

# **Economic Analysis of the Ingreso Objetivo Program in Mexico\***

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### **Introduction and Summary of Main Results**

The Ingreso Objetivo program in Mexico is a form of deficiency payment program that is familiar from textbook treatments (Gardner). However, as is the case of any policy actually applied, the program specifics may differ from textbook assumptions.

In broad outline a deficiency payment program pays participating producers the difference between the government set target price and some market-based price facing those producers. The payment makes up the deficiency between the government-determined price and the market-determined price. The motivation for such a program is that policymakers decide that the market price is too low for producers and a government payment raises the effective producer price.

Deficiency programs differ in how the target price is set, how the market-based price is set and how the quantity eligible for payment is determined. We have based our modeling of the Ingreso Objetivo program in Mexico on information available on program operation and information related to supply and demand parameters. Hard evidence on a number of parameters and program features has remained difficult to establish.

Maize is by far the most important crop included in the program measured by volume of marketing and program outlays. The payment rate relative to market price is higher for corn than that available for other grains (except rice). Cotton has the largest payment rate (payments exceed the market returns for program participants) and despite relatively low participation cotton ranks second in total outlays.

We find that removing the Ingreso Objetivo program would cause significant shifts away from maize and cotton and towards other crops, especially non-subsidized crops. It would also cause some cropland to shift to pasture or other non-crop uses. That is, the Ingreso Objetivo has maintained higher amounts of production in crops in highly subsidized regions and on subsidized

farms for which market forces would indicate less production. Removing the subsidies under the program would cause market prices to rise slightly (by a few percentage points) and this would cause an increase in production of maize and other subsidized crops on the farms that had not received the subsidies under the program. Consumers of the subsidized crops would also face the slightly higher market prices for the previously subsidized crops. The main impact however would be that taxpayers would save more than \$4.2 thousand million pesos, using 2005 as the base year. The gains to taxpayers, consumers of non-subsidized crops (which see their prices fall) and non-subsidized producers of the subsidized crops would exceed the loss to the subsidized producers and consumers of non-subsidized crops by about 1.5 thousand million pesos, representing a net loss to the Mexican economy.

We also find that removing the Ingreso Objetivo program would cause a slight increase in revenue variability on subsidized farms, but a decline in revenue variability on those farms that marketed without the benefit of subsidies. Even the reductions in variability for program participants, however, is limited by the fact that the payment rate under the program is calculated from a pre-harvest projected average price for the region and therefore cannot offset fully the actual price variability faced by participating farms.

The farms that benefit from the program are those in selected regions that tend to have larger more commercialized farms. Since the program payments are targeted to those growers that participate in the formal market and especially those who sell through registered agents, it is natural that the program benefits a select group of growers of crops of a handful of crops. Data on the size and wealth distribution of the program recipients would document more directly what is already expected from the regional distribution of payments (see the appendix tables for evidence.)

Before turning to the detailed simulation analysis of Ingreso Objetivo, we review related programs in North America and consider the current situation of the U.S. Farm Bill, which is in the process of development in the summer and fall of 2007. We also draw implications of the U.S. Farm Bill for Mexican commodity policy. This discussion of policies on other countries, especially the United States is important for two reasons. First, Mexico may be in a position to

benefit from policy lessons and especially policy mistakes of other countries. Second, policies in North American affect the market considerations that affect the rationales and operation of Mexican programs especially Ingreso Objetivo. Since U.S. policy is in the process of changing with the 2007 Farm Bill, a better understanding of the U.S. programs and their implications for Mexico is useful.

In our analysis of Ingreso Objetivo we first build a simulation model that relies on a simplified version of the program and then ask what would be the consequences for commodity markets and incomes of producers, consumers and taxpayers of removing the policy. Finally we discuss broader policy implications of our analysis and suggest alternatives for consideration of Mexican policy reform.

### **Comparison to Programs Elsewhere in North America**

The Ingreso Objetivo program is one of a basket of farm and rural policies and programs in Mexico. NAFTA partners Canada and the United States also have a complex arrays of policies that affect agricultural commodities, rural communities and the environment. Zahniser, Young and Wainio usefully summarize these policies in a unified framework. Focusing on farm income support policies they note, "In the area of income supports, each country has instituted a countercyclical program that provides additional assistance to producers during downturns in commodity prices, and each continues to decouple key support programs from production decisions." (Zahniser, Young and Wainio. p1.)

Exhibit 1 from Zahniser, Young and Wainio compare in a convenient side-by-side format the farm income support policies of Canada, the United States and Mexico. Under the 2002 Farm Bill the United States has three main income support policies (plus major subsidies for crop insurance that cost taxpayers almost \$5 billion per year.) For the grain and oilseed crops that comprise about 30 percent of U.S. agricultural by value, these programs transfer about \$20 billion per year in low-price years and about \$5 to \$10 billion in lower price years (Sumner 2007). Farmers may exercise considerable, but incomplete, planting flexibility and maintain payment eligibility for counter-cyclical and direct payments. Marketing loan benefits are inversely related to market price and tied directly to the production of the program crop. These

programs for the grains, oilseeds and cotton do most to encourage production and lower market price (Sumner, 2005).

Major commodity support in Canada is provided to dairy and poultry industries through trade barriers much as the U.S. supports its sugar industry through trade barriers. Support for the grains industry recently has been through revenue insurance programs and ad hoc assistance when prices were unusually low (Box 1). Canada has not used deficiency payment programs such as the Ingreso Objetivo.

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**Box 1. Current income support programs in North America**

| <i>United States</i>                                                                                                                                                                                                                                                                                                                                             | <i>Mexico</i>                                                                                                                                                                                                                                                                                                                                                         | <i>Canada</i>                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Triad of programs—direct payments, countercyclical payments, and marketing loans provides income support for wheat, feed grains, upland cotton, rice, peanuts, and oilseeds. New countercyclical program replaces ad hoc emergency assistance. Marketing loans extended to certain pulses, mohair, wool and honey. Extensive planting flexibility is maintained. | PROCAMPO continues to provide direct payments on a simple per hectare basis, while the Subprogram of Direct Supports to Target Income provides countercyclical assistance to grain and oilseed producers. Marketing supports geared for commercial producers continue under the guise of the Program of Direct Supports to the Producer through Marketable Surpluses. | The new Canadian Agricultural Income Stabilization (CAIS) program integrates income stabilization and disaster protection. It replaces an earlier subsidized savings program for producers, as well as a previous ad hoc program of emergency assistance. |

Source: Zahniser, Young and Wainio.

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**U.S. Deficiency Payment Programs**

The United States operated a classic deficiency payment program for maize and other feed grains, wheat, cotton and rice for several decades until 1996. Under that program congress set the target price for each commodity by law. The market-based price used to determine payments was set equal to the realized national average producer price for the crop marketing year. The deficiency payment rate was, therefore, not known until after the full national crop was marketed. This is

clearly different from the Ingreso Objetivo program, which sets the payment rate before harvest. Producers received partial advanced payments based on projections of what the ultimate payment rate would be. Participation in the program was voluntary and producers were required to idle a share of the program base area in order to qualify for the payments. For eligibility, producers were required to plant the base acreage less the idled share and received payments on that payment area times the payment yield, which was regularly updated.

The U.S. congress modified program rules in 1985 and 1990 to allow more planting flexibility (Sumner, 2007). Other uses, including leaving the land fallow, were allowed on a small share of program base and payments were reduced accordingly. The 1996 Farm Bill used the average annual payments received in the previous five years to set a payment rate per base area and base yield, which was fixed by contract through 2002. This contract payment did not vary with market price and did not require production of the program crop (although some crops, fruits, vegetables, melons, tree nuts and wild rice, were prohibited on land receiving the payments).

A second deficiency payment program evolved out of price support, loan and government stockholding policies in 1985 for rice and cotton and in the early 1990s for the other program crops including soybeans. Under this "marketing loan" program congress sets national average loan rates and program administrators set location specific loan rate at which the producer may receive a loan using the crop as collateral. When the producer sells that crop, the loan repayment rate is based on the local posted county price, or in the case of rice and cotton, on an adjusted world price. The producer therefore received as a loan benefit the difference between the government-set loan rate and the government-calculated market price at the time the quantity is sold. The producer is also required to pay interest on the loan from the period between receiving the loan at harvest and the time the loan is repaid. To facilitate program operation, if the producer wishes to sell at harvest, he or she may simply take the difference between the local loan rate and the government-determined price at that date as a "loan deficiency payment."

The marketing loan program applies to essentially all production of the covered crops in the United States. Producers are not required to idle land and other eligibility requirements are minimal. Loan benefits vary from year to year and from crop to crop. For example, Table 1,

which summarizes overall U.S. program benefits for the maize industry, shows that marketing loan benefits rose from a negligible \$77.5 million in 2003, when the average producer market price was \$2.42 per bushel to \$4.7 billion in 2005 when the average producer market price was \$1.90 per bushel. Marketing loan benefits alone were about 22 percent of the magnitude of market revenue in that year or about 42 cents per bushel.

Deficiency payment programs transfer income directly from taxpayers to producers. They usually benefit consumers by stimulating production and hence lowering the market price. This effect on market price harms producers that do not participate in the program. Gardner provides analysis of the costs and benefits of the historical deficiency payment programs in the United States. Some of these producers may be in the country and some may be producers in other countries. For example, Sumner (2006) has estimated that the U.S. program from cotton reduced world cotton prices by about 12 percent with most of that impact due to the marketing loan program. Sumner (2005) found that if U.S. maize subsidies were expected to be at their 2005 levels, they would reduce maize prices by about 10 percent, again with the bulk of the impact caused by the marketing loan program.

The other deficiency payment program now used in the United States is the Milk Income Loss Contract (MILC) program. This program authorizes payments to dairy farmers in months when the price of milk fall below a government-set target price. However, the MILC program sets a maximum payment quantity such that most relatively small producers receive payments on all their production while larger producers receive payments on only a fixed quantity. For larger dairy farms, which account for most of the milk in the United States, the MILC is equivalent to an infra-marginal payment that does not stimulate production. Indeed, since more milk is produced on the smaller farms and this causes the price of milk to be lower than otherwise, larger farms actually lose from the program because their lower market revenues more than offset their gains from program payments (Balagtas).

The difference between the government-set "target" price or marketing loan rate and grower expectations about the market price used for determining payments is the key determinant of program supply and net welfare impacts. Under the U.S. marketing loan program this difference

varies from crop to crop and from year to year. For example, the cotton marketing loan program has consistently had among the largest impacts across commodities, whereas the wheat and soybean payments and impacts have been relatively small. And, as shown in Table 1, the maize marketing loan subsidies were small in 2003. If these benefits were anticipated to be small the impacts of the program would have been small for that year.

The expected payment rate determines supply and price impacts and welfare effects of deficiency payment programs. Realized payment rates that occur after production decisions are taken cannot affect producer behavior. Thus it is important in any analysis to focus on what producers anticipate for the payment rate, and therefore what producers anticipate for the market price used to determine per unit payments. This point is particularly important in considering the effects of deficiency payment programs looking forward from 2007. Projections from the U.S. Department of Agricultural (USDA) and the Food and Agricultural Policy Research Institute (FAPRI), the U.S. Congressional Budget Office (CBO) and others point to marketing loan benefits of approximately zero for all major program crops in the United States, except cotton. If these projections reflect grower expectations, then the marketing loan program will have little impact on production or market price and therefore little net welfare loss except for cotton. One exception to this general proposition is that even if expected payments are zero and so there is no impact on production, but actual payments turn out to be positive, there remain transfers from taxpayers to consumers and producers and given a cost to raise government funds there is a net welfare loss from the program. The other exception is that program administration may be costly even if no payments are anticipated and even if no payments occur.

In general the larger is the demand elasticity facing the production included in the program (in absolute value) and the smaller the share of production in the relevant market covered by the program, the smaller are the price impacts. The larger the supply elasticity among the program participant and the larger the anticipated payments rates, the larger the supply impacts and the larger the price impacts. Also, the more elastic is the supply of production not covered by the program, the smaller the price impacts. These relationships and the consequences for the impacts of the Ingreso Objetivo deficiency payment program are calculated below and sensitivity

analysis illustrates how parameters chosen for supply and demand relationships affect the price, quantity and welfare impacts.

### **The 2007 U.S. Farm Bill and Mexican Farm Policy**

Every five years or so the United States reconsiders its major food, farm and rural policies in a new "Farm Bill." Many provisions of the currently operative law, the *Farm Security and Rural Investment Act of 2002*, will expire at the end of September 2007, so Congress, the Administration and literally hundreds of interest groups are actively considering proposals for changes to the current law in the form of the 2007 Farm Bill.

The active proposals range from slight adjustments to the 2002 Farm Bill, which was passed by the U.S. House of Representatives on July 27, 2007, to a wholesale elimination of farm programs and expansion of nutrition, conservation and research and extension efforts, which has been favored by many economists.

#### ***What is a Farm Bill?***

The 2002 Act had 10 separate titles and authorized hundreds of billion of dollars:

- I. Commodity Programs, which include programs for crop program payments and dairy programs;
- II. Conservation, which includes programs for land conservation, working lands programs and farmland protection;
- III. Agricultural Trade and Aid, which includes export programs, international food aid and international trade relations;
- IV. Nutrition Programs, which includes food stamps, commodity distributions and community nutrition programs;
- V. Farm Credit, which includes farmer loan programs under the Farm Service Agency and regulation of the Farm Credit System;
- VI. Rural Development, which includes a host of programs to aid rural communities and research related to value added agriculture and rural development

VII. Research, which includes authorization of USDA "intramural" programs, external formula funds for research and extension in the states, competitive grant programs; and a host of specific research and extension programs such as that for organic agriculture.

VIII. Forestry, which authorizes USDA Forest Service programs;

IX. Energy, which authorizes programs of research and development for biobased energy; and

X. Miscellaneous Provisions, which include modification of programs for crop insurance and organic agriculture and new initiative related to country-of-origin labeling and specialty commodities.

The 2007 Act is likely to follow a similar structure of the 2002 Act, but content of each title must be determined. The most relevant titles for international commodity markets and policies in other countries are the Commodity title, where most farm subsidy programs are authorized; the Conservation title, which also affects production; and the Energy title, which has been on everyone's policy agenda for 2007.

The Farm Bill is *authorizing* legislation because it creates and modifies government programs that set the framework for government outlays of funds or for regulating producers and consumers. The Farm Bill authorizes budget outlays for two categories of programs. The "mandatory" programs set program rules and triggers and then whatever outlays occur under the program provisions are automatically paid out each year the mandatory programs are authorized. The standard farm subsidy programs are mandatory programs. The cost of the programs depends on the rules set by the Farm Bill and by economic conditions in the relevant commodity markets. For example, the Congress set a loan rate for cotton of 52 cents per pound and whenever the relevant market price (which is the loan repayment rate) falls below 52 cents per pound the USDA makes payments to cotton producers. The amount of the payments and the cost of the program vary inversely with the market price of cotton.

Traditional farm commodity programs are limited to a handful of crops. Table 1 shows how the distribution of payments diverges from the distribution of the value of commodity production. Livestock products, horticultural crops and others receive almost none of the commodity

program payments while major grains, oilseeds and cotton receive payments far in excess of their share of farm output.

### ***Major U.S. Farm Bill Issues for 2007***

Advocates for change in 2007 have argued for reallocating funds and policy attention away from commodity programs and towards more environmental payments, more attention to nutrition information and assistance, more protection from invasive species, more effort to promote bioenergy and more research and development, among other subjects (Alston and Sumner). Others, including many economists, argue for reducing the reliance on traditional commodity support programs. Some suggest simply removing the existing programs, while others have proposed replacing the existing complex array of programs for the grains oilseeds and cotton with a new form of revenue insurance that would also replace standard crop insurance programs for these commodities.

Trade negotiations and litigation add further issues in 2007. If the negotiations of a new World Trade Organization agreement move forward they would provide some limits on farm support in the 2007 Farm Bill. But, even without a new agreement, the existing rules as interpreted in the recent WTO ruling concerning the U.S. upland cotton program suggest that U.S. commodity programs may be constrained to limit their impact on international markets (Alston and Sumner).

An alliance of specialty crops producer organizations (including fruits, vegetables tree nuts and others) is engaged thoroughly in the Farm Bill process in 2007 in an effort to shape legislation that does more for their industries. This alliance has pointedly not advocated new payment schemes for producers of specialty crops. Instead they have advocated programs related to demand expansion through promotion and nutrition education and support for consumers, and expansion of government activities that enhance long run productivity, such as research and protection from invasive species.

A major challenge facing those advocating change in 2007 relates to the long Farm Bill tradition of supporting the program crops and the current budget situation.

### ***Budgets and Market Conditions in 2007***

Every Farm Bill since 1933 has been shaped in a unique economic and political setting. The Farm Bill of 2007 is no exception. Due to the ethanol boom among other forces, prices of program crops are high in 2007 and are projected to remain high for the next five years. This means that the price contingent payments made to program crops are projected to be very low for the life of the new Farm Bill. The budget allocated to the Farm Bill committees in Congress to cover the projected costs of these mandatory programs for the period of the new Farm Bill is also low relative to the budget in the recent past. For example the corn program cost about \$10 billion for crop year 2005, but is projected to cost no more than \$2 billion in crop year 2008, if the program were unchanged in the 2007 Farm Bill. Because market prices are projected to be high, changing traditional farm programs would be credited with saving relatively little over the next Farm Bill. This means that change in farm commodity programs releases relatively few budget dollars to be reallocated to the many competing demand that have been advocated for the 2007 Farm Bill.

### ***The Current State of Farm Bill Development***

At the end of July 2007 the full House of Representatives considered the version of the 2007 Farm Bill that was passed by the House Committee on Agriculture on July 19. That proposed legislation maintains the status quo commodity programs with a few adjustments. It also adds some of the funding for research and development, market expansion, nutrition and related concerns of interest to fruit and vegetable growers and some additional funding for some conservation and nutrition programs. This package received favorable response from the Speaker of the House of Representatives, which was enough to fend off challenges from those seeking major changes in commodity programs.

The Commodity title itself includes a few changes, some of which may affect commodity markets. In particular, the target prices used to determine counter cyclical program payments were raised for wheat, barley, oat and soybeans and lowered for cotton and minor oilseeds. Loan rates, used to determine marketing loan benefits were raised for wheat, barley, oat and some

minor crops. Payment limits were adjusted to raise some limits and lower other limits. The "headline" change, to remove eligibility for individual with income of more than \$1 million per year, will have no measurable impact on any commodity market.

Additional changes for specific commodities include important subsidy increases for cotton and sugar. For sugar the House Committee bill would raise the loan rate, specifies that USDA would buy imported sugar from Mexico for resale (at a loss) to ethanol producers and requires data collection on the Mexican sugar and sweetener market. The bottom line is that sugar prices would be held above the loan rate with costs born by taxpayers through the government purchase program. For cotton the proposed legislation would readjust (downward) the loan repayment rate and authorize a subsidy for domestic use of cotton. This later provision would act as a *de facto* producer subsidy because, due to transport costs, no cotton enters the United States. Hence only U.S. produced cotton would receive the subsidy.

The Administration stated before the House Committee bill was debated on the House floor that senior officials would advise the President to veto the measure if it were to come to him in its current form. To override a veto proposed legislation must receive 2/3 of the votes in both houses of the Congress, so a veto threat is a significant event in the Farm Bill process.

The Senate is scheduled to take up the Farm Bill in its relevant Committee in September 2007. Leading Senators have expressed much more interest in significant changes in the Farm Bill commodity subsidies (programs focusing on crop revenue rather than crop prices, for example), but the form of the Senate bill remains unknown. In any case, the Senate committee is unlikely to consider its Farm Bill before the middle of September with action on the floor of the Senate somewhat later. A blending of the House and Senate versions of the Farm Bill is unlikely to occur before early October and then that compromise must be passed by both Houses of Congress. Thus it is unlikely that a bill would be available for consideration by the President before October. If the President were to veto that legislation, the process would need to start again.

#### *Implications for Mexico and Mexican Commodity Policy*

The effects of U.S. farm programs on Mexican Commodity markets and policy vary depending on the prevailing market prices. Because the largest and most distorting U.S. subsidy programs pay out more to farmers and stimulate U.S. production most when prices are low, these programs tend to push down Mexican prices when they are already low and have little effect when prices are high. One set of estimates were that based on 2005 data, the U.S. corn subsidy caused market prices to decline by about 10 percent. This order of magnitude may also apply for sorghum. Impacts are likely smaller for wheat, oilseeds and rice and somewhat larger for cotton (Sumner, 2005).

Under the current high commodity prices that are projected to continue, the effects of U.S. subsidies on Mexican markets and policy are relatively small. But, when prices decline again the U.S. programs will exacerbate the decline and push Mexican market prices and Mexican producer revenues lower than they would otherwise be. With the Ingreso Objetivo program in place, the main impact of U.S. subsidies in low price years is an increase in the budget costs of the program and even lower prices for those growers connected to the market who do not participate in the Ingreso Objetivo program.

#### **Description of the Model Used in the Simulation Analysis of the Ingreso Objetivo Program in Mexico**

We use an equilibrium displacement model to simulate the effects of the Ingreso Objetivo program on Mexican markets for grains and oilseeds covered by the program as well as other relevant crops. The use of such models is standard in economic analysis of markets (Alston, Norton, and Pardey 1995) and in the analysis of commodity policy (see among many others, Alston et al. 2006, Balagtas and Kim 2007 and Rickard and Sumner 2007). The model is calibrated to data and economic parameters representing the 2005 situation. We simulate the implications of removing the Ingreso Objetivo program on Mexican production, consumption and farm prices of crops covered by the program and other relevant crops.

Our model begins with expressions of the market supplies of Mexican crops and market demand for those crops. We model supply and demand for each of  $J = 6$  crops: maize, cotton, sorghum, wheat, other supported crops as a group (including safflower, rice, soybeans, canola, and forage wheat), and *frijoles*. All other crops and other agricultural uses of land, either as pasture or fallow land, is in the omitted category that we do not explicitly model. Effects on this category of output and resource use are left implicit. The first five are supported by the Ingreso Objetivo program, and we denote them as a subset  $J_G = \{\text{maize, cotton, sorghum, wheat, and other supported crops}\}$  of all crops. We also distinguish between two types of producers,  $k$ , those who receive Ingreso Objetivo payments ( $k = 1$ ) and those who do not ( $k = 2$ ). We model the general equilibrium supply of each crop from each type of producer as:

$$(1) \quad Q_{kj}^S = \alpha_{kj} + \sum_{i=1}^J \alpha_{kji} PP_{ki} + Z_{kj}^S,$$

where  $Q_{kj}^S$  is the quantity of crop  $j$  supplied by farmers of type  $k$ ,  $PP_{ki}$  is the producer price of crop  $i$  for farmers of type  $k$ ,  $Z_{kj}^S$  are supply shifters, and  $\alpha_{kj}$  and  $\alpha_{kji}$  are the intercept and price slopes of the linear supply function. The supply shifters  $Z_{kj}^S$  are exogenous random shocks with mean zero ( $E(Z_{kj}^S) = 0$ ) and caused, for example, by weather and changes in prices of farm inputs.

We do not explicitly model markets for other crops that, through the common use of productive resources (e.g., farm land, farm machinery, human capital), are linked to the markets for program crops and *frijoles*. Such other crops include, for example, tomatoes, fruits and other vegetable crops. However, we specify the price slopes  $\alpha_{kji}$  so as the response of  $Q_{kj}^S$  to a change in the price of commodity  $i$  accounts for the equilibrium changes in prices of crops not explicitly modeled here. That is, equation (1) represents general equilibrium supply curves.

Market demand for each crop is specified as

$$(2) \quad Q_j^D = \beta_j + \sum_{i=1}^J \beta_{ji} MP_i + Z_j^D,$$

where  $Q_j^D$  is the total quantity of the Mexican crop demanded,  $MP_i$  is the market price of crop  $i$ ,  $Z_j^D$  are demand shifters, and  $\beta_j$  and  $\beta_{jk}$  are the intercept and price slopes of the linear demand functions. The demand shifters are exogenous random shocks with mean zero ( $E(Z_j^D) = 0$ ).

We close the model with market clearing conditions on quantities and prices:

$$(3) \quad \sum_k Q_{kj}^S = Q_j^D, \text{ and}$$

$$(4) \quad PP_{kj} = \begin{cases} MP_j + \max(0, TP_j - IP_j) & \text{for } j \in J_G \text{ and } k = 1 \\ MP_j & \text{otherwise} \end{cases}$$

Equation (3) is an adding up condition that the total quantity supplied is equal to the quantity demanded. Here, we model only those quantities exchanged through market channels, excluding production of crops that are consumed on the farm or otherwise do not enter the commercial marketing channels. In the simulations that follow, we maintain the assumption that the quantities of crops consumed outside the market channels are exogenous to the program within the relevant range of prices. Farm families produce and consume these quantities on the same farm or trade only within isolated local markets that are not linked to the national and global markets that are central to the Ingreso Objetivo program. If farmers or other consumers who produce significant quantities for home consumption, or buy significant quantities in local markets that are isolated from the commercial markets, also buy significant quantities from the commercial markets by consumers the our assumption of insulation between these quantities would be violated and we would need to model these interactions.

Available data suggest that the quantity of each crop supported is less than the quantity of crops marketed (data are discussed in greater detail below). However, detailed information is not available on how payments are allocated across farms. We understand that some producers are program participants and receive payments on all quantities of supported crops produced, while some producers received no payments; and that program participants are the same for each crop.

In Equation (4), the producer price for producers who do not participate in the program is equal to the market price,  $MP_j$ . The incentive price for supported crops for producers that participate

in the program is equal to the market price plus a payment when the administratively determined target price,  $TP_j$ , is greater than the incentive price,  $IP_j$ , in which case the payment rate is equal to the difference,  $TP_j - IP_j$ . The incentive price is determined administratively, and is calculated to approximate market price at the time of harvest. The incentive price is announced at the beginning of the crop year, such that producers know the incentive price at the time of planting. However, the incentive price is not subsequently updated to reflect changes in market conditions that occur during the growing season, at harvest, or after harvest. Thus, we model the incentive price as:

$$(5) \quad IP_j = MP_j + ERR_j$$

where  $ERR_j$ , the difference between the pre-established incentive price and the realized market price, may be considered as a forecast error. We assume that the indifference price is an unbiased forecast of the market price, that is that  $E(ERR_j) = 0$ . Thus, at the time of planting, the expected harvest-time market price for producers that participate in the program is

$$(6) \quad E(IP_j) = E(MP_j) + E(ERR_j) = E(MP_j).$$

Therefore, the expected net price for program participants is

$$(7) \quad E(PP_j) = E(MP_j) + \max(0, TP_j - E(MP_j)) = \max(E(MP_j), TP_j).$$

Assuming the expected market price is less than the target price, the expected net price for program participants is equal to the target price,  $E(PP_j) = TP_j$ .

However, while we assume that the expected forecast error is zero, the actual market price at harvest typically differs from the incentive price due to unexpected changes in market conditions during the growing season, i.e.  $Z_{kj}^S$  in equation (1) and  $Z_j^D$  in equation (2). The actual net price received by program participants is

$$(8) \quad PP_j = MP_j + \max(0, TP_j - IP_j) = MP_j + \max(0, TP_j - (MP_j + ERR_j)).$$

Suppose for example that the indifference price is less than the target price, in which case the net price to program participants is

$$(9) \quad PP_j = MP_j + TP_j - (MP_j + ERR_j) = TP_j - ERR_j.$$

If events during the growing season caused the market price to be higher than the indifference price, so that  $ERR_j < 0$ , the program results in a net price for program participants that exceeds the target price. Alternatively, if the market price is less than the indifference price, so that  $ERR_j > 0$ , the program results in a net price for program participants that is less than the target price. Under our assumption that the incentive price is unbiased, i.e., that  $E(ERR_j) = 0$ , the net price to program participants is, on average, equal to the target price.

A key here is that the Ingreso Objetivo policy does not effectively guarantee the target price to program participants. Rather, the net price to participants may be higher or lower than the target price depending on whether the indifference price is lower or higher, respectively, than the actual market price. Thus, the policy may reduce, but does not eliminate price variability for program participants. The policy is similar to a per unit subsidy for program participants, where the subsidy rate is equal to  $\max(0, TP_j - IP_j)$ .

Figure 1 depicts the implications of such a program for each type of farmer in an average year, i.e. when  $ERR_j = 0$ . For any market price less than  $TP$ , a program participant receives a payment equal to the difference between  $TP$  and the market price, so that the incentive price for the program participant is  $TP$ . Given, the farm's marginal cost,  $MC$ , the resulting quantity produced and marketed is  $Q(TP)$ . For market prices higher than  $TP$  no payment is made and the market price becomes the incentive price. In contrast, for a non-participant, the market price is the incentive price even when the market price is less than the target price.

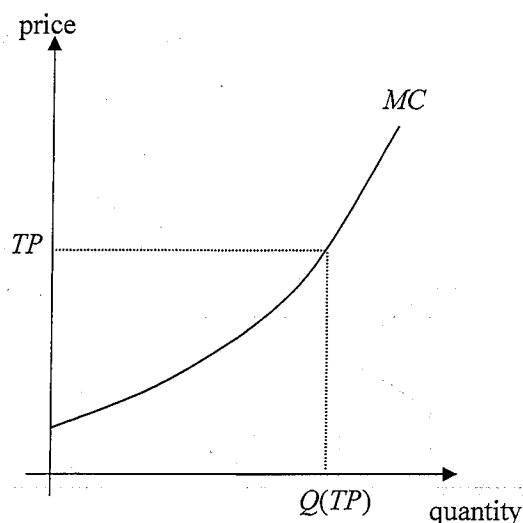


Figure 1. Effects of Ingreso Objetivo on Farm Output

The market implications of the program are depicted in figure 2, which, for the sake of simplicity, depicts a deficiency payment applied to the market for a single crop. In the left panel, the incentive price for program participants is  $TP$ . Given marginal cost  $MC_1$ , program participants supply quantity  $Q_1$ . In the right panel, the excess demand that faces non-participants is market demand,  $D$ , less  $Q_1$ , resulting in quantity produced  $Q_2$  and equilibrium market price  $MP$ . Without the program, program participants would respond to market prices, and the excess demand facing non-program participants increases (and becomes more elastic) to  $D - Q_1(\cdot)$ . The equilibrium market price is  $MP'$ , resulting in quantity produced by program participants  $Q_1'$  and quantity produced by non-participants  $Q_2'$ . The key results here are (i) the program increases the incentive price for program participants, and (ii) the market price is endogenous, and is lower because of increased production from program participants induced by the program. The magnitude of the market effects depend on responsiveness of supply from the two types of producers, and on the responsiveness of the market price along market demand curve (i.e., the price elasticity of demand).

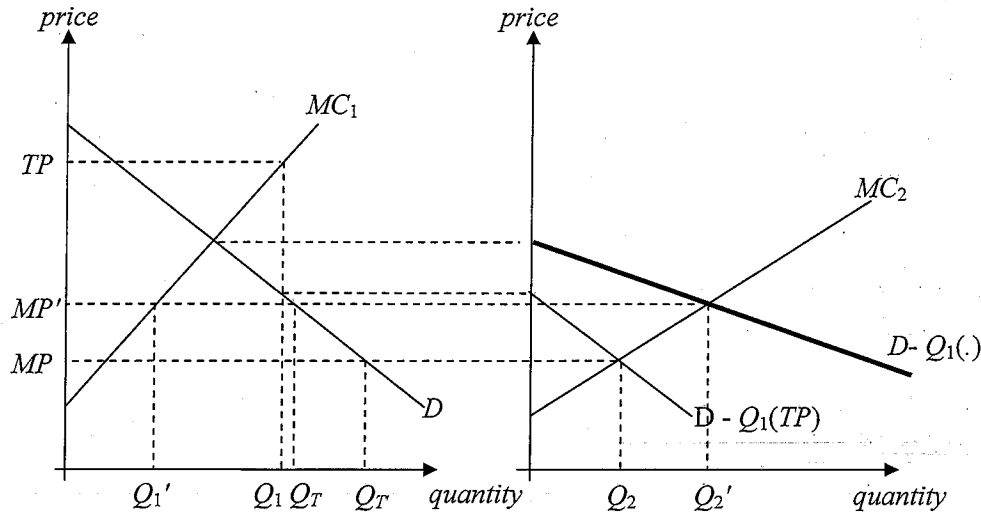


Figure 2. Market Effects of the Ingreso Objetivo Policy

The implications for economic welfare can also be depicted in figure 2. Government outlays for the program are equal to  $Q_1(TP - MP)$ , so elimination of the program would reduce government outlays by  $Q_1(TP - MP)$ . Taxpayer savings would exceed actual outlays because of the distortions created by taxes needed to generate government revenue. We take the conservative assumption that the deadweight cost of taxation is 10 percent, so that the true cost of the program to taxpayers is 110 percent of actual outlays.

We use consumer surplus as our measure the change in economic welfare of all downstream users of program crops and frijoles. We are not able to attribute the change in consumer surplus to specific downstream users (handlers, processors, wholesalers, retailers or final consumers). Given the linear approximation to demand in equation (2), the change in consumer surplus for in the market for commodity  $i$  from an increase in the market price of commodity  $i$  is

$$(10) \quad \Delta CS_i = -\Delta MP(Q_i + .5 \Delta Q_i).$$

In the left panel of figure 2, the change in consumer surplus is equal to the area to the left of the demand curve and between the two market prices ( $MP$  and  $MP'$ ). Removing the policy would

result in higher prices ( $\Delta MP > 0$ ), so that  $\Delta CS < 0$ . That is, removing the policy would make consumers of program crops worse off.

In a similar fashion, we can calculate change in producer surplus for both program participants and non-participants. The change in producer surplus for producer type  $k$  in the market for commodity  $j$  is

$$(11) \quad \Delta PS_{jk} = \Delta PP_{jk}(Q_{jk} + .5 \Delta Q_{jk}).$$

In the left panel of figure 2, the change in producer surplus for program participants is equal to the area to the left of  $MC_1$  and between  $TP$  and  $MP'$ . Removing the policy would lower the price received by participants resulting in a reduction in producer surplus. The change in producer surplus for nonparticipants is equal to the area to the left of  $MC_1$  and between  $TP$  and between the two market prices ( $MP$  and  $MP'$ ). Removing the policy would raise the market price, thereby increasing producer surplus for program participants. (In the numerical simulation below, we also take into account equilibrium changes in prices for other program crops as well as frijoles).

Use of general equilibrium supply functions, allows us to capture interaction between program crops and markets for other crops not specifically modeled here. In particular, (11) comprises not only the usual, partial equilibrium concept of net revenue, but also the net change in welfare in markets for related crops not explicitly modeled here. Thus, we cannot interpret (11) as the change in economic welfare for producer type  $k$ . (Thurman; Just, Hueth, and Schmitz; Alston, Norton, and Pardey). However, (11) can be combined with (10) and also with the taxpayer costs to provide a measure of the effects of the policy on the over-all Mexican economy. In particular, the gain to the Mexican economy from removing the deficiency payment applied to all crops is

$$(12) \quad \begin{aligned} DWG = & (\text{taxpayer savings}) - (\text{loss to consumers of supported crops}) \\ & + (\text{gains to consumers of non-supported crops}) \\ & + [(\text{gain to non-participants}) - a(\text{loss to program participants})] \\ & + (\text{net gain to the rest of the economy}) \end{aligned}$$

$$= \sum_{j=1}^6 Q_{j1} (TP_j - MP_j)(1.1) + \sum_{j=1}^6 \Delta CS_j + \sum_{j=1}^6 (PS_{j, \text{participants}} + PS_{j, \text{non-participants}}),$$

where, again, the producer surplus measure includes net welfare changes in the rest of the economy. This means for example, it is not possible to quantify separately the gains to maize producers that participate in the program separately from other producer gains and losses.

The particular program implementation that we have chosen in our base simulations reflects information from Yunez and Dyer and OECD. However, the program may be implemented in other ways, with different economic implications. Two other program implementations that could be consistent with the observed aggregate difference in quantities marketed and quantities supported:

1. All producers are paid on a fixed quantity that is less than that quantity marketed. In this case, the program is infra-marginal for all producers, and has only small effects on market prices or production. (To the extent that payments affect risk, improve access to credit, change labor-leisure tradeoffs or have similar affects, even infra-marginal benefits can affect production.)
2. All producers are paid on a fixed percentage of production. In this case, the program raises the incentive price by less than the difference between the target price and the market price. In this case, the premium is (fixed percentage of production)  $\times$  (TP – MP). This is similar to the blend price resulting from price discrimination and revenue pooling.

We do not pursue modeling based on these two other implementation approaches.

### **Model Parameters and Data**

Equations (1)-(5) define equilibrium producer prices, market prices and quantities in the markets for Mexican grains, oilseeds and related crops. To quantify the effects of the Ingreso Objetivo program relative to a scenario in which no crops are subsidized by the program (depicted in Figure 2), we solve the model for equilibrium prices and quantities when the target price,  $TP$ , is below the market price.

The model is calibrated to data and parameters reflective of the 2005 market situation. Data used to parameterize the model are reported in Table 2 and Table 3. Much more data that informed our model structure and parameter choices are provided in the appendix. Table 3 shows the importance of the program for revenues of program participants and how important participation is for the industry over all. For example, for maize, the payment rate adds 24 percent above market to participant revenues, while participants comprise about half of all maize marketings, but only about one third of all maize production in Mexico.

Model intercepts and slopes are calculated based on the data reported in Table 2 and Table 3 and assumed values of elasticities of supply and demand. The elasticities are chosen to reflect existing knowledge of market behavior over a reasonably long time horizon appropriate for analyzing program changes expected to endure. In the base simulations, own-price elasticities of demand are assumed to be -2.0 for all crops except cotton, for which the own-price elasticity of demand is assumed to be -10.0. All cross-price elasticities of demand are assumed to be zero.

In the base simulations, the own-price elasticities of supply are assumed to be 1.0 for all crops and all cross-price elasticities are imputed to capture changes in land use created by policy-induced price changes. In particular, we accept that the sum of land used in each crop including the crops and other agricultural output that we do not model explicitly is equal to a quantity of farmland that adjusts only slightly. In the extreme case, suppose there are  $N$  crops grown on Mexican farmland. Then

$$(13) \quad \sum_{i=1}^N L_i = L_T$$

where  $L_i$  the quantity of land planted in crop  $i$ , and  $L_T$  is the total supply of farmland. Assuming that the total supply of farmland is fixed, it follows that

$$(14) \quad \sum_{i=1}^N s_i (\% \text{ change in } L_i) = 0.$$

where  $s_i$  is the share of land used in crop  $i$ ,  $s_i = L_i/L_T$ . Equation (11) says that when total farmland is fixed, any increase in land use for any particular crop has to come out of land use for other crops. Suppose, for example the price of crop  $j$  increases by 1 percent, causing a 1-percent increase in production of crop  $j$  and, abstracting from changes in yield, a 1-percent increase in land used in crop  $j$ . Dividing equation (14) by  $s_j$ (% change in  $L_j$ ) yields

$$(15) \quad \sum_{i=1}^N \frac{s_i}{s_j} \frac{(\% \text{ change in } L_i)}{(\% \text{ change in } L_j)} = 0$$

Making the further assumption that the percentage change in land use for each crop in response to a percentage change in land use for crop  $j$  is the same across all other crops, it follows that

$$(16) \quad \frac{(\% \text{ change in } L_i)}{(\% \text{ change in } L_j)} = \frac{-s_j}{(1-s_j)}$$

For example, given that approximately half of Mexican farmland is planted in maize, equation (16) says that a one-percent increase in the use of land in maize causes a  $.5/(1-.5) = 1$ -percent decrease the area of farmland used in each other crop. Once again, ignoring yield response for the moment, a 1-percent increase in the price of maize causes a 1-percent increase in the production of maize and a 1-percent increase in the quantity of land planted in maize. An exogenous change in the area land used for a crop with a smaller share of total land will have smaller percentage impact on land used in other crops. Equation (16) says that land used in every other crop, and thus production used in every other crop, must fall by 1 percent. Thus, we are able to use (16) together with data on land use for the six crops that we explicitly model, to infer cross-price elasticities of supply. If (14) hold approximately then (15) and (16) also hold only approximately.

These parameters are reflective of a response to a fully anticipated and permanent policy change that reduces the incentives for production of payment recipients and increases the market price and hence production incentive of non-recipients. This suggests a relatively large supply

response compared to that estimated when price fluctuations are expected to be temporary and it is difficult to gauge grower expectations.

For the analysis of price and quantity impacts the linear supply and demand functions are sufficient approximations. For our welfare analysis when cross-commodity effects may be important requires considering the effects on marginal costs throughout the range of the supply function. In order to reflect the reality that if price were to decline past some minimum point production of that commodity would cease, we apply a shutdown price to each linear supply function. We calculated the shutdown prices as approximately one-half the market price of each commodity. Specifically the shutdown prices are specified as follows: maize 700, cotton 2500, sorghum 500, wheat 800, other supported crops 700, frijoles 4000. As a part of our sensitivity analysis we also considered shut down prices equal to about one fourth of the market prices. The relevant welfare results changed only marginally suggesting that the results are not sensitive to the position of the horizontal segment of the supply function.

To investigate the sensitivity of results to the elasticity assumptions, we also consider scenarios for which elasticities are double those in the base case and scenarios in which the elasticities are half those in the base case. These cases are presented in final tables in the results section.

Finally, to implement the model written in equations (1)-(5) requires that we specify distributions for the random shocks  $Z_j^D$  and  $Z_{kj}^S$ . We assume each demand shock  $Z_j^D$  follows a Normal distribution with mean zero and a standard deviation imputed so that the demand curve has a coefficient of variation of approximately 0.025 in equilibrium. Thus, demand shocks cause fluctuations in consumption, 95% of which fall between +/- 5 percent of the initial equilibrium consumption. We allow the demand shocks to be positively correlated across some crops. Correlation coefficients are 0.5 for pairs maize and cotton, maize and sorghum, cotton and sorghum, and sorghum and wheat and zero elsewhere. These are based on historical relationships between these commodities. We impute covariances between supply shocks for each pair of commodities to reflect this relationship.

Similarly, we assume supply shocks  $Z_{kj}^S$  follow a joint Normal distribution with means 0 and standard deviations imputed so that the coefficient of variation for supply of each crop is approximately 0.025. We allow the supply shocks to be positively correlated across all crops, since weather events and input prices are likely to be common factors affecting supplies of various crops. Correlation coefficients are 0.8 between each pair of crops. We impute covariances between supply shocks for each pair of commodities to reflect this relationship.

### Policy Scenarios

We use the model in (1)-(5) to quantify the economic effects of the Ingreso Objetivo policy on the markets for Mexican crops. In particular, we address two general and related questions:

- (1) How does the Ingreso Objetivo policy affect prices, quantities, revenues, and consumer and government expenditure on average?
- (2) How does the Ingreso Objetivo policy affect variability of producer prices and revenue in a stochastic setting?

To address the question in (1), we solve the model under the conditions that  $Z_{kj}^S = 0$  for all crops and for both types of producers (i.e., no supply shocks), and  $Z_j^D = 0$  for all crops (i.e., no demand shocks). Under these conditions, the incentive price is equal to the actual harvest-time market price,  $IP_j = MP_j$ . Thus, given that the target prices are higher than the market prices, the producer price for program participants is equal to the target price,  $PP_{kj} = TP_j$ . We then remove the policy and solve the competitive market equilibrium, and thus quantify the effects of removing the policy.

To address the question in (2), we simulate the model a large number of times (2000), each time drawing supply and demand shocks from the distributions described in the previous sections. Under the policy the incentive price is set equal to the expected market price (i.e., the price when all supply and demand shocks are zero), but in general the incentive price is not equal to the

realized market price. Thus, the policy becomes a per unit subsidy of  $TP_j - IP_j$ . For each iteration, we record equilibrium prices and quantities, which are used to compute empirical means and variability of producer prices and revenues. Similarly, we simulate a large number (2000) of market equilibria in the absence of the policy, and compute empirical means and variability of producer prices and revenues. Finally, we compare the empirical distributions of producer prices and revenues under the policy to those under a competitive market equilibrium (no policy).

Lastly, we also compute empirical distributions of producer prices and revenues under an alternative policy in which the incentive prices are announced after the supply and demand shocks are observed, so that the incentive price equals the actual market price. This hypothetical policy is the textbook example of a target price/deficiency payment mechanism.

As noted above, for question 1, we also consider an alternative parameter set where all supply and demand elasticities are reduced to 50 percent of those in the base case (the "inelastic" case) and an alternative parameter set where all supply and demand elasticities are increased to double those in the base case (the "elastic" case).

### **Simulation Results and Discussion**

Results from our base simulation of the average annual effects of the Ingreso Objetivo policy on Mexican crop markets are reported in this section. Table 4 reports the average annual changes in quantities, prices, payment rates and government expenditures caused by eliminating the policy for all covered crops. The top half of Table 4 reports the changes in 2005 quantities and quantities, while the bottom half of Table 4 reports the percentage changes implied by removing the program. All changes reported in Table 4 are relative to an initial market equilibrium under the current policy regime, as reflected in Table 2 and Table 3.

As expected, elimination of the payments causes large reductions in the net effective per unit revenue facing program participants. The greatest percentage reduction in the "effective producer price" is seen in the market for cotton, 52 percent, since the target price for this crop is

by far the highest as a percentage of market price (Table 3). By contrast sorghum and wheat exhibit reductions in effective market price of only 13 and 11 percent. Table 4 shows that program participants respond to the lower prices by reducing marketings of the supported crops. Again, the effect in cotton markets is particularly large, -41 percent. In turn, the reduction in marketings of supported crops by program participants results in higher market prices for these crops.

The percentage reductions in quantities marketed by program participants is less than the percentage reduction in the producer prices for program participants, despite our assumption that own-price elasticities of supply equal one. The smaller reduction in quantities of program crops marketed by program participants is due to the fact that resources are reallocated across crops as relative effective prices change. For example, the reduction in quantity of sorghum marketed by program participants (3 percent) is less than would be indicated by the drop in the producer price (13 percent) because as prices of corn and other supported crops also fall, some of the land (and other resources) that was in those crops are re-allocated toward sorghum. Of course, some of the resources currently allocated to program crops would be also reallocated to non-supported crops, including frijoles and crops that we do not explicitly model. As a result, elimination of the policy would result in a reduction in the market prices for the non-supported crops as shown by the drop in the market price of frijoles.

Table 5 reports the average annual effects of removing Ingreso Objetivo on producer revenue and consumer and taxpayer outlays. The producer and consumer impacts are the products of the price and quantity impacts shown in Table 4. Table 5, we note that removing Ingreso Objetivo would reduce the producer revenue of participating maize producers by almost three thousand million pesos, due to an elimination of government payments and lower production (offset only partially by a slightly higher market price. Revenue of non-participants would rise because their production would rise, as would market price. As with Table 4, given the dominance of maize in Mexican crop production, cross-commodity substitution is important for wheat and sorghum. Note that consumer (buyer) expenditures decline even though prices rise because consumers buy smaller quantities of these formerly subsidized crops. Consumers shift to other commodities some of which may be imported products.

Table 6 reports the average annual consequences for welfare aggregates of consumers, taxpayers, producers plus the non-modeled crop participants (as discussed above) and on the economy as a whole. Table 6 shows that removing Ingreso Objetivo would cause a net gain to the Mexican economy of about 1,545 million pesos. A net gain of about 426 million pesos would be attributable to the assumed 10 percent deadweight loss of taxation. The rest of the gain is associated with a better allocation of resources to grow those crops that are demanded by the market rather than those heavily subsidized by the government. We note that buyers of the subsidized commodities would lose from program elimination, while buyers of unsubsidized commodities, such as frijoles would gain from removing subsidies on competing crops. Recall that buyers gains and losses denoted "consumer surplus" include effect on handlers, processors and marketing firms as well as final consumers.

Of course the major beneficiaries from removing the subsidy are taxpayers. Taxpayers would save almost 4.7 thousand million pesos per year that are now paid to program recipients who produce and market of these crops. Alternatively, the government revenue could be used for another more pressing purpose than subsidizing these commodity crops. In Table 6 we include the 10 percent figure for deadweight cost of taxation in the taxpayer cost column.

Table 6 shows the loss in an aggregate of producer and other surplus from removing Ingreso Objetivo. This column includes cross-commodity effects of the subsidies as well as cross effects and gains and losses of producers and consumers of the unsupported commodities that are not modeled explicitly. The total loss of surplus of about 2.576 thousand million pesos includes net effects in markets for such commodities as tomatoes and other vegetables that may compete for land with maize or other crops. This net loss from removing the subsidies is allocated across commodities (-1.25 thousand million pesos for maize) based on direct effects of the program on program crop producers and cross commodity effects reflecting, for example, the effects of removing the cotton subsidy on maize production. These commodity totals also reflect the interactions with the markets for the commodities not modeled explicitly that are reflected in the interpretations of the general equilibrium supply parameters that are discusses above (Thurman; Alston, Norton and Pardey; and Just, Hueth and Schmitz).

The bottom line from Table 6 is that Ingreso Objetivo has a large net negative impact on the Mexican economy even after recognizing the benefits the program provides to participating producers and consumers of the supported crops. The major transfer is from taxpayers to producers and consumers of the program crops.

Tables 7 through 12 report results from our stochastic analysis of the effects of Ingreso Objetivo on the distribution of producer prices and revenue.

Table 7 reports means, standard deviations, and coefficients of variation from the empirical distributions of producer prices under the current regime, given the distributions of stochastic shocks  $Z_{kj}^S = 0$  and  $Z_j^D$  as discussed above. Notice that the policy does not eliminate price variation for participants because the indifference price is not identical to the realized market price. Under our assumptions about the timing of shocks, the standard deviations in crop prices are identical for participants and non-participants. However, because the policy increases the mean producer price for participants relative to non-participants, the policy does reduce variability when measured relative to the mean (i.e., the coefficient of variation is lower for program participants).

Table 8 reports the means, standard deviations and coefficients of variation of crop revenue under the current regime. Again, it is worth noting that the policy does not eliminate revenue variability for participants. Standard deviations of revenue are higher for participants than for nonparticipants. However, because mean revenue is also higher for participants, the coefficients of variation are essentially identical across the two types of producers.

Using Table 7 as a benchmark, Table 9 reports the percentage changes, caused by removing Ingreso Objetivo, in the means, standard deviations and coefficients of variation of per unit revenue received by both types of producers. The changes in the means reported in Table 9 are the same as reported in Table 4. As we found in the static analysis discussed above, removal of the policy would cause lower (effective) prices for program participants, and higher prices of supported crops for non-participants. The columns of zeros in the standard deviation column for

both types of producers underscores the point in the previous paragraph that the policy has no effect on the standard deviation of the producer prices for either type of grower. This result is due to the fact that the producer price for participants under the policy is

$$PP_j = MP_j + (TP_j - IP_j)$$

and, further, that the payment rate,  $(TP_j - IP_j)$ , is fixed once it is announced relatively early in the season. Thus, the variance (or standard deviation) of the producer price for program participants is equal to the variance (or standard deviation) of the market price which we assume occurs after the IP has been announced. Again, because elimination causes a large decrease in the average producer price for participants, the coefficient of variation of the price for program participants would increase if the policy were eliminated. Similarly, eliminating the policy would decrease the coefficient of variation in producer prices for non-participants.

Table 10 reports the percentage changes in means, standard deviations and coefficients of variation in revenue caused by eliminating the program. While the Ingreso Objetivo policy has no effect on price variability, it increases revenue variability for the main program crops. Revenue variability for program participants would be significantly lower without the policy. The effects of the policy on revenue for non-participants are mixed and relatively small.

In Tables 11 and 12, we report results from our analysis of a hypothetical deficiency payment policy which, like the Ingreso Objetivo policy, sets a target price for certain crops, but for which the indifference price is set equal to the actual market price at harvest. In this policy, the payment rate is equal to the difference between the target price and the actual market price. Thus, any fluctuations in the market price are reflected in changes in the payment rate, so that the expected and realized producer price for program participants is the target price. Like the Ingreso Objetivo, the hypothetical policy raises average producer prices for participants. Unlike the Ingreso Objetivo, and as is shown in Table 11, such a policy completely eliminates variance in the producer price of supported crops for program participants (assuming that the market price is always below the target price, which is the case in our simulations). However, the hypothetical policy increases slightly the price variability for non-participants, a result which is

linked to the effect of the policy on program participants. By eliminating variation in the incentive price for program participants, the hypothetical policy eliminates supply response by participants; that is, supply of supported crops from participants is perfectly inelastic (although still stochastic). Thus, excess demand for supported crops facing non-participants is also more inelastic, which amplifies the variability of market prices caused by supply and demand shocks.

While the hypothetical policy eliminates price variability for program participants, it *increases* revenue variability, as can be seen by comparing Table 12 to Table 8. For each supported crop except cotton, both the standard deviation and the coefficient of variation of revenue are higher under the hypothetical policy than under the Ingreso Objetivo. This result is due to the fact that the policy effectively makes demand facing program participants perfectly elastic at the target price, thereby eliminating the natural hedge associated with a downward-sloping demand curve, and thereby increasing revenue variability. (For cotton demand is already very elastic due to the global nature of the industry and Mexico's small role in world markets.)

Of course, enhanced responsiveness of market prices to shocks to the supply from non-participants increases the effectiveness of the natural hedge. Changes in weather that reduce yields, for example, also result in higher prices under the hypothetical policy than under the Ingreso Objetivo policy. Thus, revenue variability is not markedly increased under the hypothetical policy compared to the Ingreso Objetivo.

Finally, we consider how sensitive our result may be to variations in the supply and demand parameters.

In Tables 13 and 14 we replicate the results of Tables 4 and 6 for a set of more elastic demand and supply functions. For these results we use parameters double the magnitude (in absolute value) as those in the base case. The main implications of the more elastic parameter set are that market price impacts are smaller (see the column labeled "Producer Prices for Non-participants"). The quantity produced falls by more for the program participants and rises by more for the non-participants. Table 14 shows the welfare effects under the more elastic case. Consumer losses

from removing Ingreso Objetivo are even greater than in the base case but producer and other losses are smaller and the overall gain from removing the program are larger than the base case.

In Tables 15 and 16 we replicate the results of Tables 4 and 6 for a set of less elastic demand and supply functions. For these results we use parameters half as large (in absolute value) as those in the base case. The results are just the inverse of those reported in Table 13 and Table 14. The overall welfare gain from elimination of the program is somewhat smaller than indicated in Table 6, but under these assumptions the Mexican economy would still gain almost 1.4 thousand million pesos.

### **Concluding Remarks and Policy Implications**

The Ingreso Objetivo program in Mexico operates much like a classic deficiency payment program. Payments to participating producers are calculated to offset the difference between the government-set target price and a calculated representative market price, the "Indifference Price." Under Ingreso Objetivo, the payment rate is known, at least approximately, in advance of many production decisions and therefore affects the output of payment recipients. Given that they anticipate the market impacts, the program also affects production decisions of those outside the program. Ingreso Objetivo makes payments only on a subset of the amount marketed of program crops. Therefore we analyze separately the impacts on those in the program and those producing program crops who do not receive payments. We also consider the impacts on program crop consumers, producers and consumers of alternative crops and, of course, taxpayers, who finance the payments.

Program elimination would cause gains and losses across producers with major losses to program payment recipients. Farmers who market the program crops but do not have access to the subsidy gain from program elimination because the market prices would increase. Buyers of the program crop would face these slight price increases with removal of the subsidy. Removing the program would result in large net gains to the economy as a whole, about 1.5 thousand million pesos, because the program encourages production of specific crops despite market signals that indicate other crops would be a more economic use of resources. This result is

reflected in the sizable supply response from program elimination as resources, mostly farmland and farm labor, would be reallocated to their higher valued uses. Of course the main beneficiary of removing the program would be taxpayers and the economy as a whole.

Our model quantifies program benefits to a select group of farm producers and commodity buyers at the expense of other producers and the Mexican economy more generally. We have not analyzed detailed data on the distribution of farms that benefit from the program, but the distribution by state indicates that beneficiaries are the larger and well-established commercial growers in Mexico. For example, about half the maize payments are made to producers in Sinaloa. We have found no evidence that the program targets smaller farms or encourages participation from emerging commercial producers in areas that are not traditional commercial centers for inter-state exports. The very structure of the program provides payments roughly in proportion to the quantity of the program crop marketed, so larger producers naturally receive the bulk of the payments.

Ingreso Objetivo pays selected farms that market selected crops that tend to compete with imports, especially from the United States. Therefore, U.S. market conditions and policy affect the operation and cost of the program. With the full implementation of NAFTA that includes final removal of tariffs and import quotas in 2008, the markets in North America will be even more closely linked. In our simulations we incorporated a demand elasticity facing Mexican program crops of -2 (and -10 for cotton) in the base case to reflect the integration of Mexico into North American and world markets. For maize in particular, this reflects potential for substitution, on the margin, of yellow maize (much of it from the United States) for Mexican grown white maize. Such substitution potential does not imply that many Mexican retail consumers will convert from white maize in tortillas or that prices between yellow maize and white maize must converge to be equal. Rather the elastic demand reflects that the prices of white and yellow maize will be well integrated and move together because for some uses, especially livestock feed, buyers treat yellow maize and white maize as close substitutes. We note that this market integration also provides the foundation for use of U.S. export prices as the Indifference Price in determining Ingreso Objetivo payments. Market integration in North

America is also a reality for sorghum, wheat, cotton and other program crops such as rice and soybeans.

As outlined above, barring a major reversal in the U.S. senate deliberations that are likely to take place in September and October, the U.S. 2007 Farm Bill seems likely to continue substantial subsidies for the crops covered by Ingreso Objetivo. Like Ingreso Objetivo, the U.S. counter cyclical and marketing loan subsidies provide the largest payments when market prices are low. Thus when prices are expected to be low, the U.S. programs exacerbate price declines by encouraging producers to maintain added production that is not indicated by market forces. U.S. programs not only keep prices generally lower than they would otherwise be, they exasperbate price variability and especially price declines.

Countervailing duty (CVD) provisions of trade remedy laws are designed explicitly to provide redress in the case of subsidized exports into the Mexican market that cause low prices and material injury to Mexican producers. It is beyond the scope of this paper, and beyond the expertise of the authors to provide legal guidance on these issues. Nonetheless, using CVD provisions rather than Mexican subsidies to respond to U.S. subsidy programs is worth of further consideration. A CVD approach would be less costly to the Mexican economy and more direct in its targeting than is a subsidy war with the United States Congress and treasury. Beneficiaries of the CVD approach would include all producers who market the program crops and not just those who participate in Ingreso Objetivo. Raising import barriers through CVD actions would also signal to the United States that its subsidy programs are unacceptable and by reducing U.S. exports to Mexico increase U.S. industry awareness of the costs of the U.S. subsidy programs. The CVD import barriers would raise consumer prices in Mexico rather than lower consumer prices as with Ingreso Objetivo and this may call for assistance for low-income consumers.

The size of the per-unit subsidy for most crops exceeds the price suppression impacts of the U.S. subsidies on the market price n Mexico. That means that as Ingreso Objetivo over compensates U.S. subsidy effects. For example, Sumner (2005) estimates that the U.S. maize program depressed market prices by about 10 percent whereas the Ingreso Objetivo subsidy rate is about 24 percent of market price (based in both cases on 2005 data). The price suppression impact of

cotton is likely to be somewhat larger than 10 percent (Sumner 2006) and the effects on other crops is likely to be smaller than 10 percent (Sumner 2005). In all cases the Ingreso Objetivo subsidy rate is higher than the price suppression caused by U.S. subsidies.

We base our simulation analysis reported above on data from 2005. Current and projected market prices for the program crops are now much higher than those that prevailed in 2005. This means that the U.S. programs are projected to have relatively small market effects from 2007 through 2012. Furthermore, if these baseline projections hold true, Ingreso Objetivo payments will also be zero or very small during this period. This period of zero or low payments and unusually strong income from market sources provides a perfect and perhaps unique opportunity to end Ingreso Objetivo. The program has only operated for a few years and has not been thoroughly imbedded into cropland prices and the market institutions surrounding the covered crops. Program payment recipients do not currently rely on the subsidies for farm profitability and seem likely to be reliant on market incomes for the next several years. Thus, 2007 and 2008 represent an ideal window of opportunity to remove a set of regressive subsidies that distort the rural economy.

Payment recipients, of course, are likely to resist ending a program that promises payments if prices decline again. If the program proves politically resilient, several adjustments would reduce distortions and reduce the magnitude of the losses associated with a transfer from taxpayers to those select farmers who receive payments. First, the target prices should be reduced to reflect the "safety net" feature of the program. If the program is designed to provide support in times of low prices, then the target price could be set so that payments are made only when market prices are truly low by historical standards recognizing the long run trend toward lower commodity market prices in inflation adjusted terms. There are many formulas for setting target prices, but it is crucial that target prices not be used to "lock in" through generous payments the abnormally high market prices occurring in 2007 and likely to occur over the next few years. Thus, a moving average of past market prices would not be an appropriate basis for determining the more market oriented payment scheme. A program adjusted such that in low price years, payments were set to equal no more than 5 percent of market prices would assure that the programs did not provide excessive benefits.

Replacing Ingreso Objetivo with direct payments for all growers who market the program crops would also reduce the incentive distortions and could help redress the skewed distribution of payments. Such a program could pay, up to some fixed ceiling amount, all producers with a history of marketing the program crop, with no requirement that they maintain production in that or any other crop. Such single farm payments are now the mainstay of European Union farm programs. Payments could also be targeted to farms that meet environmental criteria and be used to encourage provision of ecological services from farms (Alston and Sumner, 2007).

The clearest case for removing Ingreso Objetivo is simply that it benefits only a select group of payment recipients to the detriment of Mexican agriculture and the Mexican economy. As with similar programs in other countries, there is no plausible public policy rationale for continuing to operate Ingreso Objetivo.

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**Table 1: U.S. Maize Subsidy and Value of Production, Marketing Years<sup>1</sup> 2003, 2004 and 2005, in \$1000**

| <i>Marketing year</i>                                    | <i>2003</i>      | <i>2004</i>      | <i>2005<sup>2</sup></i> |
|----------------------------------------------------------|------------------|------------------|-------------------------|
| Direct Payments                                          | 2,109,517        | 2,106,611        | 2,112,538               |
| Counter Cyclical Payments                                | 0                | 2,444,643        | 3,372,000               |
| Marketing Loan Benefits <sup>3</sup>                     | 77,500           | 2,898,547        | 4,678,570               |
| Net transfer to farmers from crop insurance <sup>4</sup> | 225,000          | 203,700          | 250,000                 |
| <b>Total subsidy</b>                                     | <b>2,412,017</b> | <b>7,653,501</b> | <b>10,413,108</b>       |
| Average market price, dollars per bushel                 | 2.42             | 2.06             | 1.90                    |
| Value of production (market revenue) <sup>5</sup>        | 24,476,803       | 24,322,597       | 21,112,937              |
| <b>Ratio of subsidy to value of production</b>           | <b>0.10</b>      | <b>0.31</b>      | <b>0.49</b>             |

Sources: Maize subsidy data by marketing year (crop year) for direct payments, counter-cyclical payments and loan deficiency payments are obtained from the Commodity Estimates Book of the 2007 President's Budget, Output 50, available at: <http://www.fsa.usda.gov/dam/bud/CCC%20Estimates%20Book/estimatesbook.htm>. Direct payments for maize in marketing years 2003-05 can be found in rows 9-11 in spreadsheet Out50C. Counter cyclical payment data can be found in spreadsheet Out50D, rows 9-11. Loan deficiency payments are found in spreadsheet Out50F, rows 9-11. Data for certificate exchange gains and marketing loan gains for crop year 2003 and 2004 are obtained from the Commodity Estimates Book of the 2007 President's Budget, Outputs 16 and 18. The data for marketing loan gains can be found in Output 16, spreadsheet "Wkst," rows 9-11. Data for certificate exchange gains can be found in Output 18, spreadsheet "Out18C, rows 9-11. Estimation of marketing loan gains and certificate exchanges gains has been discontinued and the Commodity Estimate Book in the President's 2007 Budget does not provide such data for 2005. These (minor contributors to overall subsidy) are approximated using the percentage increase from estimates that USDA provided in December 2005 for loan deficiency payments to the revised figure for loan deficiency payments in the 2007 President's Budget (published February 6, 2006) to the preliminary estimates of marketing loan gains and certificate exchange gains provided by USDA in December 2005. The maize price and value of maize production for marketing year 2003 is obtained from the USDA National Agricultural Statistical Service's Quick Stats Database (<http://www.nass.usda.gov/>). The prices and values of production for the 2004 and 2005 maize marketing years are based on data from the USDA World Agricultural Outlook Board's "World Agricultural Supply and Demand Estimates," WASDE-431 February 9, 2006, <http://usda.mannlib.cornell.edu/usda/reports/waobr/wasde-bb/>.

<sup>1</sup> The U.S. marketing year for maize begins September 1 and ends August 31.

<sup>2</sup> The 2005 data are estimates and projections (Final data is now available and the table can be updated).

<sup>3</sup> Marketing Loan Benefits consist of Loan Deficiency Payments, Certificate Exchange Gains (an unimportant option for maize) and Marketing Loan Gains.

<sup>4</sup> See Table 5 for detail.

<sup>5</sup> For marketing year 2005, we apply the mid point of the price range reported by USDA (\$1.90) times the quantity produced to obtain the value of production estimate shown in the table.

**Table 2. Data Representing 2005 Markets for Mexican Crops**

|                       | Quantity marketed                |             |        | Target price<br>Pesos/metric ton | Market price | Ingreso Objetivo |                                  |
|-----------------------|----------------------------------|-------------|--------|----------------------------------|--------------|------------------|----------------------------------|
|                       | w/ support<br>(1000 metric tons) | w/o support | total  |                                  |              | payment rate     | Gov expenditure<br>million pesos |
| Maize                 | 6,326                            | 6,238       | 12,564 | 1,650.00                         | 1,336        | 314              | 1,984                            |
| Cotton                | 141                              | 260         | 401    | 9,640.00                         | 4,569        | 5,071            | 715                              |
| Sorghum               | 1,983                            | 2,662       | 4,645  | 1,270.00                         | 1,096        | 174              | 345                              |
| Wheat                 | 2,356                            | 652         | 3,008  | 1,800.00                         | 1,607        | 193              | 454                              |
| Other supported crops | 1,022                            | 931         | 1,953  | 2,112.00                         | 1,363        | 749              | 765                              |
| Frijoles*             | 462                              | 462         | 924    | 6,903.00                         | 6,903        | n.a.             | n.a.                             |
|                       |                                  |             |        |                                  |              |                  | 4,263                            |

Sources: Quantity marketed with support, Target Price, Market Price, and Ingreso Objetivo payment rate are from SAGARPA (<http://www.infoasercar.gov.mx/programas/programas.asp?seccion=reportes>). Total quantity marketed is from also from SAGARPA (<http://www.siap.gov.mx/>). See the data appendix for more detailed market data on these and other crops.

Note: Quantities marketed of frijoles are distributed equally across participant and non-participant producers. We have no direct data on the distribution of production of non-program crops among those farms that receive payments and those that do not.

**Table 3. Ingreso Objetivo Policy Parameters for Maize, Cotton, Sorghum and Wheat**

|         | Quantity<br>Produced | Quantity Marketed |                    | Quantity Supported |                    |                    | Market<br>Price | Payment Rate |                           |
|---------|----------------------|-------------------|--------------------|--------------------|--------------------|--------------------|-----------------|--------------|---------------------------|
|         | 1000 MT              | 1000 MT           | % of<br>Production | 1000 MT            | % of<br>Production | % of<br>Marketings | (Pesos/MT)      | (Pesos/MT)   | (% of<br>Market<br>Price) |
| Maize   | 19,339               | 12,564            | 65                 | 6,326              | 33                 | 50                 | 1,336           | 314          | 24                        |
| Cotton  | 401                  | 401               | 100                | 141                | 35                 | 35                 | 4,569           | 5,071        | 111                       |
| Sorghum | 5,199                | 4,645             | 89                 | 1,983              | 38                 | 43                 | 1,096           | 174          | 16                        |
| Wheat   | 3,015                | 3,008             | 100                | 2,356              | 78                 | 78                 | 1,607           | 193          | 12                        |

**Source:** Quantity marketed with support, Target Price, Market Price, and Ingreso Objetivo payment rate are from SAGARPA (<http://www.infoasercas.gob.mx/programas/programas.asp?seccion=reportes>). Total quantity marketed is from also from SAGARPA (<http://www.siap.gob.mx/>). Production and prices are from SAGARPA-SIAP data portal, [http://www.siap.gob.mx/agricola\\_siap/entidad/index.jsp](http://www.siap.gob.mx/agricola_siap/entidad/index.jsp). See the data appendix for more detailed market data on these and other crops.

**Table 4. Effects Removing the Ingreso Objetivo Policy on Prices and Quantities**

|                       | Quantity marketed  |                 |       | Producer Prices    |                  | Ingreso Objetivo |                 |
|-----------------------|--------------------|-----------------|-------|--------------------|------------------|------------------|-----------------|
|                       | with support       | without support | total | Participants       | Non-participants | Payment rate     | Gov expenditure |
|                       | Level changes      |                 |       | Level changes      |                  |                  |                 |
|                       | (1000 metric tons) |                 |       | (Pesos/metric ton) |                  |                  | million pesos   |
| Maize                 | -891               | 172             | -719  | -275               | 38               | -314             | -1,984          |
| Cotton                | -58                | 0               | -58   | -5,004             | 66               | -5071            | -715            |
| Sorghum               | -58                | -17             | -76   | -165               | 9                | -174             | -345            |
| Wheat                 | -3                 | -9              | -11   | -190               | 3                | -193             | -454            |
| Other supported crops | -226               | 33              | -193  | -681               | 67               | -749             | -765            |
| Frijoles              | 43                 | -15             | 28    | -106               | -106             | n.a.             | n.a.            |
|                       | Percent Changes    |                 |       |                    |                  |                  |                 |
| Maize                 | -14                | 3               | -6    | -17                | 3                | -100.0           | -100.0          |
| Cotton                | -41                | -0              | -15   | -52                | 2                | -100.0           | -100.0          |
| Sorghum               | -3                 | -1              | -2    | -13                | 1                | -100.0           | -100.0          |
| Wheat                 | -0                 | -1              | -0    | -11                | 0                | -100.0           | -100.0          |
| Other supported crops | -22                | 4               | -10   | -32                | 5                | -100.0           | -100.0          |
| Frijoles              | 9                  | -3              | 3     | -2                 | -2               | n.a.             | n.a.            |

**Table 5. Effects of Removing the Ingreso Objetivo Policy on Revenue and Expenditure**

|                       | Producer Revenue             |                  |        | Expenditure |            |
|-----------------------|------------------------------|------------------|--------|-------------|------------|
|                       | Participants                 | Non-participants | Total  | Consumer    | Government |
|                       | Level Change (million pesos) |                  |        |             |            |
| Maize                 | -2,968                       | 475              | -2,492 | -508        | -1,984     |
| Cotton                | -975                         | 16               | -959   | -244        | -715       |
| Sorghum               | -392                         | 5                | -387   | -42         | -345       |
| Wheat                 | -451                         | -12              | -463   | -9          | -454       |
| Other supported crops | -1,020                       | 110              | -910   | -145        | -765       |
| Frijoles              | 243                          | -148             | 95     | 95          | n.a.       |
| TOTAL                 | -5,562                       | 446              | -5,116 | -853        | -4,263     |
|                       | Percent Change               |                  |        |             |            |
| Maize                 | -28                          | 6                | -13    | -3          | -100.0     |
| Cotton                | -72                          | 1                | -38    | -13         | -100.0     |
| Sorghum               | -16                          | 0                | -7     | -1          | -100.0     |
| Wheat                 | -11                          | -1               | -9     | -0          | -100.0     |
| Other supported crops | -47                          | 9                | -27    | -5          | -100.0     |
| Frijoles              | 8                            | -5               | 2      | 2           | n.a.       |

**Table 6. Welfare Effects of Removing the Policy, with All Supply and Demand Elasticities Twice the Magnitude of Supply and Demand Elasticities used in the Base Case.**

|                       | Change in Producer and<br>Other Surplus <sup>a</sup> | Change in Consumer<br>Surplus <sup>b</sup> | Change in Taxpayer<br>Cost <sup>c</sup> | Deadweight Gain <sup>d</sup> |
|-----------------------|------------------------------------------------------|--------------------------------------------|-----------------------------------------|------------------------------|
| -- million pesos --   |                                                      |                                            |                                         |                              |
| Maize                 | -1,248                                               | -467                                       | 2,182                                   | 467                          |
| Cotton                | -481                                                 | -25                                        | 786                                     | 280                          |
| Sorghum               | -185                                                 | -41                                        | 379                                     | 153                          |
| Wheat                 | -230                                                 | -9                                         | 499                                     | 260                          |
| Other supported crops | -453                                                 | -125                                       | 842                                     | 263                          |
| Frijoles              | 22                                                   | 100                                        |                                         | 121                          |
| TOTAL                 | -2,576                                               | -567                                       | 4,689                                   | 1,545                        |

Note: Supply elasticities are 1.0; demand elasticity for cotton is -10 and demand elasticity for other crops are -2.0.

<sup>a</sup> Includes change in producer surplus for program participants, producers who market program crops but do not participate in the program and the net welfare change in other related markets that are not explicitly modeled here associated with the adjustments in each commodity market listed.

<sup>b</sup> Includes effects of price changes on consumer welfare in each of the commodity markets listed. The "Total" is the sum of the amounts for each commodity and does not include the consumer effects for commodities not explicitly modeled. Those impacts are included in the Other Surplus in the previous column.

<sup>c</sup> Includes actual outlays plus the deadweight cost of generating government revenue. We make the conservative assumption that the deadweight cost of collecting taxes is 10 percent.

<sup>d</sup> Includes the sum of all welfare impacts noted for the previous three columns including the gains and losses in the market for commodities not explicitly modeled.

**Table 7. Distribution of Producer Prices under the Ingreso Objetivo Policy: Central Tendency and Dispersion**

|                       | Participants |          |               | Non-participants |          |               |
|-----------------------|--------------|----------|---------------|------------------|----------|---------------|
|                       | Mean         | St. Dev. | Coef. of Var. | Mean             | St. Dev. | Coef. of Var. |
|                       | (Pesos/MT)   |          |               | (Pesos/MT)       |          |               |
| Maize                 | 1,650        | 20       | 0.012         | 1,336            | 20       | 0.015         |
| Cotton                | 9,640        | 21       | 0.002         | 4,570            | 21       | 0.005         |
| Sorghum               | 1,270        | 18       | 0.014         | 1,096            | 18       | 0.017         |
| Wheat                 | 1,800        | 25       | 0.014         | 1,607            | 25       | 0.016         |
| Other Supported Crops | 2,112        | 22       | 0.011         | 1,363            | 22       | 0.016         |
| Frijoles              | 6,903        | 107      | 0.016         | 6,903            | 107      | 0.016         |

Source: Derived from model application using base case parameters.

**Table 8. Hypothetical Distribution of Revenue under the Ingreso Objetivo Policy: Central Tendency and Dispersion**

|                       | Participants    |          |               | Non-participants |          |               |
|-----------------------|-----------------|----------|---------------|------------------|----------|---------------|
|                       | Mean            | St. Dev. | Coef. of Var. | Mean             | St. Dev. | Coef. of Var. |
|                       | (million Pesos) |          |               | (million Pesos)  |          |               |
| Maize                 | 10,441          | 228      | 0.022         | 8,336            | 192      | 0.023         |
| Cotton                | 1,359           | 43       | 0.032         | 1,188            | 36       | 0.030         |
| Sorghum               | 2,519           | 57       | 0.023         | 2,918            | 67       | 0.023         |
| Wheat                 | 4,242           | 97       | 0.023         | 1,048            | 26       | 0.024         |
| Other Supported Crops | 2,159           | 51       | 0.024         | 1,269            | 31       | 0.024         |
| Frijoles              | 3,191           | 73       | 0.023         | 3,190            | 76       | 0.024         |

Source: Derived from model application using base case parameters.

**Table 9. Effects on the Distribution of Producer Prices of Removing the Ingreso Objetivo Policy**

|                       | Participants        |          |               | Non-participants |          |               |
|-----------------------|---------------------|----------|---------------|------------------|----------|---------------|
|                       | Mean                | St. Dev. | Coef. of Var. | Mean             | St. Dev. | Coef. of Var. |
|                       | (Percentage Change) |          |               |                  |          |               |
| Maize                 | -16.7               | 0.0      | 20.0          | 2.9              | 0.0      | -2.8          |
| Cotton                | -51.9               | 0.0      | 107.9         | 1.5              | 0.0      | -1.4          |
| Sorghum               | -13.0               | 0.0      | 14.9          | 0.8              | 0.0      | -0.8          |
| Wheat                 | -10.5               | 0.0      | 11.8          | 0.2              | 0.0      | -0.2          |
| Other Supported Crops | -32.3               | 0.0      | 47.6          | 4.9              | 0.0      | -4.7          |
| Frijoles              | -1.5                | 0.0      | 1.6           | -1.5             | 0.0      | 1.6           |

Source: Derived from model application using base case parameters.

**Table 10. Effects on the Distribution of Revenue of Removing the Ingreso Objetivo Policy**

|                 | Participants        |          |               | Non-participants |          |               |
|-----------------|---------------------|----------|---------------|------------------|----------|---------------|
|                 | Mean                | St. Dev. | Coef. of Var. | Mean             | St. Dev. | Coef. of Var. |
|                 | (Percentage Change) |          |               |                  |          |               |
| Maize           | -26.6               | -17.3    | 12.8          | 5.0              | 2.3      | -2.6          |
| Cotton          | -66.2               | -53.3    | 38.0          | 0.7              | 1.2      | 0.5           |
| Sorghum         | -8.5                | -14.3    | -6.3          | -3.1             | -0.8     | 2.4           |
| Wheat           | -5.8                | -13.8    | -8.5          | -7.4             | -2.8     | 4.9           |
| Other Supported |                     |          |               |                  |          |               |
| Crops           | -41.6               | -37.3    | 7.5           | 4.3              | 2.8      | -1.4          |
| Frijoles        | 15.2                | -1.4     | -14.3         | -8.7             | -3.4     | 5.8           |

Source: Derived from model application using base case parameters.

**Table 11. Distribution of Producer Prices under a Hypothetical Policy where the Indifference Price is Set Equal to the Market Price at Harvest**

|                 | Participants |          |               | Non-participants |          |               |
|-----------------|--------------|----------|---------------|------------------|----------|---------------|
|                 | Mean         | St. Dev. | Coef. of Var. | Mean             | St. Dev. | Coef. of Var. |
|                 | (Pesos/MT)   |          |               | (Pesos/MT)       |          |               |
| Maize           | 1,650        | 0        | 0.000         | 1,336            | 23       | 0.018         |
| Cotton          | 9,640        | 0        | 0.000         | 4,570            | 20       | 0.004         |
| Sorghum         | 1,270        | 0        | 0.000         | 1,096            | 20       | 0.018         |
| Wheat           | 1,800        | 0        | 0.000         | 1,607            | 31       | 0.019         |
| Other Supported |              |          |               |                  |          |               |
| Crops           | 2,112        | 0        | 0.000         | 1,363            | 24       | 0.018         |
| Frijoles        | 6,903        | 103      | 0.015         | 6,903            | 103      | 0.015         |

Source: Derived from model application using base case parameters.

**Table 12. Distribution of Revenue under a Hypothetical Policy where the Indifference Price is Set Equal to the Market Price at Harvest**

|                       | Participants    |          |               | Non-participants |          |               |
|-----------------------|-----------------|----------|---------------|------------------|----------|---------------|
|                       | Mean            | St. Dev. | Coef. of Var. | Mean             | St. Dev. | Coef. of Var. |
|                       | (million Pesos) |          |               | (million Pesos)  |          |               |
| Maize                 | 10,443          | 319      | 0.031         | 8,337            | 209      | 0.025         |
| Cotton                | 1,359           | 41       | 0.030         | 1,188            | 37       | 0.031         |
| Sorghum               | 2,520           | 77       | 0.031         | 2,917            | 71       | 0.024         |
| Wheat                 | 4,245           | 127      | 0.030         | 1,048            | 30       | 0.029         |
| Other Supported Crops | 2,159           | 66       | 0.030         | 1,270            | 34       | 0.027         |
| Frijoles              | 3,191           | 69       | 0.022         | 3,191            | 80       | 0.025         |

Source: Derived from model application using base case parameters.

**Table 13. Price and Quantity Effects of Removing the Policy, with All Supply and Demand Elasticities Twice the Magnitude of Supply and Demand Elasticities used in the Base Case.**

|                       | Quantity marketed  |             |       | Producer Prices    |                  | Ingreso Objetivo |                 |
|-----------------------|--------------------|-------------|-------|--------------------|------------------|------------------|-----------------|
|                       | with support       | w/o support | total | Participants       | Non-participants | Payment rate     | Gov expenditure |
|                       | (1000 metric tons) |             |       | Level changes      |                  |                  |                 |
|                       |                    |             |       | (Pesos/metric ton) |                  | (million pesos)  |                 |
| Maize                 | -1932              | 370         | -1562 | -272               | 42               | -314             | -1,984          |
| Cotton                | -132               | 4           | -128  | -4998              | 73               | -5071            | -715            |
| Sorghum               | -299               | 31          | -268  | -158               | 16               | -174             | -345            |
| Wheat                 | -198               | 9           | -189  | -167               | 25               | -193             | -454            |
| Other supported crops | -547               | 93          | -454  | -669               | 79               | -749             | -765            |
| Frijoles              | 42                 | -15         | 27    | -50                | -50              | n.a.             | n.a.            |
|                       | Percent Changes    |             |       |                    |                  |                  |                 |
| Maize                 | -31                | 6           | -12   | -17                | 3                | -100.0           | -100.0          |
| Cotton                | -93                | 1           | -32   | -52                | 2                | -100.0           | -100.0          |
| Sorghum               | -15                | 1           | 6     | -12                | 1                | -100.0           | -100.0          |
| Wheat                 | -8.4               | 1           | 6     | -9                 | 2                | -100.0           | -100.0          |
| Other supported crops | -54                | 10          | -23   | -32                | 6                | -100.0           | -100.0          |
| Frijoles              | 9                  | -3          | 3     | -1                 | -1               | n.a.             | n.a.            |

Note: Supply elasticities are 2.0, demand elasticity for cotton is -20 and demand elasticity for other crops are -4.0.

**Table 14. Welfare Effects of Removing the Policy, with All Supply and Demand Elasticities Twice the Magnitude of Supply and Demand Elasticities used in the Base Case.**

|                       | Change in Producer and<br>Other Surplus <sup>a</sup> | Change in Consumer<br>Surplus <sup>b</sup> | Change in Taxpayer<br>Cost <sup>c</sup> | Deadweight Gain <sup>d</sup> |
|-----------------------|------------------------------------------------------|--------------------------------------------|-----------------------------------------|------------------------------|
| -- million Pesos --   |                                                      |                                            |                                         |                              |
| Maize                 | -1,078                                               | -490                                       | 2,183                                   | 615                          |
| Cotton                | -299                                                 | -25                                        | 786                                     | 463                          |
| Sorghum               | -141                                                 | -71                                        | 379                                     | 167                          |
| Wheat                 | -150                                                 | -73                                        | 499                                     | 276                          |
| Other supported crops | -326                                                 | -137                                       | 842                                     | 378                          |
| Frijoles              | 69                                                   | 47                                         |                                         | 116                          |
| <b>TOTAL</b>          | <b>-1,925</b>                                        | <b>-748</b>                                | <b>4,689</b>                            | <b>2,016</b>                 |

Note: Supply elasticities are 2.0, demand elasticity for cotton is -20 and demand elasticity for other crops are -4.0.

<sup>a</sup> Includes change in producer surplus for program participants, producers who market program crops but do not participate in the program and the net welfare change in other related markets that are not explicitly modeled here associated with the adjustments in each commodity market listed.

<sup>b</sup> Includes effects of price changes on consumer welfare in each of the commodity markets listed. The "Total" is the sum of the amounts for each commodity and does not include the consumer effects for commodities not explicitly modeled. Those impacts are included in the Other Surplus in the previous column.

<sup>c</sup> Includes actual outlays plus the deadweight cost of generating government revenue. We make the conservative assumption that the deadweight cost of collecting taxes is 10 percent.

<sup>d</sup> Includes the sum of all welfare impacts noted for the previous three columns including the gains and losses in the market for commodities not explicitly modeled.

**Table 15. Price and Quantity Effects of Removing the Policy, with All Supply and Demand Elasticities Half the Magnitude of Supply and Demand Elasticities used in the Base Case.**

|                       | Quantity marketed  |             |       | Producer Prices    |                  | Ingreso Objetivo |                 |
|-----------------------|--------------------|-------------|-------|--------------------|------------------|------------------|-----------------|
|                       | with support       | w/o support | total | Participants       | Non-participants | Payment rate     | Gov expenditure |
|                       | Level Changes      |             |       | Level Changes      |                  |                  |                 |
|                       | (1000 metric tons) |             |       | (Pesos/metric ton) |                  | (million pesos)  |                 |
| Maize                 | -357               | 89          | -268  | -285               | 29               | -314             | -1,984          |
| Cotton                | -21                | 0           | -21   | -5,022             | 48               | -5,071           | -715            |
| Sorghum               | 68                 | -31         | 37    | -183               | -9               | -174             | -345            |
| Wheat                 | 102                | -15         | 87    | -239               | -46              | -193             | -454            |
| Other supported crops | -62                | 7           | -55   | -711               | 38               | -749             | -765            |
| Frijoles              | 45                 | -12         | 32    | -241               | -241             | n.a.             | n.a.            |
| Percent Changes       |                    |             |       |                    |                  |                  |                 |
| Maize                 | -6                 | 1           | -2    | -17                | 2                | -100.0           | -100.0          |
| Cotton                | -15                | 0           | -5    | -52                | 1                | -100.0           | -100.0          |
| Sorghum               | 3                  | -1          | 1     | -14                | -1               | -100.0           | -100.0          |
| Wheat                 | 4                  | -2          | 3     | -13                | -3               | -100.0           | -100.0          |
| Other supported crops | -6                 | 1           | -3    | -34                | 3                | -100.0           | -100.0          |
| Frijoles              | 10                 | -3          | 4     | -4                 | -4               | n.a.             | n.a.            |

Note: Supply elasticities are 1.0, demand elasticity for cotton is -5 and demand elasticity for other crops are -1.0.

**Table 16. Welfare Effects of Removing the Policy, with All Supply and Demand Elasticities Twice the Magnitude of Supply and Demand Elasticities used in the Base Case.**

|                       | Change in Producer and<br>Other Surplus <sup>a</sup> | Change in Consumer<br>Surplus <sup>b</sup> | Change in Taxpayer<br>Cost <sup>c</sup> | Deadweight Gain <sup>d</sup> |
|-----------------------|------------------------------------------------------|--------------------------------------------|-----------------------------------------|------------------------------|
|                       | -- million pesos --                                  |                                            |                                         |                              |
| Maize                 | -1,406                                               | -355                                       | 2,183                                   | 422                          |
| Cotton                | -573                                                 | -19                                        | 786                                     | 194                          |
| Sorghum               | -261                                                 | 41                                         | 379                                     | 159                          |
| Wheat                 | -382                                                 | 142                                        | 499                                     | 259                          |
| Other supported crops | -556                                                 | -73                                        | 842                                     | 212                          |
| Frijoles              | -91                                                  | 227                                        | 0                                       | 135                          |
| <b>TOTAL</b>          | <b>-3,271</b>                                        | <b>-38</b>                                 | <b>4,689</b>                            | <b>1,381</b>                 |

Note: Supply elasticities are 1.0; demand elasticity for cotton is -5 and demand elasticity for other crops are -1.0.

<sup>a</sup> Includes change in producer surplus for program participants, producers who market program crops but do not participate in the program and the net welfare change in other related markets that are not explicitly modeled here associated with the adjustments in each commodity market listed.

<sup>b</sup> Includes effects of price changes on consumer welfare in each of the commodity markets listed. The "Total" is the sum of the amounts for each commodity and does not include the consumer effects for commodities not explicitly modeled. Those impacts are included in the Other Surplus in the previous column.

<sup>c</sup> Includes actual outlays plus the deadweight cost of generating government revenue. We make the conservative assumption that the deadweight cost of collecting taxes is 10 percent.

<sup>d</sup> Includes the sum of all welfare impacts noted for the previous three columns including the gains and losses in the market for commodities not explicitly modeled.

**Data Annex is in the separate document.**