MEASURING THE IMPACT OF PUBLIC SUPPORT, A POLICY EVALUATION METHODOLOGY AND APPLYING THE POLICY EVALUATION METHODOLOGY TO FAIR ACT 1996

By

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PREFACE

The body of this dissertation is composed of three separated essays. The first essay was written with a focus on the information that is contained in the Producer Subsidy Equivalent. To compare the public assistance provided to the agriculture sector in various countries an Aggregate Measure of Support (AMS) known as the Producer Subsidy Equivalent (PSE) was developed. However, the PSE only measures the total level of support provided to agriculture, major changes in policies at equal levels of support can not be differentiated through this indicator.

There is valuable information embedded in the PSE indicator, that can allow to approximate the impact of domestic policies on trade. To achieve such a goal, a tool that permits to account for the vertical and horizontal price linkages between agricultural markets is needed. The analysis of the information included in the PSE can give more direction of the relationship of the economic variables that need to be capture in an economic model to offer a more complete treatment of impact of agricultural policies.

The second essay focuses in a methodology to analyze policy changes in the agricultural sector. A Policy Evaluation Methodology (PEM) is developed to measure the impacts on trade of domestic agricultural policies. The PEM considers the price transmission between agricultural input, production and output markets to estimate the distribution of the price and income support policies between producers and consumers. An index is generated which enables an across country and commodity comparison of the portion of the total government outlays received by the producers and the associated degree trade distortion.

Essay three cover the analysis of the Federal Agricultural Improvement Reform Act of 1996 using the methodology. The Policy Evaluation Methodology enables one to make a comparison of the impacts of agricultural policies on producers, consumers, taxpayers and trade. The approach separates the assumptions about input supply and input demand elasticities and which markets are directly impacted by each policy. When analysing the effect of changes of the FAIR ACT, the effects of each policy applied individually is different from the effect of implementing the mix of policies at the same time, and even more important, the increase or decrease in the amount of transfer given is not necessarily shown in the effects of that support in the commodity market or the factor markets since policies use different price linkages to transmit their effect. However, this information is left out of the PSE/CSE indicator. On the other hand, the mix of policies shows the presence of substitution and compensation effects producing income and trade distortions sometimes less severe than the application of the set of policies individually. This information is also left out of the PSE/CSE.

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ESSAY I

Measuring the Impact of Public Support Policies

Measuring the Impact of Public Support Policies

Abstract

To compare the public assistance provided to the agriculture sector in various countries an Aggregate Measure of Support (AMS) known as the Producer Subsidy Equivalent (PSE) was developed. However, the PSE only measures the total level of support provided to agriculture, major changes in policies at equal levels of support can not be differentiated through this indicator.

There is valuable information embedded in the PSE indicator, that can allow to approximate the impact of domestic policies on trade. To achieve such a goal, a tool that permits to account for the vertical and horizontal price linkages between agricultural markets is needed. The analysis of the information included in the PSE can give more direction of the relationship of the economic variables that need to be capture in an economic model to offer a more complete treatment of impact of agricultural policies.

Keywords: Producer Subsidy Equivalent., Agricultural Policy, Trade, World Trade Organization.

Measuring the Impact of Public Support Policies

Introduction

To compare the public assistance provided to the agriculture sector across countries an Aggregate Measure of Support (AMS) known as the Producer Subsidy Equivalent (PSE) was developed by the FAO in the 1970's and adopted by the OECD in the 1980's . The PSE was used to indicate the level of public support provided to agriculture producers, but did not actually measure the share of that support actually recieved by producers or measure the impact of that support on agricultural production, prices or trade. Generally, the PSE assumed that every public dollar spent in agriculture as a producer subsidy was retained as benefits by the producer.

The level and type of public support provided to agriculture will affect the degree to which the public policies induce changes in agricultural output and prices and distortions in trade. Because the PSE provides only a measure of the total level of support provided to agriculture, major changes in policies at equal levels of support can not be differentiated. Thus, a new AMS is needed to describe what happens to trade distortions as changes in public policies occur.

The components of the PSE can be used to measure the impact of domestic policies on trade by accounting for the vertical and horizontal price linkages between agricultural markets. The income transferred from consumers and taxpayers to producers through public policies will be shared as benefits by input suppliers, output service industries and consumers as well as producers. The market structure and characteristics and the type of policy instrument will affect how the benefits are distributed between each business and consumer involved in the agricultural market. Thus, domestic policy choices, even if passively pursued, may influence domestic price and quantities produced and consumed, economy-wide employment and economic activity, and result in international transfers of gains and losses.

Intervention in the agricultural sector may have an impact on trade either directly (through border measures) or indirectly (affecting the levels of production or consumption). These impacts across countries will differ depending on the mix of policies and the level of support. The level of complexity and diversity of policies and programs used to support agriculture differs markedly across countries.

Government Policy and Subsidies

The key priority for government policies is establishing the right price and incentive structure, promoting sustainable development and reducing program waste and budget deficits. A market failure results when markets do not reflect the full costs and benefits of production in the price of traded products and inputs. The lack of markets or information for some inputs, is also classed as a market failure. (Sutton, 1988)

Government invovlement is often pursued to correct for market failures but often creates new distortions. These policy failures (market distortions resulting from active government involvement) have been identified from sectoral subsidies, inappropriate pricing, taxation policies, price controls and regulations. A market failure implies a lack of government action, but does not imply that the markets cannot work (Sutton, 1988).

The concepts of market and policy failure can be applied to distinguish subsidies from externalities. Economic theory indicates that in efficient markets, private welfare is maximized when prices equal marginal private cost. Any deviation from this optimal allocation will lead to inefficiencies(Sutton, 1988). Government policies may create these deviations causing lower or higher prices than optimal (e.g. price controls). These inefficiencies may arrise from government subsidies and acrue to different groups in society.

Subsidies are policies that keep prices for consumers below the market level or keep prices for producers above the market level or that reduce costs for consumers by giving direct or indirect support (De Moore, 1997) . This definition differentiates between budgetary and market transfers and the between production and consumption subsidies. The OECD has classified subsidies based on the method or the origin of the transfer (Table 1).

Table 1. Taxonomy of Subsidies by Method of Transfer

Method of Transfer	*Type of Subsidies*
Budgetary Subsidies	a) **Direct Subsidies**: e.g. grants or payments to consumers or producers. b) **Budgetary effect of tax policies**: e.g. tax credits, exemptions, allowances, exclusions and deductions, rate relief, preferential tax treatment.
Public provisions of goods and services below cost.	e.g. complementary services and government R&D expenditures.
Capital cost subsidies	e.g. preferential loans, loan or liability guarantees, debt forgiveness.
Policies that create transfers through the market mechanism	a) **Domestic-oriented policies** : e.g. price regulation, quantity controls, government procurement policies, legislation. b) **Trade -oriented policies:** e.g. import and export tariff and non-tariffs barriers.

Source: OECD, 1997

Direct subsidies are public expenditures categorized by the OECD as budgetary subsidies. Subsidies such as those arising from tax policies are located in the revenue side of governments accounts. Capital cost subsidies are a separate off-budget component and are distinct from direct transfers so they do not show up in government accounts. They arise from policies that reduce the cost of capital or the financial burden, such as loans, favorable interest, liability guarantees, debt forgiveness.

Finally, there are subsidies that may result from policies that create off-budget transfers through the market mechanism. Here, domestic and international policies must be distinguished. Domestic policies encompass a broad variety of measures including minimum price guarantees, quantity controls, price regulations, and government procurement practices and restrictive tendering procedures.

The level of government involvement through programs, transfers and other means provides information not only on the levels of subsidies, but also on the distribution of involvment across markets. The latter information is excluded by the PSE measure. And, information on the distribution of subsidies is as important as the total level of subsisides since each market has a unique set of supply and demand elasticites that will affect the amount of subsisidy actually recieved by the producer (and hence the sum of the effects will be less than the PSE). The basic problem is to design an instrument or tool that can include the market effects, and to develop such a tool as can be easily used across countries. This has been of great interest in the international trade arena, especially when trade negotiators and policy makers are faced with the task of arguing about reducing or modifying the levels of protection and support so as to obtain "a level playing field".

The inclusion of domestic policies in trade negotiations, both at the bilateral (North American Free Trade Agreement) and the multilateral level (World Trade Organization), has increased the need for the development of measures that separates the level of expenditures on subsisides and the actual level of support provided. Such measures are necessary to compare the actual levels of protection or support for agriculture producers and to monitor reduction in this support through bilateral[1] and multilateral[2] agreements. Indeed, such measures are also useful at the national level during debates on budget reductions.

Policy Indicators for Agriculture

Josling (1993) defines policy indicator as a number that can be used to convey information about the level, impact, or effectiveness of a policy instrument or set of policies. To be useful, a policy measure should be comparable over time, across commodities, across policies, and across countries; easily understood and interpreted; non controversial; easily measured and replicable; and reasonably accurate.[3]

Types of indicators

Several indicators have been developed to reveal information about the level of government support . Among the different types of indicators, special attention has been given to the Aggregate Measures of Support (AMS). The aggregate measure concept focuses on measuring the extent, structure and development of agricultural protection in the world (Tangermann et al, 1987; Schwartz and Parker, 1988; Hertel, 1989; Josling and Tangermann, 1989; Peters, 1989). In this category, the most widely used measures include the nominal rate of protection (NRP), the effective rate of protection (ERP) and the Producer/Consumer subsidy equivalent (PSE).

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[1]The United States-Canada Free Trade Agreement incorporated a relative measure of the level of support to implement the provision that eliminates Canadian Import licenses from Wheat, Oats and Barley. (USGAO, 1991)

[2]Under the Uruguay Round of the General Agreement on Tariff and Trade (GATT), OECD was directed to find an indicator to monitor the agreement on the proposed reduction in the level of Agricultural support. Article 6, paragraph 4(a) Part IV of the Agreement on Agriculture.

[3] As Josling (1993) indicates, if an indicator is not comparable across commodities, time or countries, little information for the policy maker, even if it is simple to understand, noncontroversial, and easy to calculate.

Nominal Rate of Protection:

Defined as the domestic price relative to an appropriate international price (Tsakok, 1990), the nominal rate of protection provides a relative measure of trade distortion. Thus

$$NPC = \frac{P^{d}i}{P^{b}i}$$

where P^b is the border price of commodity i (e.g. the foreign price times the exchange rate), and $P^d i$ is the domestic price of commodity i.

This indicator is easy to use and understand, but it suffers from interpretation problems in situations of world price instability. Another limitation is that it only estimates the effects of protective measures placed on outputs. The estimate leaves out the effects of protection on domestic resource allocation (Henneberry and Henneberry, 1989).

Effective Rate of Protection:

As a reaction to the limitation of the NRP, the ERP includes the value of inputs. The ERP attempts to capture the production incentives of input and output subsidies (as a percentage of free trade value added). Since the input market is considered, ERP is potentially a more encompassing assessment of the protective structure of intervention. The formula of the ERP is

$$EPR = \frac{P^{d_i} - \sum_{j=1}^{k} a_{ij} P_j^d}{P^{b_i} - \sum_{j=1}^{k} a_{ij} P_j^b}$$

where P^b is the border price of commodity i (e.g. the foreign price times the exchange rate), and $P^d i$ is the domestic price of commodity i, a_{ij} is the units of input j per unit of output i, P^d_j is the domestic price of input j and P^b_j is the foreign price of input j, and P^d_j is domestic price of input j. The major problem with this indicator is the complexity of the data required for its estimation. Its calculation requires estimates of prices and input-output coefficients in the hypothetical situation of free trade (Strak, 1982).

Producer Subsidy Equivalent

The Producer Subsidy Equivalent (PSE) was developed in the 1970s by the agricultural economist Timothy Josling for the Food and Agriculture Organization (FAO) (FAO, 1973) as a general measure of agrarian support. The PSE is an equivalent-type indicator that relies on the comparability and comprehension of the instrument chosen as a proxy (Josling, 1993 ; Dixit and Roningen, 1989).

The concept became widely known in the 1980s when the Organization of Economic Cooperation and Development (OECD) began using it to implement the extent of government support for a range of commodities across all OECD countries[4] (Harley, 1996). At the same time, the United States Department of Agriculture started working extensively on the concept as well. The PSE was seen as an indicator that translated all policies that assist producers and consumers in the agricultural sector, into an equivalent level of another policy or value.

For the U.S. technical negotiating team, the PSE was the kind of quantitative

[4] Josling developed the Producer Subsidy Equivalent (PSE) approach to examine the support implied by government intervention in agriculture.(Josling,1981). The OECD developed the methodology and applied progressively to all OECD countries. PSEs were first estimated by the OECD in the context of the 1982 Ministerial Trade Mandate and subsequently as the most important element in the annual monitoring of developments in Member countries in the context of the 1987 OECD Ministerial Principles for Agricultural Reform.

information that trade negotiators needed on the trade and agriculture policies of other countries (USDA, 1987).

The PSE Concept

The Producer Subsidy Equivalent (PSE) is defined by the OECD (Cahill, 1990) as an indicator of the total value of the monetary transfers to agricultural producers resulting from agricultural policies in a given year. The PSE is used to evaluate the size of income transfers resulting from government policies.

In the PSE calculations, both transfers from consumers of agricultural products (through domestic prices), and transfers from taxpayers (through budgetary or tax expenditures) are included. (OECD,1987). In practice, PSEs for individual countries are rarely all-inclusive, because some transfers such as transfers associated with the underpricing of irrigation water or tax concessions, are often omitted due to a lack of data.

The Consumer Subsidy Equivalent (CSE) is an indicator of the value of monetary transfers to consumers resulting from agricultural policies in a given year. It comprises both transfer to, or more commonly from, domestic consumers due to market price support policies and transfers from taxpayers to consumers of agricultural products (OECD,1987). Normally, the first type of transfers are larger in absolute terms than the second (and carry a negative sign). As a result, the CSE measure assumes that any market price support given to producers is paid by an implicit tax on the consumer through higher food prices.

These two measures account for the usual budget outlays of the government intervention in the sector, but also include policies that do not result in specific budget outlays such as tariffs, import quotas and permits, and variable levies.[5]

PSE coverage

The OECD applies a broader measure for the PSE than that used by the FAO in the early stages of the indicator's development. The FAO limited itself to product-specific policy measures and paid no attention to structural policy measures such as training, technical asistance and research. (Josling and Tagermann, 1989). In contrast the OECD has included in its calculations all agricultural policy measures that affect agricultural production, consumption and trade.

The OECD distinguishes five types of agricultural policies associated with the method of monetary transfer.

Table 2. Policies included in PSE calculations

Method of transfer	*Subsidy*
Measures that simultaneously affect producer and consumer prices	e.g. Market Price Support
Measures that transfer money directly from taxpayers to producers without raising prices to consumers	e.g. Direct Payments
Measures that lower input cost, with no distinction made between subsidies to capital and those to other inputs	e.g. Reduction to input costs
Measures that in the long term reduce cost but which are not directly received by producers.	e.g. General Services
Other indirect support, the main elements of which are subnational subsidies and tax concessions.	Other Indirect Support.

They include: market price support, direct payments, input subsidies, general services, and another indirect support measures (Shelby, 1994). In the case of market

[4]These policies force consumer to pay prices higher than those prevailing in the world market. Therefore, consumers bear the cost of these policies that benefit producers through an indirect tax that never shows in government budgets.

price support, income transfers occur because the domestic market price differs from the price at the border (world market price). In the OECD countries, the domestic price is usually higher, and thus creates a transfer to producers. The scale of a specific transfer is measured by multiplying the relevant price difference by the domestic volume of production. How this affects the governments budget is only an issue in so far as a difference exists between domestic production and consumption. Disregarding inventory fluctuations, this difference corresponds with international trade. The budget benefits from taxes on imports and is burdened by subsidies for exports. Transfers to producers by means of the other government programs are paid entirely, from the budget.

PSE calculation

The PSE, as measured by the OECD, is expressed in three ways[6]:

1. as the total value of assistance to the commodity produced; (Total PSE),
2. as the total value of assistance per unit of the commodity produced; (Unit PSE),
3. as the ratio of the total value of assistance to total receipts, which is value of production, including any direct net receipts.

In algebraic form, these PSE expressions are written as:

$$\textbf{\textit{Net Total PSE}} = Q * (P - PWnc) + DP - LV + OS - FA$$

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[6] Another way PSE are expressed is through the Nominal Assistance Coefficient (NAC).The NAC provides a measure of comparison of the relationship between domestic and world market prices . The conversion of PSE into NAC is based on the assumption that all government policies per unit of transfer contribute in the same way to the price differences. This assumption stands for market price support and deficiency payment policies as long as no restriction are attached to the policy, but for other policies does not apply as easy (OECD,1991).

$$\textbf{\textit{Gross Total PSE}} = Q * (P - PWnc) + DP - LV + OS$$

$$\textbf{\textit{Unit PSE}} = \frac{Q * (P - PWnc) + DP - LV + OS - FA}{Q}$$

$$\textbf{\textit{Percentage PSE}} = 100 * \frac{(Q * (P - PWnc) + DP - LV + OS - FA)}{Q * P + DP - LV)}$$

where Q is the volume of production, P is the domestic production price, PW_{nc} is the world price (reference price) at the border in domestic currency, DP is the value of direct payments, LV is the value of levies on production, and OS refers to all other budgetary-financed support; FA refers to the feed adjustment (only for livestock products).

The OECD also conputes a Consumer Subsidy Equivalent (CSE) that includes two categories of agricultural policies.

Table 3. Policies included in CSE calculations

Method of transfer	*Subsidy*
Transfers Consumers to Producers due to market price support	e.g. Market Transfers
Budgetary transfers to consumers resulting from agricultural policies	e.g. Other Transfers

Like the PSE, the CSE as measured by the OECD is expressed in three ways:

1. as the total value of assistance to the commodity consumed; (Total PSE),
2. as the total value of assistance per unit of the commodity consumed; (Unit PSE),

3. as the ratio of the total value of assistance to total receipts, which is value of consumption, including any direct consumption subsidies.

In algebraic form, the CSE is calculated as follows:

$$\textbf{\textit{Total CSE}} = Q_c * (P_c - PWnc) + OT$$

$$\textbf{\textit{Unit CSE}} = \frac{Q_c * (P_c - PWnc) + OT}{Q_c}$$

$$\textbf{\textit{Percentage CSE}} = 100 * \frac{(Q_c * (P_c - PWnc) + OT)}{(Q_c * P_c)}$$

where Q_c is the volume of consumption, P_c is the domestic consumption price, PW_{nc} is the world price (reference price) at the border in domestic currency, OT is the value of budgetary subsidies to consumers resulting from agricultural policies.

The OECD calculates and monitors the levels of PSE and CSE for all member countries. Each policy has a corresponding monetary value, making possible a cross country comparison as the level of assistance represented by different policy instruments changes. Expressing the values in percentage form simplifies the comparison of the relative support levels over time and between products and countries. If examined across countries, the PSE and CSE indicate the relative importance of government policy in different countries and commodity markets in terms of the contribution of the policy to farmer revenues and consumer costs. When examined over time, the PSE and CSE show changing government involvement in the agricultural sector.

The PSE for a particular commodity is positive when the net effect of all programs affecting the commodity in a country is to increase the income of producers over the level of income that would be received in the absence of these programs. The PSE will have a negative value if the net effect of all programs reduces farm income. Likewise, the CSE is negative when the net effect of the programs increases the price that consumers pay for food and positive when consumers pay less for food than the world market price.

There is a closed relationship between PSE and CSE. Market price support policies that create a wedge between domestic and world prices raise consumer price. A positive(negative) transfer from consumers to producers - a subsidy (tax) to producers - is equivalent to a tax (subsidy) on consumption. (OECD, 1987). Specific consumer subsidies paid from government budgets, such as food subsidies, may partly offset such taxes on consumption. Direct payments and other budgetary support paid to producers, raise the effective price received by producers but do not raise the price paid by consumers.

Analysis of the United States Agricultural Support for 1979-1996

United States agricultural producer support levels (aggregated for all commodities) as measured by the PSE varied widely during the period from 1979-1996 (table 1), with the peak subsidy years in the mid eighties (1986-1987). Following a similar pattern, the CSE also varied widely during the same period (table 1.b). However, the average implicit tax was always lower than the average level of support to producers.

Measured as the percent of gross agricultural receipts (Percentage PSE), total transfers to all producers tripled between 1979 and 1986 (Figure 1). The average level of transfers during the 18 year period was $24.5 billion per year. While the PSE tripled the negative CSE less than doubled. (Figure 2). The average implicit tax to consumers as result of government policies peaked in 1986 at nearly $14 billion.

The pattern of support reflects the mid-1980's and early 1990's drop in world market prices. The PSE calculation reflects an inverse relationship between world price and the level of transfers to the producer. The most important government programs inversely link the level of support received to world market price levels. This inverse relationship is easily seen in the case of wheat. A simple statistical model is derived in which a linear relationship between the level of transfer and world price of wheat is formulated The equation assumes that the level of total producer subsidy equivalent (total transfer) is an inverse function of the (world) price of the commodity and is written as:

$$PSE_{wheat} = \alpha_o - \beta_1 \ (Price) + \epsilon$$

where α_o is the intercept , β_1 represents the amount that the PSE will decrease from a one dollar increase in world price and ϵ is a random and normally distributed error. Estimating this relationship with ordinary least squares (OLS) yields the following results:

PSE_{wheat}	=	10089.311	-54.04599 * Wheat-Price	$R^2 = 0.7733888$
		(1412.698)	(11.07512)	F = 23.8139

Table 3. Producer subsidy Equivalent for the United States. 1979-1976

Detail of general policy measures :	Units/	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1,991	1,992	1,993	1,994	1,995	1,996
Adjusted value of production	'000 t	107,045	110,733	111,585	112,377	112,084	111,738	109,198	105,937	112,182	110,000	118,647	123,585	118,494	124,397	122,263	130,724	130,706	145,260
A. Market price support	'000 t	8,775	8,626	8,709	9,833	10,772	11,762	14,321	15,432	15,960	9,893	9,963	14,143	12,628	12,673	14,143	12,664	8,214	11,125
B. Levies	'000 t	0	0	0	0	-657	-663	-165	-510	-265	-36	0	-8	-50	-141	-161	-222	-196	0
C. Direct payments	'000 t	608	1,175	1,964	2,049	12,360	4,767	6,946	14,313	12,923	8,071	6,091	6,961	5,478	6,657	6,285	6,017	1,587	4,591
Deficiency payments	'000 t	94	38	716	1,171	1,119	3,330	4,740	10,806	10,418	4,240	4,969	6,417	5,096	6,075	4,277	5,271	1,516	0
Area and headage payments	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disaster	'000 t	109	611	348	16	1	0	0	0	0	2,825	887	135	283	312	1,757	596	5	0
Diversion	'000 t	134	308	508	0	10,748	1,171	1,376	362	1,600	622	0	0	0	0	0	0	0	0
Storage	'000 t	271	218	443	954	480	322	370	554	534	358	163	67	16	10	9	28	4	0
Loan rate	'000 t	0	0	-48	-76	17	-30	214	2,114	187	-35	-22	161	0	0	0	0	62	75
Loan deficiency payments	'000 t	0	0	-3	-15	-4	-25	13	53	-15	-1	0	8	26	53	215	61	0	0
Marketing loans	'000 t	0	0	0	0	0	0	233	424	199	62	93	173	58	207	26	60	0	0
PFC payments	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,516
D. Reduction of input costs	'000 t	1,109	1,632	2,113	3,140	3,580	3,249	3,501	3,380	3,480	3,295	2,434	1,882	1,561	1,375	2,017	1,108	1,656	1,573
Capital grants	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest concessions	'000 t	1,006	1,386	1,869	2,851	3,189	2,856	3,033	3,112	3,347	2,635	2,074	1,714	1,287	1,122	1,063	1,097	1,085	1,002
Fertilizer	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	'000 t	-33	125	100	143	227	215	277	120	-5	521	202	19	125	100	826	-125	430	430
Irrigation	'000 t	136	121	144	146	164	178	190	147	139	139	157	149	149	153	128	136	141	141
Other	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. General services	'000 t	1,765	1,872	1,860	1,913	1,826	1,958	2,025	1,954	1,969	2,185	2,805	3,011	3,142	3,455	3,552	3,760	3,841	3,890
Research, advisory, training	'000 t	718	797	782	820	856	876	901	913	917	937	1,020	1,097	1,131	1,242	1,290	1,316	1,360	1,387
Inspection	'000 t	281	329	339	339	340	351	374	365	386	402	418	442	464	489	533	537	550	569
Pest and disease control	'000 t	204	215	223	246	179	221	228	219	246	255	275	284	303	345	374	374	386	297
Structures/infrastructures	'000 t	490	451	436	430	393	429	450	362	352	508	1,010	1,092	1,149	1,264	1,234	1,414	1,414	1,516
Marketing and promotion	'000 t	72	80	80	78	58	80	71	96	68	83	82	96	95	115	120	118	131	122
F. Sub national	'000 t	1,044	1,234	1,256	1,162	1,195	1,225	1,344	1,454	1,496	1,519	1,676	1,845	1,849	1,796	1,880	1,894	1,918	1,940
G. Other	'000 t	1,034	1,109	1,112	1,224	963	1,002	915	958	520	385	563	452	543	474	338	351	386	395
Total other support (D+E+F+G)	'000 t	4,952	5,848	6,342	7,439	7,564	7,434	7,784	7,745	7,466	7,384	7,478	7,189	7,095	7,100	7,788	7,113	7,802	7,798
Gross total PSE	US$ mn	14,335	15,649	17,015	19,321	30,039	23,301	28,887	36,980	36,083	25,311	23,532	28,286	25,151	26,289	28,054	25,573	17,406	23,513
X. Feed adjustment	US$ mn	0	0	0	0	0	0	-41	-316	-384	-78	-45	-168	-310	-206	-398	-361	-26	0
Net total PSE	US$ mn	14,335	15,649	17,015	19,321	30,039	23,301	28,845	36,664	35,699	25,233	23,488	28,117	24,841	26,082	27,657	25,213	17,380	23,513
Percentage PSE	%	13	14	15	17	27	21	26	35	32	23	20	23	21	21	23	19	13	16
Net total PSE (US$ mn)	*US$ mn*	*14,335*	*15,649*	*17,015*	*19,321*	*30,039*	*23,301*	*28,845*	*36,664*	*35,699*	*25,233*	*23,488*	*28,117*	*24,841*	*26,082*	*27,657*	*25,213*	*17,380*	*23,513*

Source: OECD, 1997

Table 4 Consumer Subsidy Equivalent for United States. 1979-1996

Detail of general policy measures : consumption	Units/ Unités	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1,991	1,992	1,993	1,994	1,995 (e)	1,996 (p)
Value of consumption	'000 t	90,492	94,038	88,377	90,715	93,826	92,443	86,209	84,013	91,597	97,295	100,749	105,938	104,187	102,921	109,420	108,134	113,834	120,524
A. Market transfers	'000 t	-9,211	-8,419	-8,354	-10,010	-11,024	-12,589	-14,661	-15,553	-14,866	-9,213	-9,410	-13,074	-11,525	-11,429	-12,873	-11,571	-8,117	-11,300
B. Other transfers	'000 t	480	707	826	834	1,757	1,904	1,753	1,622	1,642	1,358	928	711	700	705	885	802	802	782
C. Total CSE	'000 t	-8,731	-7,713	-7,528	-9,176	-9,267	-10,685	-12,908	-13,931	-13,224	-7,855	-8,482	-12,363	-10,825	-10,724	-11,989	-10,769	-7,315	-10,518
D. Percentage CSE	%	-10	-8	-9	-10	-10	-12	-15	-17	-14	-8	-8	-12	-10	-10	-11	-10	-6	-9
Total CSE (US$ mn)	*US$ mn*	*-8,731*	*-7,713*	*-7,528*	*-9,176*	*-9,267*	*-10,685*	*-12,908*	*-13,931*	*-13,224*	*-7,855*	*-8,482*	*-12,363*	*-10,825*	*-10,724*	*-11,989*	*-10,769*	*-7,315*	*-10,518*

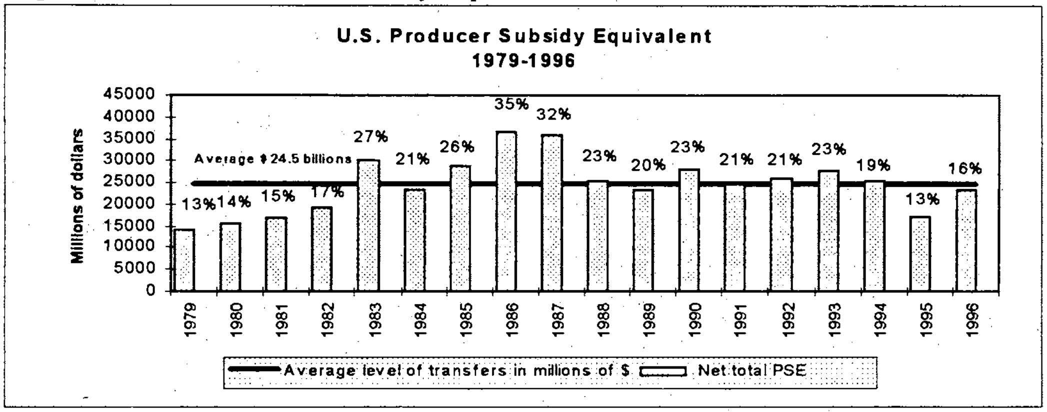
Source: OECD, 1997

Table 5. Shares of General Policy Measures in net total PSE/CSE

	Units/	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1,991	1,992	1,993	1,994	1,995
A. Market price support net of	%	61	55	51	51	34	48	49	40	43	39	42	50	49	47	49	48	46
C. Direct payments	%	4	8	12	11	41	20	24	39	36	32	26	25	22	26	23	24	9
D. Reduction of input costs	%	8	10	12	16	12	14	12	9	10	13	10	7	6	5	7	4	10
E. General services	%	12	12	11	10	6	8	7	5	6	9	12	11	13	13	13	15	22
F. Sub national	%	9	8	7	6	4	5	5	4	4	6	7	7	7	7	7	8	11
G. Other		7	7	7	6	3	4	3	3	1	2	2	2	2	2	1	1	2
TOTAL OF PSE ELEMENTS		101	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
A. Market transfers	%	105	109	111	109	119	118	114	112	112	117	111	106	106	107	107	107	111
B. Other transfers	%	-5	-9	-11	-9	-19	-18	-14	-12	-12	-17	-11	-6	-6	-7	-7	-7	-11
TOTAL OF CSE ELEMENTS		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: OECD, 1997

Figure 1. U.S. Producer Subsidy Equivalents 1979-1996



More than 70% of the variation in the PSE for wheat is explained by the price of wheat (dollars per ton). Further, for each dollar that wheat price increases PSE will decrease by $54.04 million.

During the peak years of support, the level of transfers to producers increased at about double the level of support provided in the in the late 1970s.

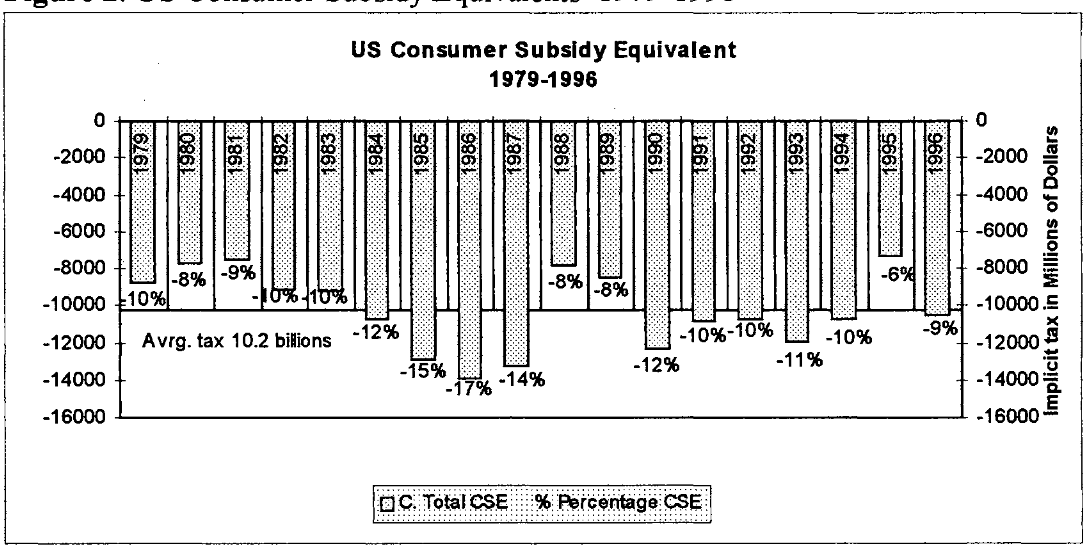
Policy Approach

Total PSE gives valuable information on the level of support. The different components of the PSE offers data on the different types of policies used by the government to transfer support to the producers or consumers.

The United States relied heavily on market price support and direct payments to transfer income to producers (Figure 3). Market price support indicates the amount of transfer that is accomplished through price intervention in the market. Direct payments indicates the amount of transfer that is accomplished through direct income transfers (Nelson, 1995).[7]

Major price intervention policies were export subsidy programs, import quotas and tariffs. These programs represented between 45-50% of total transfers over the last 18 years (Figure 3). Price intervention average $11.646 billions per year during 1979-1996 or 10% of the gross aggregated value of agricultural production. The most important U.S. price intervention came from domestic program for dairy and sugar, supplemented by import restrictions.Guaranteed minimum prices were provided by government loan rates for sugarcane and sugar beets, and by government purchase prices

Figure 2. US Consumer Subsidy Equivalents 1979-1996



for dairy products.

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[7]Trade policies often increased (or decreased) the level of domestic market prices relative to world market prices. Price intervention is based on the difference between the relative world price and the domestic price. (OECD, 1997)

Figure 3. Share of Major Policies on Total Aggregated PSE Transfers. 1979-1996

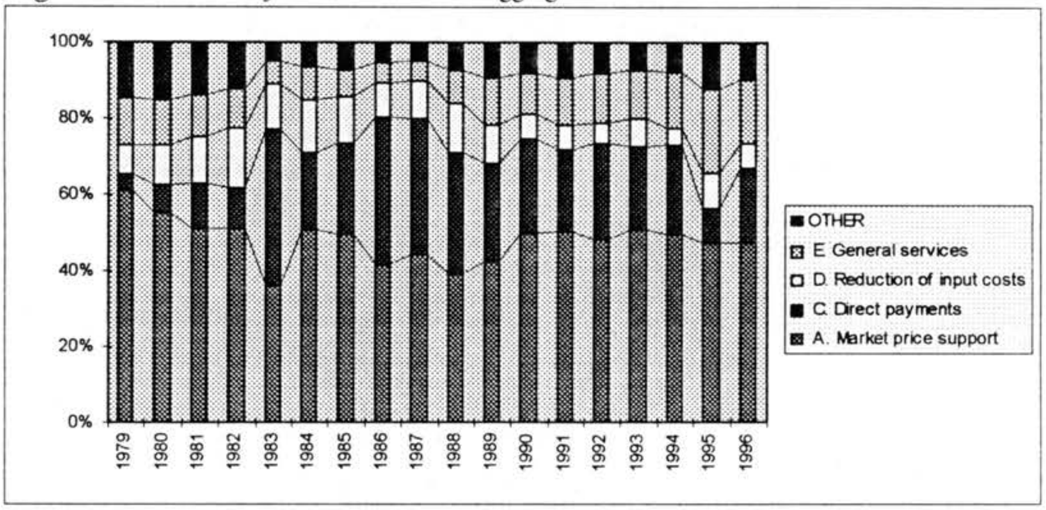


Figure 4. Share of Major Policies on Livestock and Crop PSE Transfers. 1979-1996

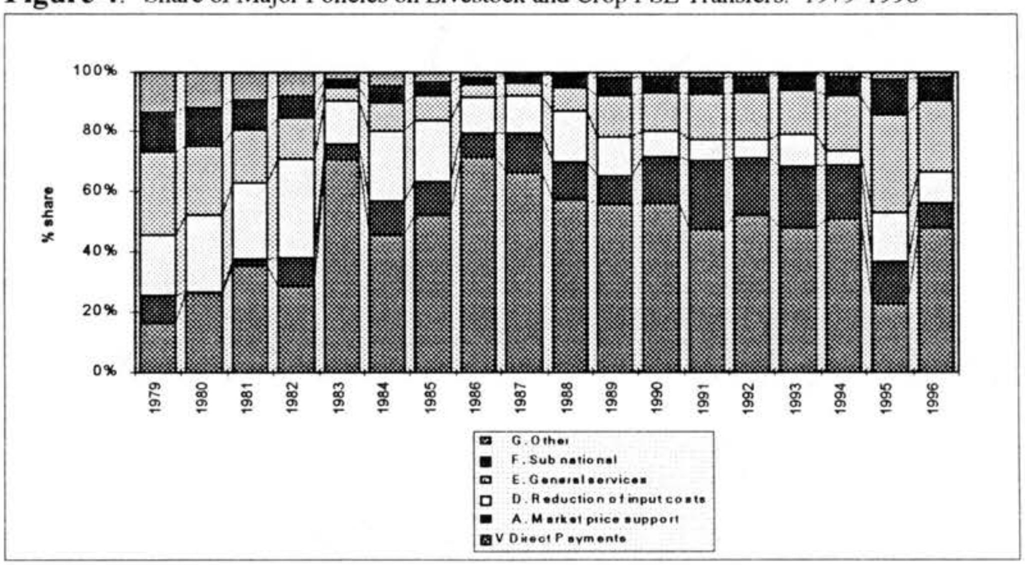
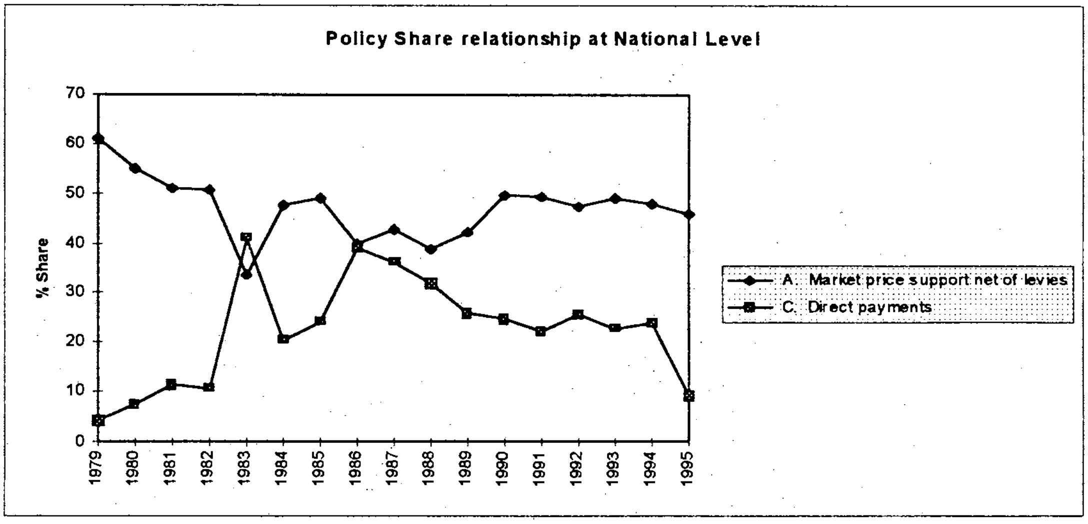


Figure 5. Income Support and Price Intervention Policies share relationship over 1979-1996



The various types of U.S. direct payment programs are listed in Table 1. Deficiency payments are by far the largest source of direct income transfers. The level of direct payments and the producer subsidy share of these payments increased steadily until 1986 and then steadily declined. These payments were made primarily to the feed and food grain crops.

Input subsidies have represented an average of 5-10% of total transfer. It amounted to $2.337 billion or 2% of total production value during the period from 1979 to 1996. Credit subsidies represented 85% of the input subsidy which was transfered through real state, operating and other farm loans.

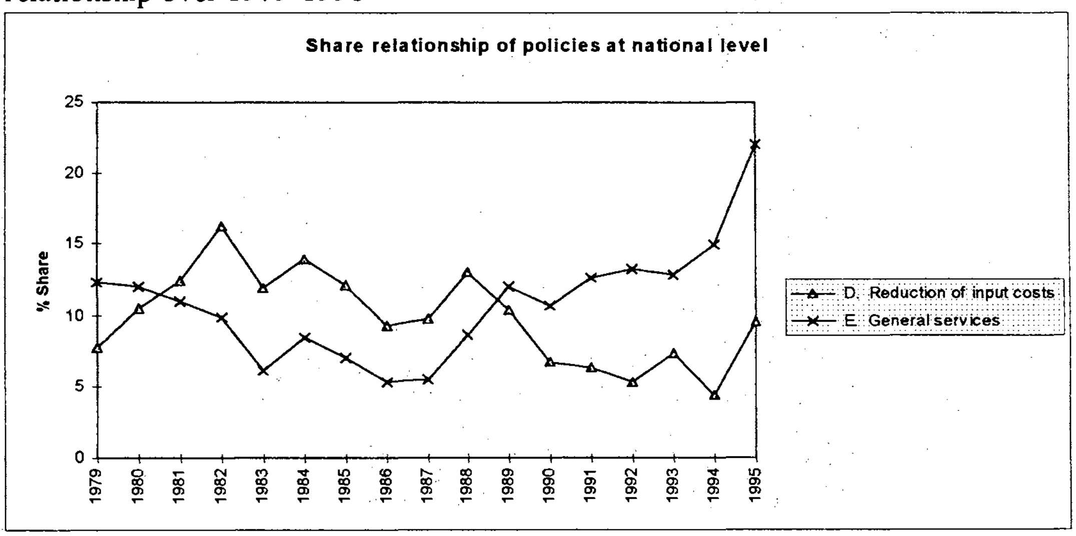
General Service policies related to marketing assistance, public research, development of public infrastructure, and the various inspection and pest control programs. These programs accounted for an average 5-15% share of total transfers.

On average, they have been used to transfer $2.599 billion (2% of average total production value) per year during 1979-1996.

The method of transfer will also offer information on the distribution of program cost across the groups in the economy. Taxpayers pay for transfers that do not directly affect agricultural commodity market prices. Consumers pay for price intervention transfers, unless the increase in price is offset by direct government transfer to consumers.

Following these transfer rules, the trend in the distribution of progduer subsidies can be shown in the mix of policies used (Figure 3 and 4).

Figure 6. Marketing Assistance and Input Reduction Cost Policies share relationship over 1979-1996



First, it should be noted that income support policies are triggered when domestic commodity prices are below target prices and price intervention policies are trigger when world price falls below domestic prices.

Policy approaches by sector:

Support levels and trend look very different when they are analyzed at the sector level. In addition, PSE patterns changed from one sector to another. The following analysis focus on the aggregate calculation of the PSE for the crop sector (wheat, corn, sorghum, rice, soybean and sugar) and the livestock sector (diary, beef, pork, poultry, sheep and eggs).

Crop PSE patterns reflect the mid-1980's and early 1990's drop in world prices. Transfers to the crop sector average $10.778 billion during the period of 1979-1986 implementation of the Food Security Act of 1985)[8] and 1987. The last 10 years show a decreasing trend in the level of support. Support is declining faster in the crop sector than in the livestock sector.(Figure 7).

Transfers to the livestock sector average $13.599 billion per year during the period of 1979 to 1996. Different from that of the crop sector, PSE levels are not as volatile in the livestock sector. Although reaching peak levels between 1985-1987 as well.

This trend is reversed when CSE calculations are observed for the each sector.

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[8] Under the 1985 Act, US commodity loan rates were decreased and the Export Enhancement Program was started. (Nelson, 1995) With the price slump and program changes, U.S. support payments and market price transfers increased in 1986-1987.

Since livestock programs depended more on price intervention (diary program), more volatility and implicit tax can be observed for the consumer of the livestock sector than for the consumer of the crop sector. (Figure 10) This indicates the importance of the policy mix.

The policy mix in the crop sector indicates how the government is distributing the cost of the programs across groups in the economy. The crop sector support relied more on income support policies (Figure 11). From 1979 to 1996, an average of 48% of the support to the sector was in the form of income support policies, equivalent to $3.870 billion. Price intervention accounted for an average of 12% of total transfer or $1.355 billion to the sector. In fact, policies directed to input cost reduction and marketing assistance represented even a bigger share than that of price intervention policies, accounting for 16% or $1.528 billion average per year and 14% or $1.361 billion per year respectively. Evidently, the government relied more on taxpayer money to afford commodity programs.

The policy mix in the livestock sector shows a complete different pattern and distribution of cost programs. This sector support relied heavily on price intervention (Figure 12) . This type of policy accounted for 75% of average transfer during 1979-1996. This is equivalent to $10.282 billions per year. Income support policies accounted only for 1% of average total transfer. An average of 98.0 millions were transferred using this kind of policy. Marketing assistance policies represented an average of 9% or $1.286 billions during the period of 1979-1986 while input reduction policies accounted for 6% or 808.0 millions of total transfer during the same period. It should be noted that policies dealing with the reduction of input cost were concentrated in subsidies to interest

Figure 7. PSE Trends in the Livestock and Crop Sector. 1979-1996

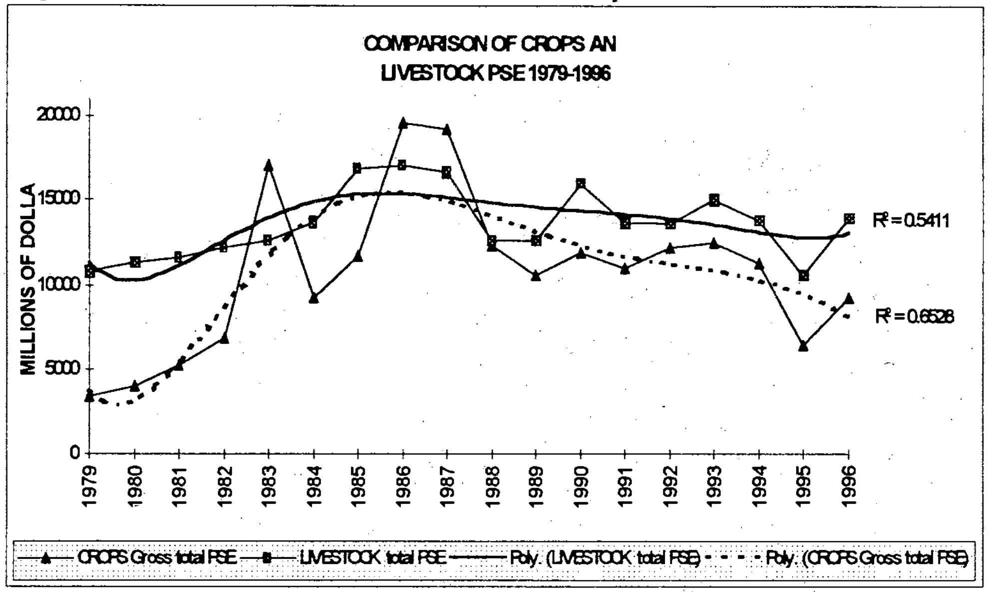


Figure 8. CSE Trend for Livestock and Crop Sector. 1979-1996

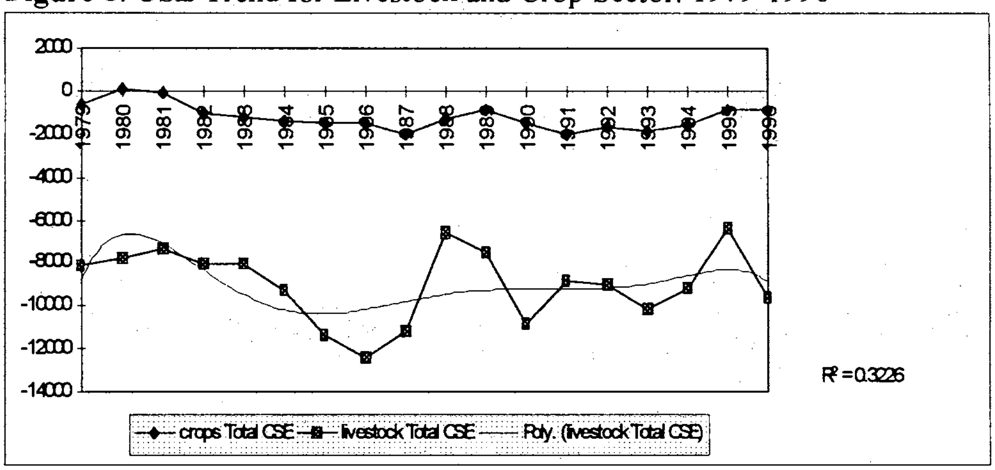


Figure 9

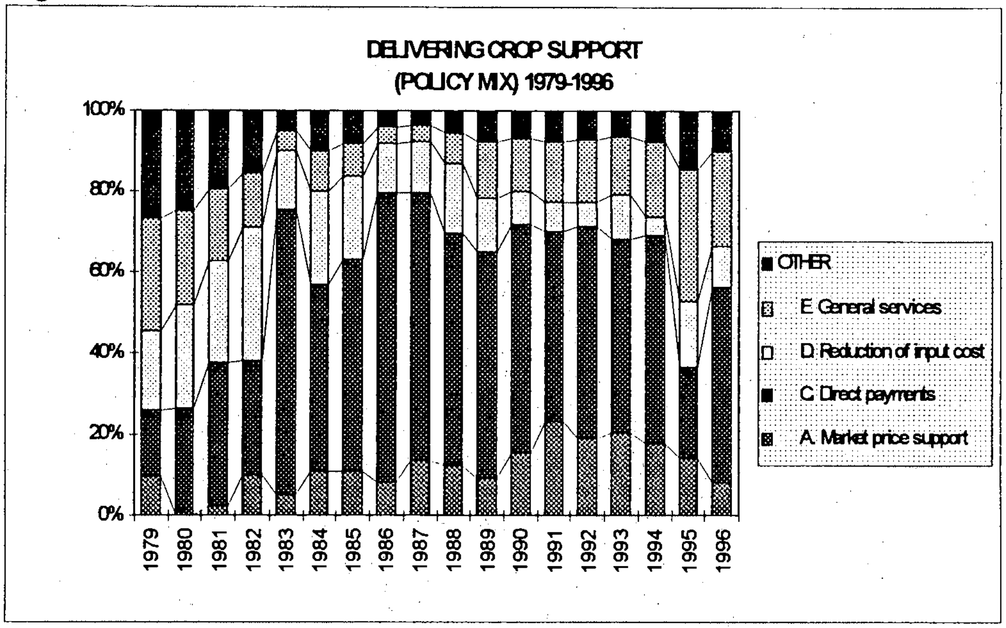
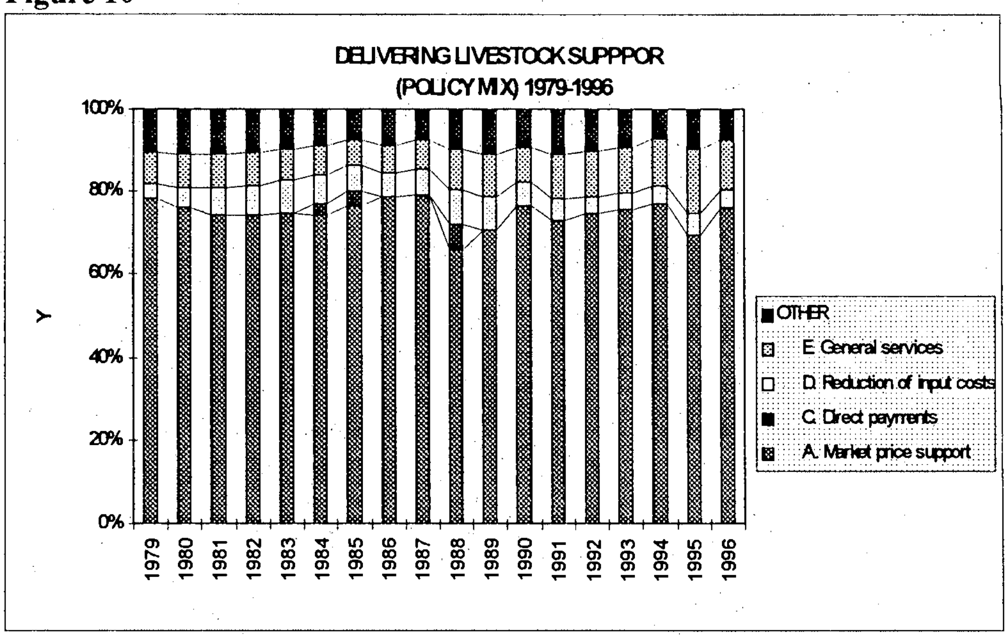


Figure 10



rates, in the form market loans. In the other hand, market assistance policies devoted more than 50% of this support on research for the sector. In the livestock sector, consumer were in charge of paying for the type of support the government was supplying to the sector.

Limitation of the Producer Subsidy Equivalent

After the 1987 OECD Summary reporttrade analysts begin to question whether the PSE could be considered an adequate measure of trade distortion caused by governmental agricultural policies. Extended analysis of the measure concluded that this is not the case. (Hamsvoort & Silvis, 1996).

As indicated before, the PSE provides a convenient way to monitor agricultural support levels over time and facilitates country and commodity comparisons by showing the total value of expeditures. In addition, the indicator can highlight commodity and country differences in agricultural support levels that can encourage excess production and distort prices and trade (Nelson, Simone and Valdez, 1995).

However, the PSE does not measure the effects of policies on production, consumption or world prices. The PSE is a measure of the apparent support to producers, not of trade, price or income distortion. The different policies covered in the PSE have different and unique implications for production and trade, but these implications are not measured by this indicator (Ballenger,N 1988; Cahill, C and Legg, W, 1990; Schwartz, N.E. and Parker, S., 1988).

The PSE and CSE measures can not directly reveal the unique effects on production, consumption, trade, and prices of a changing level or the mix of government intervention in agricultural markets. The measures are simple sums of the various levels of monetary support provided to either producers or consumers by each policy. Because of the inelastic nature of the supply and demand for agricultural commodities, the level of public support which actually becomes part of net farm income will not necessarily be equal to the total level of support. The actual level of support received by the producer or consumer depends on the policy instrument and supply and demand elasticities. Using PSE as indicator of trade distortions can be misleading when countries pursue policies that offset trade-distortion effects of producer support.(Roningen and Dixit, 1991).

The PSE does contain information that can be used to derive measures of the effects of support policies on trade and to determine the transfer of income to producers net of losses in the market. Since different policies may have very different effects on production and exports, the policy composition of the PSE is important in assessing the potential implications of a country's policies.

The Trade Distorted by Support (TDS) coefficient developed by Roningen and Dixit, (1991) is an example of using the PSE information to derived better indicators. This indicator was derived from the information in the PSE and designed to measure changes in volume of net trade from existing levels if a country completely eliminates all support to the commodity.

$$TDS_i = (q_s * e_s * s_m - q_d * e_d * s_m) + (q_s * e_s * s_p - q_d * e_d * s_c) + (q_s * e_s * s_i) - sso$$

where for each commodity i, e_s and e_dn are own -price supply and demand elasticities, q_s and q_d are observed production and consumption quantities, s_m is the *market support ratio,* s_p and s_c are *direct (income) support rates for producers and consumers,* s_i is the *support ratio for all other types of assistance to producers,* and sso is the set-aside offset, usually resulting from direct payments to producers. Roningen calculated TDS for 13-commodities and 11countries using the PSE data set (OECD, 1990)

This instrument, as others, did not consider the composition or the mix of policies transferring the support , changes in world prices that result from the removal of policies were ignored, and cross-commodity effects of policy elimination were not included.

Aggregate Measures of Support and GATT

During the Uruguay Round of GATT, negotiations on agricultural trade highlighted the interest of most governments in support measurement. In fact, at the beginning of the negotiations in 1986, the parties expressed their intent to develop an Aggregate Measure of Support (AMS) which could bring the wide range of existing agricultural support policies under a common measure by which a level playing field could be defined. The new concept was to be used not only for monitoring purposes, but also for making binding commitments. Due to this interest, the AMS was regarded as the central plan on which a new agreement could be based. However, in the final GATT agreement signed in 1996, the AMS only appeared as one of a number of elements, not the key element.

The concept of an AMS, developed after roughly 10 years of negotiations, was the Producer Subsidy Equivalent indicator. The negotiation records indicate that "this choice was a practical one, based on availability and measurability "(Hamsvoort & Silvis, 1996).

The WTO's AMS is a more narrowly defined aggregate measure of assistance. Its main goal is to facilitate multilateral reductions in domestic support. During the Uruguay round the main commitments from the countries were:

1) Establish a base AMS measure for 1986-1988
2) give credit for reductions since 1986
3) Aggregate all discipline policies into one AMS
4) Provide criteria for non-disciplined policies
5) Establish AMS ceilings 20% below the 1986-1988 base.

The WTO classified US Agricultural policies according to the fact that some were direct agricultural policies and some were not.

Table 6.

Agricultural Policies	- Trade Distorting domestic Policies (AMS). - Non-Trade distorting domestic policies "green") - Trade (non-domestic) policies
Non Agricultural Policies (non disciplined)	- Forestry/recreation - rural development/housing - USDA administrative activities

All trade distorting domestic policies were aggregated into one total WTO AMS that defines and quantifies a base level of support for each country for the 1986-1988 base period. The measure must be updated every year until 2000 and the WTO has to be notified of this update.

This notification is used by the organization to monitor the development of agricultural support levels of each country and encourage the countries to keep their support levels no larger than the agreed-to ceiling levels.[9]

[9] "...a member is in compliance with support reduction commitments [if] its...Current total AMS does not exceed the...final bound commitment level..." (Part IV, Article 6) Agreement on Agriculture.

Conclusions

Subsidies and the policies that promote may encourage practices that are economically perverse, trade distorting and ecologically destructive. In most cases, governments do not intentionally impose policies for these purposes. However, most policies have impacts other than those for which they were intended. The key issue is to what extent policies are actually serving their original purpose and to measure any adverse consequences they may have on markets or the entities involved in the market.

Agricultural policy goals and the tools used to obtain those goals differ across countries and commodities. For example, the Federal Agriculture Improvement and Reform (FAIR) Act of 1996, accelerates the trend set in the two previous major farm acts toward greater market orientation that have gradually reduced the government's involvement in U.S. agricultural markets and even more importantly has reduced the the impact of this involvment on trade. The reduction in government involvement has been achieved through a change in both the level of support and the mix of policy tools.

The FAIR act eliminated subsidies tied to production and instead provides direct payments, increasing farmers available planting decisions, allows unrestricted haying and grazing, eliminates acreage reduction programs, reduces government involvement in the management of stocks (by reducing the price support loan levels and the FOR entry levels), and eliminates multi peril mandatory crop insurance.

Before the FAIR Act, US agricultural policy goals included price and income protection and income enhancement for farmers and assurance of adequate supplies of food and fibers for consumers at reasonable prices. Goals growing in importance in the eighties included conservation, protection of cropland, and competitiveness in world markets.

The income support paid to U.S. farmers prior to the FAIR Act was tied to production of specific commodities. This transfer directly impacted the consumers and producers in the market for that commodity. The new direct payment does not affect any specific market but may affect many agricultural and nonagricultural markets depending upon the associated expenditure patterns of the farmers. Thus, even if the same level of support is provided with the direct payment as was provided with the previous income support program the market distortion that is created will vary considerably between the two policies.

A change in the mix of support provided to agriculture through a change in the level of the components of PSE will have implications on output and income different from those on exports, land values and employment. These differences can be systematically related to the instruments used to support agriculture and the mix that is recorded in PSE information.(Hertel, 1989).

The changing level of support applied across the mix of policy tools will result in different direct impacts on consumption, production and income and will also affect the distribution of program cost among different groups in the economy (e.g. consumer or taxpayer). For example, since taxpayers pay for transfers that do not directly affect agricultural commodity market prices and consumer pay for price intervention transfers, a reallocation of expenditures between market price supports or direct payments will have a different impact on consumers and taxpayers. Additionally, any change in the mix of support instruments will have a different impact on the induced effects of the policies on trade, employment, input use and the environment.

Presenting the formula used to calculate the unit PSE it can be shown that the PSE can be maintained at constant levels but countries can choose a mix of policies that will be less or more trade distorting or that will have less effect on employment or income. Changing instruments from indirect programs to direct payment programs can lower the distorting effects of just maintaining some policies at constant level of total support.

$$\textbf{\textit{Unit PSE}} = \frac{Q * (P - PWnc) + DP - LV + OS - FA}{Q}$$

There is an enormous significance of analyzing the effects of the composition of support and its side effects. And it goes beyond the basic information of the indicator on the level of support given to a further multidimensional fashion that can inform about the policy choices effects in a more reliable way.

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Essay II

A Policy Evaluation Methodology

A Policy Evaluation Methodology

Abstract

A Policy Evaluation Methodology (PEM) is developed to measure the impacts on trade of domestic agricultural policies. The PEM considers the price transmission between agricultural input, production and output markets to estimate the distribution of the price and income support policies between producers and consumers. An index is generated which enables an across country and commodity comparison of the portion of the total government outlays received by the producers and the associated degreetrade distortion.

Key words: trade distortions, commodity programs

A Policy Evaluation Methodology

Introduction

More than a decade ago, the OECD Secretariat and the Economic Research Service initiated the measurement of producer and consumer subsidy equivalents (PSE/CSE), and the analysis of the trade impacts of policies through various modeling exercises (OECD, 1984; Roningen and Dixit, 1988). These modeling exercises used the PSEs/CSEs as aggregated measures of the level of public support provided to agriculture. The PSE/CSE measures assumes a $1 dollar transfer to producers for each 1 dollar of public expenditure. However, several recent studies indicate that policy instruments such as market price support, direct payments, and input subsidies have very different effects on farm income and trade distortion (OECD,1996; Liapis, 1990). This suggests that accuratelly measure the value of public transfer to agricultural producers requires an accounting of the differential impacts of policies.

A new analytical approach is proposed to address this issue. The methodology requires the separation of PSEs/CSEs into sub-categories of policies and the evaluation of their individual and aggregated impact in the input and commodity markets using a simulation instrument. The simulation model provides for the presention of impacts of the changes in specific policies on several economic indicators which are normalized as indexes to permit comparison of the policies on an equal basis. These indexes are presented in a matrix form to allow comparison among policies and across commodities.

The main idea of such methodology is to create a more accurate aggregate measure of support for U.S. agriculture. The main goal will be to construct a relatively simple multimarket partial equilibrium model that enables policy makers to better understand and compare the multidimensional economic effects of a diverse set of policy instruments. This model could be replicated for various others countries, to create a simple and common analytical framework that will improve upon the information contained in the PSEs/CSEs facilitating future trade negotiations in the agricultural sector. This is important in the post-Uruguay Round policy climate where many nations are moving away from traditional market price support instruments, to income support and other increasingly complex mixes of policy instruments for which aggregate measures of support represented solely as output price wedges are less useful.

This paper describes the theoretical grounds and modeling approach used to develop a more accurate measure of aggregate support for U.S. agricultural producers. The paper also provides estimates of the effects of disaggregating the PSE components and include them in an individual policy analysis. The paper begins with a brief description of the simulation framework, followed by a description of the policy regime in place in 1995. The findings of our analysis are presented next, focusing on the policy impacts on farm income and trade. The paper concludes by pointing out the limitations of the analysis and areas for future work.

Structure[10]

The Policy Evaluation methodology (PEM) enables an assessment of the impacts of changes in the mix and levels of support in agricultural policies on a range of

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[10] Debrew (1996) presented the grounds for this methodology in a paper submitted to the meeting of the OECD working parties held in France on June 1996. The working parties agreed that the Secretariat would proceed with the proposed extension of the analysis to OECD-wide assessments of trade and welfare effects of farm policy, with first results to be reported in January 1997.

policy relevant indicators. The methodology traces the impacts of public support policies through the market (both direct and indirect) to determine the share of the support that is actually transmitted into different variables as distortion. The PEM complements the information derived from the PSE and CSE and can be used with these measures to form relative indexes of distortion through time and across countries and commodities.

The methodology realies on the information embedded in the PSEs/CSEs data base. This information is used in a positive model based upon the theory of vertical and horizontal linkages between markets and the concept that government support in a market is inefficient. That is, the non-target groups (producers or consumers) of any policy will receive some benefits from the government support due to the market supply and demand elasticities.

The methodology is designed to allow for policies having the same direct effect on specific economic variables to have different induced effects on other variables such as trade, employment and domestic welfare. The PEM uses a two stage estimation procedure. The first stage estimates the direct impacts of changes in the various components of support described in the PSE on production, consumption, income and any production indicators. The second stage assembles these results into a matrix with rows containing the different components of the PSE (ways of supporting or taxing farmers) and columns denoting the effects of the various support components on several aggregate welfare variables.

In the past, simple partial equilibrium models have been preferred in the economic literature for measuring the inputs of agricultural policies on agricultural markets. Because alternative policies are typically proposals that have not been tried, it is often necessary to make conjectures about counter factual situations on little direct evidence. Braverman (1987) and Gardner (1987) considered that the best way to make conjectures is with a simulation model of some kind.[11]

Therefore, a simulation model is used to estimate the coefficients that capture the impacts of different policies in the input and commodity markets. These coefficients will enable the construction of different indexes reflecting overall effects of the levels of support of the government in the sector

Simulation Model Development

Questions can be raised about the type of simulation model that is most helpful in analyzing interventions in the agricultural markets. Braverman has done extensive research on this area and indicates that among the different approaches, single market, supply-demand analysis, multi market supply-demand models and mathematical programming and computable general equilibrium model are the most famous and widely used. The use of the supply-demand model allows for an extention of the empirical work modeling different types of intervention and the resulting gains and losses, but it has limitations when dealing with interventions in one or more closely related product markets. Larger multi market models incorporate nonagricultural sectors which is helpful, but sometimes their complexity makes the incorporation of institutional detail much more difficult. For the most part, supply -demand models are the preferred model

[11]This forces the analyst to be systematic about inferences and conjectures made, explicit about facts used and assumptions maintained, and lead to the quantitative statement of the results.

of the agricultural sector for this kind of analysis.

For example, a single -output two input model developed by Hicks (1932) to investigate policy and wage issues in labor economics was applied by Floyd (1965) in the agricultural sector to study the effects of farm price support on the returns to land and labor. This model analyzed the agricultural sector as a single sector and did not include other market inputs. Muth (1965) used a comparative static model assuming linearly homogenous production, competitive markets and constant input supply and output demand elasticities to derive the demand for productive factors and the industry supply curve. His model considered one market for output and no trade, very similar to the model used by Floyd but did not cover the issue of government support and its impacts on production.

Gardner (1987) adopted Muth's model to empirically explain the effects on production and three inputs markets of exogenously changing agricultural policies. This model allows the incorporation of government changes in percentage changes, but did not included the export sector and did not allowed for the incorporation of measures of support as explanatory variables.

Retaking Muth's work, Hertel (1988) developed a partial equilibrium single country model with limited input market interaction to study the significance of agricultural technology and factor mobility in determining the impact of changing support policies. In his work a measure of support, very similar to the PSE was developed, but no attention was given to any specific policy. The analysis concluded that the impact on output, export, employment, and land values of across the-board-reductions in farm support will vary systematically across countries, depending on a country's reliance on export, output and input subsidies. Gunter, Jeong and White (1996) extended Hertel's work to allow simultaneous changes in policies or shifts in input supplies in many countries at the same time, but again a attention was given to specific policies. The model quantified the magnitude and distribution of costs associated with the changes in input regulation across countries.

However, none of these simulation models accounted for the effects of individual policies and the mix of the policies on the input market or the relationship between the input and commodity markets. In addition, information to create the price wedges was vague and not uniform across policies. This is a role that PSE should take in the new modeling techniques.

To develop the PEM estimation technique, a positive model of the agricultural sector was developed. The modeling approach retakes the partial equilibrium approach followed in the economic literature to represent the interaction of demand and supply for three aggregated commodities: Feed Grains, Food Grains and Oilseeds. This modeling approach allows for the analysis of effect of supporting a single relatively small sector of the economy, capturing the impacts within the sector.

The modeling approach included in the PEM methodology can be identify as an intermediate run static multiple-product, deterministic, reduced form, multiple input model that represents the crop sector in a given year. The rest of the world is represented through exports demand equations. The factor markets are explicitly modeled and are endogenously linked with aggregate supply and demand of the aggregated commodities.

Factor markets are assumed to be traded domestically and competitively.

Inputs are assumed to be freely mobile, with their prices determined by their opportunity cost in non-farm activities. This serves to highlight the importance which factor mobility plays in determining the ultimate impact of farm policy. Within the context of the present analysis, the PEM is constructed to capture the effects of changing the different components of the PSE on the input, output and trade markets. Therefore, in terms of the model structure, the relationship among inputs and between input and output markets are important. These elements in the PEM model rely strongly on the single country models of Muth, (1965) , Gardner (1985), and Hertel, (1988).

The support policies are modeled in the form of either ad-valorem subsidy equivalents or quantitative restrictions. This approach facilitates qualitative analysis and permits a close relationship to be drawn between policy instruments and support levels as measured by the PSE in the model.

In the simulation model, the impacts of support policies are analyzed by introducing them into an undistorted economic environment (predetermine equilibrium level). The basic model can be modified to simulate the effects of policies and programs in two generic ways: either as quantitative restrictions or as changes in the support rates in the various markets. Quantitative restrictions on the commodity supplied are appropriate for supply managed commodities while programs such as the CRP may be represented as a shift in the factor supply functions. The treatment of changes in the support rate parallels the analysis of taxes in Layrad and Walters (1979) and Harberger (1979), which they described as creating wedges between selling and buying prices. Generally, programs that reduce the cost of inputs create a wedge between buyer and seller price in the relevant input market. Commodity programs are represented as wedges between the prices received by farmers and those paid by foreign and/or domestic buyers. The effects of policy changes in the policies will be assumed to be equal and opposite in sign to those resulting from the inverse changes of those particular policies. This approach, following Harberger's (1978) classic analysis of the corporate income tax, was particularly useful in obtaining qualitative results based on an equal cost comparison of different methods of supporting agriculture.

Theoretical Base for the Simulation component of PEM

Following previous work of the OECD working group, an easy to replicate approach was chosen for the first stages of the model design. The Cobb Douglas functional form was selected as a starting point for the project. However, because of the limitation of this functional form, a Constant Elasticity of Substitution (CES) production function was chosen. Under these circumstances, two identical simulation models with different technology were designed to run parallel experiments. The simulation components are referred as Cobb Douglas Framework and CES framework, respectively.

The Cobb Douglas framework

The first modeling framework begins with the assumed profit function for 3 aggregated commodities and is described algebraically in equation (1).

$$(1)\quad \pi = Pq_i\ Qs_i - \sum_i pd_{ij}^{inp} * X_{ij}^{d}$$

Where π represent profits, Pq_i is the price the producer receives for commodity i, Qs_i is the quantity produced of commodity i, pd_{ij}^{inp} is the price of input j used in the production of output i and X_{ij}^{d}, is the quantity of input j used in the production of output.

The production function is assumed to be of the form[12]:

$$\textbf{(14)}\quad Qs_i = \gamma_i \, \Pi_{j=7}^{n=3} \, (X_{ij}^{d})^{a_i}$$

Where the quantity of commodity i (Qs_i) is a function of the quantity of input j (X_{ij}^{d}) required to produced commodity i and a_i is the elasticity of production of input j in commodity i; and γ, the constant for the production function of commodity i.

Deriving Factor Demands

From the first order condition of the profit function we can derive the level in which input price price equals its value of marginal product.

$$\textbf{(15)}\quad \frac{\partial \pi_i}{\partial X_{ij}^{d}} = pq_i \; a_{ij} \; \frac{Qs_i}{X_{ij}^{d}} - pd_{ij}^{inp} = 0$$

The level of input needed to maximize profits can also be derived from the first order condition of the profit function as;

$$\textbf{(16)}\quad X_{ij}^{d} = a_{ij} \left(\frac{pd_{ij}^{inp}}{pq_i}\right)^{-1} Qs_i$$

This factor demand is related to the elasticity of production and prices. The

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12 When the parameter of substitution of the CES equals zero, the value of elasticity is one, and the CES function reduces to a neoclassical Cobb Douglas form. This is the most widely applied functional form in partial equilibrium. This functional form captures a smooth substitution among primary factors when its elasticity of substitution is one. The relative factor shares are constant, the capital-labor ratio and the wage-rental ratio rise by the same proportions; thus capital rises exactly the same as labor's share.

assumption of a Cobb Douglas production function simplifies the analysis but imposes restrictions that can affect the conclusions related to changes in policies affecting the input markets. When using an elasticity of substitution of one, the Cobb Douglas production function is representing complementary factors, no substitution among inputs is possible and competitive or independent factors are forced to be complements.

The input demand functions estimated from a Cobb-Douglas production function contain certain "built-in" characteristics . These characteristics can alter the effects of the analysis and they have been described by Chand and Kaul, (1986) as follows:

1. Own price elasticity of factor demand is always elastic.
2. All variable factors are complementary to each other .
3. The effects of a change in any fixed factor is symmetric on all the variable inputs inputs.
4. Cross price elasticity of all factors with respect to the price of any other factor is the same in magnitude and sign.
5. Price elasticity of factor demand with respect to output is always more than one.

The Constant Elasticity of Substitution framework

Other forms of production functions are less restrictive than the Cobb Douglas. CES allows for a constant elasticity of substitution for each industry, but different elasticity of substitution for different industries. The factor shares of output may also vary across industries. The function is linearly homogenous. The total output and total cost of the factors are the same if each of the factors is paid its marginal product. Since the CES is homogenous and quasi-additive, its factor shares are independent of total output and its elasticity of substitution is the same for all input pairs. In this functional form the elasticity of substitution is different from 1, the substitution parameter is different from zero. The larger the elasticity of substitution, the flatter the isoquant, and the greater the substitutability. However when use in modeling production processes with more than two factors, CES suffers the severe limitation that substitution elasticity between any pair of factors is equal. Perhaps less serious, CES assumes substitution elasticity remains constant as factors vary. The CES production function is defined as;

$$\textbf{(17)} \qquad Qs_i = \gamma_i[\Sigma_j \ \delta_{ij} \ X_{ij}^{\ \rho_i}]^{-1/\rho_i} \quad , \quad \sigma_i = \frac{1}{1+\rho}$$

For *i= Food grains, 2:feed grains, 3: oilseeds*; and *j=1:purchased inputs, 2:fertilizer, 3:chemicals, 4:hired labor, 5:irrigation, 6:energy, 7:non purchased inputs* , where *Qsi* is the output of commodity *i*, X_{ij} is the quantity of input *j* used in the production of commodity *i* indexed over *j* , γ is the efficiency parameter ($\gamma_i > 0$), δ is the distribution parameter of input *j* from commodity *i* , ρ_i is the substitution parameter in commodity *i* $(-1<\rho_i)$ and σ is the elasticity of substitution of the inputs in the production of commodity *i*.

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The demand for inputs can be derived both from the profit maximization principle or the cost-minimization principle. The profit function is written as:

$$\textbf{(18)}\quad MAX\ \Pi_i = Pq_i \quad \gamma_i[\Sigma_j\ \delta_{ij}\ X_{ij}^{d\ -\rho_i}]^{-1/\rho_i} - \Sigma Pd_{ij}^{inp}\ X_{ij}^{d}$$

where Π_i is the total profit from the production of output i, $Pd^{inp}{}_{ij}$ the price the producer pays for input j ion the production of commodity i, Pq_i is the price producers receive for commodity i. This price will be inclusive of any government subsidies or taxes. The total demand for factor j in the grain sector ($X^d{}_j$) equals the aggregation of the demand of input j use in food, feed and oilseed production.

The marginal revenue product of factor j is itself the demand for that particular factor under profit maximization because the marginal revenue product is derived from the first order condition for maximum profit:

$$\textbf{(19)}\qquad \frac{\partial \Pi}{\partial X_{ij}^{d}} = Pq_i \frac{\delta_{ij}}{\gamma_i^{\rho}}\ Qs_i^{\,1+\rho}\ X_{ij}^{d\ \ -(1+\rho} - Pd_{ij}^{inp} = 0$$

Assuming the second-order condition for profit maximization hold, and after some mathematical transformation, we obtain the derived demand for factor j. Again, the elasticity of substitution has an important role. The elasticity is the slope associated with the factor prices.

$$\textbf{(20)}\quad X_{ij}^{d} = Qs_i[(\frac{\delta_i}{\gamma_i})^{\sigma_i}\ (\frac{Pd_{ij}^{inp}}{Pq_i})^{-1/1+\rho_i}]$$

The elasticity of substitution (σ) is defined as function of the prices of inputs and quantities:

$$\textbf{(21)} \quad \sigma = \frac{d(X_j^{inp}/X_{j'}^{inp})}{d(Pd_j^{inp}/Pd_{j'}^{inp})} \frac{(Pd_j^{inp}/Pd_{j'}^{inp})}{(X_j^{inp}/X_{j'}^{inp})}$$

which, for the CES function, can be simplified using the marginal rate of technical substitution equation to:

$$\textbf{(22)} \quad \sigma = \frac{1}{1 + \rho}$$

In the PEM modeling component, the elasticity of substitution (σ) is exogenously defined and the substitution parameter (ρ) is derived from the value of the elasticity using equation 23. The elasticity of substitution is different from unity as long as the substitution parameter is different from zero. Given the possible values of the substitution parameter $\rho(-1 < \rho < \infty)$, the elasticity of substitution can vary within a broad range: $0 < \sigma < \infty$. The larger the value of sigma, the flatter the isoquant, and the greater is the substitutability.

PEM Simulation Model Specification

The simulation method used in PEM can be broadly divided into six components including production equations, commodity demand equations, factor demand equations, factor supply equations, market clearing equations, and price or policy equations. Each component is constrained to the theoretical assumptions noted earlier depending upon the production framework. The price equations are used as the instruments for introducing shocks to the model and linking each of the components.

Production equations

The production equation is a function of seven inputs. One is an aggregation of non-purchased inputs that represents human and physical capital employed in production (land and own farm labor) and six purchased inputs (fertilizer, chemicals, hired labor, irrigation, energy and other purchased factors).

In the Cobb Douglas framework, the production elasticity for each input is equal to the share of each input to total cash receipts. The sum of all shares is equal to one. The production equations are represented by a production function of the following form:

$$\textbf{(22)}\quad Qs_i = \gamma_i\, \Pi_{j=7}^{n=3}\, (X_{ij}^{d})^{a_i}, \qquad \Sigma_{i=7}\, a_i = 1$$

For i= food, feed and oilseeds; and j= chemicals, fertilizer, hired labor, irrigation, energy, other purchased inputs and non purchased inputs. The quantity of commodity i (Qs_i) is a function of X_i^d which is the quantity of input j required to produced commodity i; a_i , the elasticity of production of input j in commodity i; and γ, the constant for the production function of commodity i.

In the CES framework production of each of the three outputs (food grains, feed grains, and oilseeds) is also a function of the same seven inputs: irrigation, fertilizer, chemicals, energy, hired labor, other purchased inputs and non-purchased inputs. But factor shares are independent of output and are derived form the base year equilibrium condition. The production function is algebraically described as

$$(23) \qquad Qs_i = \gamma_i[\Sigma_j \, \delta_{ij} \, X_{ij}^{-\rho_i}]^{-1/\rho_i} \quad ,$$

i= Food grains, 2:feed grains, 3: oilseeds
j=1:purchased inputs, 2:fertilizer, 3:chemicals, 4:hired labor, 5:irrigation, 6:energy, 7:non purchased inputs

Where Qs_i, is output of commodity *i*, X_{ij} is the quantity of input *j* used in the production of commodity *i* indexed over *j*, γ_i is the efficiency parameter ($\gamma_i > 0$), δ_{ij} is the distribution parameter of input *j* from commodity *i*, ρ_i is the substitution parameter in commodity *i* $(-1<\rho_i)$.

Commodity demand equations

In both frameworks, demand for each commodity is assumed to be a multiplicative function of the consumer price of all commodities, and is represented by constant elasticity functions. Commodities are linked in these equations through cross price elasticities of demand. Therefore, substitution among commodities is allowed for consumers. Each demand equation contains a set of demand shifters, such as the level and distribution of disposable income, representing all exogenous variables affecting demand but excluded from the analysis. The value of the demand shifters is embodied in the base year, and since the policies examined are not expected to affect the value of these shifters, only the impact of changes in prices are modeled. Therefore, demand is estimated as,

$$(25) \quad Qd_i = \mu_i(\Pi_{i=3} \, Pc_i^{\lambda_i})$$

Where, Qd_i is quantity demanded of commodity i, μ_i is the demand constant for commodity i, Pc_i is the price consumers pay for commodity i and λ_i is the own and cross price elasticities of the i^{th} commodity.

Factor Demand equations

The factor demand equations are represented by the input demand equations derived directly from the first order condition for profit maximization. In the Cobb Douglas framework, the equations are a function of the quantity of inputs, the factor share of the input and output prices as follows:

$$\textbf{(25)}\quad X_{ij}^{d} = a_{ij}\,\left(\frac{pd_{ij}^{inp}}{pq_i}\right)^{-1} Qs_i$$

In the CES framework, factor demand equations are also derived from the marginal revenue product *(MRP)* equation for factor *(j)* used in the production of commodity *(i)* under profit maximization assumptions. The derived factor demand equations are function of the output price, the factor price, the elasticity of substitution and the share parameters of the production function described by:

$$\textbf{(27)}\quad X_{ij}^{d} = Qs_i[(\frac{\delta_i}{\gamma_i})^{\sigma_i}\,(\frac{Pd_{ij}^{inp}}{Pq_i})^{-1/1+\rho_i}]$$

Where Pd^{inp} the price the producer pays for input j to produce commodity i, Pq_i is the price producers receive for commodity I.

There are twenty one of these equations in each simulation framework, which have the same structure for all seven inputs and for all three commodities. Total demand for factor j in the food and feed grain and oilseeds sector (X^d_j) equals the aggregation of the demand of input j use in food, feed and oilseed production.

$$\textbf{(28)}\quad X_j^d = \sum_{ij} X_{ij}^d$$

For i= food, feed and oilseeds; and j= chemicals, fertilizer, hired labor, irrigation, energy, other purchased inputs and non purchased inputs.

Factor Supply equations

The supply of inputs are represented by equations that are a function of the market price of the inputs exclusive of subsidies. There is only one supply function for each of the six purchased inputs. The market price of an input is the same across commodities. These equations are based on the constant elasticity functional form:

$$\textbf{(29)}\quad X_j^S = \varsigma_j \,(Ps_j^{inp})^{\zeta_j}$$

Where X^s_{ij} is the total quantity of factor j supplied to the producers, ς_j is the constant of factor j , Ps^{inp} is the market price of factor j across the sector and ζ is the supply elasticity of factor j in the sector. The total quantity of factor j supplied X^s_j in the grain sector equals the quantity demanded of the factor in each commodity.

$$\textbf{(30)}\quad X_j^s = \sum X_i^d$$

In contrast, there is a separate supply function for the non purchased inputs (farmer owned) in each commodity market,

$$(31)\quad X_{ij}^{S} = \varsigma_{ij}\,(Ps_{ij}^{inp})^{\zeta_j}$$

Where X^{s}_{ij} is the total quantity of factor j supplied to the producers of the i^{th} commodities , ς_j is the constant of factor j , Ps^{inp} is the market price of factor j across the sector and ζ is the supply elasticity of factor j in the sector.

Export quantity equations

The quantity of exports *(Qx_i)* is derived in the model as the difference between the quantity produced and domestic quantity consumed of commodity *i*. Gardner indicates that similar static models assume that the absolute magnitude of stocks will remain constant, therefore, stocks are not modeled to facilitate interpretation of the policy shocks.

$$(32)\quad Qx_i = Qs_i - Qd_i$$

Price and policy linkage equations

The policy structure of the model is embedded in equations linking domestic *(output)* price to world price, and output price to factor price. As stated before, the support policies are introduced into an undistorted environment representing the equilibrium in the base year They are modeled in the form of ad-valorem subsidy equivalents that are represented by wedges in the price equations.

Because the focus of this analysis is the effect of agricultural policies on income and trade, only three of the five categories of agricultural policies considered in the PSE calculations are included in the model: market price intervention support *(mps)*, income support policies *(incPay)* , and input reduction cost subsidies *(sub)*.

World Price

World price Pw_i for commodity i is a function of U.S. exports of the i^{th} commodity. The equation is represented by a constant elasticity function:

$$\textbf{(33)}\quad Pw_i = \phi_i \, (Qx_i)^{\xi_i}$$

where Qx_i is the quantity of commodity i exported which is endogenously estimated in the model and ξ_i is the export price flexibility of commodity i. The price flexibility of export demand summarizes in one parameter the reactions of both exporting and importing countries to an export quantity change by the United States. Other factors which affect world prices are represented in the constant. Export flexibilities were obtained from the AGLINK model of the OECD and are described in the model parameter section of this paper.

Producers price

Producers price (Pq_i) is a function of world price and the per unit *mps* rate, a price wedge that represents any price intervention policy in the United States. Farmer decisions are affected by market returns and direct subsidies.

$$\textbf{(34)}\quad Pq_i = Pw_i + mps$$

If the world price is lower than the farm gate price (positive mps), then producers are effectively being subsidized. A negative transfer can occur when policies keep internal prices below world prices (e.g. export tax).

Consumer price

Consumer price (Pc_i) is derived from the world price for commodity *i*. This price also contains several wedges. A wedge representing price intervention policies, consumer subsidies, other subsidies and loan rate programs that may affect consumer price. A positive *(mps)* indicates an implicit tax where consumers pay higher prices, either because of a price floor or the existence of export subsidies. When the loan rate is above the U.S. market price, consumers pay a higher price. When loan rate is below the market price, consumers pay the market price and government does not provide outlays for the loan rate program.

In addition, the consumer price also includes direct subsidies *(Csub)* derived from demand enhancement programs[13]. Consumer subsidies are assumed to reduce the price of consumption.

$$\textbf{(35)} \quad Pc_i = Pw_i + mps - Csub +/- otherS$$

Factor price

Six prices characterized the factor price block; three for the factors that are purchased and three for those factors not purchased. The purchased factor price block includes: the factor market price, the factor supply price and the subsidy price provided to producers. The last one includes a price wedge that represents the support government gives to producers through input price reduction policies. The market price

[13] The Emergency Food Assistance Program (TEFAP), Child Nutrition Programs (CNP), Commodity Supplemental Food Program (CSFP), Food Distribution Program for Indian Reservation (FDPIR), Nutrition Program for the Elderly (NPE) and Summer Camps and Charitable Institutions Program (CI), Food Stamp Program (FSP) all subsidized consumers.

of the input in the free market is not affected directly by subsidies and is equivalent to the factor supply price:

$$\textbf{(36)}\quad Ps_j^{inp} = Pm_j^{inp}$$

The producers' price of the input, is the market price less the price wedge representing the subsidy. Therefore, the program creates a wedge between the market price and the consumption price for the factor:

$$\textbf{(37)}\quad Pd_j^{inp} = Pm_j - Subs_j^{inp}$$

In the non-purchased factor block the prices are: the shadow price of the non-purchased factor, the factor supply price, and producers' cost for using the non-purchased input for each commodity. The shadow price of the non-purchased input is not affected directly by subsidies to support income (e.g. deficiency payments) and is equivalent to the non-purchased factor supply price:

$$\textbf{(38)}\quad Ps_{ij}^{inp-non\ purch} = Shadow\ Price_{ij}^{inp-non\ purch}$$

The producers' input price, is the shadow price less the price wedge that represents the subsidy provided through income support policies (e.g. deficiency payment). Income support subsidies are capitalized in the bundle of non purchased inputs (land and farm labor) and they are supposed to reduce the shadow price of these inputs. Therefore, income support policies create a wedge between the market price and the price of consuming the factor.

$$\textbf{(39)}\quad Pd_{ij}^{inp-non\ purch} = Shadow\ price_{ij}^{inp-non\ purch} - Subs_j^{inp-non\ purch}$$

The difference between equations **(25)-(26)** and **(27)-(28)** is that there is a single supply and demand price for the j^{th} purchased input and a different supply and demand factor price for non purchased inputs for each commodity. This means that changes in market conditions or rates can affect different groups of farmers differently.

Market clearing equations

The model has eight markets for each commodity: the market for the commodity itself that includes the estimation of the level of exports and a separate market for each of the seven factors of production. These markets are all in equilibrium at the beginning of the simulation through market clearing conditions used to enforce the equality of supply and demand in both commodity and factor markets:

$$\textbf{(40)} \quad 0 = Qs_i - Qd_i - Qx_i$$

$$\textbf{(41)} \quad 0 = (\textstyle\sum_i X_{ij}^{dnonpurchased}) - X_{ij}^{snonpruchased}$$

The model represents competition across the six purchased inputs across commodities. A single market equation is therefore used for each.

$$\textbf{(42)} \quad 0 = (\textstyle\sum_i X_{ij}^{d}) - X_j^{s}$$

Matrix Information

The matrix approach permits the comparisons of specific policies and (e.g.

market price support, input subsidies, direct payments, indirect measures) and their quantitative impacts on, trade, farm employment or transfer efficiency or other economic meaures. Even when the mix of agricultural policies differ among commodities with constant levels of total support, the PEM allows for an approximation of the domestic and international impacts of the change in the policy mix. The PSE measure does not allow this flexibility. The matrix contains rows denoting the different support policies and columns containing the indicators that describe the effects of the various support measures.

Each entry in the table can be interpreted as an impact multiplier of effectiveness of the support component. The number of rows in a policy evaluation matrix depends on the number of policy instruments used to support farmers. The number of columns depends on the number of specific effects that are to be measured for each policy instrument.

The interpretation of results forces the policy maker and the policy analyst to acknowledge the trade-off between the direct policy impact and the various indirect impacts. It is possible to include more than one indicator for measuring impacts within a particular component of support.

Policy Regime and PSE Data in the Base Year

The U.S. PEM simulation component is calibrated to represent the market conditions for 1995, the last year of the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA 90). United States policy goals for FACTA 90 included price and income protection, income enhancement for farmers, as well as assurance of adequate supplies of food and fibers for consumers. Supply controls, direct payments, and nonrecourse commodity loans were important components of the price and income programs. The FACTA 90 froze target prices, while commodity loan rates were based on 85 percent of a five year moving average of market prices. Greater flexibility was introduced that allowed producers to plant up to 25 percent of their crop acreage base to crops other than those for which the base was established.[14]

The PSE/CSE data base for 1995 includes this information in the form of the monetary transfers to the sector. The PSEs/CSEs indicate that total transfers from the government was $2.16 billion (Table 1).

Table 1. U.S. Levels of Support 1995

		Food Grains	Feed Grains	Oilseeds
Market price support	US$1000			
Trade measures	US$ 1000	172,497	0.00	0.00
Direct payments				
Deficiency payments	US$1000	900,336	82,000	0
Area and headage payments	US$1000	0	0	0
Disaster	US$1000	0	0	0
Diversion	US$1000	0	0	0
Storage	US$1000	0	3,663	0
Loan rate	US$1000	4,960	28,461	16,312
Loan deficiency payments	US$1000	0	0	0
Marketing loans	US$1000	0	0	0
PFC payments	US$1000	0	0	0
Reduction of input costs				
Capital grants	US$1000	0	0.00	0.00
Interest concessions	US$1000	89,089	232,148	111,731
Fertilizer	US$1000	0	0	0
Transport	US$1000	0	0	0
Insurance	US$1000	134,248	180,705	68,267
Irrigation	US$1000	26,222	62,283	39,192
Consumer Subsidies				
Consumption subsidies	US$1000	49,451	18,222	1,586

Source: OECD, 1997

[14] Under the 1990 FACTA, farmers were only required to plant 15% of their crop base to crops not receiving a deficiency payment (normal flex acreage), however they could also plant an additional 10% of their crop base to crops not receiving a deficiency payment (optional flex acreage).

Nearly half (46%) of the transfer from consumers and taxpayers to producers in 1995 was through income support policies, in the form of deficiency payments. Market price support accounted for only 8% of the total monetary transfer and was given to food grain producers. Amongst the different "reduction of input costs" policies, interest concessions represented 20% of gross PSE, while insurance represented 18%. Finally, irrigation reached 6% of the total amount transferred. From these transfers, food grains producers captured 62% of the government subsidies while feed grain producers and oilseeds producers received 27% and 11% of total transfers respectively.

Model Parameters

The modeling component of the PEM simulates the economic interaction of demand and supply for three aggregate commodities (food grains, feed grains and oilseeds) and seven factors of production: irrigation, fertilizer, chemicals, energy, hired labor, other purchased inputs and non- purchased inputs. Commodity production is estimated using these factors with a Cobb Douglas technology and a CES production function. Mathematically, the Cobb Douglas functional form and the CES are homogenous and weakly separable, and their elasticity of substitution is a constant that plays an important role in output.

Factor shares of the seven inputs used in the production of the three commodities in both simulation frameworks are presented in Table 2. Data from the Farm Costs and Returns Survey were used to estimate the factor shares and factor earnings for the three groups of crops analyzed in the Cobb Douglas framework. The Farm Cost and Return Survey (FCS) is a multi frame stratified survey. It is conducted annually and provides historical estimates of costs, reflecting actual levels of input use, production practices, yields, and prices as measured by surveys of producers and suppliers. The structure of the accounts separates cash expenditures (when factor of production are purchased) and non cash expenditures (when factor are owned). ERS combines in a single account the production cost and returns of farm operators and landlords. If a landlord pays a share of farmer's cost as part of a rental agreement, then those costs are added to the operator's cost and subtracted from the rental value of the land. Total economic costs, including returns to all factors of production, are equal to the gross value of production.

By assumption, the Cobb Douglas function is homogenous of degree one or linearly homogenous. This implies that if all the factors of production are increased in a given proportion, output increases in exactly the same proportion. From Euler's theorem, it is assumed that if each input is paid its marginal product, the total product is exhausted. Each parameter directly indicates the share of output paid to the respective input.

Therefore, factor shares are not independent of output. Since factor shares for the base year are calculated directly from the Farm Cost and Return Survey (FCS). Equation **(32)** is used to derived factor share of each input.

$$\textbf{(43)} \quad a_i = \frac{Pd_{ij}^{inp} * X_i}{P_i * Qs_i}$$

Where Pd_{ij}^{inp} is the price of the input, X_i is the quantity used of the input, P_i is the price of the commodity and Q_s is the quantity supplied of the commodity.

Table 2. Relative Factor Shares. Cobb Douglass Framework

Factors	wheat	c. grains	oilseeds
Other Purchased inputs	0.31	0.32	0.37
Irrigation	0.01	0.06	0.07
Fertilizer	0.16	0.17	0.04
Chemicals	0.04	0.08	0.11
Energy	0.06	0.06	0.03
Hired Labor	0.03	0.02	0.03
Non Purchased inputs	0.38	0.29	0.34

In the CES framework, the factor shares are independent of output as a result of the homothetic property. Rather than focus on the factor shares, we focus on the derivation of the distribution parameter of each input. The distribution parameter (δ_{ij}) is derived for each commodity using the factor shares data for the base year as calculated for the Cobb Douglas framework as follows;

$$\textbf{(44)} \quad FS^{inp} = \left(\frac{\delta_{ij}}{\gamma_{ij}^{\rho}}\right)^{\sigma}\left(\frac{P_i}{Pd_{ij}^{inp}}\right)^{1-\sigma}$$

In the CES factor shares are a function not only of the constants γ, δ and σ but also of the factor prices. (Table 3).

Table 3. Relative Factor Shares. Cobb Douglass Framework

	Food	Grains	oilseeds
Other Purchased inputs*	0.338	0.390	0.431
Irrigation	0.002	0.00053	0.02612
Fertilizer	0.160	0.179	0.046
Chemicals	0.044	0.084	0.117
Energy	0.064	0.057	0.036
Hired Labor	0.030	0.025	0.028
Non Purchased inputs	0.394	0.298	0.357

*includes : seed, custom operation, repairs and other inputs

Price elasticities of demand where obtained from AGLINK a simulation and econometrics model of the OECD. The own price elasticity of demand is higher for food grains than feed grains (table 4).

Table 4. Aggregated Demand Elasticities

On quantity demanded of:	impact of 1% of change in price of:		
	Food Grains	**Feed Grains**	**Oilseeds**
Domestic Demand - Food	-0.47	0.26	0.06
Domestic Demand - Feed	0.07	-0.25	-0.07
Domestic Demand - Oilseeds	0.05	-0.1	-0.25

Factor supply elasticities were constructed form the little information that economic theory has about it. They are not result of empirical or econometric exercises, but rather, they are based on assumptions that no factor is completely fixed. The issue of fixity in agriculture has been widely discussed by Galbraith and Black, 1938 and Johnson, 1956, indicating that in the short run, supply responses are not perfectly elastic, even though over time, labor and other resources can be withdrawn at relatively low cost to non-agricultural use (Gardner, 1987). Vasava and Chambers (1983) rejected the hypothesis that one or more factors are absolutely fixed in U.S. agriculture, even in the short run. Therefore, the model is assuming that other purchased inputs and hired labor are more mobile than fertilizer and chemicals. Non-purchased inputs, irrigation and energy are assumed to be the less mobile of the inputs. The values in table 5, represent the assumption described above.

Table 5. Input Supply Elasticities

Supply elasticity Other Purchased inputs	0.9
Supply elasticity Irrigation	0.2
Supply elasticity Fertilizer	0.4
Supply elasticity Chemicals	0.4
Supply elasticity Energy	0.2
Supply elasticity Hired Labor	0.6
Supply elasticity Non Purchased inputs	0.2

Export demand elasticities and export price flexibilities were obtained from the

OECD. Cross price export flexibilities are assumed to be zero (Table 6).

Table 6. Export Flexibilities

	Impact on world price of a 1% increase in exports		
Food G.	-0.17	0	0
Feed Grain	0	-0.19	0
Oilseed	0	0	-0.83

Calibration of the simulation Component in PEM

Some assumptions need to be incorporated in various variables and coefficients so that the model equations, which are essentially tautologies, hold for the data used in the base year calibration. This is the case for the market clearing conditions and price relationships.

The model is calibrated to represent exactly the equilibrium for the 1995 base year for all the variables, parameters and constants (Table 7). The model variables include quantities and prices for crop production, demand, exports and the supply and demand for the inputs.

Table 7. Base year Variables

Calibrated Variable	1995	FOOD	FEED	OILSEEDS
Farm gate Price	$/t	167.18	127.55	248.75
World Price	$/t	159.78	127.55	248.75
Domestic Demand Price	$/t	168.26	127.42	248.71
Producer Price	$/t	170.09	127.55	248.76
Farm sales	$000	10,105,220	23,892,175	14,738,528
Consumer Sales	$000	5,220,439	20,372,074	10,031,392
Export sales	$000	4,745,508	3,499,200	4,705,150
Quantity of inputs				
Other Purchased inputs	units	3,283,694.02	8,969,750.28	6,060,776.13
Irrigation	units	8,513.26	33,391.80	390,488.72
Fertilizer	units	1,567,479.02	4,144,293.60	658,233.15
Chemicals	units	439,704.50	1,954,533.46	1,673,908.48
Energy	units	635,545.59	1,329,735.75	515,256.28
Hired Labor	units	300,889.94	595,858.15	405,325.94
Non Purchased inputs	units	3,828,280.50	6,864,612.38	5,034,539.40

The variables used for the calibration of other model variables and parameters are:

- * the values of the prices and quantities of the commodities in the base year,
- * the values of the elasticity and flexibility parameters,
- * the share of the value of production going to each input in the base year,
- * the PSE data on support for the agricultural sector.

Input prices are defined as unity (table 8) and quantities are calibrated to correspond to the derived first order condition from the profit maximization function using the variables and parameter of the base year.

Table 8. Input demand and supply prices

Price Demand of Inputs			
Other Purchased inputs	1.0000	1.0000	1.0000
Irrigation	0.6984	0.3883	0.9671
Fertilizer	1.0000	1.0000	1.0000
Chemicals	1.0000	1.0000	1.0000
Energy	1.0000	1.0000	1.0000
Hired Labor	1.0000	1.0000	1.0000
Non Purchased inputs	0.9966	0.9998	1.0000
Capital	0.9946	0.9890	0.9935
Insurance	0.9877	0.9916	0.9963
Price Supply of Inputs			
Other Purchased inputs	1.0000	1.0000	1.0000
Irrigation	1.0000	1.0000	1.0000
Fertilizer	1.0000	1.0000	1.0000
Chemicals	1.0000	1.0000	1.0000
Energy	1.0000	1.0000	1.0000
Hired Labor	1.0000	1.0000	1.0000
Non Purchased inputs	1.0000	1.0000	1.0000

These prices will be inclusive of the per unit rate of the subsidies (table 9) that in the model's assumption decreases the price of the input. In this way, the quantity of each input is determined as the product of the factor share and the value of the commodity produced inclusive of support to farmers. Therefore the quantity of inputs used is equivalent to the total value of sales of the commodity. This will allow the model to hold the assumption of zero profits for profit maximization because paying the marginal value of each input will exhaust profits.

Table 9. Per unit rate of subsidy calculated at the index

Subsidy to Output	Food	Feed	Oilseed
Trade measures	2.90	0.00	0.00
Other	0.00	0.00	0.00
Income Enhancement			
Deficiency payments	0.0034	0.0002	0.0000
Area and headage payments	0.0000	0.0000	0.0000
Disaster	0.0000	0.0000	0.0000
Diversion	0.0000	0.0000	0.0000
Storage	0.0000	0.0003	0.0000
Loan rate	0.0012	0.0022	0.0040
Loan deficiency payments	0.0000	0.0000	0.0000
Marketing loans	0.0000	0.0000	0.0000
PFC payments	0.0000	0.0000	0.0000
Reduction of input costs			
Capital grants	0.0000	0.0000	0.0000
Interest concessions	0.0054	0.0110	0.0065
Fertilizer	0.0000	0.0000	0.0000
Transport	0.0000	0.0000	0.0000
Insurance	0.0123	0.0084	0.0037
Irrigation	0.3016	0.6117	0.0329
Energy	0.0000	0.0000	0.0000
Hired labor	0.0000	0.0000	0.0000
Chemicals	0.0000	0.0000	0.0000
Other Purchased Inputs	0.0000	0.0000	0.0000
General services			
Research,advisory,training	1.7935	1.3512	2.6879
Inspection	0.0530	0.0399	0.0000
Pest. and disease control	0.5094	0.3838	0.7634
Structures/infrastructures	4.4169	3.3276	6.6198
Marketing and promotion	0.1722	0.1297	0.2581
Consumer Subsidies			
Consumption subsidies	1.5938	0.1140	0.0393

The parameters required for the calibration are different depending upopn the production technology applied. For the Cobb Douglas, the elasticity of substitution which is sert to unity. For the CES the elasticity of substitution is set to 0.2. This allows a better way to perfom sensitivity analysis on the importance and sensitivity of the results respect to the substitution among inputs. The input supply elasticities (Table 5)represents the position of the industry as a price taker in this market when they are set in the range of 0.5-1, and they recognize the scarcity of the input and the operation of the capital market when set to a range of 0-0.5. The model is calibrated with all the subsidies based on the 1995 levels given in table 8. These rates represent per unit rates of the subsidy. The model solution indicates an equilibrium result of the shock introduced for 1995.

Solution of the PEM modeling approach

Equations (11) to (28) are structured and arranged recursively so they are a function of 12 variables: six prices for purchased inputs (Pm_j), three prices for non purchased inputs (Pm_{ji}) and the quantity of exports for the three commodities (Qx_i). The model can therefore be thought of as consisting of eigth equations (21) to (28) in these 12 variables with equations (11) to (28) being used to calculate the values plugged into the twelve market clearing conditions. The equations are coded in an spreadsheet following the structure described before and then simultaneously solved.

Equations (29) to (31) are all expressed in excess demand form and a set of arbitrary starting values for the twelve variables defined above are introduced. These values usually correspond to the levels of equilibrium of those variables before any shock to the model. The built in algorithm[15] in the spreadsheet is used to minimize the sum of the squared excess demand in each market, changing the values of the 12 function variables.

$$ED^2 = \Sigma_i(Ed_{i_{ouput}})^2 + \Sigma_i(Ed_{nonpurchasedinputs\ i})^2 + (Ed_{nonpurchasedinputs\ j})^2 \quad (45)$$

In equilibrium, ED^2 is equal to zero implying that the excess demand in each market is zero.

Empirical Results

Agricultural support policies in the U.S. have transferred income from taxpayers to consumers and from consumers and taxpayers to agricultural producers. Furthermore, as indicated earlier, the impact of policies on the economic welfare of producers and the farm sector is likely to be different depending on the mix used. Using the PEM, an indicative analysis can be generated, which assesses the relative efficiency or effectiveness of individual policy instruments or policies using some standard comparison.

Indicative Analysis of PSE components

In this exercise, each of the policies analyzed is modified to an equivalent of $1

15 An outline of the solve system of equations using the EXCEL software can be found in a work of MacDonald, Z (1996)

dollar change in the original monetary transfer level of 1995. This is done separately to income support policies (in the form of deficiency payments), price intervention policies (in the form of market price support) and input reduction of input cost policies. Then, the effects on income and exports are evaluated at the margin.

Our primary objective is to evaluate how changes in the policies affects farm income and the degree of trade distortion. Two indexes were developed to accomplish this task, one of income transfer efficiency and the other of trade distortion. These indices are the ratio of the total change in farm income or the total change in exports (value) divided by the total change in the producer subsidy equivalent:

$$\text{(18)} \qquad \textit{Income Transfer Efficiency Index} = \frac{\Delta \textit{ Farm Income}}{\Delta \textit{ PSE}}$$

$$\text{(19)} \qquad \textit{Export Value Index} = \frac{\Delta \textit{ Export value}}{\Delta \textit{ PSE}}$$

The income transfer efficiency index captures the portion of the transfer payments that actually increases farm income. The closer the index is to one, the greater is the efficiency of the policy. It is possible for the index to be greater than one when the policy is not only efficient but stimulates supply and demand in a way that raises prices, production or both.

The export volume index measures the impact of a commodity specific policy on the quantity of exports of that commodity. The greater the index the greater the distortion the policy causes in the quantity of commodity exports.

We concentrate on these two measures because they represent two areas of current policy focus: raising farm income as a domestic policy objective and reducing the level of trade distortion.

Income effects

In the model, farm income is defined as total revenue from the market (TR) minus the cost of inputs not supplied by the farmer plus any income support payments (deficiency payments).

$$(20)\quad FI = TR - (\Sigma Pd_{ij}^{inp} * X_{ij}) + (\ incPay)$$

The implications for farm income of a \$1 change in a monetary transfer through various components of policy are illustrated in table 10 for the Cobb Douglas frame work. Several observations are apparent from the model results.

Cobb Douglas Frame work

First, a \$1.00 change in transfer payments to the farm sector through any of the components of agricultural policy leads to a less than equivalent change in domestic farm income. The rest of the monetary transfer accrues either to other agents in domestic markets, foreign consumers/producers, or is lost as deadweight loss (inefficient use of resources). Why is this the case? Largely because changes in monetary transfers to the U.S. farm sector lead not only to changes in the level of support, but also to changes in supply and demand. These supply and demand changes differ in magnitude and direction, allowing for a different allocation of resources in the factor and commodity markets. Therefore, a policy can transfer support efficiently; but may also produce a side effect that can be a negative stimulus to another sector, depressing output price or increasing input cost.

Among the policies examined, income support policies are the most efficient means of enhancing producer incomes. A dollar of support transferred through direct payments changes farm income by an average of 84 cents. The large efficiency occurs is because this type of policy has little effect at the margin in prices or quantities produced, leaving the variable cost of production very stable.[16] However, this effect may be a result by design. We assume that income support policies did not affect production decisions. Income support policies were tied to a planted base acreage that would not increase even if producer decided to plant more. After that base, producer did not received any payment. However, farmers could plant less. Hence, income transfers did not influence output or price. If an investment or capital accumulation function is specified and the modelling approach introduces investment as an input, income transfers may have an output effect.

The least efficient means of raising producer incomes is through subsidies to purchased inputs. A dollar of monetary transfer through subsidies to purchased inputs leads to different increases depending on the commodity. A $1 dollar expenditure on reducing input costs increases income by 15 to 40. However, these results are conditioned on the parameters assumed for the production function, especially, the elasticity of substitution (which in this case is one assuming a complementary relationship among inputs) and the elasticity of supply of purchased inputs and non-

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[16] Deficiency payments can have different impacts if analyzed at the margin or average.

purchased inputs.

Across commodities the results are similar in direction , but some differences can be noted in magnitude. Price intervention policies are more effective for transfering income to food grain producers than to any other commodity producer, almost twice greater than feed grains and almost 3 times more than oilseeds.

Input subsidies seems to be more responsive in the food grain sector, where they are more income efficient than in the other two commodities. Oilseed subsidies to inputs are the most inefficient in increasing income to farmers.

Table 10 . Impact on Farm Income of a $1 change in Various Components of Support. Cobb Douglas Frame Work

	Food	Feed	Oilseeds
Income Support	$ 0.849	$ 0.826	$ 0.869
Price Intervention	$ 0.405	$ 0.245	$ 0.137
Input cost reduction			
fertilizer	$ 0.167	$ 0.028	$ 0.008
irrigation	$ 0.167	$ 0.068	$ 0.019
chemicals	$ 0.207	$ 0.024	$ 0.006
hired labor	$ 0.236	$ 0.073	$ 0.028
energy	$ 0.20 0	$ 0.029	$ 0.008

CES Framework

Applying the CES framework, we can point out similar observations (Table 11). A $1 change in transfer payments to the farm sector through any of the components of agricultural policy leads to a less than equivalent change in domestic farm income. However, it should be noted than in general, the transmission efficiency improved when the elasticities of substitution is less than one, as in the CES.

In the CES framework, income support policies are also the most efficient means of enhancing producer incomes among the policies we examined. A dollar of support transfered through income support policies increases farm income by an average of 84 cents. This result is very similar to that of the Cobb Douglas framework.

The least efficient means of raising producer income is through subsidies to purchased inputs. However, the multiplier effect is not the same in all the commodities. When the multipliers are analysed across commodities, it can be noted that two inputs (chemicals and hired labor) in the food grain commodities reduce their income efficiency. The rest of the inputs improve or stayed the same across commodities

Price intervention policies have the greater change when comparing results between frameworks. Their multiplier registered the higher increase due to the change in elasticity, increasing their transfer efficiency to farmer income an average of 23 cents in each commodity.

Table 11 . Impact on Farm Income of a $1 change in Various Components of Support. CES Frame Work

	Food-ces	Feed-ces	Oilseeds-cb
Income Support	$ 0.849	$ 0.831	$ 0.865
Price Intervention	$ 0.743	$ 0.517	$ 0.371
Input cost reduction			
fertilizer	$ 0.171	$ 0.028	$ 0.007
irrigation	$ 0.171	$ 0.197	$ 0.023
chemicals	$ 0.205	$ 0.025	$ 0.010
hired labor	$ 0.216	$ 0.035	$ 0.016
energy	$ 0.200	$ 0.029	$ 0.008

Trade Effects

The second set of experiments attempts to evaluate how the change of policies affects the value of trade (exports). The trade impact index is being used as a proxy for trade distortion. The larger the impact of the policy on trade, the greater the distorting capacity of the policy.

The effects of a one dollar change in the level of support on trade value by commodity and across policies are presented in Table 12 for the Cobb Douglas Frame work. The results suggest that, at the margin, support given through subsidies to inputs can be as distorting to trade as the support given through market price support policies, the most trade distorting farm policy. A $1.00 change in input subsidies, changes export value of food grains, feed grain and oilseeds around one to two cents per ton.

A $1 change in market price supportpolicies also increases the value of exports also by one to two cents per ton. This result is very interesting because international trade organization have always focused their regulatory attention on market price support policies as the greater way to distort trade. But little attention has been put on the effects of domestic input policies.

Income support policies in the form of deficiency payments are less distorting among the three policies analysed. Deficiency payments can be changed allowing the market price to change or legislating a new target price. If export demand increases driving the market price up deficiency payments decreases. If export demand decreases driving the market price down, deficiency payments increases. On the other hand, if a new farm act increase the target price and market loan rates remain constant, deficiency payments increase, but the effect on exports is undetermined.

Across commodities, market price support policies are more distorting for oilseeds than for any other commodity, but input cost reduction policies seems to be slightly more trade distorting when applied to food grains.

Table 12 . Estimated impact on Trade volume (tons of exports of a $1 change in various components of support. Cobb Douglas Framework

	Food	Feed	Oilseeds
Income Support	$ 0.005	$ 0.003	$ 0.003
Price Support	$ 0.015	$ 0.016	$ 0.021
Input cost reduction			
fertilizer	$ 0.008	$ 0.005	$ 0.012
irrigation	$ 0.016	$ 0.018	$ 0.015
chemicals	$ 0.013	$ 0.008	$ 0.007
hired labor	$ 0.014	$ 0.013	$ 0.015
energy	$ 0.012	$ 0.010	$ 0.014

CES framework

The impact of policies on trade using the CES framework differs little form the results using the Cobb-Douglas (Table 13). Market price support and reduction input cost policies caused similar distortions in trade. Income support policies continue to be the least distorting policies applied.

Table 13. Estimated impact on Trade volume (tons of exports of a $1 change in various components of support. CES Framework

	Food-ces	Feed-ces	Oilseeds-cb
Income Support	$ 0.005	$ 0.0032	$ 0.0032
Price Intervention	$ 0.015	$ 0.0157	$ 0.0209
Input cost reduction			
fertilizer	$ 0.008	$ 0.005	$ 0.013
irrigation	$ 0.008	$ 0.022	$ 0.016
chemicals	$ 0.013	$ 0.008	$ 0.007
hired labor	$ 0.014	$ 0.012	$ 0.015
energy	$ 0.012	$ 0.009	$ 0.014

However, subsidies to irrigation seems to increase their capacity to distort trade across the three commodities. Why is this the case? As mentioned before, these results are influenced by the parameters in the production function, the elasticity of substitution and the supply elasticity of inputs. There is a greater output reaction when the factosr of production not owned by the farmer are shocked through input subsidies than when non-purchased inputs are targeted by income payments. Purchased inputs are modelled as being more responsive to price changes in the supply side than non-purchased inputs (higher supply elasticity). The input supply elasticity combined with the magnitude of the elasticity of substitution results in greater output changes that directly affects trade.

Conclusion

The modeling component of the Policy Evaluation Methodology is a multiple-product, multiple input, partial equilibrium model that represents the interaction of demand and supply for three aggregated commodities: Feed Grains, Food Grains and Oilseeds. The PEM includes factor markets that are endogenously linked with aggregate supply and demand of the commodity groups. The model may be characterized as a static, deterministic, reduced form, supply and demand model with explicit factor markets.

The PEM is designed to allow for policies having the same direct effect on specific economic variables to have different induced effects on other variables such as trade, employment and domestic welfare. First, information from the PSE data base is disaggregated by policies and introduce into the simulation model as price wedges. This requires knowledge of the effect of each policy analyzed. The, simulation model estimates the direct and indirect impacts of changes in the various measures of support described in the PSE on production, consumption, income and any production indicators. Amatrix of the results is assembled with rows containing the different components of the PSE (ways of supporting or taxing farmers) and columns denoting the effects of the various support components on variables of interest to the policy maker.

The PEM tool can be replicated easily and due to the fact that iot is coded in a spreadsheet, it is easily converted and analyzed. The modeling approach does no require a great amount of data from the countries and relies on the PSE data for creating the prices wages that identify policies in the model. The PSE data brings uniformity to the comparison of analyzes when the methodology is used.

The empirical results for the United States indicate that the policies used to transfer support to producer are not 100% efficient and that some level of deadweight loss is possible. Across policies, income support policies are the most efficient way to transfer income to the producer and are at the same time the less trade distorting policies. Input subsidies and price intervention policies can have similar effects in the trade arena, when analyzed at the margin. This is a result to consider since input subsidies are not the target of international trade organization.

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ESSAY III

Applying the Policy Evaluation Methodology to Fair Act 1996

Applying the Policy Evaluation Methodology to Fair Act 1996

Abstract

The Policy Evaluation Methodology enables one to make a comparison of the impacts of agricultural policies on producers, consumers, taxpayers and trade. The approach separates the assumptions about input supply and input demand elasticities and which markets are directly impacted by each policy. When analysing the effect of changes of the FAIR ACT, the effects of each policy applied individually is different from the effect of implementing the mix of policies at the same time, and even more important, the increase or decrease in the amount of transfer given is not necessarily shown in the effects of that support in the commodity market or the factor markets since policies use different price linkages to transmit their effect. However, this information is left out of the PSE/CSE indicator. On the other hand, the mix of policies shows the presence of substitution and compensation effects producing income and trade distortions sometimes less severe than the application of the set of policies individually. This information is also left out of the PSE/CSE.

Key Words: legislation, FAIR Act, PSE/CSE, Policy

Applying the Policy Evaluation Methodology to Fair Act 1996

Introduction

The Producer Subsidy Equivalent only measures the total level of support provided to agriculture and major changes in policies at equal levels of support may not be differentiated through this indicator. A Policy Evaluation Methodology is used to determine the impact of various levels and types of agricultural subsidies on agricultural producers, consumers and trade. This methodology account for the vertical and horizontal price linkages between agricultural markets.The PEM uses the components of the PSE as inputs to a simulation model that identifies the impacts of government transfers on several economic variables. Of great importance is the analysis of the recent changes in the mix of policies produced by the new farm legislation.

Starting in 1996, the Federal Agriculture Improvement and Reform (FAIR) Act accelerated the trend toward greater market orientation by reducing the government's involvement in agricultural markets. The reduction in government involvement was achieved through a change in both the level of support and the mix of policy tools (type of transfer payments). The FAIR Act eliminated subsidies tied to production and instead provided payments to producers regardless of their level of production, increased planting flexibility, allowed unrestricted haying and grazing, eliminated acreage reduction programs, reduced government involvement in the management of stocks (by reducing the price support loan levels and the FOR entry levels), and eliminated multi-peril mandatory crop insurance.

Prior to the FAIR Act, federal income support policies were tied to the production of specific commodities. These support policies transfered income from taxpayer to consumers and producers in the market for that commodity. The new income support payments are tied to historic levels but have not production requirements. Thus, the new form of payments do not directly affect any specific market but may affect many agricultural and nonagricultural markets depending upon the associated expenditure patterns of the farmers. Even if the same level of support is provided with the new direct payment as was provided with the previous income support program, the market distortion that is created may vary considerably between the two policies. This kind of effect escapes the scope of the PSE/CSE.

This paper applies the Policy Evaluation methodology to measure the effects of the changes in the policies and the mix of policies in several indicator of interest. The methodology uses the information supplied by the PSEs/CSEs as inputs into a positive model that includes the vertical and horizontal linkages between agricultural input, consumption and production markets to capture the intermarket trasnfer of subsidies. That is, the non-target groups (input suppliers, producers or consumers) of any policy will receive some benefits from the government support due to the varying levels of price transmission between markets associated with market supply and demand elasticities. Two types of measurements of the impacts of agricultural support policies are possible using the PEM. First, an analysis to assess the relative efficiency or effectiveness of individual policy instruments or policies using some standard comparison. Second, an evaluation of the impacts of specific changes in policy between two points in time. This analysis is summarized using a matrix of indexes that allow for a comparison of effects among policies and across commodities.

The methodology Structure

To develop the PEM, a positive model of the agricultural sector was developed. The modeling approach retakes the partial equilibrium approach followed in the economic literature to represent the interaction of demand and supply for three aggregated commodities: Feed Grains, Food Grains and Oilseeds (Hicks, 1932, Floyd 1965, Muth, 1965, Gardner, 1987, Hertel, 1988, Gunter Jeong and White, 1996). The partial equilibrium enables measurements of the effect of supporting a single, relatively small sector of the economy, capturing the impacts within the sector.

The modeling approach can be identify as an intermediate run static multiple-product, deterministic, reduced form, multiple input, model that represents the crop sector in a given year and where the rest of the world is represented through export demand equations. The factor markets are explicitly modeled and are endogenously linked with aggregate supply and demand equations for the aggregated commodities.

Factor markets are assumed to be traded domestically and competitively. Inputs are assumed to be freely mobile, with their prices determined by their opportunity cost in non-farm activities. This serves to highlight the importance which factor mobility plays in determining the ultimate impact of farm policy. Within the context of the present analysis, the PEM is constructed to capture the effects of changing the value of different components of the PSE on the input, output and trade markets. Therefore, in terms of the model structure, the relationship among inputs and between input and output markets are important. These elements in the PEM model rely strongly on the single country models of Muth, (1965) , Gardner (1985), and Hertel, (1988).

The support policies are modeled in the form of either ad-valorem subsidy equivalents or quantitative restrictions. This approach facilitates qualitative analysis and permits a close relationship to be drawn between policy instruments in the model and support levels as measured by the PSE.

The Policy Regime in the Methodology

The basic model can be modified to simulate the effects of policies and programs in two generic ways: either as quantitative restrictions or as changes in the support rates in the various markets. Quantitative restrictions on commodity supplied are appropriate for supply managed commodities while programs such as the CRP may be represented as shifting factor supply functions. The treatment of policies and programs parallels the analysis of taxes in Layrad and Walters (1979) and Harberger (1962), described as creating wedges between selling and buying prices. Generally, programs which reduce the cost of inputs create a wedge between the buyer and seller price in the relevant input market. Commodity based programs are represented as creating wedges between the prices received by farmers and those paid by foreign and/or domestic buyers.

Producer Subsidy Equivalent Data

The PSE system is an accounting framework which records the amount of government expenditures on policies and programs and are deemed transfers from consumers to producers. One of the biggest advantages of this system is that it is readily comprehensible and may limit issues of debate to the general classification of each program and the amount of disbursements and transfers from consumers.

The PSE measures the level of support, and describes the type of policy approach the government is using. The different components of the PSE can offer data on the different policies used by the government to transfer support to producers or consumers.

Implicit in the categorization and the allocation of producer and consumer benefits is an incidence analysis. The OECD distinguishes five types of agricultural policies that can be associated with the method of transfer used to deliver their objective in the PSE. They are: market price support, direct payments, input subsidies, general services, and other indirect support measures (Shelby, 1994).

Table 1. Policies included in PSE calculations

Method of transfer	***Subsidy***
Measures that simultaneously affect producer and consumer prices	e.g. Market Price Support
Measures that transfer money directly from taxpayers to producers without raising prices to consumers	e.g. Direct Payments
Measures that lower input cost, with no distinction made between subsidies to capital and those to other inputs	e.g. Reduction to input costs
Measures that in the long term reduce cost but which are not directly received by producers.	e.g. General Services
Other indirect support, the main elements of which are subnational subsidies and tax concessions.	e.g. measures funded nationally by member states in the case of the European Union. Other Indirect Support.

In the case of market price support, income transfers occur because the domestic market price differs from the price at the border (world market price). In the OECD countries, the domestic price is usually higher than the border price creatin a transfer to producers. The total value of the transfer is measured by multiplying the relevant price difference by the domestic volume of production. How this affects the governments budget is only an issue in so far as a difference exists between domestic production and consumption. Disregarding inventory fluctuations, this difference corresponds with international trade. The budget benefits from taxes on imports and is burdened by subsidies on exports. Transfers to producers from government programs may be paid entirely, from the budget, consumers or both. The key difference between market price support and direct payments is the source of the income trasnfer. With the price support consumer directly contribute to producer surplus whereas in the case of direct payments to producers, consumers do not directly contribute to producers.

Price intervention measures the potential implications of domestic trade policies on market prices and support levels. Income support measures the amount of direct government payments received by producers of agricultural commodities (Nelson, 1995).[17]

The United States relied heavily on price intervention and income support policies in providing subsidies to producers (Table 2) prior to the enactment of FAIR Act. Major market price support policies included export subsidy programs, import quotas, guarantee prices and tariffs. The U.S. market price support policies represented between 45-50% of total support transfers toU.S. producers over the last 18 years. The cost of market price support programs averaged $11.646 billions per year for the period 1979-1996, or 10% of the gross aggregated valued of agricultural production. The market price support programs for dairy and sugar, represented the largest share of expenditures on these programs. Guaranteed minimum prices were provided for

[17]Trade policies often increased (or decreased) the level of domestic market prices relative to world market prices. Price intervention is based on the difference between the relative world price and the domestic price. (OECD, 1997)

sugarcane and sugar beets, and by government purchase prices for dairy products.

Direct payments as defined by the OECD accounted for a steady 20% of the transfer to producers between 1985 to 1994 due to the drop in prices around the world. They average 5% of total value of agricultural production or $6.046 billions per year during 1979-1996. The U.S. deficiency payments represented 65% of the total transfer of direct payments followed by diversion payments that account for 15%, disaster payments reaching 7% .

Analysis of Producer Subsidy Equivalent Data for the Base Year

The modeling component of the PEM is calibrated to represent the market conditions for 1995, the last year of the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA 90). Major policy goals for FACTA 90 included price and income protection, as well as assurance of adequate supplies of food and fibers for consumers. Supply controls, direct payments, and nonrecourse commodity loans were important components of the price and income programs, and procedures were established to allow greater direction of production decisions from market signals.

Table 2. PSE Levels of Support for all Agricultural Commodities 1979-1996

Detail of general policy measures :	Units/	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1,991	1,992	1,993	1,994	1,995	1,996
Adjusted value of production	'000 t	107,045	110,733	111,585	112,377	112,084	111,738	109,198	105,937	112,182	110,000	118,647	123,585	118,494	124,397	122,263	130,724	130,706	145,260
A. Market price support	'000 t	8,775	8,626	8,709	9,833	10,772	11,762	14,321	15,432	15,960	9,893	9,963	14,143	12,628	12,673	14,143	12,664	8,214	11,125
B. Levies	'000 t	**0**	**0**	**0**	**0**	**-657**	**-663**	**-165**	**-510**	**-265**	**-36**	**0**	**-8**	**-50**	**-141**	**-161**	**-222**	**-196**	**0**
C. Direct payments	'000 t	**608**	**1,175**	**1,964**	**2,049**	**12,360**	**4,767**	**6,946**	**14,313**	**12,923**	**8,071**	**6,091**	**6,961**	**5,478**	**6,657**	**6,285**	**6,017**	**1,587**	**4,591**
Deficiency payments	'000 t	94	38	716	1,171	1,119	3,330	4,740	10,806	10,418	4,240	4,969	6,417	5,096	6,075	4,277	5,271	1,516	0
Area and headage payments	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disaster	'000 t	109	611	348	16	1	0	0	0	0	2,825	887	135	283	312	1,757	596	5	0
Diversion	'000 t	134	308	508	0	10,748	1,171	1,376	362	1,600	622	0	0	0	0	0	0	0	0
Storage	'000 t	271	218	443	954	480	322	370	554	534	358	163	67	16	10	9	28	4	0
Loan rate	'000 t	0	0	-48	-76	17	-30	214	2,114	187	-35	-22	161	0	0	0	0	62	75
Loan deficiency payments	'000 t	0	0	-3	-15	-4	-25	13	53	-15	-1	0	8	26	53	215	61	0	0
Marketing loans	'000 t	0	0	0	0	0	0	233	424	199	62	93	173	58	207	26	60	0	0
PFC payments	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,516
D. Reduction of input costs	'000 t	**1,109**	**1,632**	**2,113**	**3,140**	**3,580**	**3,249**	**3,501**	**3,380**	**3,480**	**3,295**	**2,434**	**1,882**	**1,561**	**1,375**	**2,017**	**1,108**	**1,656**	**1,573**
Capital grants	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest concessions	'000 t	1,006	1,386	1,869	2,851	3,189	2,856	3,033	3,112	3,347	2,635	2,074	1,714	1,287	1,122	1,063	1,097	1,085	1,002
Fertilizer	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	'000 t	-33	125	100	143	227	215	277	120	-5	521	202	19	125	100	826	-125	430	430
Irrigation	'000 t	136	121	144	146	164	178	190	147	139	139	157	149	149	153	128	136	141	141
Other	'000 t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. General services	'000 t	**1,765**	**1,872**	**1,860**	**1,913**	**1,826**	**1,958**	**2,025**	**1,954**	**1,969**	**2,185**	**2,805**	**3,011**	**3,142**	**3,455**	**3,552**	**3,760**	**3,841**	**3,890**
Research, advisory, training	'000 t	718	797	782	820	856	876	901	913	917	937	1,020	1,097	1,131	1,242	1,290	1,316	1,360	1,387
Inspection	'000 t	281	329	339	339	340	351	374	365	386	402	418	442	464	489	533	537	550	569
Pest and disease control	'000 t	204	215	223	246	179	221	228	219	246	255	275	284	303	345	374	374	386	297
Structures/infrastructures	'000 t	490	451	436	430	393	429	450	362	352	508	1,010	1,092	1,149	1,264	1,234	1,414	1,414	1,516
Marketing and promotion	'000 t	72	80	80	78	58	80	71	96	68	83	82	96	95	115	120	118	131	122
F. Sub national	'000 t	**1,044**	**1,234**	**1,256**	**1,162**	**1,195**	**1,225**	**1,344**	**1,454**	**1,496**	**1,519**	**1,676**	**1,845**	**1,849**	**1,796**	**1,880**	**1,894**	**1,918**	**1,940**
G. Other	'000 t	**1,034**	**1,109**	**1,112**	**1,224**	**963**	**1,002**	**915**	**958**	**520**	**385**	**563**	**452**	**543**	**474**	**338**	**351**	**386**	**395**
Total other support (D+E+F+G)	'000 t	**4,952**	**5,848**	**6,342**	**7,439**	**7,564**	**7,434**	**7,784**	**7,745**	**7,466**	**7,384**	**7,478**	**7,189**	**7,095**	**7,100**	**7,788**	**7,113**	**7,802**	**7,798**
Gross total PSE	US$ mn	**14,335**	**15,649**	**17,015**	**19,321**	**30,039**	**23,301**	**28,887**	**36,980**	**36,063**	**25,311**	**23,532**	**28,286**	**25,151**	**26,289**	**28,054**	**25,573**	**17,406**	**23,513**
X. Feed adjustment	US$ mn	**0**	**0**	**0**	**0**	**0**	**0**	**-41**	**-316**	**-384**	**-78**	**-45**	**-168**	**-310**	**-206**	**-398**	**-361**	**-26**	**0**
Net total PSE	US$ mn	**14,335**	**15,649**	**17,015**	**19,321**	**30,039**	**23,301**	**28,845**	**36,664**	**35,699**	**25,233**	**23,488**	**28,117**	**24,841**	**26,082**	**27,657**	**25,213**	**17,380**	**23,513**
Percentage PSE	%	**13**	**14**	**15**	**17**	**27**	**21**	**26**	**35**	**32**	**23**	**20**	**23**	**21**	**21**	**23**	**19**	**13**	**16**
Net total PSE (US$ mn)	*US$ mn*	*14.335*	*15.649*	*17.015*	*19.321*	*30.039*	*23.301*	*28.845*	*36.664*	*35.699*	*25.233*	*23.488*	*28.117*	*24.841*	*26.082*	*27.657*	*25.213*	*17.380*	*23.513*

Source: OECD, 1997

The target prices were continued at the 1990 levels, commodity loan rates were based on 85 percent of a five year moving average of market prices. Greater flexibility was introduced that allowed producers to plant up to 25 percent of their crop acreage base to crops other than those for which the base was established.[18]

The PSEs/CSEs data base information for market price support, direct payments and input reduction cost policies indicates that total gross PSE (to producers) totaled $1.9 billion in 1995(first column, item VII, table 3). Nearly half (46%) of the total transfer from consumers and taxpayers to producers was in the form of deficiency payments.

Market price support accounted for only 8% of the total monetary transfer and was received exclusively by food grain producers. Amongst the different items in reduction in input costs, interest concessions represent 20% of total transfers, while insurance represented 18%. Finally, irrigation reached 6% of the total transfer. Food grains producers captured 62% of the transfers while feed grain producers and oilseeds producers received 27% and 11% of total transfers respectively.

The OECD data base reports government outlays on loan rate for the base year. However, the information provided by the USDA on loan rate indicates that the average loan rate was below the market price during 1995 and 1996. The discrepancy is left for further research. For the use in the PEM, it is assumed that these subsidies correspond to storage and other handling expenses the government has to carry out from fiscal year to fiscal year, with no effect on consumer price . Therefore, affects of the loan rate are

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[18] Under the 1990 FACTA, farmers were only required to plant 15% of their crop base to crops not receiving a deficiency payment (normal flex acreage), however they could also plant an additional 10% of their crop base to crops not receiving a deficiency payment (optional flex acreage)

not modeled.

Policy regime under the Federal Agricultural Improvement Reform Act

The Federal Agriculture Improvement and Reform (FAIR) Act of 1996 moves toward a greater market orientation by reducing the government's involvement in agricultural markets. This has occured as both a change in the level of support and the mix of policy tools. payments to producer regardless of their level of production, eliminated the relationship between income payments and current market prices, increased planting flexibility opportunities for the farmer, allowed unrestricted haying and grazing, eliminated acreage reduction programs, reduced government involvement in the management of stocks and eliminated multi-peril crop insurance as requirement to participate in the government programs.

The transition from the FACTA 90 to the the Federal Agriculture Improvement and Reform (FAIR) Act of 1996 reflects the orientation of the new law in the agricultural markets and the impact on the PSE components. Price intervention policies (in the form of market price support programs) were set to zero for food grains, Income support policies (in the form of deficiency payments) were eliminated and a new policy instrument was created; the Production Flexibility Contracts (PFC). The policy changes were reflected in the PSE data base (second column of Table 3).

Table 3. Changes in level of support 1995-1996

		FOOD	GRAINS	FEED	GRAINS	OIL	SEEDS
		1,995	1,996	1,995	1,996	1,995	1,996
I Level of production	'000 t	59,412	62,106	187,310	235,344	59,24	65,399
						8	
II Production price (farm gate)	US$/t	167	158	128	106	249	239
III Value of production	US$ mn	9,933	9,813	23,892	25,016	14,73	15,620
						8	
IV Levies	US$ mn	0	0	0	0	0	0
V Direct Payments	US$ mn	905	1,993	114	2,185	16	20
VI Adjusted value of production	US$ mn	10,838	11,805	24,006	27,201	14,75	15,639
						5	
VII Gross total PSE	**US$ mn**	**1,921**	**2,826**	**1,998**	**4,025**	**1,117**	**1,128**
A. Market price support	**US$ mn**	**172**	**0**	0	0	0	0
Trade measures	US$ mn	172	0	0	0	0	0
Other	US$ mn			0	0	0	0
B. Levies	**US$ mn**	**0**	**0**			0	0
C. Direct payments	**US$ mn**	**905**	**1,993**	**114**	**2,185**	**16**	**20**
Deficiency payments	US$ mn	900	0	82	0	0	0
Area and headage payments	US$ mn	0	0	0	0	0	0
Disaster	US$ mn	0	0	0	0	0	0
Diversion	US$ mn	0	0	0	0	0	0
Storage	US$ mn	0	0	4	0	0	0
Loan rate	US$ mn	5	7	28	39	16	20
Loan deficiency payments	US$ mn	0	0	0	0	0	0
Marketing loans	US$ mn						
PFC payments	US$ mn	0	1,986	0	2,147	0	0
D. Reduction of input costs	**US$ mn**	**250**	**236**	**475**	**423**	**219**	**220**
Capital grants	US$ mn			0	0	0	0
Interest concessions	US$ mn	89	76	232	180	112	113
Fertilizer	US$ mn	0	0	0	0	0	0
Transport	US$ mn			0	0	0	0
Insurance	US$ mn	134	134	181	181	68	68
Irrigation	US$ mn	26	26	62	62	39	39
Other	US$ mn			0	0		
E. General services	**US$ mn**	**413**	**421**	**980**	**999**	**612**	**624**
Research,advisory,training	US$ mn	107	105	253	249	159	156
Inspection	US$ mn	3	3	7	7	0	0
Pest. and disease control	US$ mn	30	22	72	53	45	34
Structures/infrastructures	US$ mn	262	281	623	668	392	420
Marketing and promotion	US$ mn	10	9	24	22	15	14
F. Sub national	**US$ mn**	**150**	**146**	**357**	**348**	**225**	**219**
G. Other	**US$ mn**	**30**	**30**	**72**	**71**	**45**	**45**
VIII Gross unit PSE	**US$/t**	**32**	**45**	**11**	**17**	**19**	**17**
IX Gross percentage PSE	**%**	**18**	**24**	**8**	**15**	**8**	**7**

Source: OECD, 1997

Focusing on the changes to the mix of policies and price intervention policies between 1995 and 1996, the PSE indicates that the type of direct payments (income support policies)changed while increased the level of support for food grains from $900 millions to 1.9 billions. The level of support for feed grains also increase from $ 114 millions to $2.18 billions.

Since PSE is basically an accounting system, it can not give information about the impact or effects of the changes in the mix of policies. Moreover, the measures indicates that the United States is increasing their support to the sector. Transfers from market price supports, direct payments and input cost reduction policies reached $1.32 billions in 1995 for food grains, but increased to $2.2 billions by 1996 an increased of 60% over the 1995 levels. The increased level of support was even stronger in the feed grain sector. Transfers from market price support, direct payments and input cost reduction policies increased from $589 million in 1995 to $2.6 billion in 1996s.

The income support paid to U.S. farmers prior to the FAIR Act was tied to production of specific commodities. This transfer could be viewed as a production subsidy. A deficiency payment rate was determined based on the diference between the legislated target price and the greater of the market price and the price support loan rate. This rate was then multiplied by the program yield and the number of elegible acres to determine the total amount of government payment. The program yield had until 1985 been based upon an historical average but was frozen at that time. The elegible acreage was also based upon an historical average of acres planted or considered planted to the commodity. The 1990 Agricultural Law reduced elegible acreage by 15%. Thus the deficiency payment rate was not applied to all production as actual yield often exceeded program yield and acres harvested exceeded acres elegible for program benefits. Nonetheless, the deficiency payment rate could be viewd as a per unit subsidy for production. As a production subsidy, the policy had a direct impact on the market.

The new PFC payments do not affect any specific market as producers are not required to produce output to receive the payments. The affect of the PFC payment to agricultural and nonagricultural markets depends upon the associated expenditure patterns of the farmers. Thus, the same level of support for the PFC and the deficiency payments may have different market distortions impacts.

The market distortion impacts include the net transfer of income to producers. Because the deficiency payment acts as a subsidy, market price is depressed and the producers lose a share of their payments to consumers in the form of lower prices. However, with the PFC producers will lose a portion of the payment only to the extent that their expenditures increase the price of goods and thus transfers income to producers of other goods and services. However, the PSE accounts both policies as having equal, dollar for dollar transfers, to producers.

Using the PEM offers some more information about the real effects of these changes and goes beyond the accounting limitation of the PSE indicator.

Empirical Analysis

The move from FACTA 90 to the current legislation (FAIR ACT) represents a change in the mix of policies. In evaluating a particular change in policy mix the net effect for all the changes is measured. In this exercise, the levels of support given in

1995 are set to the monetary transfer levels specified in the 1996 farm legislation, increasing or decreasing individual policies. Later, all the changes are simulated one by one and compared to the total mix to measure the net impact of the mix of policies. The impact of policies on the economic welfare of producers and the farm sector is likely to be different depending on the mix used.

To evaluate and translate the impact of the changes in policy to the policy maker, a series of indexes are designed to capture the principal impacts of changes in the economic variables of interest. The indexes are then presented in a matrix that allows for cross comparison by commodity.

Income Transfer Efficiency

The income transfer efficiency index captures the portion of the transfer payments that actually increases farm income. The index is constructed as the ratio of the total change in income divided by the change in PSE transfers. The closer the index is to one, the greater is the efficiency of the policy. It is possible for the index to be greater than one when the policy is not only efficient but stimulates supply and demand in a way that raises prices, production or both.

$$\textbf{(49)} \qquad \textit{Income Transfer Efficiency Index} = \frac{\Delta \textit{ Farm Income}}{\Delta \textit{ PSE}}$$

Export Value Distortion

The export value index measures the impact of a commodity specific policy on the quantity of exports of that commodity. The index is constructed as the ratio of the total change in export value divided by the change in PSE transfers. The greater the index the greater the trade distortion the policy causes in terms of the value of commodity exports.

(50) $$Export\ Value\ Index = \frac{\Delta\ Export\ value}{\Delta\ PSE}$$

Program drift coefficient

Changes in policy usually reflects government goals of reducing or increasing expenditures on support programs. However, it is unlikely that the policy change will reach specific targeted monetary goals. A change in a policy will produce market adjustments in production sales and input use, as a response to the different subsidy rate introduced in the economy. The difference between the planned change in program expenditure and the actual change in expenditure produced is captured by this coefficient (as a percentage planned expenditure) as a program drift.

(51) $$Program\ Drift = \frac{PSE_{act} - PSE_{plan}}{PSE_{plan}}$$

Transfer share to Consumption

This indicator is constructed as the ratio of the change in consumer surplus and the change on PSE. PSE calculations developed a relationship between market price support policies and consumer indicating that market price support is an implicit tax on consumers. The transfer share to consumption is an indicator that shows the proportion of a transfer captured by consumers as measured through the change in consumer surplus. A reduction in consumer surplus due to a change in PSE transfers will indicated the increased in the implicit tax of the transfer, an increased in consumer surplus will show the consumer capturing part of the producer transfer.

(52) $$Consumer\ Surplus = 0.5\ ({}_2Pc_i - {}_1Pc_i)\,{}_1Qc_i + 0.5\ ({}_2Pc_i - {}_1Pc_i)\,{}_2Qc_i$$

where ${}_2Pc_i$ is the simulated price of commodity i and ${}_1Pc_i$ is the base year price of commodity i.

(53) $$Transfer\ share\ consumption = \frac{\Delta\ Consumer\ surplus}{\Delta\ PSE}$$

Transfer Share to Input Suppliers

When changes in the level or type of transfer to producers occur, input suppliers are indirectly affected by those changes due to the response of producer to purchase more or less inputs. An input supplier index is constructed as the ratio of the change in supplier surplus to the change in PSE. This index captures the portion of the transfer that producer transmit to the input market.

(54) $$Supplier\ Surplus = \frac{\varsigma_j}{(\zeta_j + 1)}\ ({}_2Ps_j^{(\zeta_j + 1)} - {}_1Ps_j^{(\zeta_j + 1)})$$

where ς_j is the constant of the factor supply equation for factor j; ζ_j is the supply elasticity of factor j; ${}_2Ps_j$ is the simulated price of factor j and ${}_1Ps_j$ is the base year price of factor j.

(55) $$Transfer\ share\ supplier = \frac{\Delta\ Supplier\ surplus}{\Delta\ PSE}$$

FAIR 1996 Changes in Deficiency Payments and Flexibility Contract.

In 1996, the FAIR act eliminated deficiency payments and flexibility contracts were create . The amount of income transfers recorded in the PSE increased by more than $3 billion dollars from which food grain producers captured 31% and feed grain producers received 69% of the new payments. The simulation component captures these legislative changes and the changing levels of support given. In the model, deficiency payments were reduced from $900 million to zero for food grain producers, and from $82.0 million to zero for feed grain producers.

Flexibility contracts were increased from zero to $1,986.25 million for food grain producers and to $2,146.5 million for feed grain producers. These changes affected the per unit rate of subsidy andimpacted different markets. The flexibility contract, was modelled as a lump sum payment that is added to farmer income and at this stage was assumed not to impactother variables of the model.

The reduction in the deficiency payment and the introduction of flexibility contracts in food and feed grains increased food and feed grain income transfers, 60%

and 130% over 1995 levels respectively with a drift coefficient of 0.01%.

The combined reduction in deficiency payments and increase in payment through flexibility contracts made the efficiency multiplier very close to one. This simply demostrates the substitution effects of a policy that is efficicent in income trasnfer(PFC) for a policy that is not very efficient (deficiency payments)

An indirect gainner in this policy game was the oilseed producer. While the government did not directly transfer support to these producers, income for the sector increased almost $948 million. Trade multipliers indicate that some response to the change in income support policies accured in the value of exports for food grains which gained half a cent per ton for each dollar transfered to the sector.

Table 4. Policy Evaluation matrix for the 1996 levels of Direct Payments

			Food Grains	Feed Grains	Oilseeds
Transfer Share Consumption	$		-0.006	0.000	-0.000
Transfer Share Supplier	$		0.000	-0.000	0.000
Income Transfer	$		0.997	0.999	0.000
Value of Exports	$		0.005	-0.001	0.000
PSE Change	%		61%	130%	0%
Increase in income		$1,000	1,081,915	2,063,138	948,000
Increase in Export value		$1,000	5,199	-2,702	54
Change in Transfer (PSE)		$1,000	1,085,644	2,064,992	9
Gain Consumer Surplus		$1,000	-8,599	84	-997
Gain Producer Surplus		$1,000	-6,103	-934	250
Gain Supplier Surplus		$1,000	410	-436	239
Policy Drift	%		0.01%		

Consumer surplus declined in the food grain sector as a result of the change by almost $8.0 millions from the base levels of value consumed before the change . This indicates that a proportion of the deficiency payments was received by consumers (one sixth of a cent per dollar on deficiency payment). In this exercise, flexibility contracts were modelled as a lump sum amount that increased income but it was assumed that the payments did not impact other variables in the model. Finally, the change in the supplier surplus was small indicating the small proportion of each policy that is received by the input suppliers.

FAIR 1996 Changes in Market Price Support

From the 1995 levels, the FAIR act reduced market price support for food grains bringing the expenditure for this policy from $172.5 million to zero. Feed grains and oilseeds did not received any support from this kind of policy in 1995. The model was used to measure the impact of these legislative changes, reducing the amount of transfer given to food producer through market price support.

The reduction in the market price support program of food grains had a targeted budget reduction of $172 millions in PSE transfers, but the market adjustments in production sales and input use in response to the change in the policy translated into a greater reduction in PSE transfer than that planned by the government (1.52% or $2.6 millions more) (Table 5).

Each dollar taken from the market price support program reduced food grain farmers income by 74 cents indirectly, 8 cents of the oilseeds farmers income was also lost.. As a result of the market adjustments, feed grain farmer income was increased by 14 cents. This is a result of the substitution effect through the demand side of the commodities in study. In this case, feed grain was the indirect winner of the policy mix capturing some of the benefits of the reduction in PSE.

With respect to trade, the greater response to exports isfound in the feed grain sector. Each dollar reduction in the market price support program increases the value of exports by almost 2 cents per ton. This is equivalent to the lost suffered by food grain exports, but much less than the combined loss in export value of food grains and oilseeds.

Table 5. Policy Evaluation matrix for the 1996 levels of market support

		Food Grains	Feed Grains	Oilseeds
Transfer Share Consumption	$	0.003	-0.211	0.087
Transfer Share Supplier	$	-0.201	0.046	-0.021
Income Transfer	$	-0.740	0.146	-0.083
Value of Exports	$	-0.017	0.018	-0.022
PSE Change	%	-9.8%	0.0%	0.0%
Increase in income	$1,000	-129,619	25,632	-14,468
Increase in Export value	$1,000	-88,658	46,723	-859
Change in Transfer (PSE)	$1,000	-175,148	164	-144
Gain Consumer Surplus	$1,000	592	-36,879	15,216
Gain Producer Surplus	$1,000	-40,608	6,210	-3,820
Gain Supplier Surplus	$1,000	-35,245	8,064	-3,658
Policy Drift	%	1.52%		

Feed sector consumers were also affected as a result of the reduction in market price support losing two cents per unit form their original consumer surplus level.

Input supplier captured the loss suffered by the food grain producers in their market support program. In fact, suppliers lost 20 cents per each dollar reduced from the program. Again, this indicates that some of the support targeted for the producer is captured by other agents in the economy. Feed grain suppliers were the beneficiaries of the policy and because of the market adjustments they captured almost 5 cents per dollar.

FAIR 1996 Net Aggregated Impacts

The aggregated net impacts of the policies are illustrated in table 6. This table is the result of simulating the mix of changes (transfer levels)in the policy variables resulting from the previous legislation (FACTA 90) to the agricultural law (FAIR 96)

The mix of policies had a total drift coefficient of 22%. The intended total transfer from the policies simulated as reported in the PSE data base was $2.9 billion, however, total PSE transfer after market adjustments was $3.23 billions.

The transfer efficiency coefficient indicates that the mix of policies was more efficient in increasing feed grain income, where each dollar of transfer translated to 60 cents of increased producer income. The efficiency in the food grain sector was about half of that in the feed grain sector. For the mix of policies, of each dollar spent to transfer income to producers, farmers in the food grain sector captured only 30 cents .

The mix of policies had a greater increasing trade value in the feed grain sector than in the other sector, increasing the value of exports two cents per ton for every dollar trasnferred.

Table 6. Policy Evaluation matrix for the 1996 levels of the policy mix

		Food Grains	Feed Grains	Oilseeds
Transfer Share Consumption	$	0.085	-0.018	0.004
Transfer Share Supplier	$	-0.019	0.004	-0.001
Income Transfer	$	0.305	0.645	-0.000
Value of Exports	$	-0.069	0.022	0.000
PSE Change	%	68%	129%	-2%
Increase in income	$1,000	988,295	2,088,341	-13,725
Increase in Export value	$1,000	-83,395	43,980	-847
Change in Transfer (PSE)	$1,000	1,216,578	2,036,678	-16,446
Gain Consumer Surplus	$1,000	103,631	-36,788	14,111
Gain Producer Surplus	$1,000	-46,740	5,155	-3,624
Gain Supplier Surplus	$1,000	-23,149	7,471	-3,470
Policy Drift	%	22%		

The change in the policy mix allowed the consumers of food grains to capture 8 cents for each dollar spent on to food grain producers. Feed grain suppliers captured a third of a cent per unit from each dollar spent.

Evidently, the effects of each policy applied individually was different from the effect of implementing the mix of policies at the same time, and even more important, the increase or decrease in the amount of transfers given was not necessarily shown in the effects of that support in the commodity market or the factor markets since different policies used different price linkages to transmit their effect. Levels of support of U.S. measure through the aggregated PSE/CES show an increase from 1995 to 1996. Most of which is reported as income support. If this change is simulated as deficiency payments, the impacts will be higher than noting that the flexibility contracts do not affect production decisions. However, this information is left out of the PSE/CSE. On the other hand, the mix of policies shows the presence of substitution and compensation effects producing income and trade distortions sometimes less severe than the application of the set of policies individually. This information is also left out of the PSE/CSE.

Conclusion

The Policy Evaluation Methodology enables one to make a comparison of the impacts of agricultural policies on producers, consumers, taxpayers and trade. Because of the numerous constraints, the approach taken was to use parameters estimated in previous work rather than estimating a new set of parameters. The approach separates the assumptions about input supply and input demand elasticities and which markets are directly impacted by each policy. The transparency of these two sets of assumptions in the model may also be a limitation of the model for two reasons. First, some countries may be without previous estimates and thus will require considerable work in estimating the parameters. Second, considerable room exists for disagreement over what market is directly affected by various policy instruments. Direct payments offers the best example of a policy which is not tied to a market transaction and thus can be placed into the model at several points.

A limitation of considerable importance is the lack of vertical and horizontal market linkages in the model. Through these vertical and horizontal markets "support leakage" could be traced out of the market for which the support was intended. In the current PEM, the definition of consumer is all markets downstream from the crop producer which includes several important agricultural industries including other agricultural producers (e.g., livestock, poultry and aquaculture) and agricultural output services (e.g., processors, transportation, storage). Each of these downstream industries may be the beneficiary of farm price and income support policies. Further, some countries may pass considerable levels of income support to agricultural producers through subsidies to these sectors or industries while other countries may tax producers through policies which adversely affect the downstream industries. An extension of the PEM model to include these downstream agricultural industries and the policies which affect them constitute an improvement.

The horizontal price linkages are also limited in the current PEM. The measurement of input supply and demand elasticities is an area that is limited in previous research. The potential of these estimates to affect the magnitude of the outcomes of the PEM model is thus unknown .

Based on these limitations and initial findings, we envision two areas of focus in terms of future PEM work. First, we need to included the downstream consumers that may be the beneficiaries of farm price and income support policies (e.g. livestock sector). Second, in co-operation with the OECD, we need to further disaggregate the direct income components of policies, focusing on those elements starting to gain prominence. To this end, we need to examine environmental and other rural area program payments and evaluate how they might be incorporated into the modeling framework. This requires more attention to be put on developing policy-relevant indicators. Other areas that are crucial include employment indicators and simple indices of environmental impacts. Finally, linkages across countries should be designed allowing the model to capture the cross country analysis of the agricultural policies.

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Appendix

Producer subsidy Equivalents. Food Grains. United States 1979-1996

Producer subsidy equivalents	Units/	1982	1983	1984	1985	1986	1987	1986	1989	1990	1,991	1,992	1,993	1,994	1,995	1,996
I Level of production	'000 t	75,200	65,900	70,700	66,000	56,800	57,362	49,320	55,428	74,462	53,867	67,141	65,208	63,167	59,412	62,106
II Production price (farm gate)	US$/t	130	130	124	113	88	94	137	137	96	110	119	120	127	167	158
III Value of production	US$ mn	9,806	8,547	8,781	7,471	4,998	5,417	6,741	7,576	7,141	5,940	7,993	7,811	8,007	9,933	9,813
IV Levies	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V Direct Payments	US$ mn	730	3,342	2,114	2,521	4,330	3,537	1,774	1,069	2,576	2,329	1,488	2,131	1,223	905	1,993
VI Adjusted value of production	US$ mn	10,538	11,869	10,895	9,992	9,329	8,954	8,515	6,645	9,717	8,289	9,481	9,942	9,231	10,838	11,805
VII Gross total PSE	**US$ mn**	**1,662**	**4,602**	**3,162**	**3,876**	**5,715**	**5,595**	**3,313**	**2,279**	**4,416**	**4,484**	**3,563**	**4,556**	**3,159**	**1,921**	**2,826**
A. Market price support	**US$ mn**	**0**	**0**	**0**	**263**	**579**	**1,386**	**677**	**309**	**1,172**	**1,607**	**1,365**	**1,659**	**1,272**	**172**	**0**
Trade measures	US$ mn	0	0	0	263	579	1,386	677	309	1,172	1,607	1,365	1,659	1,272	172	0
Other	US$ mn															
B. Levies	**US$ mn**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C. Direct payments	**US$ mn**	**730**	**3,342**	**2,114**	**2,521**	**4,330**	**3,537**	**1,774**	**1,069**	**2,576**	**2,329**	**1,488**	**2,131**	**1,223**	**905**	**1,993**
Deficiency payments	US$ mn	477	770	1,050	1,555	3,457	3,267	1,216	572	2,420	2,246	1,371	1,900	1,146	900	0
Area and headage payments	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disaster	US$ mn	12	1	0	0	0	0	469	470	39	67	109	227	77	0	0
Diversion	US$ mn	0	2,332	635	853	215	0	0	0	0	0	0	0	0	0	0
Storage	US$ mn	243	192	176	172	170	145	99	46	17	16	8	3	0	0	0
Loan rate	US$ mn	-2	48	53	141	487	106	-10	-22	100	0	0	0	0	5	7
Loan deficiency payments	US$ mn	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Marketing loans	US$ mn															
PFC payments	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,986
D. Reduction of input costs	**US$ mn**	**529**	**887**	**672**	**753**	**536**	**431**	**551**	**462**	**234**	**159**	**203**	**254**	**167**	**250**	**236**
Capital grants	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0			
Interest concessions	US$ mn	466	844	575	565	483	407	301	254	158	79	62	81	73	89	76
Fertilizer	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0			
Insurance	US$ mn	12	7	62	155	49	2	223	179	50	57	94	148	72	134	134
Irrigation	US$ mn	29	36	35	33	24	22	27	29	26	22	27	24	22	26	26
Other	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0			
E. General services	**US$ mn**	**190**	**184**	**186**	**170**	**132**	**126**	**183**	**284**	**289**	**259**	**348**	**361**	**349**	**413**	**421**
Research,advisory,training	US$ mn	73	75	75	67	52	52	63	71	70	82	67	88	67	107	105
Inspection	US$ mn	3	2	1	1	2	1	1	2	2	3	3	3	3	3	3
Pest. and disease control	US$ mn	22	16	19	17	13	14	17	19	18	17	24	25	25	30	22
Structures/infrastructures	US$ mn	84	86	65	79	60	55	97	187	193	174	227	236	228	262	281
Marketing and promotion	US$ mn	7	5	7	5	5	4	6	6	6	5	8	8	8	10	9
F. Sub national	**US$ mn**	**104**	**105**	**105**	**101**	**83**	**85**	**102**	**116**	**117**	**101**	**126**	**128**	**125**	**150**	**146**
G. Other	**US$ mn**	**109**	**84**	**86**	**68**	**55**	**30**	**26**	**39**	**29**	**30**	**33**	**23**	**23**	**30**	**30**
VIII Gross unit PSE	**US$/t**	**22**	**70**	**45**	**59**	**101**	**98**	**67**	**41**	**59**	**83**	**53**	**70**	**50**	**32**	**45**
IX Gross percentage PSE	**%**	**16**	**39**	**29**	**39**	**61**	**62**	**39**	**26**	**45**	**54**	**38**	**46**	**34**	**18**	**24**

Producer subsidy Equivalents. Oilseeds. United States 1979-1996

Producer subsidy equivalents	Units/	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1,991	1,992	1,993	1,994	1,995	1,996
I Level of production	'000 t	48,800	54,400	59,600	44,500	50,600	57,100	52,799	52,746	42,153	52,354	52,417	54,077	59,802	50,920	68,502	59,248	85,399
II Production price (farm gate)	US$/t	278	222	209	287	213	188	178	218	273	209	211	205	204	235	201	249	239
III Value of production	US$ mn	13,562	12,071	12,468	12,778	10,753	10,706	9,272	11,396	11,492	10,946	11,055	11,087	12,176	11,974	13,793	14,738	15,620
IV Levies	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V Direct Payments	US$ mn	0	-3	-15	-4	-25	-13	53	-15	506	131	41	77	30	481	164	18	20
VI Adjusted value of production	US$ mn	13,562	12,068	12,453	12,772	10,727	10,693	9,324	11,381	11,999	11,076	11,096	11,164	12,207	12,455	13,957	14,755	15,639
VII Gross total PSE	**US$ mn**	761	827	974	992	828	955	1,020	805	1,364	982	913	972	937	1,590	1,110	1,117	1,128
A. Market price support	**US$ mn**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade measures	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Levies	**US$ mn**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Direct payments	**US$ mn**	0	-3	-15	-4	-25	-13	53	-15	506	131	41	77	30	481	164	16	20
Deficiency payments	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area and headage payments	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disaster	US$ mn	0	0	0	0	0	0	0	0	507	131	41	77	31	481	163	0	0
Diversion	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Storage	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan rate	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	20
Loan deficiency pay	US$ mn	0	-3	-15	-4	-25	-13	53	-15	-1	-1	-1	0	-1	0	1	0	0
Marketing loans	US$ mn																	
Other	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Reduction of input	**US$ mn**	199	329	483	433	386	483	475	322	324	218	207	175	141	315	93	219	220
Capital grants	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest concessions	US$ mn	143	172	286	256	230	347	354	253	202	180	160	130	112	110	105	112	113
Fertilizer	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transport	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insurance	US$ mn	22	120	139	123	113	88	75	24	76	-4	7	3	-13	186	-49	68	68
Irrigation	US$ mn	34	36	38	54	43	48	45	45	46	42	40	42	42	38	38	39	39
Other	US$ mn																	
E. General services	**US$ mn**	264	233	248	276	229	242	240	260	314	409	441	478	525	558	598	612	624
Research,advisory,training	US$ mn	102	89	97	114	93	97	96	108	109	102	107	115	132	137	149	159	158
Inspection	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pest. and disease control	US$ mn	27	25	29	24	23	25	23	29	30	28	28	31	37	40	43	45	34
Structures/infrastructures	US$ mn	124	110	111	130	105	113	110	114	188	271	296	323	344	389	393	392	420
Marketing and promotion	US$ mn	10	9	9	8	9	8	10	8	10	8	9	10	12	13	13	15	14
F. Sub national	**US$ mn**	157	142	137	159	130	144	153	177	176	168	180	187	191	200	215	225	219
G. Other	**US$ mn**	141	126	144	128	106	98	101	61	45	56	44	55	50	36	40	45	45
VIII Gross unit PSE	**US$/t**	16	15	16	22	18	17	19	15	32	19	17	18	18	31	16	19	17
IX Gross percentage PSE	**%**	6	7	8	8	8	9	11	7	11	9	8	9	8	13	8	8	7

Producer subsidy Equivalents. Feed Grains. United States 1979-1996

Producer subsidy equivalents	Units/	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1,991	1,992	1,993	1,994	1,995	1,996
I Level of production	'000 t	208,300	209,200	106,000	194,500	225,200	209,600	181,145	125,204	191,158	201,535	189,878	240,729	160,943	256,630	187,310	235,344
II Production price (farm gate)	US$/t	98	106	128	105	88	59	76	100	93	90	93	81	98	89	128	108
III Value of production	US$ mn	20,393	22,071	13,557	20,442	19,773	12,450	13,835	12,520	17,760	18,090	17,718	19,817	15,840	22,833	23,892	25,016
IV Levies	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V Direct Payments	US$ mn	362	839	7,185	1,757	2,809	8,020	7,767	3,941	3,834	3,152	2,187	3,781	2,499	3,560	114	2,185
VI Adjusted value of	US$ mn	20,755	22,909	20,722	22,199	22,581	20,470	21,602	16,461	21,594	21,242	19,903	23,399	18,339	26,393	24,006	27,201
VII Gross total PSE	**US$ mn**	**1,809**	**2,881**	**8,698**	**3,472**	**4,682**	**9,826**	**9,824**	**5,663**	**5,449**	**4,661**	**3,692**	**5,357**	**4,299**	**5,178**	**1,998**	**4,025**
A. Market price support	**US$ mn**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade measures	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Levies	**US$ mn**																
C. Direct payments	**US$ mn**	382	839	7,165	1,757	2,809	8,020	7,767	3,941	3,834	3,152	2,187	3,781	2,499	3,560	114	2,185
Deficiency payments	US$ mn	0	291	0	1,654	2,480	6,195	5,918	2,163	3,505	3,013	2,080	3,625	1,520	3,199	82	0
Area and headage	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disaster	US$ mn	92	0	0	0	0	0	0	1,003	220	32	108	156	973	330	0	0
Diversion	US$ mn	0	0	6,937	0	0	133	1,468	563	0	0	0	0	0	0	0	0
Storage	US$ mn	283	608	232	107	175	359	387	246	111	48	0	1	6	27	4	0
Loan rate	US$ mn	-13	-60	-5	-4	154	1,333	14	-33	-2	59	0	0	0	0	28	39
Marketing loans	US$ mn																
PFC payments	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,147
D. Reduction of input costs	**US$ mn**	586	1,122	933	851	975	1,137	1,438	1,131	572	407	336	327	727	183	475	423
Capital grants	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest concessions	US$ mn	552	1,074	798	758	868	1,093	1,415	874	525	400	232	248	201	266	232	180
Fertilizer	US$ mn	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Transport	US$ mn	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Insurance	US$ mn	-27	-17	78	12	19	-17	-33	207	-23	-59	36	12	474	-146	181	181
Irrigation	US$ mn	61	65	57	81	68	61	56	50	69	67	67	67	51	63	62	62
Other	US$ mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. General services	**US$ mn**	**408**	**434**	**296**	**427**	**450**	**328**	**324**	**347**	**675**	**732**	**778**	**858**	**756**	**1,008**	**980**	**999**
esearch,advisory,training	US$ mn	149	167	121	172	179	129	134	120	168	177	185	214	184	250	253	249
Inspection	US$ mn	16	7	4	2	3	5	2	1	4	6	8	7	7	8	7	7
Pest. and disease con	US$ mn	43	50	25	43	45	31	36	33	45	46	49	59	53	71	72	53
Structures/infrastructures	US$ mn	185	193	138	194	209	149	142	183	444	488	521	558	495	657	623	668
Marketing and promo	US$ mn	15	18	8	16	14	14	10	11	13	15	16	20	17	22	24	22
F. Sub national	**US$ mn**	240	237	168	240	266	206	219	194	276	297	302	309	288	359	357	348
G. Other	**US$ mn**	**212**	**250**	**136**	**197**	**181**	**136**	**76**	**49**	**93**	**73**	**89**	**82**	**48**	**67**	**72**	**71**
VIII Gross unit PSE	**US$/t**	**9**	**14**	**82**	**18**	**21**	**47**	**54**	**45**	**29**	**23**	**19**	**22**	**27**	**20**	**11**	**17**
IX Gross percentage PSE	**%**	**9**	**13**	**42**	**16**	**21**	**48**	**45**	**34**	**25**	**22**	**19**	**23**	**23**	**20**	**8**	**15**

VITA

Nolan Quiros

Candidate for the Degree of

Doctor of Philosophy

Thesis: MEASURING THE IMPACT OF PUBLIC SUPPORT, A POLICY EVALUATION METHODOLOGY AND APPLYING THE POLICY EVALUATION METHODOLOGY TO FAIR ACT 1996

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