system (HVAT) and the two most efficient systems (BVAT and SVAT), along with subsidy financing. The first thing to notice is that once we introduce even a little concern for income distribution (e.g. $\alpha = 0.5$) the cost of raising a peso becomes substantially less than one peso for all financing instruments. This reflects the fact that the indirect income effects are distributed in favor of the poor at the expense of the non-

¹⁷ We are implicitly assuming that cross-price elasticities are zero or sufficiently small as to make this general rule of thumb valid. See, for example, Coady and Drèze (2000) and Myles (1995) for more detailed discussion.

poor. The second thing to notice is that the relationship between the cost of public funds and α is U-shaped, with the former beginning to rise after $\alpha=1$. Eventually, at around $\alpha=3$, the cost of public funds goes above unity. This pattern indicates that although the poor as a whole benefit from the indirect effects, the poorest of the poor do not, and the greater the weight we place on the income of the poorest the higher the social cost of raising revenue through the alternative VAT instruments.

Introducing distributional concerns into the analysis also changes the ranking of VAT instruments. This is brought out in Figure 1b where we plot the cost of public funds for $\alpha=0$ to $\alpha=3$. At $\alpha=0$ the cost is highest for HVAT and lowest for SVAT. However, by $\alpha=0.5$ SVAT is replaced by BVAT as the least costly alternative and by $\alpha=2$ SVAT replaces HVAT as the most costly alternative. Therefore, although SVAT is the most efficient form of VAT financing it becomes the least attractive form of financing when one has a high degree of aversion to inequality or severe poverty.

Although the cost of financing the program through reducing subsidies follows the same U-shaped pattern, it remains the most attractive form of finance throughout. In fact, for higher values of α , it also appears to be the least regressive form of financing. This is brought out clearly in Figure 2 which shows the benefit-cost ratios (BCRs) across the instruments discussed above. The higher the value of α the more attractive subsidy reductions look relative to VAT financing. For example, at only moderate levels of aversion to income inequality, the BCR with subsidy financing is about four, i.e. every \$100 raised to finance the program increases welfare by \$400, a very high social return by any standard. But even the BCRs for VAT financing increase with α reflecting the targeting of the transfers at poor households. This brings out one of the main attractions of the program, i.e. the fact that it is very efficiently targeted. More generally, it indicates the potential return in welfare terms from introducing a more efficiently targeted transfer program. The presence of such a program enables one to design a more efficient tax system by lessening the need to trade-off efficiency goals against equity objectives, e.g.

by reducing the need for high subsidies on necessities or high taxes on price-elastic luxuries which exist for equity reasons.

Section 5: Summary and Conclusions

Most analyzes of the welfare impact of cash transfers have essentially been undertaken within a partial equilibrium framework which focuses exclusively on the direct effect of the transfers on the beneficiaries. In this paper we emphasize the need to take a general equilibrium perspective of the program. In particular, we focus in on the indirect welfare effects which arise from the need to finance the program domestically. This focus is motivated by the belief that any credible poverty alleviation strategy must have underlying it a credible financing strategy.

Both in the body of the report and more formally in the appendices, we show how the indirect effects arising from the need for domestic financing can be separated into three components: (i) the *redistribution effect* due to some households being taxed to finance the transfers to households, (ii) the *reallocation effect* which results when those financing the program have different consumption patterns (or income elasticities) from those receiving the transfers so that there is a second-round effect on government revenue when taxes differ across commodities, and (iii) the *distortionary effect* which arises when the program is financed by manipulating distortionary taxes and subsidies. The first effect can be viewed as capturing the equity implications of the program and the last two effects as capturing the efficiency implications.

The approach taken in our analysis is to model the indirect income effects arising from the cash transfers using a computable general equilibrium model of the Mexican economy. We then super-impose both the consequent direct and indirect income effects onto a household-level data set and calculate the resulting welfare effects within a standard social welfare framework. We do this for a number of policy scenarios involving the elimination of food subsidies and various reforms of the structure of value-

added taxes (VATs). The actual program was financed by the elimination of subsidies and the various forms of VAT financing can then be interpreted as alternative financing strategies which can be compared to the chosen one.

In presenting the results of our simulations we show how the three separate components of the indirect income effects can be subsumed within one parameter, the *cost of public funds*. This term represents the welfare cost of financing the program and should be compared to the welfare benefit from the transfers. These costs and benefits will obviously depend on how society values extra income to different (e.g. extremely poor, moderately poor, and non-poor) households. We start by ignoring welfare gains arising from the redistribution of income, i.e. we assume that income to all households is seen as being of equal social value. In this case the redistribution effect is zero so that the underlying cost of public funds captures the efficiency (i.e. reallocation and distortionary) effects associated with financing the transfers.

Our results show that financing the program through the elimination of distortionary food subsidies is associated with a substantial welfare *gain*, with the cost of raising \$100 being only \$62. In other words, even if we do not attach any social value to the redistribution of income such a cash transfer program is welfare improving. Among the VAT reforms considered, only the two alternatives which shift taxes towards price inelastic commodities show welfare gains. Nevertheless, these gains are much smaller than those associated with subsidy elimination. These welfare gains result from the reform of the VAT structure with a shift of taxes towards relatively price inelastic commodities, this being a more efficient structure for raising revenue. The other three VAT alternatives, which increase taxes on relatively price elastic commodities, have welfare costs of between \$105-\$107 per \$100 raised.

The whole motivation of the transfer program is, of course, the underlying belief that there are welfare gains associated with the redistribution of income to lower-income

households. The existing VAT structure with zero rating of price inelastic necessities (such as basic and manufactured foods) consumed disproportionately by low-income households and higher rates on price elastic luxuries (such as consumer durables) consumed disproportionately by higher-income households, is presumably motivated by similar equity objectives. It is not surprising then that when we allow for such concerns the welfare impact of the program increases substantially. Not only does the benefit of the program increase but the cost of raising this revenue decreases.

At only moderate levels of aversion to income inequality, the benefit-cost ratio increases for all instruments, but is especially high for subsidies. This high return reflects the efficient targeting of transfers to poor households and the fact that the non-poor bear the brunt of the withdrawal of food subsidies. However, it does appear that while the poor as a whole do not bear the brunt of the subsidy withdrawal, the poorest of the poor do lose out. Thus, as we place a relatively higher social value on income to the poorest households we find that the cost of raising a unit of public funds begins to increase. But because of the efficient targeting of transfers the social benefit of the transfers increases by even more so that the benefit-cost ratio for the program increases systematically as our concern for the poorest households increases. This pattern also holds for all of the VAT financing alternatives, but these are always clearly dominated by subsidy financing. The results from our simulations therefore clearly bring out the welfare gains from introducing a new efficiently targeted redistributive program; not only are the benefits from more efficient targeting substantial but they are reinforced by the welfare gains from being able to reform the existing system of subsidies and taxes to reduce the underlying trade-off between equity and efficiency. The previous system of food subsidies and zero rating of foods had a high efficiency cost because of the need to address equity concerns.

It is clear from our results that the cost of financing transfer programs may be reduced substantially through appropriate reform of the supporting tax system. Where the existing system is very inefficient and where it takes time to develop the institutions necessary to

implement a more efficient system, there may be a strong argument for financing such poverty alleviation programs through borrowing. The desirability of such an outcome is reinforced when the economy is expected to grow strongly over time so that future generations are better off. In the absence of reform, the attractiveness of such programs hinges on their targeting efficiency which enables a given level of poverty reduction at a lower revenue cost. In very poor countries with low tax bases the social costs of taxation may be very high so that one can only improve the distribution of income by making everyone poorer. Without any prospects of growth the only sustainable poverty alleviation strategy may have to be based on foreign aid aimed at stimulating investment and growth.

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Table 1a—CGE Changes in Nominal Income (% from base)

Households	Transfer ¹	Subsidy	VAT adjustments ²					
			PVAT	TVAT	SVAT	HVAT	BVAT	
North								
Poor	30	26.2	24.61	23.97	23.65	24.93	23.91	
Medium		-4.61	-2.58	-3.08	-4.81	-2.24	-4.43	
Rich		-8.62	-0.46	-1.72	-9.22	0.17	-7.79	
Central								
Poor	30	28.15	25.64	24.7	24.24	26.08	24.65	
Medium		-3.07	-2.55	-3.16	-4.64	-2.19	-4.25	
Rich		-8.64	1.16	0.46	-7.04	1.5	-5.81	
S.West								
Poor	30	26.62	26.16	24.98	23.03	26.66	23.73	
Medium		-3.34	-2.87	-3.7	-5.5	-2.49	-4.96	
Rich		-3.9	-3.79	-4.41	-6.5	-3.55	-5.99	
S.East								
Poor	30	27.14	26.19	25.14	23.89	26.73	24.43	
Medium		-2.93	-3.31	-3.96	-4.46	-2.89	-4.2	
Rich		-1.91	-3.1	-3.97	-3.8	-2.62	-3.52	
Urban								
Poor		-1.85	-4.31	-4.73	-3.52	-4.04	-3.55	
Medium		-1.62	-3.76	-4.1	-3.08	-3.59	-3.1	
Rich		-1.47	-3.27	-3.55	-2.55	-3.2	-2.58	

Note:

¹ The program gives cash transfers to poor households in rural areas, equivalent to a 30% increase in nominal incomes. Poor, medium, and rich correspond to income terciles.

² See Table 2 for an explanation of VAT experiments.

Table 1b— CGE Changes in Factor Prices (% from base)

Factors	Subsidy	VAT adjustments ¹				
		PVAT	TVAT	SVAT	HVAT	BVAT
Labor						
Agr-North	-8.43	2.66	2.14	-8.93	2.94	-7.30
Agr-Central	6.64	1.16	0.68	-7.57	1.40	-6.32
Agr-Southwest	-5.54	2.25	1.73	-8.82	2.52	-7.25
Agr-Southeast	-3.53	1.97	1.42	-8.77	2.26	-7.24
Professional	-1.16	-3.13	-3.77	-3.46	-2.90	-3.24
White Collar	-1.00	-3.19	-3.36	-2.52	-3.20	-2.55
Blue Collar	-1.44	-2.93	-2.98	-2.62	-3.02	-2.64
Unskilled	-1.38	-2.78	-2.90	-3.28	-2.82	-3.16
Land						
Dry-North	-12.11	4.09	3.67	-8.18	4.29	-6.46
Dry-Central	-9.70	3.37	2.86	-8.93	3.63	-7.19
Dry-Southwest	-14.43	4.47	3.97	-8.38	4.73	-6.58
Dry-Southeast	-7.46	2.64	2.09	-8.73	2.94	-7.12
Irrig-North	-12.87	3.10	2.53	-9.47	3.41	-7.70
Irrig-Central	-15.06	2.48	1.88	-10.32	2.82	-8.53
Irrig-Southwest	-18.21	2.93	2.33	-10.55	3.27	-8.67
Irrig-Southeast	2.54	-0.40	-1.00	-9.64	-0.08	-8.31
Capital	-1.67	-2.96	-3.40	-2.71	-2.86	-2.60
Exchange Rate ²	0.99	1.01	1.00	1.00	1.01	1.00

Note:

¹ See Table 2 for explanation of VAT experiments.

² An increase in the exchange rate is a depreciation.

Table 2— Description of VAT Experiments

VAT Experiment	Description	Low Rate ^a (%)	Middle Rate ^b (%)	High Rate ^c (%)
Base	--	0.0	5.0	10.0
PVAT	proportional increase in Base VAT rates	0.0	7.3	14.6
HVAT	increase in High Rate only	0.0	5.0	16.1
TVAT	uniform top rate	0.0	11.4	11.4
BVAT	uniform bottom rate	7.2	7.2	10.0
SVAT	single rate	8.3	8.3	8.3

Note:

^a Low Rate is applied to all raw agricultural, processed agricultural and other food activities.

^b Middle Rate is applied to *Light Manufacturing, Intermediate Goods, and Professional Services* activities.

^c High Rate is applied to *Capital Goods, Consumer Durables, Construction, and Commerce, Trade and Transportation* activities.

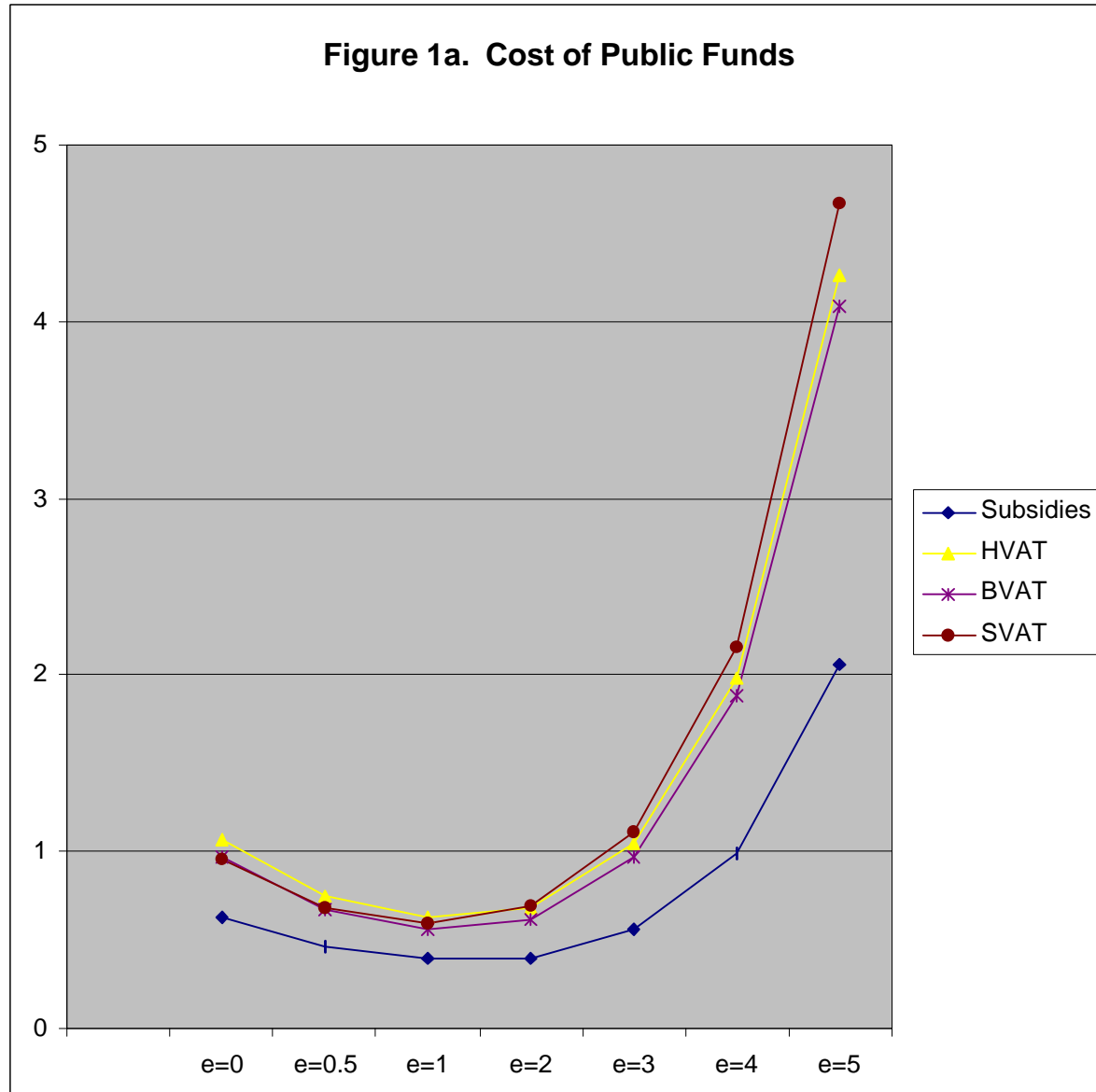
Table 3—Social Cost of Public Funds

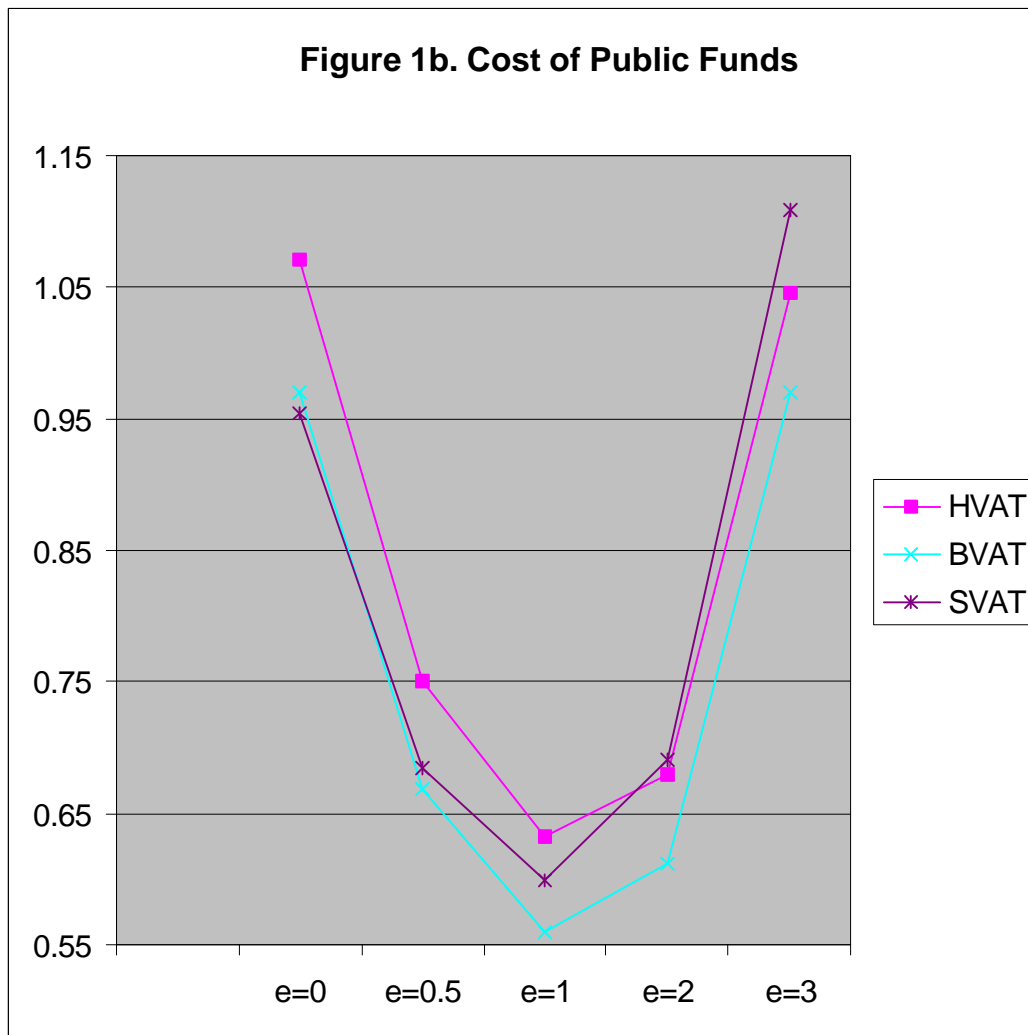
Inequality Aversion ²	Benefit (€ _D)	Cost of Raising a Unit of Revenue (€) ¹					
		Food Subsidies	PVAT (0,7.5, 15)	HVAT (0,5,16)	TVAT (0,11)	BVAT (7,10)	SVAT (8.3)
α=0	1	0.625	1.061	1.071	1.051	0.969	0.955
α=0.5	1.242	0.468	0.732	0.751	0.718	0.668	0.685
α=1	1.584	0.397	0.611	0.633	0.602	0.560	0.599
α=2	2.792	0.395	0.658	0.679	0.664	0.612	0.690
α=3	5.448	0.557	1.023	1.045	1.054	0.970	1.109
α=4	11.549	0.996	1.962	1.988	2.042	1.882	2.155
α=5	26.011	2.060	4.227	4.263	4.425	4.082	4.671

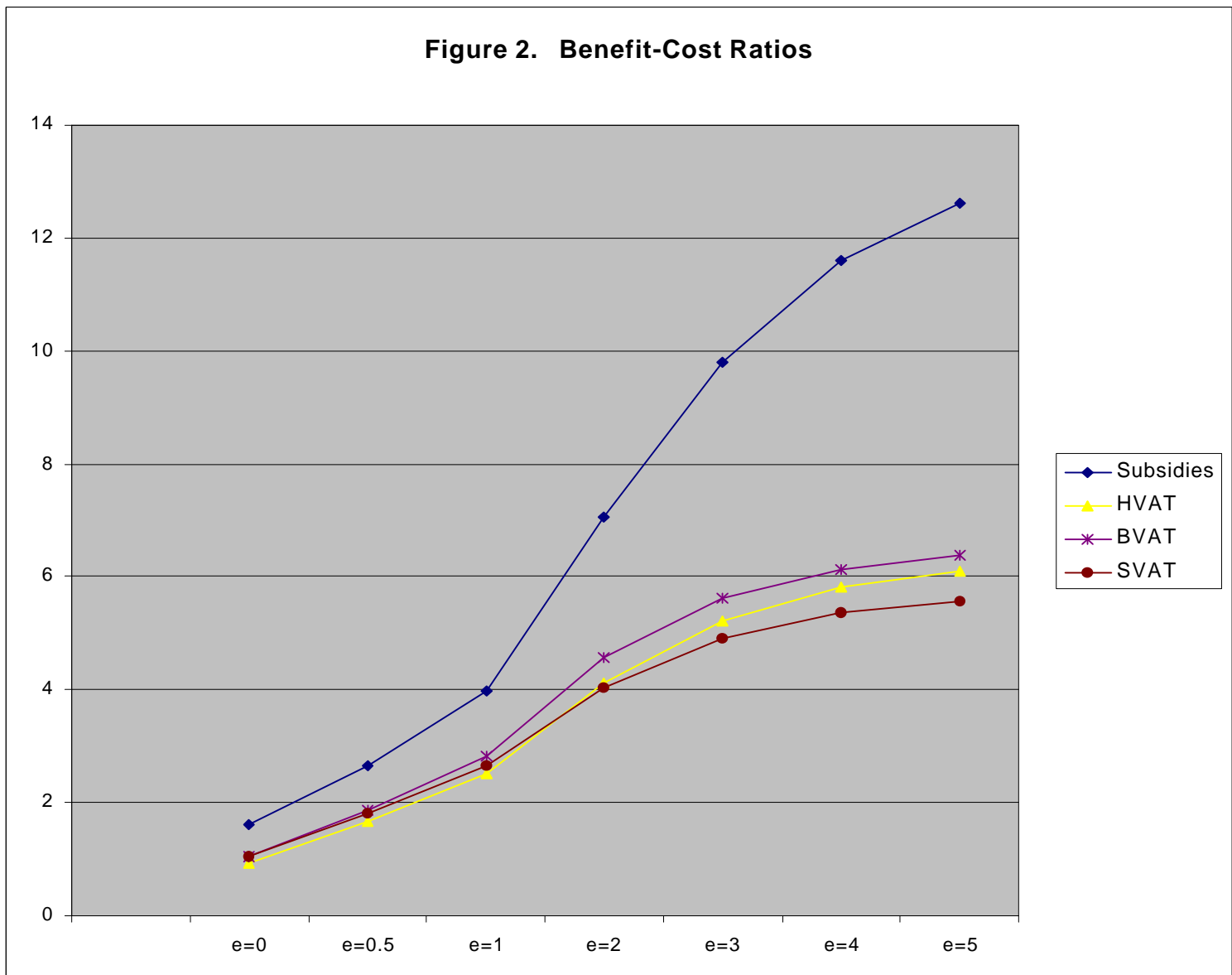
Note:

¹ See Table 2 for details of VAT structures before and after the program. The numbers in brackets indicate the rates after financing the program.

² The value α=0 indicates no distributional concerns with aversion for inequality captured by α>0, with α=5 incorporating the greatest concern for poorest households.







APPENDIX A

**Formal Derivation of Welfare Impact of Cash Transfers and
Separation into Redistribution, Reallocation and Distortionary Effects**

In this appendix we present a more formal discussion of the welfare impacts of cash transfer programs. Consider a simple economy made up of households, firms and the government. We assume that welfare of household h is captured by a standard indirect utility function, $V^h(\mathbf{q}, \mathbf{w}, m^h)$, where \mathbf{q} is a vector of commodity prices, \mathbf{w} a vector of factor prices, and m^h is household lump-sum income (including government transfers, r^h , and lump-sum taxes, T^h).¹⁸ The budget constraint for each household (denoted by h superscript) is then given by $\mathbf{q} \cdot \mathbf{x}^h = \mathbf{w} \cdot \mathbf{f}^h + m^h$ where \mathbf{x} and \mathbf{f} are the demand for final goods and the supply of factors respectively. Firms are assumed to operate under constant returns to scale so that supply is demand determined and profits are zero. The government's budget constraint is given by:

$$R \equiv \mathbf{t} \cdot \mathbf{x} + \hat{\mathbf{o}} \cdot \mathbf{f} - \sum_h \hat{Q}_h r^h + \sum_h \hat{Q}_h T^h$$

where \mathbf{t} and $\hat{\mathbf{o}}$ are vectors of taxes on commodities consumed and factors supplied by households respectively, and $\mathbf{t} = \mathbf{q} \cdot \mathbf{p}$ with \mathbf{p} being a vector of producer prices. Since producer prices are assumed fixed we have $d\mathbf{q} = d\mathbf{t}$.

The objective of the "social planner" is to introduce policy reforms which increase social welfare as captured by a conventional Bergson-Samuelson social welfare function:

$$W(V^1(\mathbf{q}, \mathbf{w}, m^1), \dots, V^h(\mathbf{q}, \mathbf{w}, m^h), \dots, V^H(\mathbf{q}, \mathbf{w}, m^H))$$

¹⁸ Throughout we use bold type to denote vectors (small letters) and matrices (capital letters).

defined over H households.¹⁹ The social welfare effects of income and price changes are calculated as:

$$dW = \sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial m^h} dm^h + \sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial q} dq + \sum_h \frac{\partial W}{\partial V^h} \frac{\partial V^h}{\partial w} dw$$

where the first term captures the direct welfare effect from income transfers and the final two terms capture the indirect welfare effects coming through the resulting general equilibrium changes in commodity and factor prices. Defining $\hat{a}^h \equiv (\partial W / \partial m^h)$ and using Roy's identity, this can be rewritten as:²⁰

$$dW = \sum_h \hat{a}^h dm^h + \sum_h \hat{a}^h de^h - \sum_h \sum_i \hat{a}^h x_i^h dq_i$$

where \hat{a}^h is the so-called social marginal utility of income to household h (or "welfare weight"), de^h is the change in factor incomes, x_i^h is the quantity of commodity i consumed by household h , and dp_i the corresponding price change. Multiplying and dividing both terms by total income y^h and the second term by q_i , this can be rewritten as:

$$dW = \sum_h \hat{a}^h y^h [\ddot{o}^h + \tilde{a}^h - \sum_i \dot{e}_i \tilde{n}_i]$$

where \ddot{o}^h and \tilde{a}^h are the proportionate changes in household income due to the direct transfers and indirect income effects respectively, \tilde{n}_i the proportionate change in the price of commodity i , \dot{e}_i is the share of expenditure on commodity i in the total expenditure of the household, and we use the household budget constraint. The term in brackets can be interpreted as the proportionate change in real incomes (i.e., nominal incomes minus a

¹⁹ This specification has important implications for the way in which we model the program below. In particular, the absence of public goods from the utility functions and the static nature of the specification means that to ensure consistency we must keep both the supply of public goods and investment constant in our CGE model.

²⁰ From Roy's identity the effect from dw (subsumed within dy) will depend on the level of factor supplies, i.e., $(\partial V^h / \partial \mathbf{w}) = \mathbf{f}^h$.

cost-of-living index). These proportionate changes are outputs from the CGE model and are then applied to household-level data.

In order to make explicit the three welfare impacts of the program (i.e., redistribution, reallocation and distortion), it is useful to formally derive the welfare impact of cash transfers within the above framework.²¹ The problem the "social planner" then faces is to redistribute resources using the most efficient policy instruments from among a set which includes, for example, commodity taxes or subsidies and cash transfers. The constraints facing the planner are the market equilibrium constraints that demand must equal supply as well as the government budget constraint. For ease of exposition, factor supplies are subsumed within the vector \mathbf{x} with negative values if the household is a net supplier of these factors. As shown in Drèze and Stern (1987), using Walras' law, the planner's problem may be rewritten as:

$$\mathcal{L}(s; \hat{u}) \equiv W(\dots, V^h(s; \hat{u}), \dots) + \bar{e} R \quad (AI)$$

where \mathbf{s} is a vector of policy instruments which are completely controlled by the planner and are chosen optimally, $\hat{\mathbf{u}}$ is a vector of policy instruments which are outside the planner's complete control and which include the policy instruments highlighted above, and \bar{e} is the Lagrange multiplier on the government budget constraint (i.e., the marginal social - or shadow - value of government revenue). As before, $V^h(\cdot)$ is the indirect utility function for h , and $W(\cdot)$ is a Bergson-Samuelson social welfare function. This formulation of the problem has the attraction of presenting the problem in terms of the standard trade-off between consumer welfare and government revenue. The impact of any "policy reform" on $W(\cdot)$ captures the direct welfare impact of the reform while the

²¹ To bring out the main sources of welfare changes, the model presented is more simple than the CGE. More complex market structures can, however, be easily incorporated by replacing producer prices with shadow prices and actual with shadow government revenue (see Drèze and Stern, 1987).

impact on revenue captures the indirect welfare impacts.²²

The policy reform under consideration is a cash transfer program, $d\mathbf{r} = \{dr^h\}$.

Differentiating (1) w.r.t. \mathbf{m} we get:²³

$$\frac{\partial W}{\partial \mathbf{m}} d\mathbf{r} = \sum_h \hat{\alpha}^h dr^h - \ddot{\epsilon} (\hat{Q}_h dr^h - \mathbf{t} \cdot \mathbf{X}_m \cdot d\mathbf{r}) \quad (\text{A2})$$

where \mathbf{X}_m is a matrix with each household's marginal budget shares across commodities as column entries. The first term captures the direct welfare impact of the cash transfer program; as captured by typical evaluations of such programs. The term in brackets is the net revenue cost of the program calculated as the program budget adjusted for any changes in revenue due to higher demands by these households. $\ddot{\epsilon}$ is the social cost of the revenue used to finance the transfer and will depend on the set of instruments used to balance the budget.

Pinning down the value of $\ddot{\epsilon}$ involves specifying how the program is to be financed. If it is to be financed by lump-sum taxes, T^h , then we have a similar equation as (3) replacing $d\mathbf{m}$ with $d\mathbf{T}$. The net impact on welfare is then:

$$\frac{\partial W}{\partial \mathbf{r}} d\mathbf{m} = \sum_h \hat{\alpha}^h (dr^h - dT^h) + \ddot{\epsilon} [-\sum_h dr^h + \mathbf{t} \cdot \mathbf{X}_m \cdot d\mathbf{m} + \sum_h dT^h - \mathbf{t} \cdot \mathbf{X}_m \cdot d\mathbf{T}]$$

where $d\mathbf{m} = (d\mathbf{r} - d\mathbf{T})$. If lump-sum taxes exactly cover the direct transfers, i.e.,

$\hat{Q}_h dT^h = \hat{Q}_h dm^h$, then we have:

²² This implicitly assumes that the only distortions in the economy are government induced. Where other market imperfections exist one needs to focus on "shadow revenue" which captures income effects accruing outside the government budget. See Drèze and Stern (1987) for detailed discussion.

²³ We also use the property that the gradient of \mathcal{L} equals the gradient of V^* .

$$\frac{dW}{dr} dm = \sum_h \hat{a}^h (dr^h - dT^h) + \ddot{e} [t.X_m.dr - t.X_m.dT]$$

where the first term captures the pure *redistribution* impact and the second captures the *reallocation* impact. If the reallocation effect is zero (e.g., if marginal budget shares are the same across households or if taxes are zero), then we are left with only a redistribution effect.²⁴

Now consider the program being financed by a change in indirect taxes, dt . Using the standard properties of the indirect utility function, the welfare impact of a tax change is then:

$$\frac{\partial W}{\partial t} = - \hat{a}.x.dt + \ddot{e} \left(x + t.\frac{\partial x}{\partial t} \right) dt \quad (A3)$$

The first term indicates that households gain from the reform according to the level of their existing consumption, i.e., the existing level of demand gives a measure of this welfare effect in money terms. The direct impact on social welfare is greater the more poor households consume the commodities with the highest tax increases. Again, the social cost of raising revenue using a commodity tax is lower if households respond to the price change by switching demand away from (towards) relatively highly subsidized (taxed) commodities. Fully differentiating the budget constraint, setting $x.dt = \hat{Q}_h dr^h$, and using the Slutsky decomposition, we get a net change in welfare:

$$\frac{\partial W}{\partial t} dt = \sum_h \hat{a}^h (dr^h - x^h.dt) + \ddot{e} t.X_m.(dr - x.dt) + \ddot{e} t.\frac{\partial x^c}{\partial q}.dt$$

where x^c is the compensated demand function. Again the first term is the redistribution

²⁴ In general, because of the presence of indirect revenue effects, we can not solve out analytically for the vector $d\mathbf{T}$ which keeps revenue constant. To do so we would have to assume that marginal budget shares are constant across households.

effect, the second the reallocation effect, and the third is the *distortion* effect of using distortionary taxes to finance the transfers.²⁵

The above analysis identifies the source of the welfare impacts from a poverty alleviation cash transfer program financed domestically, identifying separately the equity (i.e., distribution) and efficiency (i.e., reallocation and distortion) impacts. It also provides a useful framework for interpreting the results from our analysis presented later in the text, especially in understanding the origin of the indirect welfare effects.

²⁵ When indirect taxes are set optimally we further know that $t \cdot (\partial x_i^c / \partial \mathbf{q}) / x_i = b_i / \bar{e}$, where b_i is a weighted average of household $b^h = \hat{a}^h - \bar{e}^h + \bar{e} t \cdot (\partial \mathbf{x}^h / \partial \mathbf{m}^h)$ with the share of each household in the total consumption of commodity i as weights. See Coady and Drèze (1999) for a more detailed discussion.

APPENDIX B**CGE Model Sets, Variables and Parameters of CGE Model****SETS**

AAC global set

SUBSETS OF AAC

a Activities
 c Commodities
 cm(c) Imported Commodities
 cnm(c) Non-imported Commodities
 ce(c) Exported Commodities
 cne(c) Non-exported Commodities
 f Factors
 lab(f) Labor Factors
 ld(f) Land Factors
 ins Institutions (domestic and rest of world)
 id(ins) Domestic Institutions
 h(ins) Households
 en(ins) Enterprises

PARAMETERS

\hat{a}_a^a shift parameter for CES activity production function
 \hat{a}_a^{ac} shift parameter for domestic commodity aggregation fn
 \hat{a}_c^q shift parameter for Armington function
 \hat{a}_c^t shift parameter for CET function
 $\hat{a}_{a,h}^h$ LES marginal budget shares for home consumed goods (activities)
 $\hat{a}_{c,h}^m$ LES marginal budget shares for marketed goods (commodities)
 cwts_c consumer price index weights
 $\ddot{a}_{f,a}^a$ share parameter for CES activity production function
 $\ddot{a}_{a,c}^{ac}$ share parameter for domestic commodity aggregation fn
 \ddot{a}_c^q share parameter for Armington function
 \ddot{a}_c^t share parameter for CET function
 dwts_c domestic sales price weights
 $\tilde{a}_{a,h}^h$ LES subsistence minima for home consumed goods (activities)

$\tilde{a}_{c,h}^m$	LES subsistence minima for marketed goods (commodities)
$ica_{c,a}$	intermediate input c per unit of activity a
$insub_a$	input subsidy for activity a
mps_{ins}	marginal propensity to save for domestic institution
$p01_{ins}$	0-1 parameter (1 for institution with variable income tax rate -0 for others)
$p04_a$	0-1 parameter (1 for activity with variable VAT rate -0 for others)
$qbardst_c$	inventory investment by sector of origin
$qbarg_c$	exogenous (unscaled) government demand
$qbarinv_c$	exogenous (unscaled) investment demand
\tilde{n}_c^{ac}	domestic commodity aggregation function exponent
\tilde{n}_c^q	Armington function exponent
\tilde{n}_a^a	CES activity production function exponent
\tilde{n}_c^t	CET function exponent
$shif_{id,f}$	share of domestic institution id in income of factor f
$shii_{id,idp}$	share of domestic institution id in post-tax post-savings income of institution idp
$supernum_h$	LES supernumerary income
ta_a	producer tax rate
te_{ce}	export tax rate
tf_f	tax per physical unit of factor f
$\tilde{e}_{a,c}$	yield of commodity c per unit of activity a
$tins_{ins}$	direct tax rate on institution ins
tm_c	tariff rates on imports of c
tq_c	sales tax
$tr_{i,aac}$	transfers from institution or factor ACC to institution i
tva_a	value added tax for activity a

VARIABLES

CPI	consumer price index (PQ-based)
DPI	index for domestic-sales producer prices (PDS-based)
DTINS	change in domestic institution tax share
DTAXADJ	direct tax scaling factor
DVATADJ	VAT scaling factor
EG	government expenditure
EXR	exchange rate
FSAV	foreign savings
GADJ	government demand scaling factor
GSAV	government savings
IADJ	investment scaling factor (for fixed capital formation)
INVEST	total investment value
PA_a	output price of activity A
PDD_c	demand price for com'y c produced & sold domestically
PDS_c	supply price for com'y c produced & sold domestically
PE_c	price of exports
PM_c	price of imports
PQ_c	price of composite good c
PVA_a	value added price

PWE_{ce}	world price of exports
PWM_{cm}	world price of imports
PX_c	average output price
$PXAC_{a,c}$	price of commodity c from activity a
QA_a	domestic activity output
QD_c	domestic sales
QE_{cm}	exports
$QF_{f,a}$	demand for factor f from activity a
QFS_f	factor supply
QG_c	government consumption
$QH_{c,h}$	household consumption demand
$QINT_c$	intermediate demand for c
$QINV_c$	fixed investment demand
QM_{cm}	imports
QQ_c	composite goods supply
QX_c	commodity output
$QXAC_{a,c}$	output of commodity c from activity a
SADJ	savings adjustment variable for dom. inst'ons
SAVINGS	total savings value
$TRII_{i,ip}$	transfers to domestic institution i from domestic institution ip
$TTINS_{ins}$	total direct tax on institution ins
TVAADJ	change in activity's VAT share
WALRAS	savings-investment imbalance (should be zero)
WF_f	average factor price (rent)
$WFDIST_{f,a}$	factor market distortion variable
YD_{id}	expendable income
YF_f	factor income
YG	government income
YHA_h	own household consumption/income
YHM_h	marketed income
YI_{ins}	income of (domestic non-governmental) institution i
$YIF_{ins,f}$	income of institution i from factor f

Notes: A bar over a variable indicates that the variable is exogenously fixed.

A "p" added to a set symbol indicates an alias.

MODEL EQUATIONS

Table C1— Price Block

$$PM_{cm} = \overline{PWM}_{cm} \cdot (1 + tm_{cm}) \cdot EXR \quad (14)$$

$$PE_{ce} = \overline{PWE}_{ce} \cdot (1 - te_{ce}) \cdot EXR \quad (15)$$

$$PQ_c \cdot (1 - tq_c) \cdot QQ_c = PDD_c \cdot QD_c + PM_{cm} \cdot QM_{cm} \quad (16)$$

$$PX_c \cdot QX_c = PDS_c \cdot QD_c + PE_{ce} \cdot QE_{ce} \quad (17)$$

$$PDD_c = PDS_c \quad (18)$$

$$PA_a = \sum_c \hat{e}_{a,c} \cdot PXAC_{a,c} \quad (19)$$

$$PVA_a = PA_a \cdot (1 - ta_a + insub_a) - \sum_c ica_{c,a} \cdot PQ_c \quad (20)$$

$$\overline{CPI} = \sum_c cwts_c \cdot PQ_c \quad (21)$$

$$\overline{DPI} = \sum_c dwts_c \cdot PDS_c \quad (22)$$

Table C2—Supply and Trade Block

$$QA_a = \hat{a}_a^a \cdot \left(\sum_f \ddot{a}_{f,a}^a \cdot QF_{f,a}^{-\hat{n}_a^a} \right)^{-\frac{1}{\hat{n}_a^a}} \quad (23)$$

$$\begin{aligned} WF_f \cdot \overline{WFDIST}_{f,a} &= PVA_a \cdot (1 - DVATADJ \cdot tva_a \cdot (1 + tvaadj \cdot P04_a)) \\ &\cdot \hat{a}_a^a \cdot \left(\sum_{fp} \ddot{a}_{fp,a}^a \cdot QF_{fp,a}^{-\hat{n}_a^a} \right)^{-\frac{1}{\hat{n}_a^a} - 1} \cdot \ddot{a}_{f,a}^a \cdot QF_{f,a}^{-\hat{n}_a^a - 1} \end{aligned} \quad (24)$$

$$QINT_c = \sum_a ica_{c,a} \cdot QA_a \quad (25)$$

$$QXAC_{a,c} = \hat{e}_{a,c} \cdot (QA_a - \sum_h QAH_{a,h}) \quad (26)$$

$$QX_c = \hat{a}_c^{ac} \cdot \sum_a (\ddot{a}_{a,c}^{ac} \cdot QXAC_{a,c}^{-\hat{n}_c^{ac}})^{-\frac{1}{\hat{n}_c^{ac}}} \quad (27)$$

$$\begin{aligned} PXAC_{a,c} &= PX_c \cdot \hat{a}_c^{ac} \cdot \left(\sum_{ap} \ddot{a}_{ap,c}^{ac} \cdot QXAC_{ap,c}^{-\hat{n}_c^{ac}} \right)^{-\frac{1}{\hat{n}_c^{ac}} - 1} \\ &\cdot \ddot{a}_{a,c}^{ac} \cdot QXAC_{a,c}^{-\hat{n}_c^{ac} - 1} \end{aligned} \quad (28)$$

$$QX_{ce} = \hat{a}_{ce}^t \cdot (\hat{a}_{ce}^t \cdot QE_{ce}^{\hat{n}_{ce}^t} + (1 - \hat{a}_{ce}^t) \cdot QD_{ce}^{\hat{n}_{ce}^t})^{\frac{1}{\hat{n}_{ce}^t}} \quad (29)$$

$$QX_{cne} = QD_{cne} \quad (30)$$

$$QE_{ce} = QD_{ce} \cdot \left(\frac{PE_{ce}}{PDS_{ce}} \right) \cdot \left(\frac{1 - \hat{a}_{ce}^t}{\hat{a}_{ce}^t} \right)^{\frac{1}{\hat{n}_{ce}^t} - 1} \quad (31)$$

$$QQ_{cm} = \text{alpha}_{cm} \cdot (\text{delta}_{cm} \cdot QM_{cm}^{-\text{rho}_{cm}} + (1 - \text{delta}_{cm}) \cdot QD_{cm}^{-\text{rho}_{cm}})^{-\frac{1}{\text{rho}_{cm}}} \quad (32)$$

$$QQ_{cm} = QD_{cm} \quad (33)$$

$$QM_{cm} = QD_{cm} \cdot \left(\frac{PDD_{cm}}{PM_{cm}} \right) \cdot \left(\frac{\ddot{a}_{cm}^q}{1 - \ddot{a}_{cm}^q} \right)^{\frac{1}{1 + \ddot{n}_{cm}^q}} \quad (34)$$

Table C3—Institution Block

$$YF_f = \sum_a \overline{WF}_f \cdot \overline{WFDIST}_{f,a} \cdot QF_{f,a} \quad (35)$$

$$YIF_{id,f} = shif_{id,f} \cdot (YF_f - tr_{row,f} \cdot EXR) \cdot (1 - tf_f) \quad (36)$$

$$YI_{id} = \sum_f YIF_{id,f} + \sum_{idp} TRII_{id,idp} + tr_{id,gov} + tr_{id,row} \cdot EXR \quad (37)$$

$$TTINS_{idp} = (\overline{DTAXADJ} \cdot tins_{idp} - \overline{DTINS} \cdot p01_{idp}) \quad (38)$$

$$TRII_{id,en} = shii_{id,en} \cdot (1 - \overline{SADJ} \cdot mps_{en}) \cdot (1 - TTINS_{en}) \cdot YI_{en} \quad (39)$$

$$TRII_{id,h} = shii_{id,h} \cdot (1 - \overline{SADJ} \cdot mps_h) \cdot (1 - TTINS_h) \cdot YHM_h + YHA_h \quad (40)$$

$$YD_h = (1 - \overline{SADJ} \cdot mps_h) \cdot \left((1 - \sum_{ins} shii_{ins,h}) \cdot (1 - TTINS_h) \cdot YHM_h + YHA_h \right) \quad (41)$$

$$PQ_c \cdot QH_{c,h} = PQ_c \cdot \tilde{a}_{c,h}^m + \hat{a}_{c,h}^m \cdot (YD_h - \sum_{cp} PQ_{cp} \cdot \tilde{a}_{cp,h}^m - \sum_a PA_a \cdot \tilde{a}_{a,h}^h) \quad (42)$$

$$PA_a \cdot QAH_{a,h} = PA_a \cdot \tilde{a}_{a,h}^h + \hat{a}_{a,h}^h \cdot (YD_h - \sum_c PQ_c \cdot \tilde{a}_{c,h}^m - \sum_{ap} PA_{ap} \cdot \tilde{a}_{ap,h}^h) \quad (43)$$

$$YHA_h = \sum_a PA_a \cdot QAH_{a,h} \quad (44)$$

$$YHM_h = YI_h - YHA_h \quad (45)$$

$$\begin{aligned}
YG &= \sum_{id} (TTINS_{id}) \cdot YI_{id} + \sum_a DVATADJ \cdot tva_a \cdot (1 + tvaadj \cdot P04_a) \cdot PVA_a \cdot QA_a \\
&+ \sum_a ta_a \cdot PA_a \cdot QA_a + \sum_{cm} tm_{cm} \cdot QM_{cm} \cdot \overline{PWM}_{cm} \cdot EXR \\
&+ \sum_{ce} te_{ce} \cdot QE_{ce} \cdot \overline{PWE}_{ce} \cdot EXR + \sum_c tq_c \cdot PQ_c \cdot QQ_c \\
&+ \sum_f tf_f \cdot YF_{f_f} + tr_{gov, row} \cdot EXR
\end{aligned} \tag{46}$$

$$EG = \sum_c PQ_c \cdot QG_c + \sum_{id} tr_{id, gov} + \sum_a insub_a \cdot QA_a \tag{47}$$

$$QG_c = \overline{GADJ} \cdot qbarg_c \tag{48}$$

$$GSAV = YG - EG \tag{49}$$

$$QINV_c = IADJ \cdot qbarinv_c \tag{50}$$

$$INVEST = \sum_c PQ_c \cdot (QINV_c + qbardst_c) \tag{51}$$

$$\begin{aligned}
SAVINGS &= \sum_{en} \overline{SADJ} \cdot mps_{en} \cdot (1 - TTINS_{en}) \cdot YI_{en} \\
&+ \sum_h sadj \cdot mps_h \cdot (1 - TTINS_h) \cdot YHM_h + YHA_h \\
&+ GSAV + \overline{FSAV} \cdot EXR
\end{aligned} \tag{52}$$

Table C4—System Constraint Block

$$QQ_c = QINT_c + \sum_h QH_{c,h} + QG_c + QINV_c + qbardst_c \tag{53}$$

$$\overline{QFS}_f = \sum_a QF_{f,a} \quad (54)$$

$$\sum_{cm} \overline{PWM}_{cm} \cdot QM_{cm} + \sum_f tr_{row,f} = \sum_c \overline{PWE}_c \cdot QE_c + \sum_{id} tr_{id,row} + \overline{FSAV} \quad (55)$$

$$SAVINGS = INVEST + WALRAS \quad (56)$$

Appendix Table 1—Rural Regions

1. North	3. Southwest
-Baja California Norte	-Nayarit
-Baja California Sur	-Jalisco
-Sonora	-Colima
-Sinaloa	-Michoacan
-Chihuahua	-Estado de Mexico
-Coahuila	-Distrito Federal
-Nuevo Leon	-Guerrero
	-Morelos
2. Central	4. Southeast
-Durango	-Veracruz
-Zacatecas	-Oaxaca
-Agascalientes	-Chiapas
-San Luis Potosi	-Tabasco
-Guanajuato	-Campeche
-Queretaro	-Yucatan
-Hidalgo	-Quintana Roo
-Tlaxcala	
-Puebla	
-Tamaulipas	

Appendix Table 2—National Sectors in Model¹

1. Maize
2. Wheat
3. Beans
4. Other Grains (Sorghum, Barley)
5. Fruits and Vegetables
6. Other Crops (Tobacco, Hemp, Cotton, Cocoa, Sugar, Coffee, Soy, Safflower, Sesame and Others)
7. Livestock/Forestry/Fisheries (Bovines, Goats, Sheep, Bees, Poultry and Others, Forestry and Fisheries)
8. Dairy
9. Prepared Fruits and Vegetables
10. Wheat Manufacturing
11. Corn Manufacturing
12. Sugar Manufacturing
13. Other Processed Foods (Coffee Manufacturing, Processed Meats, Oils and Fats, Feeds, Alcohol, Beverages and Others)
14. Light Manufacturing (Lumber, Wood, Paper, Print, and Cigar Manufacturing, Soft Fiber Textiles, Hard Fiber Textiles, Other Textiles, Leather, Apparel)
15. Intermediates (Chemicals, Synthetics, Rubber, Glass, Cement, Fertilizers, Other Chemicals, Oil Refining, Oil and Gasoline, Petrochemicals, Coal, Iron, Non-Ferrous Metal, Sand/Gravel, Minerals)
16. Consumer Items (Pharmaceuticals, Soaps, Plastic, Metal Furnishings, Household Appliances, Electronic Equipment, Automobiles and Parts)
17. Capital Goods (Metal Products, Metal Manufacturing, Non-Electronic Machines, Electronic Machines, Other Electric Goods, Transportation Materials, Mineral Manufacturing, Iron Manufacturing, Non-Ferrous Metal Manufacturing, Others)
18. Professional Services (Professional Services, Education, Medical, Finance/Real Estate, Public Administration and Defense, Electricity, Gas and Water)
19. Other Services (Other Services, Restaurants)
20. Construction
21. Commerce, Trade and Transportation

¹ Note that there are four activities for each of the agricultural crop sectors (sectors 1- 6): one for each region. Otherwise, the activities are the same as these sectors. The commodities are the same as these sectors.

Appendix Table 3—Summary Statistics

	Prod. Tax ¹	VAT	Sales Tax	Tariff	Export Tax	Output	Sectoral Composition (%)			Exports/ Output	Imports/ Dom. Supply
							Dom. Supply	Imports	Exports		
Maize	0.000	--	0.006	0.012	0.007	0.62	0.83	1.17	0.03	0.85	24.19
Wheat	-0.571	--	0.000	0.007	0.032	0.12	0.12	0.00	0.01	1.44	0.07
Beans	-0.003	--	0.008	0.009	0.006	0.11	0.10	0.14	0.17	29.03	24.37
Oth. Grain	-0.449	--	0.000	0.000	0.008	0.16	0.16		0.00	0.15	
Fruit & Veg	-0.001	--	0.006	0.000	0.018	0.75	0.64	0.32	0.95	23.43	8.55
Oth. Crops	-0.002	--	0.007	0.016	0.006	0.84	0.77	1.55	1.89	41.72	34.75
Livestock	0.001	--	0.008	0.014	0.033	2.20	2.21	0.39	0.42	3.53	3.00
Dairy	-0.308	--	0.008	0.005	0.007	1.81	1.89	0.56	0.12	1.18	5.04
Maize Manuf.	-0.308	--	0.008	0.018	0.007	1.47	1.47	0.02	0.10	1.28	0.28
Wht Manuf.	-0.308	--	0.008	0.030	0.006	1.13	1.03	0.17	0.70	11.54	2.75
Fr.Veg. Prep	0.002	--	0.006	0.017	0.009	0.30	0.20	0.18	0.69	43.62	15.60
Sugar	0.002	--	0.005	0.034	0.023	0.40	0.41	0.35	0.30	14.09	14.94
Other Food	0.002	--	0.008	0.016	0.007	4.29	4.46	3.38	2.50	10.81	13.01
Light Manuf	0.002	0.05	0.007	0.027	0.009	5.50	5.73	11.78	10.27	34.71	35.29
Intermediates	0.002	0.05	0.006	0.016	0.019	5.43	5.57	12.50	11.44	39.14	38.54
Cap. Goods	0.002	0.10	0.007	0.021	0.012	7.36	9.89	46.26	30.68	77.52	80.23
Cons. Items	0.002	0.10	0.007	0.023	0.006	11.96	8.41	21.24	39.74	61.78	43.33
Construction	0.003	0.10	0.006	--	--	5.24	5.28	--	--	--	--
Prof.Services	0.007	0.05	0.008	--	--	19.96	20.15	--	--	--	--
Oth. Services	0.004	--	0.009	--	--	11.15	11.27	--	--	--	--
Commerce	0.003	0.10	0.009	--	--	19.22	19.43	--	--	--	--

Note:

¹ A negative entry for the producer tax represents a producer subsidy. The figures for the regionalized agricultural activities are weighted averages.

Appendix Table 4— Production Elasticities

	Elasticity of Substitution For Production Function	Armington Elasticities	CET Elasticities
Maize	0.6	4	4
Wheat	0.6	4	4
Beans	0.6	4	4
Other Grains	0.6	4	4
Frt & Veg	0.5	2	4
Other Crops	0.5	4	4
Livestock	0.6	3	0.5
Dairy	1.5	3	3
Fr & Veg Prep	1.5	3	3
Wheat Mfg	1.5	3	3
Maize Mfg	1.5	3	3
Sugar	1.5	3	3
Other Food	1.5	3	3
Lt. Manuf	2	0.2	2
Intermediate	0.6	0.2	2
Capital Goods	0.6	0.2	2
Consumer Goods	1.5	0.2	2
Construction	0.8	2	2
Prof. Svcs	0.8	2	2
Other Svcs	2	2	2
Commerce	0.8	2	2

Appendix Table 5A—Marginal Budget Shares for Home Consumed Goods

Sectors\ Households	RP-N	RP-C	RP-SW	RP-SE	RM-N	RM-C	RM-SW	RM-SE	RR-N	RR-C	RR-SW	RR-SE
Maize	0.000	0.003	0.003	0.004	0.000	0.003	0.001	0.002	0.000	0.001	0.000	0.003
Wheat	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Beans	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oth. Grains	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Frt & Veg	0.001	0.000	0.001	0.001	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.002
Oth. Crops	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note:

The column labels refer to the following sets of household and regions:

Households

RP Rural Poor
 RM Rural Medium
 RR Rural Rich
 UP Urban Poor
 UM Urban Medium
 UR Urban Rich

Regions

-N North
 -C Central
 -SW Southwest
 -SE Southeast

Appendix Table 5B—Marginal Budget Shares for Marketed Goods

Sectors\ Households	RP-N	RP-C	RP-SW	RP-SE	RM-N	RM-C	RM-SW	RM-SE	RR-N	RR-C	RR-SW	RR-SE
Maize	0.001	0.008	0.006	0.010	0.000	0.005	0.002	0.003	0.000	0.013	0.005	0.000
Wheat	0.002	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Beans	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.005	0.001
Oth. Grains	0.003	0.001	0.002	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.011	0.000
Frt & Veg	0.007	0.009	0.010	0.007	0.007	0.011	0.011	0.008	0.005	0.004	0.015	0.010
Oth. Crops	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.000
Livestock	0.017	0.018	0.031	0.042	0.010	0.011	0.021	0.023	0.015	0.003	0.012	0.012
Dairy	0.066	0.057	0.066	0.050	0.045	0.035	0.052	0.041	0.023	0.010	0.065	0.028
Fr.Veg Prep	0.014	0.010	0.011	0.006	0.010	0.009	0.009	0.006	0.003	0.000	0.007	0.004
Wheat Mfg	0.018	0.027	0.025	0.027	0.013	0.019	0.024	0.023	0.020	0.007	0.021	0.016
Maize Mfg	0.037	0.034	0.035	0.038	0.030	0.026	0.043	0.030	0.079	0.013	0.062	0.023
Sugar	0.018	0.024	0.019	0.040	0.009	0.016	0.016	0.017	0.001	0.004	0.013	0.005
Other Food	0.079	0.061	0.058	0.062	0.079	0.056	0.067	0.059	0.056	0.043	0.067	0.050
Lt. Manuf	0.049	0.041	0.034	0.032	0.049	0.051	0.047	0.038	0.051	0.048	0.063	0.045
Intermediate	0.014	0.008	0.008	0.007	0.014	0.010	0.009	0.008	0.004	0.012	0.012	0.009
Cap. Goods	0.110	0.071	0.068	0.063	0.103	0.081	0.080	0.067	0.105	0.094	0.095	0.078
Cons.Goods	0.082	0.053	0.050	0.049	0.110	0.076	0.068	0.077	0.083	0.228	0.080	0.057
Prof. Svcs	0.083	0.077	0.081	0.072	0.082	0.076	0.071	0.068	0.043	0.156	0.086	0.053
Other Svcs	0.134	0.136	0.101	0.087	0.138	0.167	0.134	0.153	0.135	0.107	0.127	0.185
Commerce	0.264	0.360	0.391	0.399	0.297	0.342	0.344	0.374	0.373	0.256	0.251	0.418

Appendix Table 5C—Own Price Elasticity of Home Consumed Goods

Sectors/ Households	RP-N	RP-C	RP-SW	RP-SE	RM-N	RM-C	RM-SW	RM-SE	RR-N	RR-C	RR-SW	RR-SE
Maize	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	0.0	-0.6	-0.6	-0.6
Wheat	-0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.0	-0.6	0.0	0.0	0.0
Beans	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.6	0.0	-0.6	-0.6
Other Grains	-0.2	-0.2	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	0.0
Frt & Veg	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.6	0.0	0.0	-0.6
Other Crops	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.6	0.0	-0.6	-0.6

Appendix Table 5D— Own Price Elasticity of Demand for Market Consumed Goods

Sectors\ Households	RP-N	RP-C	RP-SW	RP-SE	RM-N	RM-C	RM-SW	RM-SE	RR-N	RR-C	RR-SW	RR-SE	HHUP	HHUM	HHUR
Maize	-0.10	-0.11	-0.11	-0.11	-0.10	-0.10	-0.10	-0.10	--	-0.61	-0.60	--	-0.10	-0.10	-0.60
Wheat	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.60	--	-0.60	--	-0.20	-0.20	-0.60
Beans	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.60	-0.60	-0.60	-0.60	-0.10	-0.10	-0.60
Other Grains	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	--	--	-0.60	--	-0.20	-0.20	-0.60
Frt & Veg	-0.31	-0.31	-0.31	-0.30	-0.40	-0.41	-0.41	-0.40	-0.60	-0.60	-0.61	-0.60	-0.31	-0.40	-0.60
Other Crops	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.60	--	-0.60	-0.60	-0.30	-0.30	-0.90
Livestock	-0.90	-0.90	-0.90	-0.90	-0.80	-0.80	-0.80	-0.80	-0.70	-0.70	-0.70	-0.70	-0.90	-0.80	-0.70
Dairy	-0.91	-0.91	-0.91	-0.91	-0.81	-0.81	-0.81	-0.81	-0.71	-0.70	-0.72	-0.71	-0.91	-0.81	-0.71
Fr. Veg Prep	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.80	--	-0.80	-0.80	-0.90	-0.90	-0.80
Wheat Mfg	-0.71	-0.71	-0.71	-0.71	-0.80	-0.80	-0.80	-0.80	-0.80	-0.80	-0.80	-0.80	-0.71	-0.80	-0.80
Maize Mfg	-0.61	-0.61	-0.61	-0.62	-0.71	-0.71	-0.71	-0.71	-0.82	-0.80	-0.81	-0.80	-0.61	-0.70	-0.80
Sugar	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.90	-0.80	-0.80	-0.80	-0.80	-0.90	-0.90	-0.80
Other Food	-0.45	-0.44	-0.43	-0.44	-0.54	-0.53	-0.53	-0.53	-0.62	-0.62	-0.63	-0.62	-0.43	-0.53	-0.62
Lt. Manuf	-0.43	-0.42	-0.42	-0.42	-0.52	-0.53	-0.52	-0.52	-0.62	-0.62	-0.63	-0.62	-0.42	-0.52	-0.62
Intermediate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cap. Goods	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cons. Goods	-0.54	-0.53	-0.52	-0.52	-0.73	-0.72	-0.72	-0.72	-0.73	-0.77	-0.72	-0.72	-0.53	-0.72	-0.73
Prof. Svcs	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.53	-0.52	-0.58	-0.54	-0.53	-0.55	-0.58	-0.60
Other Svcs	-0.91	-0.91	-0.91	-0.91	-0.91	-0.92	-0.91	-0.92	-0.83	-0.82	-0.83	-0.84	-0.91	-0.91	-0.84
Commerce	-0.93	-0.94	-0.94	-0.94	-0.93	-0.93	-0.93	-0.94	-0.87	-0.85	-0.85	-0.88	-0.94	-0.93	-0.85