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TECHNIQUES FOR RAPID ANALYSIS OF GOVERNMENT MARKET INTERVENTIONS AFFECTING THE AGRICULTURAL SECTOR: AN APPLICATION OF PARTIAL EQUILIBRIUM ANALYSIS

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By: JENNIFER BREMER-FOX

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Prime Contractor: **Abt Associates Inc.**, 55 Wheeler Street, Cambridge, Massachusetts 02138 • (617) 492-7100

Subcontractors: **Robert R. Nathan Associates, Inc.** 1301 Pennsylvania Avenue, N.W., Washington, D.C. 20004 • (202) 393-2700

Abel, Daft & Earley, 1339 Wisconsin Avenue, N.W., Washington, D.C. 20007 • (202) 342-7620

Oklahoma State University, Department of Agricultural Economics, Stillwater, Oklahoma 74078 • (405) 624-6157

Techniques for Rapid Analysis of Government Market Interventions Affecting the Agricultural Sector: An Application of Partial Equilibrium Analysis

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Dr. Jennifer Bremer-Fox

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1. Jennifer Bremer-Fox
2.
3.

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This paper is intended to help analysts in developing country governments, as well as others concerned with policies affecting the agricultural sector, to carry out analyses of policy impacts when time or data are severely limited. Techniques using supply and demand models are presented. Methods of calculation are designed to be completed with pen and calculator, but can readily be converted to a microcomputer spreadsheet format.

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ABSTRACT

This paper is intended to help analysts in developing country governments, as well as others concerned with policies affecting the agricultural sector, to carry out analyses of policy impacts when time and data, or both, are severely limited. The technique presented here, supply/demand analysis or SDA, is an application of partial equilibrium analysis. The methods of calculation presented are designed to be completed with pen and calculator, but can readily be converted to a spreadsheet format by analysts familiar with this method of analysis.

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RAPID APPRAISAL OF GOVERNMENT MARKET INTERVENTIONS AFFECTING THE AGRICULTURAL SECTOR

Introduction

World experience with agricultural development over the past 10 years has demonstrated that growth in production and rural incomes occurs most quickly where the government has put in place a set of policies that favor the agricultural sector, or, at a minimum, policies that do not shift the terms of trade against agriculture. Government support to agriculture in the form of research, extension, and state investment has not been able to overcome the negative effects of policies such as compulsory delivery of grain at artificially low prices. Indeed, policies that reduce agriculture's profitability have proven to be major barriers to widespread application of yield- and area-increasing technologies.

Equally important, policies that assign the public sector a major part of the responsibility for processing and marketing of inputs and agricultural products, or prohibit private activity altogether, have been associated with heavy effective taxation of rural producers, slow expansion in the marketed surplus, and in extreme cases, a fall in agricultural production. Policies favoring urban areas and generation of government revenues have also been found to have extremely negative consequences for income growth among the rural poor majority, for the equity of income distribution, and for nutrition.

This paper is intended to help analysts in developing country governments, as well as others concerned with policies affecting the agricultural sector, to carry out analyses of policy impacts when time and data, or both, are severely limited. The technique presented here, supply/demand analysis or SDA, is an application of partial equilibrium analysis. The methods of calculation presented are designed to be completed with pen and calculator, but can readily be converted to a spreadsheet format by analysts familiar with this method of analysis.[1]

Before proceeding, it is appropriate to clarify how the term policy is used in this paper, as the term is regularly applied to a wide range of concepts by different authors. As used here

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1. Development of a spreadsheet program incorporating these methods is tentatively planned for the second phase of the Agricultural Policy Analysis Project.

- A policy is a government intervention in a macroeconomic or agricultural market that directly affects the operation of that market.

- Examples of policies include taxes and subsidies, restrictions such as government monopolies or import quotas, and direct government provision of goods and services in competition with or replacing the private sector, such as subsidized sale of fertilizer in government outlets.

- Examples of actions not included in this definition include general statements of government goals and objectives; government programs to provide services that do not compete with or replace the private sector such as agricultural research and decisions governing these programs; and specific rules for the operation of the government, such as personnel or leave "policies."

The use of this relatively narrow definition in this paper is not meant to suggest that other policy issues are not important. On the contrary, a large number of policy questions arise in management of the agricultural sector that do not meet this definition, but are nonetheless extremely important for the development of the sector, including strategic questions, such as the decision to promote export crops over grain for local consumption, and decisions regarding the allocation of public resources among competing uses, such as research and investment in infrastructure. These questions do not lend themselves to partial equilibrium analysis techniques of the type discussed in this paper, however, and therefore will not be discussed further here.

Recognition of the importance of policy has naturally led donors and government officials to place increased priority on policy analysis and, where necessary, reform. Although analysis of alternative policy interventions has therefore assumed increased importance, the analytic process generally falls short of the academic ideal. The reality of the policy-making process requires, more often than not, that analysis of alternatives be carried out quickly and without the data necessary for a sophisticated consideration of the impacts.

In this situation, simplified techniques are necessary to produce estimates of policy impact within the time available. Such an approach does not replace more careful and in-depth analysis of policy alternatives; on the contrary, the analytic skills, data, and understanding of the agricultural sector generated by in-depth studies are the basis for success in rapid analysis. Significant changes in policy with the potential to have a major and lasting impact on the agricultural sector and the national economy deserve the thorough and careful consideration that can only be provided by an in-depth analysis. Where such an analysis is impossible, however, techniques such as those described here can dramatically improve the information available to policy makers forced to make a decision in a limited time frame with the data available. The analytic method presented here -- supply/demand analysis or SDA -- permits

experienced analysts to assemble and organize readily available data so that they are of maximum utility for policy making and project design.

At the same time, the analyst must remain aware of the limitations of this or any partial equilibrium approach to analysis of major policy interventions. Particularly when policy changes are implemented in the context of a broad reform program affecting several different policies or are carried out during a time when market conditions -- domestic or international -- are undergoing rapid change, a partial equilibrium technique may not be adequate. Under these circumstances, the analyst is forced to use more complex techniques, such as general equilibrium analysis. Even where this is not possible, it is advisable for the analyst to consider the broader effects of specific measures being analyzed. Quantitative or qualitative analysis of these broader, or second order, effects provides important guidance to the decision maker on the total impact to be expected from a given policy measures. Although discussion of these second order effects is precluded in a short paper such as this, such considerations are nonetheless an important part of even a "quick and dirty" analysis.

A second important caveat to the use of the techniques presented here derives from the need to recognize that the quantitative estimates obtained are only that -- estimates. Wherever possible the analyst should present the findings in the form of a range of likely outcomes, rather than fixing upon the specific point estimates falling out of the analysis. Our understanding of the underlying dynamics of the agricultural sector, particularly in developing countries, is simply insufficient to make confident predictions of specific outcomes from a given policy intervention and it is the analyst's responsibility to help the decision maker not only to understand the analysis and the results, but also to interpret them in the light of this uncertainty.

Introduction to the Methodology

The SDA methodology applies standard neoclassical economic analysis techniques to examine the impact of introducing or changing a specific policy intervention. The methodology uses a three-step process yielding quantitative estimates of selected impacts:

1. Identification of the intervention based on the typology presented below, in order to interpret correctly how the intervention affects demand and supply for the relevant product(s).

2. Determination of the new equilibrium for demand and supply, based on the nature of the proposed change, the current equilibrium price and quantity, and basic demand and supply parameters (elasticities).

3. Analysis of the impact of the shift to the new equilibrium on a set of variables of interest to policy makers.

Because it is a partial (rather than general) equilibrium appraoch, the methodology is best used to examine the impact of interventions that affect a specific product, such as wheat or milk. It is less applicable to interventions affecting an input used to produce a wide range of products, such as land or fertilizer, although SDA can be used to analyze the impact on each of a limited number of products, which may then be combined to estimate the total input. In general, SDA cannot be used to examine the impact of macroeconomic policy changes on the agricultural sector (although there are some limited applications, such as estimating the effect of a devaluation on the supply of a particular product or group of products).

The methodology yields partial equilibrium estimates (also sometimes called first order effects) for a given policy change. It is therefore best applied to policy changes that do not have a major impact on costs and returns for a large number of products. The technique can be applied to examine a reduction of the tax on maize from 25 percent to 10 percent, for example, but more sophisticated techniques are needed to develop quantitative estimates of, say, an increase in the tax on agricultural income from 10 percent to 30 percent or introduction of a land reform. Similarly, the methodology is not readily applicable to reforms involving multiple policy changes affecting different products and inputs, such as a reform to bring the prices for several different crops to world-equivalent levels. Both of these more complex reforms affect the agricultural sector in too many ways to be analyzed with a simplified technique such as SDA.

A Typology of Market Interventions

Policy interventions may be divided into three broad categories in accordance with the way in which their impact on the market is felt. These three categories may be defined as follows:

Type A: Interventions that require the government to buy and/or sell the good or service affected

Examples:
Government monopolies or trading companies
Some subsidy programs or taxation systems (e.g., sale of subsidized fertilizer through a parastatal; distribution of subsidized grain through fair-price shops; taxation of cocoa through a marketing board)
Guaranteed price floors and ceilings
Some foreign exchange controls
Most deficit-financing systems

Type B: Interventions that require the government to pay money to or collect money from buyers or sellers, but not to take part in the transaction directly

Examples:

Import taxes or tariffs, export subsidies and rebates
Sales taxes
Some subsidy systems (e.g., food stamps)
Import licenses

Type C: Interventions that regulate market participants or the operation of the market itself

Examples:
Licensing of traders
Import quotas and non-tariff barriers
Price controls or price floors and ceilings not backed by guaranteed government purchase
Margin controls
Regulation of internal movement of grains
Interest rate restrictions and other banking regulation
Fixed foreign exchange rates

In analyzing the impact of possible policy changes, the analyst must carefully examine both the official policy and the way it is actually implemented to identify the type of intervention involved and its resulting impact on the market. Superficially similar interventions may in fact be very different, depending on the way in which they are implemented. For example, an "agricultural credit subsidy" may take any of the following forms (as well as several others):

Type A: A subsidy system where agricultural credit is the monopoly of a state-owned bank, which may introduce a two-tiered pricing structure for agricultural credit, in which some is subsidized and some is not and both the price and the availability of credit differ greatly among farmers, depending on their gender, location, and resource base

Type B: Direct payments from the government to participating agricultural banks, which, if implemented effectively rather than merely promised, may decrease the price of credit and increase its availability, at some cost to the government

Type C: A government-imposed ceiling on interest rates costs the treasury nothing but may decrease the supply of credit and increase its cost to farmers

This example illustrates two distinctions that are extremely important in identifying the nature of the intervention under study and analyzing its impact:

- Is the policy applied universally (e.g., most import tariffs) or selectively (e.g., a fertilizer subsidy available only to cooperative members)?
- Particularly where the policy is applied selectively, are transactions permitted outside this system or are all such transactions illegal?

Both of these distinctions require additional explanation. Continuing the example of a government-owned credit bank, one would ask first whether all farmers (traders, processors, etc.) are eligible for subsidized credit, both in theory and in practice. In other words, is the government bank ready and able to meet the demand for credit at the subsidized price? If this is not the case (or if there is reason to believe that the subsidy is rendered illusory by very high transaction costs at the state-owned bank), it is then necessary to ask whether farmers who do not have access to government-subsidized credit are able to borrow from private institutions operating legally. The answers to these questions provide key indicators as to whether the "credit subsidy" increases or decreases the cost and availability of credit to farmers, as well as the equity impacts of the government's credit policies.

It is quite common for several interventions belonging to one or more of the three categories above to coexist in the same market. Until recently, for example, most West African governments both purchased grain at the official price on their own accounts (a type A intervention because the government actually buys and sells the commodity affected) and mandated that all private transactions take place at the official price (a type C intervention where the government does not make up the difference between the price it imposes and the market-determined price), as well as taxing traders heavily (a type B action where the government adds or subtracts funds from market transactions between private economic actors). The presence of multiple interventions in a single market may make it difficult to determine the impact of changing a single policy intervention. In the example above, the impact of a change in the official price must be analyzed both in terms of changes in the government's purchasing program (amount purchased as well as price paid) and the impact, if any, on purchases through private channels, but the latter may be affected by several policy interventions, in addition to the official price.

Impact Categories

In nearly all cases, a given policy intervention affects many different elements of the national economy. A change in any one intervention, such as an official price, must therefore be analyzed in terms of its impact on each element of the national economy involved, not just on the group most immediately affected. An increase in the government's official price, for example, will almost surely affect farmer income and government expenditure levels directly. It is also likely to affect production levels and consumer

prices and, in consequence, to lead to changes in the amount purchased by consumers (and real consumer income) and/or the amounts imported and exported. Indirect effects on other agricultural products and the use of agricultural inputs can also be anticipated.

At the same time, the number of impacts evaluated, particularly in a "quick and dirty" analysis such as that discussed here, must be limited for two related reasons. First, as policy impacts become more and more distant conceptually from the initial change, they become harder and harder to measure or predict, because of the presence of intervening factors and our poor understanding of complex markets in developing countries. Second, the need for rapid information on the expected effect of a given policy change implies that the analysis must be strictly constrained in order to produce useful information within the timeframe available for decision making.

It is therefore useful to select a set of impact areas, against which all proposed policy changes are evaluated. This set can be expanded to include additional areas, as time and data permit, but provides a strong basis for making comparable analyses of alternative interventions in different markets. A basic set of impacts, and that used in the remainder of this paper, consists of the following:

Domestic production:	changes in the level of output of the product or products affected
Farm income:	changes in the farmers' gross and net income
Domestic consumption:	changes in the level of the product(s) consumed domestically
Real consumer income:	changes in consumer expenditures and the associated income effect
Government budget:	direct effect on government revenues and expenditures as the result of the policy change
Trade balance:	changes in imports and exports

In some cases, political or economic conditions may make it desirable to disaggregate impacts within these categories. In particular, the analysts' decision-maker clientele may require separate estimates of the impact on specific consumer groups (e.g., urban), rather than on all consumers.

Overview of the Methodology for Estimating Impacts

The methodology presented here combines three types of information to estimate the likely impact of proposed policy changes:

- Information on the current situation: current levels for price, consumption, production, and trade for the commodity directly affected by the policy change
- Basic demand and supply parameters: demand and supply elasticities or the best available estimates of these parameters
- The policy context: the nature and level of the current interventions in the market and those to be analyzed

Based on this information, the analysis proceeds in five steps:

- Definition of the current situation: analysis of the current situation in the appropriate markets (e.g., for a change in the fertilizer policy, such as an increase in the subsidy, the price and quantity of fertilizer sold in country and its distribution among imports, local production, and exports)
- Translation into a supply-demand diagram: representation of the current situation in terms of the standard neoclassical demand and supply curves, based on the current price and quantity levels, supply and demand elasticities, and the role of trade in the domestic market
- Definition of the proposed policy change: determination of how the policy change will affect the demand and supply situation, as represented in the supply-demand diagram
- Estimation of the impact on price and quantity: the expected impact on the quantity supplied and demanded and the price in the domestic market where the intervention takes place
- Estimation of other impacts: calculation of the expected impact in the remaining areas defined above, based on the estimated effect on domestic production, consumption, and price

Each of these steps deserves additional comment before we turn to the specific examples in the following sections.

Definition of the Current Situation

The price and quantity levels for commodities sold on the national market are in theory unambiguous, but in practice these basic values may be difficult to determine, even setting aside data problems. There is not one price for sorghum, say, but a range of prices, depending on the level in the market structure (farm gate, rural market, wholesale, urban retail, import, etc.), the time of year, the quality, and the volume involved in the transaction. Reported quantity levels may also require interpretation or adjustment, depending on whether the figure refers to total production, production net of seed and losses, the amount marketed (i.e., deducting on-farm consumption from net production), or another definition. Data sources may be vague on which of these alternative definitions is being used, and the issue is often further complicated by the degree of processing involved: whether the reported quantity represents milled rice or paddy, livestock on the hoof or dressed weight, and so on.

To deal with this problem, the analyst must define a point in the market channel to evaluate the price, such as the average price in the capital city wholesale market or the average farm-gate price in the major producing region, and then adjust this price up or down to reflect the situation in other parts of the market channel. This decision is based on the relative reliability of data for different points in the system and the nature of the policy changes to be examined. The analyst should select a definition corresponding as closely as possible to the point where the intervention takes place (e.g., the rural market price if the intervention is a price support implemented through a rural buying campaign), but the availability and reliability of data are also important considerations.

A number of market interventions commonly used by developing country governments result in a multiple pricing structure for a given commodity. For example, part of a given crop may be purchased by the government at an official price while the remainder moves on free market channels at another price. In this situation, the appropriate price on which to base the analysis is generally that prevailing on the free market channel (although, as discussed in Chapter 3 below, other prices are also incorporated into the analysis). In most cases, the amount traded by the government is relatively inflexible for budgetary or administrative reasons, and consequently farmers and consumers must make their final or "marginal" trade at the free market price.

Once price is defined, a definition for quantity should then be selected to be consistent with the price definition. All figures must then be corrected to be consistent with these definitions.

The definition of the current market situation also includes specification of the amount <u>imported or exported</u>; the amount <u>purchased or sold by the government</u>, if any; and the amount <u>traded on the open market</u> and/or <u>consumed on-farm</u>. In many cases, the last-named quantity must be estimated as a residual given trade, official purchases, and estimates of total production.

Finally, it is useful to list the policy interventions affecting the product under analysis, in order to interpret the market being studied. At a minimum, any tax or subsidy on international trade should be identified, including tariffs and over- or under-valuation of the exchange rate, as these interventions are likely to have a major impact on the functioning of domestic markets, and therefore to affect the way in which any other intervention operates.

Transition into a Supply-demand Diagram

The current price and quantity levels in the domestic market define a point that may be plotted on a standard neo-classical supply-demand diagram (see Figure 1). This point represents the intersection of the supply curve and the demand curve. It can be used to plot the entire curves when combined with two other pieces of information: the demand and supply elasticities and the shape of the curves (i.e., their functional form). Elasticity estimates are generally derived from econometric analysis of historical or cross-sectional data. Because such analyses are fairly intensive in their requirements for data and analytic input, a reliable estimate for a given product in a specific country cannot be assured. Demand elasticity estimates, often based on income and expenditure surveys, exist for a growing number of countries, however, and tend to cover a wide range of commodities for each country. Supply elasticities (and demand elasticities for input such as fertilizer) are less common, but may frequently be identified in the academic literature.

Where elasticity estimates cannot be found, the analyst has two choices: (1) use an estimate from another country with similar characteristics or (2) use several different estimates covering the expected range from low to high price-responsiveness. These two approaches can be combined, by beginning with an estimate from another country and then varying it upward and downward to develop a range of impact estimates. Elasticity estimates from other countries can be identified from a number of sources, identified in the appendix.

Choice of a functional form for the supply and demand curves is equally a matter for professional judgment. The approach suggested here is simply to assume that the curves can be approximated by straight lines over the range relevant to the analysis. This has the important advantage of simplifying the calculations required, because the (supply or demand) elasticity can be translated into the slope of the curve, which can then be used to calculate the intercept. Because all lines are straight, calculation of impacts, such as income transfers, requires only simple algebra and geometry. (Examples of the calculation are given in Chapter 3; the same procedure is applicable to all analytic situations.)

If the analyst is not comfortable with this approach, any alternative functional form can also be used, provided it permits the analyst to plot out the current supply or demand curve with the information available and to interpret the affect of shifting it to reflect policy changes. Supply curves based on Cobb-Douglas and constant elasticity of substitution production functions appear frequently in the literature, for example. The methods outlined below can be used with these or virtually any specification for the

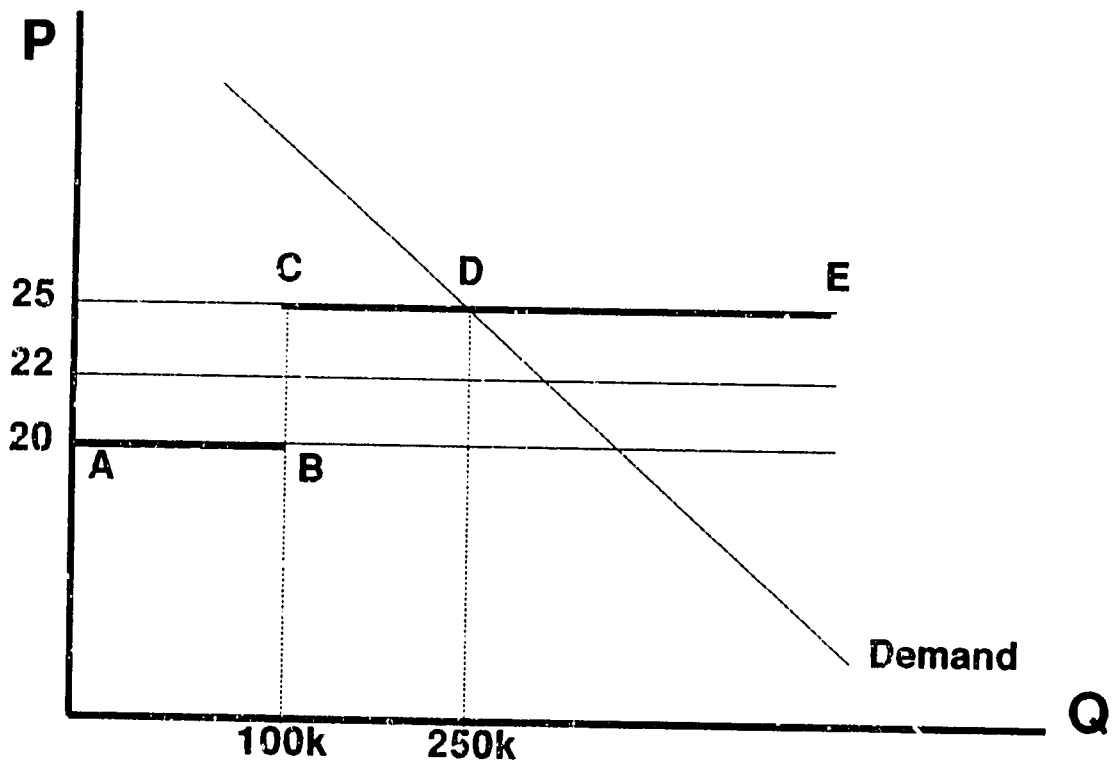

Figure 1. Supply-demand diagram for example 1, decrease in government-subsidized imports (situation prior to proposed policy change).

supply and demand curves. We should note, however, that calculations of impact may become quite complicated for non-linear supply and demand curves, requiring integral calculus rather than simple geometry.

Definition of the Proposed Policy Change

This step, clearly the critical step in the process, is by no means easy or automatic. Budgetary shortages and implementation shortfalls frequently introduce a gap between the official description of a given policy intervention and the actual shape it takes in the marketplace. Imprecise terminology adds to the problem, with the result that the analyst must take considerable care to understand the way in which the intervention being studied affects supply and demand and to reflect this understanding in the supply-demand diagram. Correct identification of the interventions with respect to the three types given above is an important first step in this task, as demonstrated by the examples given in sections C through E below. The analyst must also determine where in the market channel the intervention is to be implemented. In most cases, policy interventions are implemented at the wholesale (producer) level, the retail (consumer) level, or in the country's international trade system.

Estimation of the Impact on Price and Quantity

Once the intervention under study has been defined in terms of its effect on demand or supply in the market most directly affected. To accomplish this using SDA, the analyst plots the new supply or demand curve that will result from the intervention and then calculates the new equilibrium price and quantity. For example, if the intervention is an increase in the tariff on imported grain, the analyst plots the new import price and calculates the price that will prevail in the domestic market, given domestic supply conditions. This price determines the quantity demanded by consumers and the proportion of this demand that is satisfied from domestic production and imports. (More detailed examples are given below.)

Estimation of Other Impacts

The calculation of the new equilibrium price and quantity resulting from the intervention provides the basis for calculating the estimated change in each of the six variables identified above (domestic production, producer income, domestic consumption, consumer income, trade, and the government budget). Interpretation of these figures completes the analytic process.

This five-step procedure requires that two important assumptions be made. First, it supposes that the so-called <u>small-country assumption</u> holds, that is, that the amount imported and exported by the country in question does not have a measurable impact on the price paid or received on the world market. This assumption, which is unrelated to the size of the country, is generally valid, but may require careful examination for certain country-commodity pairs (e.g., rice in Thailand) or where markets are highly fragmented (Mexico, for example, is a relatively small producer of tomatoes in world terms, but a major producer in terms of the market in the southern United States). Quality or

varietal differences may also require attention in this regard (e.g., long-staple cotton vs. medium-staple, flavor-grade cocoa vs. other grades).

Second, and more important, it assumes that the prices and quantities prevailing in the domestic market (both before and after the policy intervention) are market-clearing levels, that is, that supply and demand are roughly in balance at those levels, allowing for trade. This assumption is less stringent than assuming that the current levels represent a long-term equilibrium, much less that such an equilibrium is the outcome of free market conditions. As further discussed below, this assumption may well hold even if a significant proportion of the trades in the marketplace take place at some other price (e.g., if half of the consumers buy their grain at a subsidized price different from the market price).

Analysis of Interventions Involving Government Ownership

Most of the important policy interventions implemented in the agricultural sectors of developing countries involve direct participation of the government as a buyer and seller of the target commodities. Examples of such interventions include:

Product markets:	Government purchase of domestically produced maize for sale to feed mills at a subsidized price; government importation of rice for sale to consumers at a subsidized price; a government monopsony on the purchase of cotton for export; a floor price for wheat producers backed by government purchases whenever the open market price threatens to fall below the floor
Input markets:	Government sale of fertilizer at a subsidized price; government provision of tractor services at a subsidized price; government credit schemes for farmers

These and other policy interventions that operate through government purchase and sale of the target commodities are often chosen in preference to direct subsidies or taxes to accomplish a given purpose, such as encouraging farmers to use fertilizer by lowering its price. This decision rests on two primary considerations. First, government decision makers often have a strong preference for dealing directly with consumers or producers rather than relying on markets to achieve the desired results. For example, they may be unwilling to provide a subsidy to fertilizer dealers because they do not believe that this subsidy will be passed on to farmers. Second, direct participation in the market may appear to be administratively simpler and possibly less expensive than implementing a tax or subsidy program. As a practical matter, it may be virtually impossible for a developing country government to implement a sales tax on domestic grain sales, making an indirect tax (e.g.,

forced purchase at a price below the market price) an attractive option. The fact that direct government involvement in the market may well cost the government more and yield fewer benefits than expected is only now being recognized by developing country governments and donors.

Framing the Problem

The impact of Type A interventions depends on several factors that together define the intervention and shape the way government participation in the market interacts with private market activity. To determine the impact of existing or potential interventions of this type, the analyst must answer the following questions, some of which are straightforward while others may be quite difficult to answer:

- Does the government exercise monopoly or monopsony power over the market or does it compete with private buyers and sellers? In some cases, an official monopoly may exist (e.g., private sale of fertilizer is illegal), but in reality private traders may control a significant share of the market. In other cases, private traders may operate legally, but the government may nonetheless exercise monopoly power as, for example, the sole source of an imported input.

- Where the government price may be more attractive to farmers or consumers than the open-market price (or where the government is the "only game in town"), is the government able to meet demand (or respond to supply) at that price, or are quantities limited? Is the government able to purchase as much as farmers wish to sell at the official floor price, for example, or are purchases constrained by budgetary or administrative limitations? Do government stores selling subsidized grain to consumers -- or fertilizer to farmers -- offer sufficient quantities to meet demand or must consumers (or farmers) turn to the private market to meet their needs?

- Is the good traded or at least tradeable? The dynamics of the domestic market and the government's role in it differ greatly, depending on whether the good is an import not produced in country, an import competing with local production, a local product or service produced solely for the domestic market, or a local product aimed at least in part at the export market. The government can easily establish an effective monopoly in a product that must be imported, for example (assuming the government has effective control over its borders, which not all governments do), or in a product produced entirely in government factories, but it is much more difficult to establish an effective monopoly in a product that is

widely produced locally by a large number of private sector firms or farms.

- Can the good be resold easily? Even if the government establishes an effective monopoly in a market for a particular product, an active private black or gray market can arise if the product is one that can easily be resold, such as fertilizer and most other goods, but not if it is a product that is difficult to resell, such as credit, tractor services, or most other services.

- Are the government's sales or purchases additional to private sector trades or do they merely substitute for trades that could or would have taken place in any case? In other words, is the government adding to effective demand or supply? If the government purchases local grain for sale to consumers, for example, are the government's customers primarily well-off urban residents who would have purchased grain on the private market if the government grain were not available, or are they low-income consumers who would not have been able to purchase grain on the open market?

The last question is perhaps the most important one for determining the impact of the government's actions, because it is crucial to defining the "no intervention" case with which the intervention is being compared. Unfortunately, it is also the most difficult to answer, because the additionality of government supply or demand is likely to depend on the time frame for the analysis. Suppose the government has a monopoly on rice imports, for example, which it has maintained for several years. It can be argued that the government's imports are additional to the supply of rice on the domestic market because there are no private importers. If the government were to permit private trades, however, it is highly likely that private merchants would move into the void rapidly, so the government's activity is additional only in the very short run.

Estimating the Impacts

This section provides two examples applying the SDA technique outlined above to changes in Type A interventions:

- A reduction in the quantity of fertilizer sold at subsidized prices in government-sponsored cooperatives

- An increase in the price at which the government procures maize from farmers

The examples used are strictly hypothetical. In each case, the situation is sketched only briefly, without the complications that would inevitably

characterize an actual intervention, because the purpose of these examples is to demonstrate the technique, not to discuss the issues that arise from the case itself. The first example will be presented in quantitative terms, to illustrate the method; the second example will be analyzed only graphically, emphasizing the differences between it and the first example.

Example 1: A reduction in the quantity of fertilizer sold at subsidized prices in government-sponsored cooperatives.

Step 1: Definition of the current situation. The current situation may be described as follows:

> The government imports fertilizer, which it sells at 20 pesos/kilogram. Given an import price of 22 pesos/kilogram and marketing cost of 3 pesos, the government loses 5 pesos on each kilo sold. At the current volume of 100,000 MT, this amounts to a loss of 500 million pesos annually. The private sector also imports fertilizer at the same price as the government and sells it at 25 pesos/kilogram. Private imports currently total 150,000 MT and, since there are no local producers, use of fertilizer nationally totals 250,000 MT. Because supplies at the government store are rationed, no farmer can increase his purchases at the subsidized price above the current level and any farmer who wants more fertilizer must buy it at the open market price. The local price elasticity of demand for fertilizer has been estimated at -1.2. Fertilizer is used solely for maize production.

Step 2: Translation into a supply-demand diagram. Figure 1 shows the current situation as translated into a supply-demand diagram.[2] Note that the demand curve has the usual shape (downward sloping), but that the supply curve consists of two horizontal segments. The lower segment (AB) represents the government's imports, which are decided administratively, while the upper segment (CDE) represents the imports by the private sector, which are presumed to meet whatever demand remains at the market price.

The procedure for calculating the demand curve from the information presented above is as follows:

- Calculate the slope of the demand curve at the current equilibrium level. As further explained below, this is accomplished by translating the elasticity (-1.2) and the current price at the margin and the total quantity being sold into a slope. In this situation, the price paid by the farmers on the private market constitutes the marginal price, as it is assumed that this is the price that farmers must pay for an additional bag of fertilizer, even though some farmers are able to purchase fertilizer from the government store at a lower price.

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2. Figures are not drawn to scale.

- Calculate the intercept of the demand curve and the y or price axis, given the slope and the current price and quantity levels, as shown below.

The same procedure would be used to calculate the supply curve if fertilizer were produced locally rather than imported (using the elasticity of supply for fertilizer rather than the elasticity of demand).

The slope calculation used here assumes that the demand curve can be approximated by a straight line, at least over the range covered by the analysis. The demand curve therefore has the following familiar $y = a + bx$ functional form, or

$$\text{Price} = \text{constant} - (\text{slope} \times \text{quantity})$$

The calculation is based on the definition of the demand elasticity as the percentage change in the quantity demanded relative to the percentage change in price:

$$\text{Demand Elasticity} = -1.2 = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

or

$$= \frac{(\text{Change in quantity/quantity})}{(\text{Change in price/price})}$$

Because the slope is the ratio of the change in quantity to the change in price, it is possible to calculate the slope by rearranging the equation above:

$$\text{Slope} = \frac{\text{Change in quantity}}{\text{Change in price}} = \frac{\text{Elasticity} \times \text{Quantity}}{\text{Price}}$$

or, using the values in our example,

$$\text{Slope} = \frac{(-1.2) \times 250{,}000}{25{,}000}$$

$$= -12$$

Because supply-demand diagrams traditionally plot price on the vertical axis and quantity horizontally, even though quantity is the dependent variable in the equation, the slope in the diagram is the reciprocal of the value calculated, or -.083 (1/-12).

This slope can then be used to calculate the intercept by rearranging the demand curve equation as follows:

$$\text{Price} = \text{intercept} + (\text{slope} \times \text{quantity})$$

or

$$\text{Intercept} = \text{price} - (\text{slope} \times \text{quantity})$$

or, using the values from our example,

$$\text{Intercept} = 25{,}000 - (-.083 \times 250{,}000) = 45{,}750$$

In other words, at a price of 45.75 pesos per kilogram, farmers would cease to buy fertilizer (at least in theory).

Step 3: Definition of the proposed policy change. The proposed policy change may be described as follows:

> Growing concern over the high cost of the fertilizer subsidy has led the government to consider reducing the amount sold from 100,000 MT to 75,000 MT. The government is particularly concerned about the impact on farmer fertilizer use and private imports.

Step 4: Estimation of the impact on price and quantity. Figure 2 shows the proposed change, translated into a supply-demand diagram (note that the letter-designation of points on Figure 2 does not correspond to that of Figure 1). Several points are worth noting regarding this diagram and its interpretation. First, the reduction in the quantity of subsidized fertilizer sold by the government does not affect either the total amount of fertilizer sold or the price on the open market. Instead, sales simply shift to the private channels. This conclusion may surprise government decision makers, but it follows directly from standard economic theory, given that the open-market price is the price that farmers are already using to decide whether or not to buy more fertilizer, and that the country imports fertilizer (i.e., an increase in the quantity used does not imply an increase in the price).[3]

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3. If farmers who purchase fertilizer at the government shop are able to buy as much as they want (i.e., subsidized fertilizer is not rationed as we have assumed), then the situation should be analyzed using two separate demand curves, one for farmers eligible to use the government store (who, in our example, purchased 100,000 MT at a price of 20,000 pesos per MT) and one for other farmers (who purchased 150,000 MT at a price of 25,000). Even if the demand elasticities at the current purchase level are the same for both groups (which is probably not the case), the demand curves for each group will have different slopes and intercepts and, therefore, the total demand curve derived by summing the two individual curves will have a different slope and intercept from that derived above.

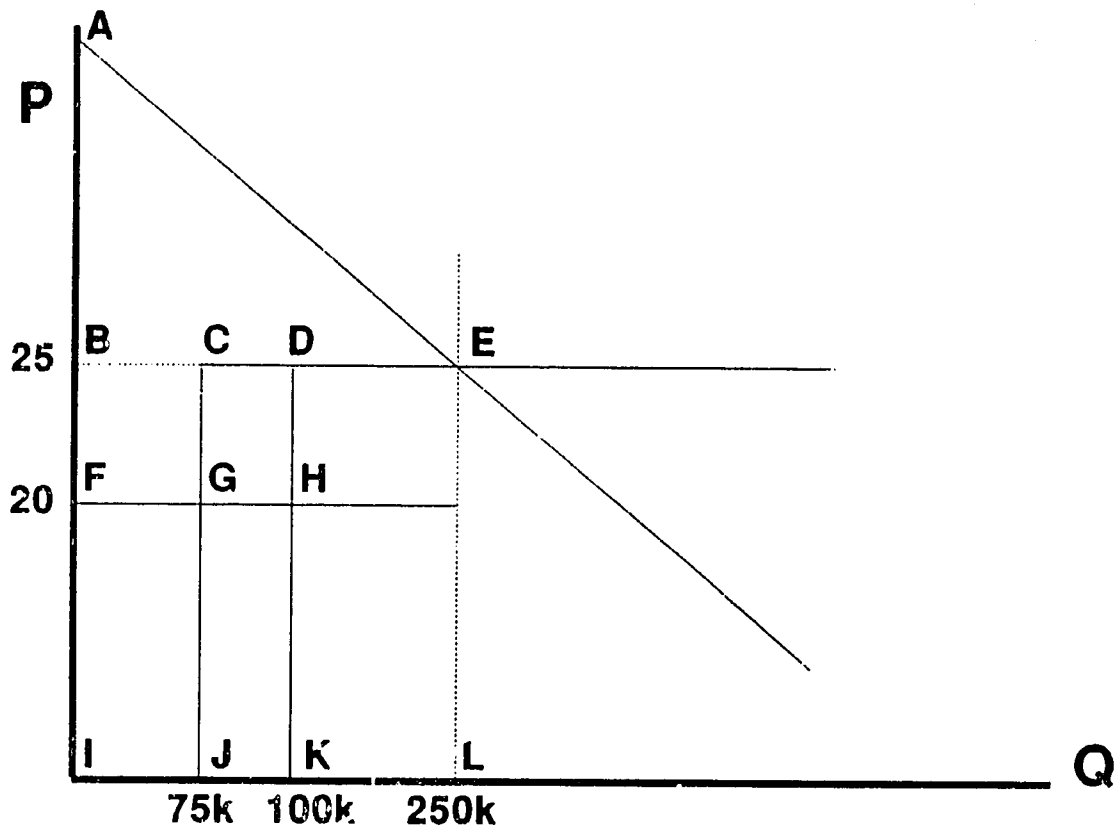

Figure 2. Supply-demand diagram for example 1, decrease in government-subsidized imports (situation following proposed policy change).

Second, it should be noted that the results would be quite different if the country produced fertilizer locally, rather than importing it. Suppose, for example, that fertilizer used locally was produced in a domestic factory producing entirely for the domestic market with little or no capacity to increase production. In this case, the supply curve would have a horizontal section corresponding to the government's imports for subsidized sale and a steeply sloped (or even vertical) section, corresponding to domestic output (see Figure 3). Under these conditions, a reduction in the government's imports (from Q3 to Q4) would lead to a reduction in total supply (assuming private sector imports continued to be barred or unaffordable, given farmer demand), a reduction in fertilizer use from Q1 to Q2, and a sharp increase in the price from P1 to P2. It must be emphasized that, in this scenario, a change in the government's price would have no impact on farmer demand or the price in the free market, assuming that the government price remained below the free market level and did not displace it as the marginal price. The contrast between these two situations indicates the importance of basing the analysis on a careful description of the current situation.

Step 5: Estimation of other impacts. Even though price and quantity do not change at the margin, farmer income is affected by the shift in the subsidized quantity available. The change in farmer income can be calculated in two alternative ways:

- The change in the farmers' "consumer surplus" (as consumers of fertilizer)
- The change in the farmers' expenditure for fertilizer

In this case, the change in farmer outlays for fertilizer is also equivalent to the change in their net income, because fertilizer use, and therefore maize production, would not change in the short term. The long-term implications of a change in the average price of fertilizer are more difficult to assess.

The consumers' surplus is represented by the area between what they would be willing to pay, as indicated by the demand curve, and what they actually pay. In most cases, all consumers pay the same price, and the consumers' surplus is therefore the area under the demand curve and above this price. In this case, however, farmer/consumers pay two prices, and therefore the consumer surplus is the area AEDHF in Figure 2, before the policy change, and the area AECGF after the policy change. The difference between the two is the rectangle CDHG. The area of this rectangle is 125 million pesos (25,000 metric tons times 5,000 pesos per ton)

Farmers' expenditures for fertilizer before the policy change are represented by the sum of the two rectangles IFHK and KDEL, showing expenditures for government and private sector fertilizer respectively. After the policy change, expenditures constitute the sum of rectangles FGIJ and

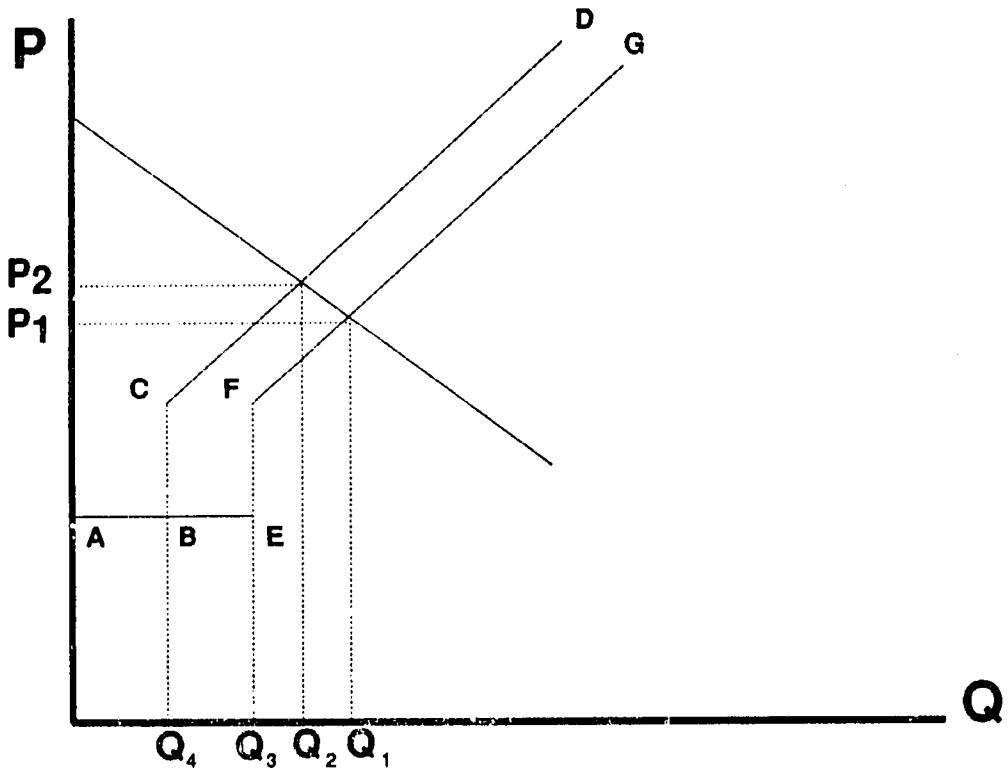

Figure 3. Supply-demand diagram for a decrease in government-subsidized imports in competition with local supply.

JCEL. The difference between the two is rectangle CDHG. In this example, both measures of the impact on the farmers therefore give the same result. This result is due to the somewhat unusual shape of the supply curve in this case. If the supply curve took the standard shape (upward sloping), the two measures would give different results.

In either case, the areas representing the farmers' change in income can be calculated using simple algebra or geometry or, if necessary, by plotting the supply-demand diagram on graph paper and counting the squares.

The proposed policy change would not have an impact on trade, because total fertilizer imports would remain unchanged. Similarly, there would be no impact on consumers because, in theory, neither the production level nor the price of maize would change. The policy shift would have an effect on the government's budget (and on the government's foreign exchange expenditures). These changes can be calculated easily as the change in the government's revenues from fertilizer sales less the change in its expenditures to finance these sales. Before the policy change, the government spent 2.5 billion pesos (100,000 MT times 25,000 pesos per ton) and recovered only 2 billion pesos (100,000 MT times 20,000 pesos per ton), for a total loss of 500 million pesos. After the policy change, the government would spend 1.875 billion pesos (75,000 MT times 25,000 pesos per ton) and would recover 1.5 billion pesos, thus reducing the net loss to 375 million pesos, for a savings of 125 million pesos. This figure equals the additional cost to the farmers, as would be expected given that the government's program as defined is a pure income transfer to farmers.

In many cases, the local currency value does not accurately reflect the scarcity value of traded goods, such as fertilizer, because of over-valuation or under-valuation of the local currency. The change in foreign exchange expenditures should then be revalued using the shadow price of foreign exchange to measure the full saving to the country. This is not necessary in our example, because the total level of imports does not change.

Example 2: Increase in the price at which the government procures maize from farmers. In this hypothetical case, the current situation and the proposed policy change can be described as follows:

> The government currently procures maize from farmers at 10 francs/kilogram and sells the maize to consumers in fair price shops at 20 francs/kilogram. Both of these prices are below the current free-market levels of 15 and 22 francs/kilogram, respectively. Farmers are required to sell one ton to the government for each hectare planted to maize. Given current average yields of three tons and on-farm consumption of one ton, these sales equate to half of the marketed supply. The government's actual marketing costs are 10 francs/kilogram, with the result that the operation just breaks even at the current price level. The country neither imports nor exports maize and, at current world price levels, is effectively insulated from the international market

by transportation costs,[4] so the world market is not a factor. The government is considering raising the price paid to farmers to 17 francs/kilo, to encourage local production. Available information indicates that the total volume of maize marketed is 100,000 MT (50,000 through the government channel and 50,000 through private channels).

Figure 4 shows this situation in graphic terms. The upper section of the graph shows the situation at the farm level, with total supply and marketed supply as well as wholesale demand. The lower section shows the situation at the consumer level, after marketing costs are taken into consideration. Prior to the policy intervention, the government is purchasing quantity Q1, while the private traders are purchasing Q1-Q2. From the point of view of the farmers, the demand curve has the somewhat unusual shape indicated by points ABCD. In this case, the government's operations in the marketplace are not really additional to private sector marketing, because the government buys grain that would otherwise be bought by private traders at the higher price prevailing on the open market and the government sells it to consumers, many (perhaps all) of whom would buy grain on the private market if the cheaper government supplies were not available. In effect, the program confiscates income from the farmers represented by the rectangle between line AB and the 15-franc price line.

If the planned price rise is instituted, however, the government will find itself the sole purchaser of grain, and therefore the sole seller. The total quantity moving through the government channel will increase dramatically, as the higher farm-gate price calls forth additional production and private sellers move out of the market entirely. At the proposed farm-gate price of 17 francs, farmers would like to sell quantity Q3. As shown in the diagram, the supply of grain will still fall short of demand at the government's below-market price, however, with consumers demanding Q4 at the subsidized price of 20 francs. Consequently, a black market is likely to develop, as consumers are willing to pay a price between 20 and 22 francs for the last bag of grain at the projected level of supply. In addition, the program will become very costly to the government, as it will lose 7 francs per kilo (the sale price of 20 less the procurement and marketing cost of 27) on the large volume of grain represented by Q3. If the government is committed to displacing the private sector and imposing its preferred prices on both farmers and consumers (not necessarily a wise course of action), the analyst might suggest improving the outcome somewhat by raising the government's sales price to consumers slightly to bring demand and supply more closely into balance and to reduce the government's own losses.

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4. In other words, the in-country price of maize for local consumption is too low to make imports feasible, but not low enough to make exports attractive.

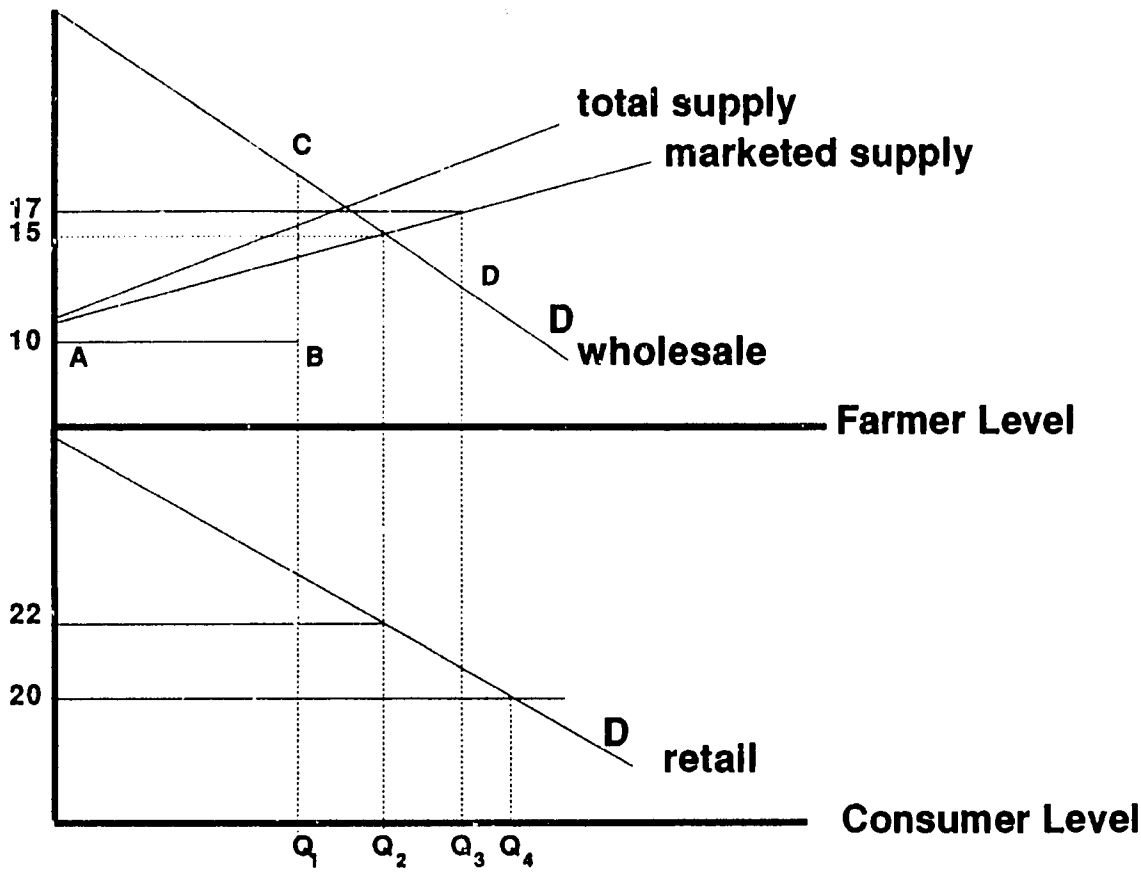

Figure 4. Supply-demand diagram for example 2, decrease in government procurement price for grain.

Analysis of Subsidies and Taxes

Taxes and subsidies constitute the classic government market intervention. They differ from the Type A interventions discussed above in that the government neither takes possession of nor distributes the good being taxed or subsidized. In effect, the government stands between buyer and seller, either deducting part of the revenue from the transaction, so that the buyer pays more than the seller receives (a tax), or adding funds to the transaction, so that the buyer pays less than the seller receives (a subsidy). The government's presence at the sale may be quite literal, as in the case of a customs agent who collects part of the sales price for an export, or it may be abstract, as in the collection of a sales tax where receipts must be turned over to the government monthly or annually.

As noted above, developing country governments often prefer to subsidize or tax transactions through a Type A intervention (buying and selling) rather than through a classic tax or subsidy as found in the textbooks. This preference is based on a mix of theoretical considerations (e.g., government officials do not believe that a subsidy provided to fertilizer dealers will reach the farmers) and practical issues (e.g., the government has no cost-effective means of tracking private sector grain sales in rural areas in order to impose a tax or provide a subsidy).

Governments also find it easier to tax (or, rarely, subsidize) many domestic operations as a whole, rather than on the basis of each transaction. The government may charge a fee for a license required for truckers, grain traders, and so on. This type of tax, which does not increase or decrease directly with the volume of transactions undertaken, is a Type C intervention and is therefore discussed below.

The most common application of the classic tax or subsidy is therefore in trade markets, in the form of export subsidies, tariffs, import taxes, and so on collected at the border (in theory or in practice). All governments maintain administrative systems for controlling transactions and the movement of goods and people across their borders, providing a ready means of implementing this type of intervention in trade markets. Other examples of Type B interventions include the following:

Product markets:	Sales taxes on particular goods (e.g., mandatory government stamps) or on all transactions at a particular type of store (e.g., retail stalls in a public market); food stamps and other subsidies not linked to purchase at government outlets
Input markets:	Sales taxes on particular goods (e.g., stamps); payroll taxes on wage-labor inputs to agricultural processing or marketing firms

Framing the Problem

Taxes and subsidies are much simpler to analyze than Type A interventions. In general, they fall into one of the following two categories, although combinations of these are also possible:

- Unit tax or subsidy: a fixed amount based on the physical unit sold, such as three pesos per kilogram
- Ad valorem tax or subsidy: an amount based on the value of the good sold, such as a tariff set at 3 percent of the cif value

The questions to be addressed in framing the problem for analysis are also straightforward, although they may be difficult to answer in practice:

- Does the tax or subsidy apply in theory to all transactions or only to some? In the case of an import tariff, for example, are certain classes of importers, such as small firms, exempt from the duty? In the case of a food stamp program, is eligibility limited to urban residents or those with incomes below a certain level?
- Does the tax or subsidy apply in practice to all transactions? Is the government able to collect the official tariff on all (or nearly all) rice imports, or do smuggling and corruption limit collections to a fraction of actual trades?

Estimating the Impact

This section uses two examples to demonstrate the differences between Type A and Type B interventions and their analysis using the SDA technique outlined above:

- A reduction in a unit tax on locally produced fertilizer
- An increase in an ad valorem tax on imported fertilizer

As in the previous section, both examples are strictly hypothetical and the situation in each case is sketched only briefly, without the complications that would inevitably characterize a real-world situation. As before, the first example will be presented in quantitative terms, to illustrate the method, while the second example will be analyzed only graphically, emphasizing the differences between it and the first example.

Example 3: A reduction in a unit tax on a locally produced input. The same five-step procedure is used as outlined above.

Step 1: Definition of the current situation. The current situation may be described as follows:

> Four local fertilizer companies currently produce a total of 100,000 MT of fertilizer, all of which is sold locally. The current price, which is determined competitively, is 75 francs per bag of 100 kilograms. (750 francs/MT). No fertilizer is imported, because of a prohibitively high tariff that is strictly enforced. Domestic sales of fertilizer are subject to a tax of 10 francs per bag (100 francs/MT), which is used to finance a variety of rural development programs. Technical studies have indicated that local factories have limited capacity to increase production in the short run, with an estimated supply elasticity of only 0.25. Farmer demand for fertilizer, on the other hand, is quite price responsive, with an estimated elasticity of -1.2.

Step 2: Translation into a supply-demand diagram. Figure 5 shows the current situation translated into a supply-demand diagram, using the information in the paragraph above to define the supply and demand curves. Using the procedure outlined in Chapter 3, the demand curve is calculated to be $P = 1{,}375 - (.00625 \times Q)$ and the supply curve is $P = -1{,}950 + (.026 \times Q)$.[5] Note that the current price used as the basis for calculating the supply equation is 650, not 750, because suppliers must pay a tax of 100 and therefore are responding to the lower price. The effective market supply is $(-1{,}950 + 100) + (.026 \times Q)$, including the tax, or $-1{,}850 + (.026 \times Q)$.

Step 3: Definition of the proposed policy change. The proposed policy change may be described as follows:

> The government wishes to encourage greater fertilizer use and local production by reducing the sales tax on fertilizer from 10 francs to 5 francs.

Step 4: Estimation of the impact on price and quantity. As shown in Figure 6, the proposed policy change would shift the supply curve downward (rightward) by 50 francs/MT. In other words, the new supply curve is $P = (-1{,}950 + 50) + (.026 \times Q)$ or $-1{,}900 + (.026 \times Q)$. The impact on the equilibrium price is somewhat less, however, because the tax reduction increases demand, forcing the manufacturers to incur somewhat higher costs in order to raise their output. The new equilibrium price is calculated as the value at which demand (as measured by the original demand curve) and supply (as measured by the new supply curve) are equal:

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5. The negative intercept for the supply curve is a result of the hypothetical numbers used in the example; normally one would expect the intercept to be a positive number reflecting the factories' fixed costs, that is, the price below which they would not be able to supply any fertilizer.

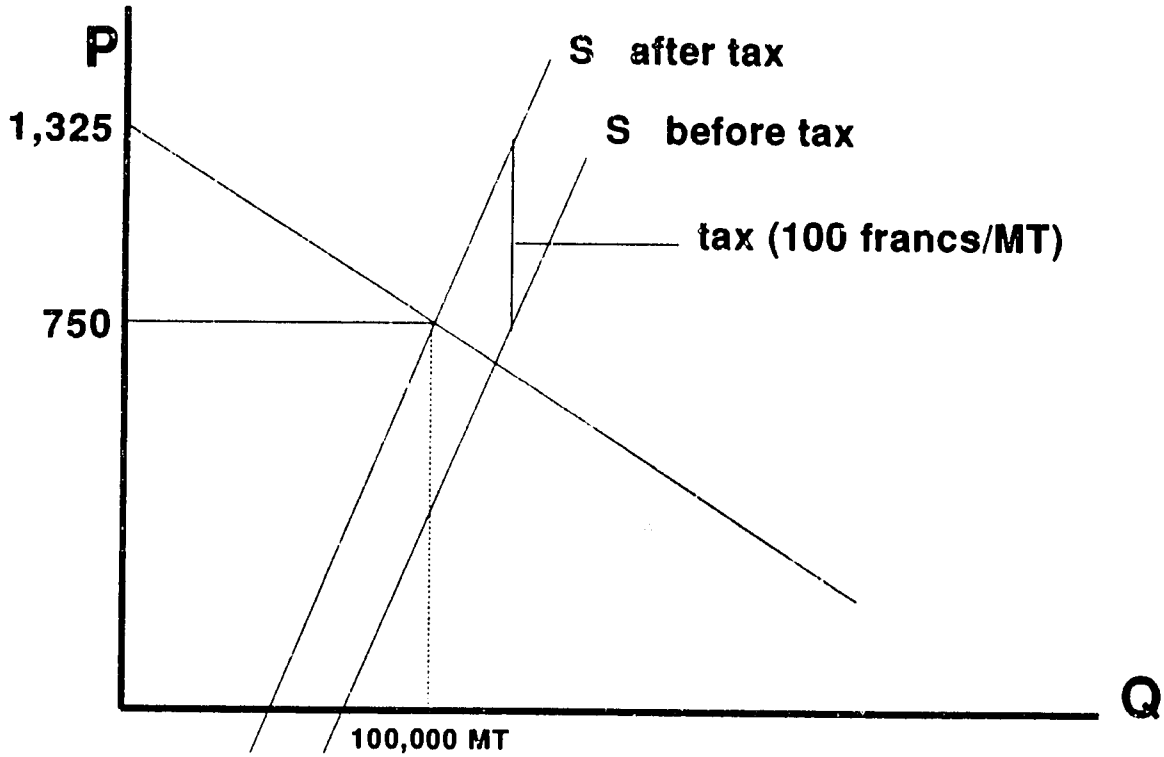

Figure 5. Supply-demand diagram for example 3, reduction in a unit tax on a locally produced input (situation prior to proposed policy change).

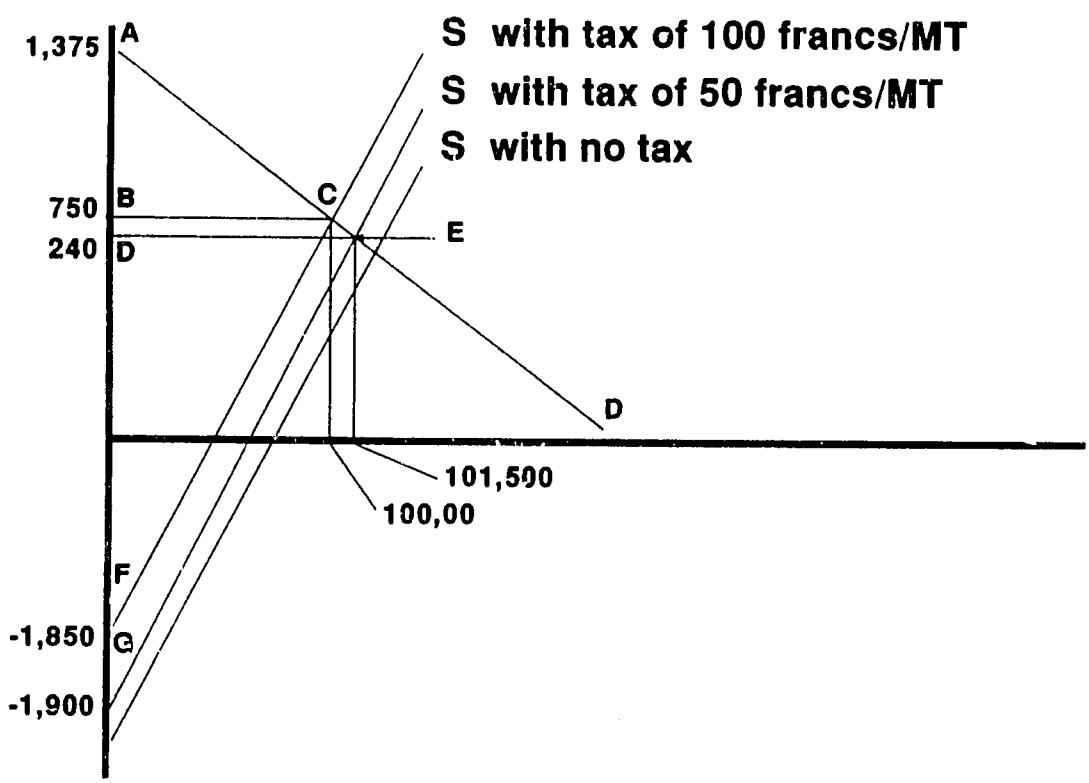

Figure 6. Supply-demand diagram for example 3, reduction in a unit tax on a locally produced input (situation following proposed policy change).

$$1{,}375 - (.00625 \times Q) = -1{,}900 + (.026 \times Q)$$

This equation may be solved for the equilibrium quantity of 101,550 MT. This value can then be substituted into either the demand or supply curve to calculate the new equilibrium price at which fertilizer will be sold, which is 740.3 francs/MT. Because supply is relatively less elastic than demand, the equilibrium price can be expected to fall by much less than the reduction in tax, in this case, by about 10 francs, even though the tax was reduced by 50 francs.

Step 5: Estimation of other impacts. The new price and quantity provide the basis for calculating other variables of interest to the decision makers considering this policy change, such as the impacts on government revenues, corporate profits, and net farmer benefits. The impact on government revenue (ignoring the cost of implementing the change) is simply calculated as the difference between revenue (quantity sold times tax) before and after the reform, or [(100,000 x 100) - (101,550 x 50)] or 4.92 million francs. The impact on corporate profits (producer surplus) can be measured by calculating the difference between the areas of triangles BCF and DEG in Figure 6, while the net farmer benefits (consumer surplus) corresponds to the difference between triangles ABC and ADE.[6] With the information provided, it is not possible to calculate the impact on foreign exchange, agricultural production, or domestic consumption, but these impacts can be estimated if the analysts have information on the foreign exchange required to increase fertilizer production, the impact on agricultural production of increased fertilizer use, the likely disposition of the additional output (domestic consumption versus export), domestic demand, and international prices. Although these calculations will not be shown here, for the sake of brevity, it should be noted that the total foreign exchange impact is likely to include both the negative effect of additional imports required to raise fertilizer production and the positive effect of foreign exchange earned or saved because of the increase in agricultural production.

Example 4: An increase in an ad valorem tax on an imported input. In this hypothetical case, the situation is similar to that in the previous example, with the important exception that fertilizer is both produced locally and imported. The government taxes imports, rather than local production, with an ad valorem tariff set at 20 percent of the cif value. The government plans to

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6. Because all these triangles are right triangles, the simplest way to calculate their area is to multiply their dimensions and divide by two. Thus, producer surplus is [(750 + 1,850) x (100,000/2)] before the reform and [(740 + 1,900) x (101,550/2] after the reform, for a net increase of 4 million francs, while using the same procedure, farmer surplus increases from 31.25 million to 32.24 million francs, for a net increase of approximately 1 million francs, netting a total increase in consumer-producer surplus of nearly 5 million francs. In keeping with economic theory, this increase is slightly more than the government's loss, because of the deadweight loss associated with the tax.

raise the tariff to 30 percent in order to increase tax revenue and encourage local fertilizer production.

This situation is represented in Figure 7. The total supply curve is the sum of the domestic and international supply curves. The kinked line ABC represents total supply in the case of a 20 percent tariff, for example. As in the previous examples, the first step in analyzing the impact is to calculate the new price and quantity levels, which are found by calculating the new price (130/120 times the old price) and then determining demand and domestic supply at the new price by substituting it into the demand and supply equations to derive an estimate of the new quantity demanded by farmers and supplied by local producers. The difference between the two provides the estimate of import levels after the policy change. In Figure 7, the price would rise from P1 to P2 when the tariff increased, while the quantity supplied by domestic producers would rise from Q1 to Q2 and the quantity purchased on the world market would fall from (Q4-Q1) to (Q3-Q2). The price and quantity values can then be used to derive estimates of the effect on tariff revenues, farmer and fertilizer-producer income, and so on.

It should be noted that, in this example, the ad valorem tax applies to an import. Because imports are generally assumed to have a perfectly elastic or horizontal supply curve, such that the amount imported can be increased with little if any impact on the price paid, the effect of a change in an ad valorem tax is to shift the import supply curve up or down by the appropriate percentage. If an ad valorem tax applies to a good with an upward-sloping supply curve (e.g., a 10 percent sales tax on domestically produced fertilizer), an increase in the tax increases the slope of the curve proportionately. All impacts must be calculated based on this new, steeper supply curve.

Analysis of Other Market Interventions

The wide variation within this category makes it impossible to formulate hard and fast rules for analysis of other market interventions. Each intervention must be examined case by case to define what it is and how it affects the market. Many Type C interventions affect who may participate in specific markets (e.g., licensing of traders), making it difficult to determine what effect, if any, they have on market operation. In some cases, such licensing may simply be a cost of doing business which, spread over a year's activity, has only a trivial impact on prices and no effect at all on the decision to go into business. In other cases, procedures may make it so difficult to obtain a license that only a few traders are able to enter into and remain in a particular line of business. In this situation, a monopoly or cartel may arise with far-reaching impacts on price and the quantity traded that are difficult to relate to the license itself.

Framing the Problem

Three classes of Type C intervention are particularly common in developing country government efforts to regulate agriculture:

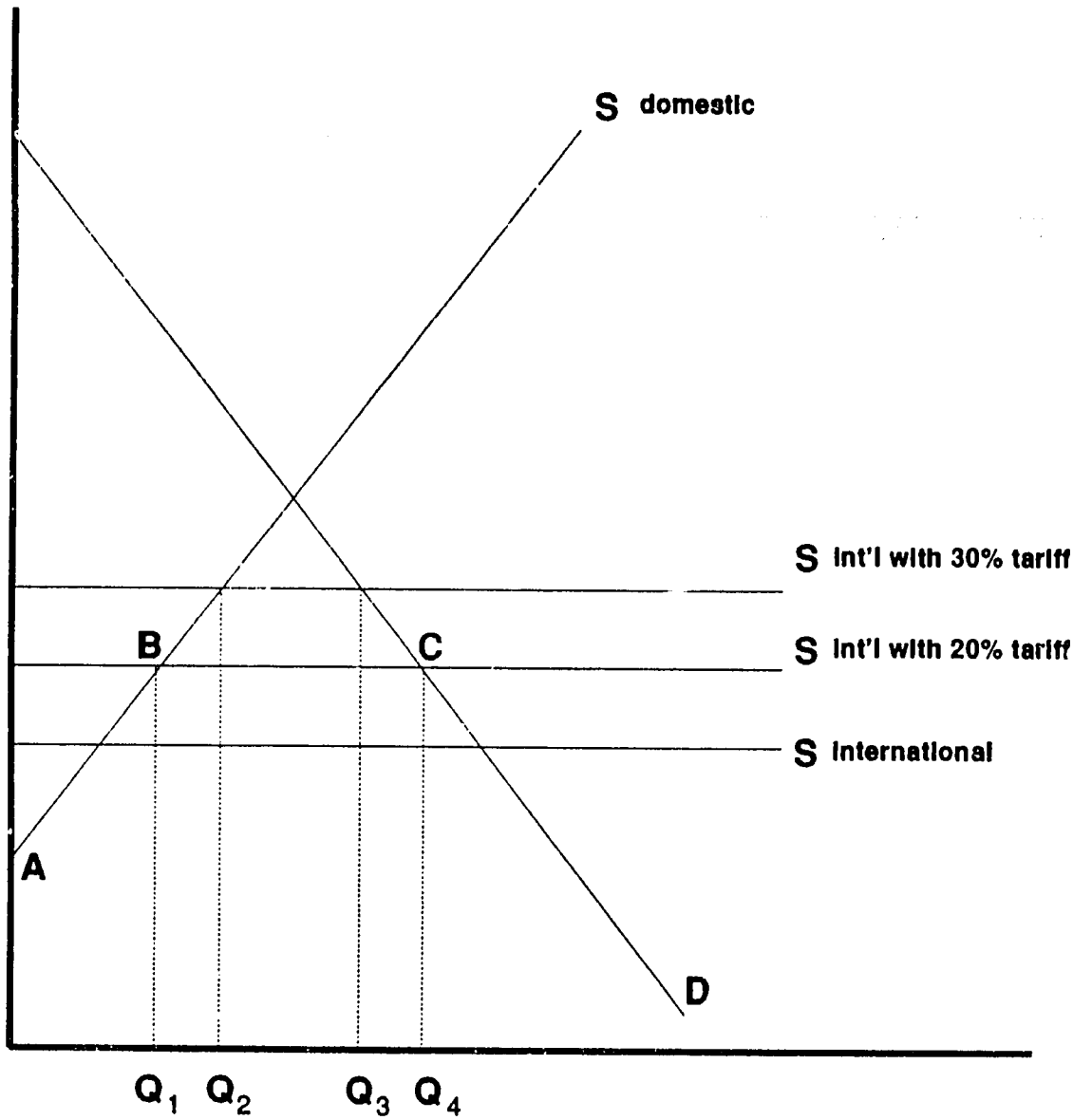

Figure 7. Supply-demand diagram for example 4, increase in an ad valorem tax on an imported input.

- Barriers to entry: licenses, regulations (e.g., all machinery dealers must have a licensed engineer on the staff), and other registration requirements

- Fixed or "fiat" prices: government-set prices that are not backed by a procurement system to support the official level nor supported through other means such as a subsidy

- Quotas and other quantitative restrictions (including bans on imports), which are applied almost exclusively in trade markets

Other Type C interventions include a wide variety of regulations applying to agricultural transactions. In the majority of cases, these regulations range from the beneficial (e.g., standardization of weights and measures) to the irrelevant (prohibition of trade during certain hours or on certain days). In other cases, however, regulations may impose real costs on buyers and sellers that raise marketing margins, reduce the supply of marketing services, or discourage investment, with or without counterbalancing benefits in the eyes of those introducing the regulations. Examples of the latter include requirements that marketing agents operate in certain geographic zones, bans on trade in certain products between regions, and restrictions on the age at which cattle may be slaughtered.

As with taxes and subsidies, the principal requirement to frame the problem for analysis is to determine whether, in theory and in practice, the regulation applies to all transactions equally, or only to some.

Estimating the Impact

As indicated above, most Type C interventions cannot be assessed using the simple partial equilibrium techniques discussed here, because their effects on supply and/or demand are too indirect. The analyst is limited to a non-quantified assessment of the costs and benefits of the regulation, including its impact on the number of traders, farmers, and consumers participating in the market, their costs, the quantities bought and sold, and so on.

Two Type C interventions can be assessed in more quantitative terms, however: quotas and fixed prices. This section will provide an example of the impact calculations for an import quota and a brief discussion of the analytic approach for a fixed price.

Example 5: Change in an import quota. As this example shows, the effects of an import tariff parallel those of an import quota in some respects, and differ in others.

Step 1: Definition of the current situation. The current situation may be described as follows:

The situation is essentially the same as in the previous two examples, with the exception that, instead of restricting imports with a tariff, the government limits total imports to 20,000 MT. The demand and supply curves are assumed to be the same as in Example 3 (although the equilibrium price, as discussed below, will be different because of the presence of imports). The import price is 50 francs/bag or 500 francs/MT.

Step 2: Translation into a supply-demand diagram. As Figure 8 shows, the addition of an import tariff introduces a "kink" into the supply curve, so that it takes the shape ABCD. At prices below the world price (500 francs/MT), only domestic producers are in the market. At prices above the world price, the full amount permitted by the quota is imported, shifting the supply curve rightward by the amount of the quota, and domestic suppliers provide the difference needed to satisfy national demand. The price on the domestic market is determined by the intersection of demand and supply. In this case, the supply curve at prices above the world price has the same slope as the domestic supply curve, but, because it is shifted rightward, a different intercept. Remember that the slope of .026 implies that an increase in the quantity of 20,000 MT causes the intercept to shift downward by .026 x 20,000 or 520 francs to -2,470. Setting this new supply curve equal to the demand curve yields the following equation, which can be solved for the equilibrium quantity:

$$-2{,}470 + (.026 \times Q) = 1{,}375 - (.00625 \times Q)$$

Solving for quantity and then substituting to derive price, we estimate the current price-quantity pair as Q1 = 119,225 MT and P1 = 629.8 francs/MT. (In a real-world case, the analyst would have this information; the calculations are included here to facilitate comparisons with the preceding examples.) Domestic fertilizer production therefore falls somewhat below 100,000 MT, replaced by imports, which are cheaper at the margin.

Step 3: Definition of the proposed policy change. The government plans to increase the import quota to 30,000 MT. (In a more realistic situation, the government might also introduce a tariff at the same time to discourage imports.)

Step 4: Estimation of the impact on price and quantity. Figure 9 shows the impact of an increase in the quota. The new supply curve is shifted rightward by the amount of the change, 10,000 MT. As a result, the supply curve at that point has the equation:

$$P = (-2{,}470 - (.026 \times 10{,}000)) + (.026 \times Q)$$

or

$$P = -2{,}730 + (.026 \times Q)$$

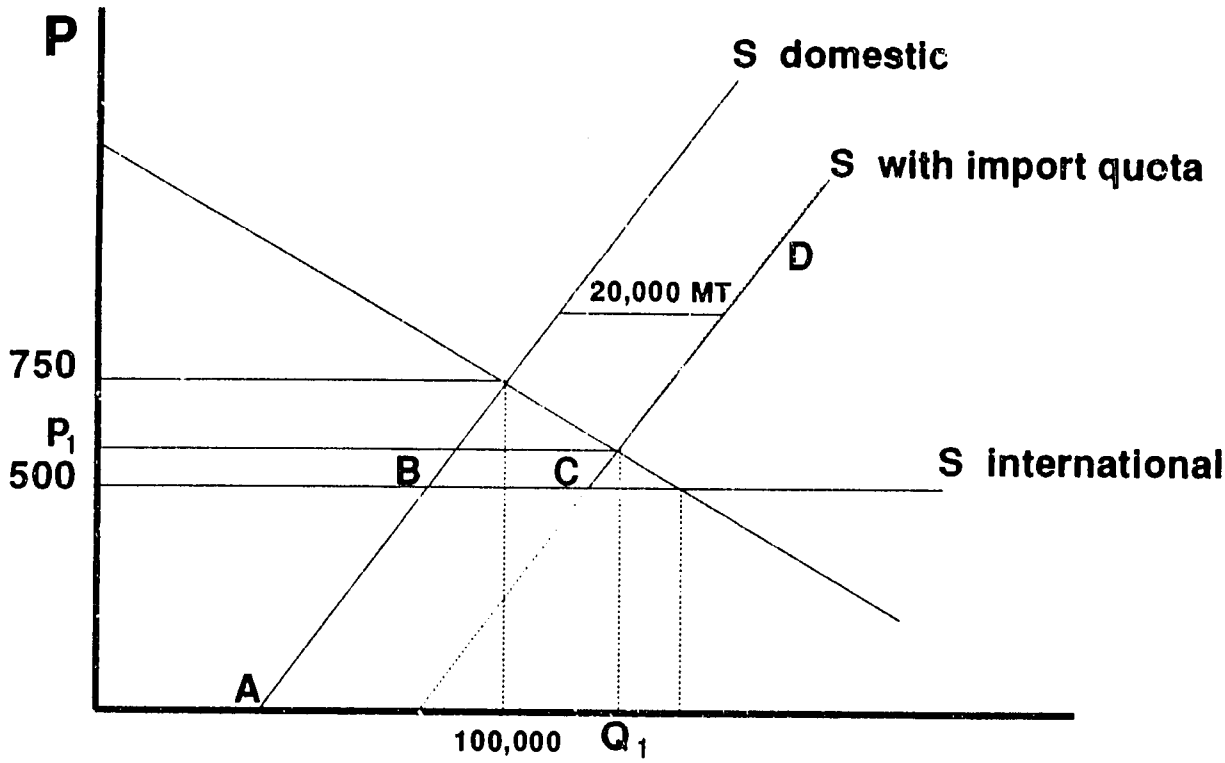

Figure 8. Supply-demand diagram for example 5, change in an import quota (situation prior to proposed policy change).

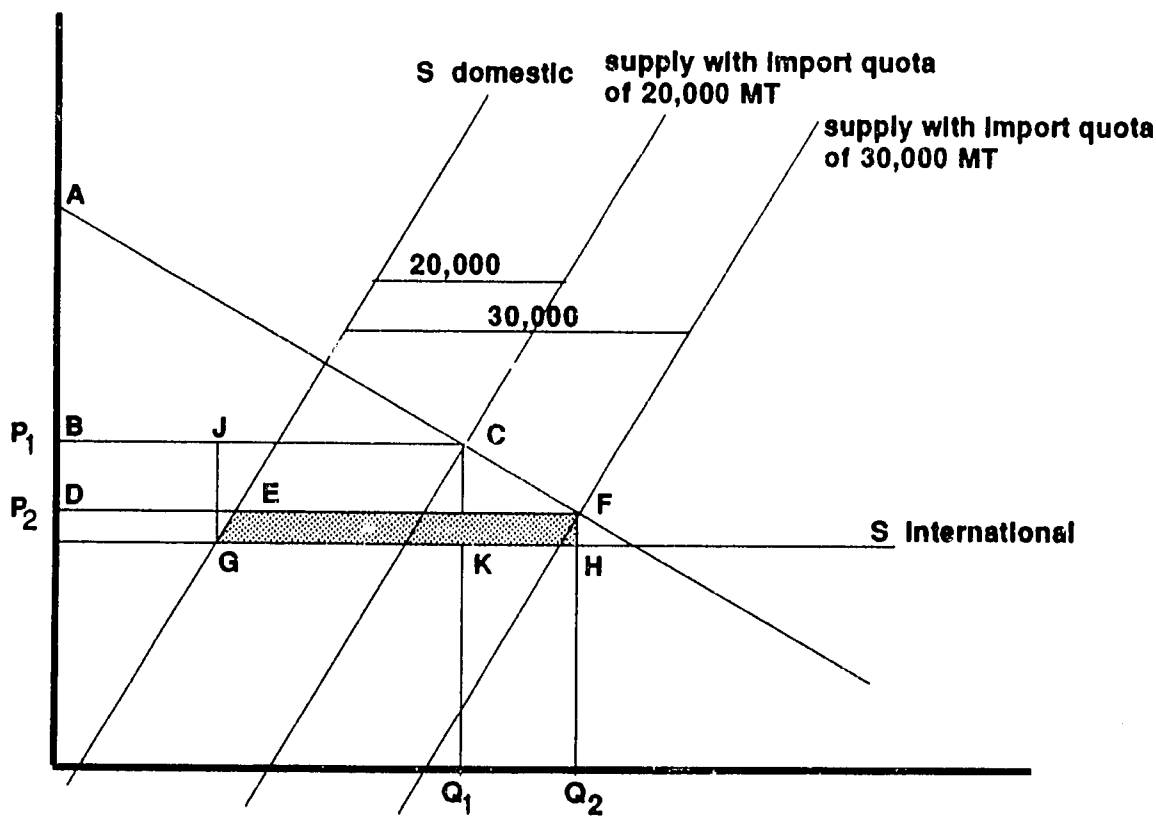

Figure 9. Supply-demand diagram for example 5, change in an import quota (situation following proposed policy change).

The new market-clearing price and quantity can be estimated by calculating the levels at which this new supply curve will cross the demand curve:

$$-2{,}730 + (.026 \times Q) = 1{,}375 - (.00625 \times Q)$$

By solving for Q, a new quantity of 127,287 MT can be estimated. Substituting this new value into the demand curve provides the estimated price after the policy change of 579.5 francs/MT.[7]

Step 5: Estimation of other impacts. As in the previous examples, producer and consumer surplus are estimated by calculating the areas of the triangles formed by the price lines and the supply and demand curves, respectively. (The change in the farmers' surplus, for example, is the difference between triangles ABC and ADF.) The direct impact on foreign exchange is straightforward, as an increase in the quota raises imports by approximately 8,000 MT (127,000 - 119,000) and therefore foreign exchange by the cost of these additional imports (4 million francs, given our assumed price of 500 francs/MT). Indirect effects, including the change in foreign exchange needed by local fertilizer producers and the impact on net agricultural exports, are more complex. Unlike a change in a tariff, a change in a quota has no direct impact on the government budget, unless import licenses are sold or auctioned. Figure 9 provides a measure of how much importers would be willing to pay for import licenses: the shaded rectangle EFGH, which is simply the imported quantity (30,000 MT) times the difference between the world price and the domestic price of 79 francs/MT. (In reality, marketing costs would have to be subtracted as well to derive an actual willingness to pay estimate.) Whether this rectangle increases or decreases in size following the proposed increase in the import quota depends on the slope of the demand curve (prior to the increase in the tariff, the rectangle describing importer willingness to pay would be JCGK). The rectangle also provides a measure of the likely extent of corruption in the event that licenses are distributed by some mechanism other than open sale or auction.

Example 6: Introduction of a fixed price. Figure 10 presents the familiar demand and supply diagram, with equilibrium price P and quantity Q representing in this case supply and demand for milk on the local market. In this hypothetical case, the current situation and the proposed policy change may be described as follows:

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7. As in the previous examples, we are showing the results of the calculations to several decimal places, so that the reader can duplicate the work more easily. It should be emphasized that the rapid appraisal technique here does not permit this level of accuracy with regard to the predicted impact of the policy change. In this case, for example, the analyst would be in a much stronger position predicting a new fertilizer price of, say, 550-600 francs per MT and a total sales level of about 130,000 MT.

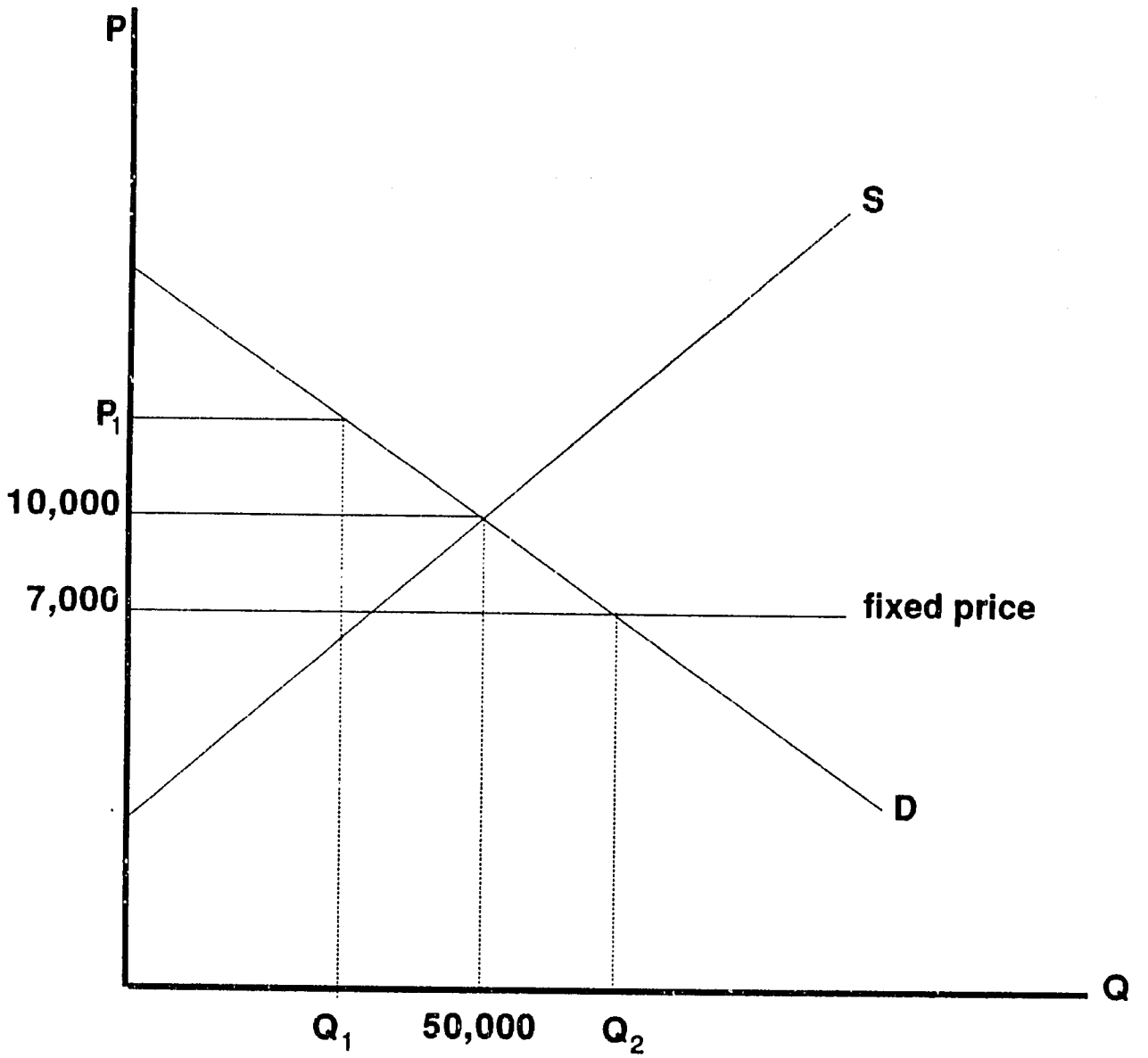

Figure 10. Supply-demand diagram for example 6, introduction of a fixed price.

The national milk market operates on an essentially free-market basis, resulting in a price of 10 pesos per liter and a quantity consumed and produced of 50,000 MT. Milk is neither imported nor exported. Motivated by political pressure from urban consumers and concern over nutrition, the government is considering imposing a fixed price of 7 pesos per liter. The price will be imposed under the government's price-control system, which provides penalties for retailers violating the price, but does not include government intervention to support the official price. The government will not, for example, import milk for sale at the subsidized price in this case (a Type A intervention) nor will it provide subsidies to merchants or consumers to lower the effective price of milk (a Type B intervention).

As shown in Figure 10, the impact of this intervention is likely to be the opposite of what government decision makers wish to achieve. At a reduced price of 7 pesos, farmers are willing to supply only the reduced quantity Q1, whereas consumers want to purchase Q2. If farmers reduce production to Q1, as they are likely to do, the shortage of milk on the market will drive the price up to P1, creating a black market in milk. Only limited quantities, if any, will be available to consumers at the official price. It is unlikely, moreover, that the higher price will be passed back to farmers. Instead, much of it will be absorbed by intermediaries in the market as a "rent" generated by the artificial milk scarcity created by the government.

A Note on Data and Interpretation of Results

As with any discussion of a technique for rapid analysis of complex issues, it is appropriate to end this paper on a note of caution. The techniques presented here can be used to derive quantitative estimates of the impact of specific policy interventions with very little information and a minimum of calculation. These techniques are particularly suited to situations where time and information are in short supply, and rough estimates of the impact of alternative government interventions are needed quickly to support decision making.

The estimates are only as good as the underlying data, however. The analyst can, and should, provide a range of estimates to reflect uncertainties regarding economic values that are key to the analysis. If elasticity estimates more closely resemble guesses than well-established parameters, or if the analysis depends critically on world price levels that have shown a high degree of variability in recent years, the analyst should prepare a range of estimates that indicate how changes in the values used would change the results of the analysis. This being said, it must also be recognized that few decision makers (or members of their staff) are comfortable with ranges: they prefer firm estimates, whether or not this position is a reasonable one. Numbers provided by the analyst can easily take on a life of their own, making it doubly important for the analyst to surround any numbers provided with sufficient explanation and interpretation to minimize misuse of the results.

Interpretation and presentation of the results therefore emerge as critical elements of the analytic task, equally as important in supporting sound decision making as the analysis itself. The means chosen to carry out this assignment depends on the audience: some decision makers are comfortable with charts and graphs, while others can better absorb information if it is packaged into a brief text. In the latter case, the analyst must take care to pepper the final report with phrases that emphasize that the results obtained are tentative estimates, not predictions from an infallible economic priesthood. Phrases such as "should exceed x pesos and may be as high as y pesos" are critical to setting the right tone for the reader.

It is also important to stress the limitations of the techniques presented here. The methods discussed in this paper are best applied to relatively small changes in a single market intervention, such as a 10 percent reduction in the amount of subsidized fertilizer provided through the official channel or a 20 percent increase in the tariff on rice. They can be applied to analyze larger changes, but not to derive quantitative estimates of the impact. They simply cannot be applied to analysis of comprehensive changes affecting multiple markets, such as a revision of the tariff code or privatization of input supply. Techniques exist to analyze changes of this magnitude, of course, but they are considerably more demanding of time, data, and analytic resources. There is no free lunch for the economist, either.

APPENDIX A. A CHECKLIST OF COMMON POLICY INTERVENTIONS AFFECTING THE AGRICULTURAL SECTOR

The following list is intended to serve as a checklist of policy interventions commonly used in developing countries that affect the agricultural sector. It is perhaps inevitable that any list of this kind must fail to include all possible interventions, given the inventiveness of policy makers faced with outcomes that they do not like and the temptation to try to change these outcomes by tampering with agricultural or macroeconomic markets. The authors hope that, despite these omissions, the list will be useful as a starting point for identifying the current policy interventions in a given agricultural market, alternatives, and interventions in other markets that affect the one under study.

The list organizes the interventions into three levels -- macroeconomic, sectoral, and subsectoral. Macroeconomic policies include fiscal, monetary, and trade policies as well as commercial regulations affecting the private sector as a whole. Sectoral policies are generally those affecting inputs used in a wide range of agricultural production activities (e.g., land, labor, credit, fertilizer). Subsectoral policies include interventions aimed at a specific product, such as a subsidy on coffee seedlings or a tax on cotton. Within each group, interventions are grouped in accordance with the typology described in the text:

<u>Type A</u>: Interventions that require the government to buy and/or sell a good or service

<u>Type B</u>: Interventions that require the government to give money to or collect money from those participating in the transaction, without participating itself directly

<u>Type C</u>: Interventions that change the rules of the marketplace with respect to who may buy or sell which commodities at what price and under what conditions

Macroeconomic Policies

For purposes of analyzing agricultural sector policies, macroeconomic policies may be divided into four sub-categories: fiscal policies, monetary and credit policies, trade policies, and commercial regulation. In each of these categories, macroeconomic policies include only those policy interventions that affect so-called "macro prices" (interest rates, wage rates, foreign exchange rates) or those that, in theory at least, affect all firms or individuals in the economy, regardless of the specific sector involved.

Fiscal Policies

Fiscal policies include all policies governing government attempts to gather revenue and government decisions to spend money. As implemented in developing countries, many of these policies are more appropriately dealt with at the sectoral and subsectoral level. Fiscal policies that work primarily at the macroeconomic level and are not dealt with elsewhere include the following:

Type A: Buying and Selling

Subsidies to other economic activities through investments and operating expenses to provide public services, such as education, utilities, and infrastructure, at less than full cost.

Deficit financing in the domestic economy through sale of government securities or borrowing from the banking system.

Type B: Taxes and Subsidies

Income taxes that collect a portion of all (or virtually all) income earned in the country (but often exclude some or all agricultural income).

Sales and value-added taxes that collect a tax on all (or virtually all) transactions in the country (but often affect only transactions in the formal market).

Head taxes that collect a fixed amount for every family member (and are often implemented differently in rural areas than in urban areas).

Type C: Regulation of the Market

(see below)

Monetary and Credit Policies

Type A: Buying and Selling

Government monopolies on credit, including nationalization of banks.

Government banks that do not constitute a monopoly but that do not operate under wholly commercial conditions.

Rediscounting of loans made by other institutions, whether to influence the money supply or interest rates, to encourage or discourage private loans, or for another purpose.

Type B: Taxes and Subsidies

Credit subsidies to non-government (and non-government owned) banks, either universal or applicable to specific sectors other than agriculture.

Fees and other taxes on bank transactions or on the amounts held in bank accounts.

Type C: Regulation of the Market

Interest rate controls, which may be set at different levels for different sectors and types of loans (e.g., medium-term, long-term).

Credit allocations, which may set ceilings on the total availability of loan funds for the private sector and/or determine its allocation among the various sectors, regions, etc.

Banking regulations that place requirements on firms wishing to enter or remain in the banking business, such as capital requirements, reserve requirements, restrictions on branch operations, and so on.

Lending regulations that affect who may borrow, in what sums, under what conditions, and so on, such as laws forbidding direct loans to women without their husbands' permission.

Reporting requirements that, in combination with other policies, may reduce access to the formal lending sector.

Trade Policies

Type A: Buying and Selling

Government monopolies on importation or exportation of non-agricultural commodities, particularly where such trade is not carried out on a wholly commercial basis.

Government trading companies that compete with private sector firms but do not operate on a wholly commercial basis (firms operating on a commercial basis without a monopoly do not constitute market interventions).

Government monopolies on foreign exchange trading, whether or not explicitly accompanied by control over exchange rates.

Type B: Taxes and Subsidies

Tariffs and subsidies on imports and exports, including variable levies, ad valorem tariffs, and fixed tariffs.

Export and import licensing, when non-trivial sums are associated with obtaining such licenses.

Type C: Regulation of the Market

Regulation of letters of credit and other banking service transactions tied to trade, including down payment requirements, waiting periods, etc.

Quotas on the amount of a good that may be exported or imported, implemented through import/export licenses (allocated through non-price mechanisms) or a variety of other schemes.

"Twinning" and countertrade, which require importers to buy a specified amount of goods locally in proportion to the amount they import (to be exported in the case of countertrade; to be sold domestically in the case of twinning or jumellage).

Minimum or maximum prices for goods exported or imported that are applied to large categories of goods (i.e., are not limited to a few agricultural commodities).

Fixed exchange rates not accompanied by a government monopoly on foreign exchange trading.

Cumbersome administrative or reporting procedures that significantly impede private transactions.

Commercial Regulation

Type A: Buying and Selling

Government monopolies in areas outside of the agricultural sector, that influence investment and incomes inside the sector, such as monopolies in agricultural processing or production of goods (tinplate, for example) used in such processing.

Government-owned firms that do not hold monopolies nor operate on a wholly commercial basis.

Type B: Taxes and Subsidies

Taxes on corporate income and profit, which may distort investment or operating decisions, depending on the specific provisions and how they are enforced.

Type C: Regulations of the Market

Licensing or registration requirements that limit entry into a specific line of business, or place unreasonable restrictions on how a firm may operate.

Investment licensing, which requires firms to obtain government permission before establishing or expanding production capacity.

Margin controls, which limit the amount of mark-up that may be applied over purchase price in setting the sales price.

Price controls that are applied economy-wide or to broad categories of goods (i.e., not limited to specific inputs or agricultural commodities, as discussed below).

Sectoral Policies

Land, Labor, and Capital

Type A: Buying and Selling

Government banks that provide credit to the agricultural sector or to specific subsectors on non-commercial terms.

Sale or rental of government land for agriculture on non-commercial terms, including free distribution and sale of concessions for timber harvest, grazing, etc.

Government investments in expanding or improving land, including road-building projects to open up new areas.

Type B: Taxes and Subsidies

Land taxes, whether universally applied or scaled to reflect the degree to which land is fully utilized.

Credit subsidies paid to private institutions making loans to the agricultural sector.

Taxes on land transactions, land registration, etc.

Subsidization of investments to expand or improve land, including conservation measures.

Type C: Regulation of the Market

Land tenure restrictions including limits on the maximum size of holdings, etc.

Zoning and other land-use restrictions on privately-owned land.

Nucleus estate requirements that mandate that farms above a certain size provide technical and marketing support for small farmers in the area.

Minimum wages for agricultural labor.

Other labor restrictions including maximum hours or limits on work by women or children.

Interest rate controls on private lending activity.

Prohibition of private lending for agriculture.

Intermediate Inputs

In addition to the interventions discussed in this section, several of the trade interventions listed above can be applied in ways that affect the domestic market for specific intermediate inputs. These include quotas limiting the amount that can be imported, licensing requirements that allocate these amounts to specific firms, and so on.

Type A: Buying and Selling

Government monopolies on the sale of inputs such as fertilizer and pesticide, which may serve as a mechanism for subsidizing or taxing these inputs and may also be linked to quantitative restrictions on the amount of these inputs available. (NOTE: The impact of this intervention differs greatly depending on whether the amount supplied is or is not sufficient to meet demand at the subsidized price.)

Government-owned distribution companies including agricultural banks and government-sponsored cooperatives, that compete with private suppliers on a non-commercial basis, and may serve as outlets for the subsidized sale of limited amounts of the commodity. (If the amount is not limited and distribution is not restricted to certain groups such as cooperative members or maize farmers, unsubsidized private sales will not take place, and the government will have an effective monopoly.)

Government trucking companies that provide services on a non-commercial basis and may give preferential rates to certain transactions (e.g., shipment of fertilizers produced in government factories).

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Forced sale of government-produced inputs (e.g., agricultural machinery) to private traders, either on a monopoly basis or through a twinning arrangement requiring them to buy from the government factory in order to trade in imported or locally produced goods.

Type B: Taxes and Subsidies

Sales taxes applying to specific agricultural transactions, such as those conducted in public markets.

Market taxes, such as stall fees and other taxes on firms operating in the market.

Subsidies on the sale of inputs that take the form of payments to private firms engaging in this type of transaction (very rare).

Type C: Regulation of the Market

Price controls that set the prices at which private firms may sell agricultural inputs.

Margin controls that limit the amount that the wholesale price may be marked up by the retailer.

Licensing of traders in ways that limit entry or tend to divide up the market.

Regulation of firms, such as requirements that machinery dealers operate service stations, which may restrict entry or add to the cost of doing business unreasonably.

Administrative allocation of fuel or other inputs needed by input marketing systems.

Linkage of input sales to participation in government-sponsored activities, such as a requirement that a machinery dealer pay a commission to a government-owned bank in order for his customers to be eligible for loans.

Restrictions on the goods sold (e.g., types of pesticides), which are not based on strictly technical considerations.

Subsectoral Policies

Basic Grains and Staple Foods

Type A: Buying and Selling

Guaranteed price floor or band for producers, which requires the government to be willing to purchase as much of the commodity as

necessary to maintain the price at the specified level. (The impact of this program depends greatly on the degree to which the government has sufficient financial and administrative resources to make the guarantee universally effective.)

Guaranteed price ceiling or band for consumers or wholesalers (e.g., mills), which requires the government to sell as much of the commodity as necessary to maintain the price at the specified level (and implies willingness to import if necessary, as simply buying and reselling on the local market would not necessarily affect the price unless other controls are in place).

Fair price shops, ration shops, government-sponsored cooperatives, and other mechanisms for selling a limited quantity of staple foods at a below-market price, with or without attempts to target the commodities to low-income groups, and with or without explicit limits on the amount an individual can buy.

Compulsory procurement, which requires that all or part of the crop be delivered to government agents, generally at a below-market price.

Government monopolies on trading in certain commodities at the farm-gate, wholesale, and/or retail level, both those established officially and those resulting from a guaranteed price system.

Government processing plants (e.g., rice mills) that do not operate on a wholly commercial basis.

Government-owned companies that supply inputs used in grain marketing on a non-commercial basis (e.g., bagging).

Government monopolies on seed, such as hybrid maize seed.

Government-owned seed farms that do not operate on a wholly commercial basis.

Other buffer stocks procured at market prices and held for one or more seasons for sale or distribution in times of shortage.

Feed distribution of food aid or other commodities designed to meet temporary or long-term food deficits.

Type B: Taxes and Subsidies

Taxes and subsidies on private transactions, such as market taxes levied specifically on grain transactions.

Taxes or subsidies on inputs used by the market, such as sacks and pest-control chemicals, that are paid by the government to (or collected from) private firms.

Taxes or subsidies on privately grown seed.

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Licensing of grain traders when such licensing imposes a tax on traders, rather than simply serving as a monitoring device.

Licensing of seed producers or other efforts to control the supply of seed, except those instituted for wholly technical reasons.

Type C: Regulation of the Market

Fixed prices for producers set by government decree (including local government decree) but not backed up by the government's purchasing power.

Fixed prices for consumers set by government decree but not backed by the government's guarantee to sell staples at this price.

Licensing of grain traders, when such licensing acts as a barrier to entry rather than a formality, including licensing by local governments and national authorities.

Requirements that traders in grain, seed, or other inputs specific to staple crops have specific equipment or facilities (e.g., storehouses) or operate in certain areas (e.g., remote regions).

Restrictions on domestic trading, including when or where it may or must be conducted, controls on interregional movement of grain, etc.

Restrictions on international trading, including prohibition of private import or export of basic staples, or attempts to mandate the prices offered or accepted.

Fibers, Oilseeds, and Other Industrial

Type A: Buying and Selling

Mandatory delivery of all or part of the crop to government trading organizations, marketing boards, etc.

Government monopolies in trading for certain commodities, such as cotton, cocoa, and coffee.

Guaranteed prices for producers, backed by effective government guarantees to support the price by procurement.

Government-owned processing plants that do not operate on a wholly commercial basis, such as cotton gins, etc.

Government plantations that operate on a non-commercial basis in competition with private producers or as suppliers to private processors and traders.

Government monopolies on seed and other inputs, either produced on government farms or imported.

Type B: Taxes and Subsidies

Government subsidies or taxes on processing, including subsidy payments to some or all processing plants (e.g., oilseed mills).

Subsidies paid to seed producers or other inputs suppliers for inputs specific to industrial crops.

Subsidy payments or taxes for producers not specifically linked to government procurement (very rare in developing countries).

Licensing of traders that taxes trade in the commodity.

Type C: Regulation of the Market

Price controls at the farm-gate, wholesale, retail, or trade level that are not backed by government price support programs.

Prohibition of private domestic trading in certain commodities or in specific types of a given commodity (e.g., long-staple cotton).

Prohibition of private export of certain commodities.

Licensing of traders that bars entry.

Requirements on traders, processors, or input suppliers that serve as barriers to entry or inappropriately raise the cost of doing business in specific commodity areas.

Fruits and Vegetables and Livestock

Although governments generally do not intervene in the markets for perishable commodities to the extent that they do in markets for staples and industrial crops, efforts to control or influence these markets are common in heavily regulated market environments.

Type A: Buying and Selling

Government marketing boards, particularly in small countries where price swings for perishables may be exaggerated by the thinness of the market.

Government farms that produce meat, milk, or horticultural products and do not operate on a wholly commercial basis.

Government monopoly on production or specific inputs, such as feed concentrates.

Government processing plants, e.g., dairies, that do not operate on a wholly commercial basis.

Type B: Taxes and Subsidies

Taxes and subsidies on milk or livestock products paid directly to (or collected from) producers or processors, with no requirement to market to the government (rare in developing countries).

Taxes and subsidies on imported feed or animals not linked to government trading activities.

Licensing of traders that serves as a tax on their operation.

Type C: Regulation of the Market

Price controls at the farm-gate, wholesale, retail, or trade levels that are not backed by government price support programs.

Restrictions on the operation of private firms, such as dairies or slaughterhouses, which are not motivated by strictly technical considerations (e.g., prohibition on slaughtering animals below a specified age).

Licensing of firms which acts as a barrier to entry or raises the cost of operation in ways not linked to technical considerations, such as protection of consumer health.

Requirement to use a particular wholesale or retail market facility, to the extent that this acts as a restraint on the number of firms in operation.