

Agricultural Policy Analysis Matrix

The study of agricultural policy spans three levels-microeconomic behaviors of producers, marketing and trade, and macroeconomic linkages. Practitioners of agricultural economics typically give different emphasis to these three topics; micro production issues receive the greatest attention, marketing and trade get less, and macroeconomic links receive little or no coverage. This book argues that excessive specialization precludes successful policy analysis; applied agricultural economists need to understand all of the components of and links among farming systems, domestic and international markets, and macroeconomic policy. Policy analysts have to appreciate feedbacks and tradeoffs within the big picture.

The policy analysis matrix is a product of two accounting identities, one defining profitability as the difference between revenues and costs and the other measuring the effects of divergences (distorting policies and market failures) as the difference between observed parameters and parameters that would exist if the divergences were removed. By filling in the elements of the PAM for an agricultural system, an analyst can measure both the extent of transfers occasioned by the set of policies acting on the system and the inherent economic efficiency of the system.

Profits are defined as the difference between total (or per unit) sales revenues and costs of production. This definition generates the first identity of the accounting matrix. In the PAM, profitability is measured horizontally, across the columns of the matrix, as demonstrated in Table 2.1. Profits, shown in the right-hand column, are found by the subtraction of costs, given in the two middle columns, from revenues, indicated in the left-hand column. Each of the column entries is thus a component of the profits identity-revenues less costs equals profits.

Each PAM contains two cost columns, one for tradable inputs and the other for domestic factors. Intermediate inputs-including fertilizer, pesticides, purchased seeds, compound feeds, electricity, transportation, and fuel-are divided into their tradable-input and domestic factor components. This process of disaggregation of intermediate goods or

services separates intermediate costs into four categories-tradable inputs, domestic factors, transfers (taxes or subsidies that are set aside

Table 2.1: Policy Analysis Matrix

	Revenue	Costs		Profit
	s			
		Tradable Inputs	Domestic	
			Factors	
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergences	I	J	K	L

Table Notes:

Private profits, D, equal A minus B minus C. Social profits, H, equal E minus F minus G. 'Output transfers, I, equal A minus E. Input transfers, J, equal B minus F. Factor transfers, K, equal C minus G. Net transfers, L, equal D minus H; they also equal I minus J minus K.

Ratio Indicators for Comparison of Unlike Outputs:

Private cost ratio (PCR): $C/(A - B)$. Domestic resource cost ratio (DRC): $G/(E - F)$ Nominal protection coefficient (NPC) on tradable outputs (NPCO): A/E on tradable inputs (NPCI): B/F Effective protection coefficient (EPC): $(A - B)/(E - F)$ Profitability coefficient (PC): $(A - B - C)/(E - F - G)$ or D/H Subsidy ratio to producers (SRP): L/E or $(D - H)/E$

in social evaluations), and non tradable inputs (which themselves have to be further disaggregated so that ultimately all component costs are classified as tradable inputs, domestic factors, or transfers).

An example illustrates the process of disaggregating intermediate goods or services. Fertilizer is for most countries a tradable intermediate input. If a particular country is a net importer of fertilizer, the social valuation of a specific kind of fertilizer for its agricultural system is given by the cif (costs, insurance, and freight) import price for that fertilizer plus

the social costs of moving the input to the representative location in the system. Finding the import price is usually straightforward. Finding the social valuation of the domestic marketing costs is another story, however. It is necessary to study the transportation industry-road or rail-and disaggregate the costs into labor, capital, fuel, and so forth. Each type of cost then needs to be further broken down through use of an appropriate world price and an estimate of local transportation costs.

2.1.1. Private Profitability

The data entered in the first row of Table 2.1 provide a measure of private profitability. The term private refers to observed revenues and costs reflecting actual market prices received or paid by farmers, merchants, or processors in the agricultural system. The private, or actual, market prices thus incorporate the underlying economic costs and valuations plus the effects of all policies and market failures. In Table 2.1, private profits, D , are the difference between revenues (A) and costs ($B + C$); and all four entries in the top row are measured in observed prices. The calculation begins with the construction of separate budgets for farming, marketing, and processing. The components of these budgets are usually entered in PAM as local currency per physical unit, although the analysis can also be carried out using a foreign currency per unit.

The private profitability calculations show the competitiveness of the agricultural system, given current technologies, output values, input costs, and policy transfers. The cost of capital, defined as the pretax return that owners of capital require to maintain their investment in the system, is included in domestic costs (C); hence, profits (D) are excess profits-above-normal returns to operators of the activity. If private profits are negative ($D < 0$), operators are earning a subnormal rate of return and thus can be expected to exit from this activity unless something changes to increase profits to at least a normal level ($D = 0$). Alternatively, positive private profits ($D > 0$) are an indication of supernormal returns and should lead to future expansion of the system, unless the farming area cannot be expanded or substitute crops are more privately profitable.

2.1.2. Social Profitability

The second row of the accounting matrix utilizes social prices, as indicated in Table 2.1. These valuations measure comparative advantage or efficiency in the agricultural commodity system. Efficient outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income. Social profits, H , are an efficiency measure because outputs, E , and inputs, $F + G$, are valued in prices that reflect scarcity values or social opportunity costs. Social profits, like the private analogue, are the difference between revenues and costs, all measured in social prices- $H = (E - F - G)$.

For outputs (E) and inputs (F) that are traded internationally, the appropriate social valuations are given by world prices-cif import prices for goods or services that are imported or fob export prices for exportable. World prices represent the government's choice to permit consumers and producers to import, export, or produce goods or services domestically; the social value of additional domestic output is thus the foreign exchange saved by reducing imports or earned by expanding exports (for each unit of production, the cif import or fob export price). Because of global output fluctuations or distorting policies abroad, the appropriate world prices might not be those that prevail during the base year chosen for the study. Instead, expected long-run values serve as social valuations for tradable outputs and inputs.

The services provided by domestic factors of production-labor, capital, and land-do not have world prices because the markets for these services are considered to be domestic. The social valuation of each factor service is found by estimation of the net income forgone because the factor is not employed in its best alternative use. This approach requires the commodity systems under analysis to be excluded from social factor price determination. For example, if land is planted to wheat, it cannot grow barley during the identical crop season; the social opportunity cost of the land for the wheat system is thus the net income lost because the land cannot produce barley. Similarly, the labor and capital used to produce wheat cannot simultaneously provide services elsewhere in agriculture or in other sectors of the economy. Their social opportunity costs are measured by the net income

given up because alternative activities are deprived of the labor and capital services applied to wheat production.

The practice of social valuation of domestic factors begins with a distinction between mobile and fixed factors of production. Mobile factors, usually capital and labor, are factors that can move from agriculture to other sectors of the economy, such as industry, services, and energy. For mobile factors, prices are determined by aggregate supply and demand forces. Because alternative uses for these factors are available throughout the economy, the social values of capital and labor are determined at a national level, not solely within the agricultural sector. Actual wage rates for labor and rates of return to capital investment are therefore affected by a host of policies, some of which may distort factor prices directly. An enforced and binding minimum-wage law, for example, raises the market wage above what it would have been in the absence of policy and causes observed wages to be higher than the social opportunity cost of labor. But indirect effects can also be important. Distortions of output prices cause different activities to expand or contract, altering in turn the demand and prices of mobile domestic factors.

Fixed, or immobile, factors of production are the factors whose private or social opportunity costs are determined within a particular sector of the economy. The value of agricultural land, for example, is usually determined only by the land's worth in growing alternative crops. Because land is immobile, its value is not directly affected by events in the industrial and service sectors of the economy. But the social opportunity cost of farmland is sometimes difficult to estimate. Within any agroclimatic zone, complete specialization in the most profitable crop is rarely observed. Instead, farmers prefer rotations or intercropping systems that reduce risks of income losses from price variability, yield losses, and pest and disease infestation. Therefore, the social opportunity cost of the land is not accurately approximated by the net profitabilities of a single best alternative crop; instead, it is measured by some weighted average of the social profits accruing from the set of crops planted. Because the correct weights and social profits associated with each crop in the set are generally not known, it is convenient in assessing farming activities to reinterpret crop profits as rents to land and other fixed factors (for example, management

and the ability to bear risk) per hectare of land used. This reinterpretation includes private (and social) returns to land as parts of D (and H). Profitability per hectare is then interpreted as the ability of a farming activity to cover its long-run variable costs, in either private or social prices or as a return to fixed factors such as land, management skill, and water resources.

2.1.3. Effects of Divergences

The second identity of the accounting matrix concerns the differences between private and social valuations of revenues, costs, and profits. For each entry in the matrix-measured vertically-any divergence between the observed private (actual market) price and the estimated social (efficiency) price must be explained by the effects of policy or by the existence of market failures. This critical relationship follows directly from the definition of social prices. Social prices correct for the effects of distorting policies-policies that lead to an inefficient use of resources. These policies often are introduced because decision-makers are willing to accept some inefficiencies (and thus lower total income) in order to further non efficiency objectives, such as the redistribution of income or the improvement of domestic food security. In this circumstance, assessing the tradeoffs between efficiency and non efficiency objectives becomes a central part of policy analysis.

But not all policies distort the allocation of resources. Some policies are enacted expressly to improve efficiency by

Table 2.2: Expanded Policy Analysis Matrix

	Revenues	Costs	Profits	
		Tradable Inputs	Domestic Factors	
Private Prices	A	B	C	D
Social Prices	E	F	G	G
Diverges and efficient policy	I	J	K	L
Effects of market failures	M	N	O	P
Effects of distorting policy	Q	R	S	T
Effects of efficient policy	U	V	W	X

Table Notes:

Private profits, D, equal $A - B - C$. Social profits, H, equal $E - F - G$. Output transfers, I, equal $A - E$; they also equal $M + Q + U$. Input transfers, J, equal $B - F$; they also equal $N + R + V$. Factor transfers, K, equal $C - G$; they also equal $O + S + W$. Net transfers, L, equal $D - H$; they also equal $I - J - K$; and they equal $P + T + X$.

Whenever monopolies or monopsonies (seller or buyer control over market prices), externalities (costs for which the imposer cannot be charged or benefits for which the provider cannot receive compensation), or factor market imperfections (inadequate development of institutions to provide competitive services and full information) prevent a market from creating an efficient allocation of products or factors. Hence, one needs to distinguish distorting policies, which cause losses of potential income, from efficient policies, which offset the effects of market failures and thus create greater income. Because efficient policies correct divergences, they reduce the differences between private and social valuations.

Interpretation of the effects of divergences can be clarified by the expansion of the PAM to include six rows, as shown in Table 2.2. In this expanded PAM, each entry measuring the effects of divergences (I, J, K, and L) is disaggregated into three categories—market failures (fourth row), distorting policies (fifth row), and efficient policies (sixth row). The introduction of efficient policies to offset market failures would change the entries in the first and third rows. To bring about perfect efficiency, a government would introduce efficient policies to offset the effects of market failures and avoid distorting policies, thereby ensuring equality of private and social prices.

In the absence of market failure in the product markets, all divergences between private and social prices of tradable output and inputs are caused by distorting policy. Because the principles are identical for all tradable products, the matrix entries for revenues (tradable outputs) and tradable inputs can be considered together. Output transfers, $I = (A - E)$, and

input transfers, $J = (B - F)$, arise from two kinds of policies that cause divergences between observed and world product prices: commodity-specific policies and exchange-rate policy.

Policies that apply to specific commodities include a wide range of taxes or subsidies and trade policy. For example, producer revenues per unit can be raised by producer subsidies (sometimes called deficiency payments in agriculture), tariffs or import quotas on outputs (which raise domestic prices), or domestic price supports enforced by government stockpiling (which require a complementary trade restriction for tradable products). Commodity-specific policies on inputs also affect private profitability. For example, per unit producer costs can be lowered by direct input subsidies or by subsidies on imported inputs.

Typically, PAM accounting is done in domestic currency, but world prices are quoted in foreign currency. Hence, a foreign exchange rate is needed to convert world prices into domestic equivalents. The social exchange rate may differ from observed exchange rates. Undervalued exchange rates reflect an excess supply of foreign exchange that is accumulating as excessive reserves and reducing potential income. Overvalued exchange rates correspond to conditions of excess demand; this demand results in extra foreign borrowing, excessive drawing down of exchange reserves, or rationing of foreign exchange among domestic users.

An overvalued exchange rate is an implicit tax on producers of tradable products because too little domestic currency is earned by exports or paid out for imports. In the absence of commodity policy, the world price of a tradable good determines its domestic price. When the exchange rate is overvalued, the domestic price is lower than its efficiency level and domestic producers are effectively taxed. Undervalued exchange rates exert the opposite effects. Correction for this distortion in PAM is done by conversion of world prices (E and F in the matrix) at the social exchange rate rather than at the official rate. Because exchange rates affect both product prices and factor prices, exchange-rate adjustments are limited to special circumstances—the appearance of multiple exchange-rate regimes or the government's failure to adjust the exchange rate enough to offset the effects of domestic inflation.

The social costs of domestic factors (G) reflect underlying supply and demand conditions in domestic factor markets. Factor prices are thus influenced by the prevailing set of macroeconomic and commodity price policies. In addition, the government can affect factor costs with tax or subsidy policies for one or more of the factors (capital, labor, or land) that create a divergence between private costs (C) and social costs (G). Finally, market imperfections, arising from imperfect information or underdeveloped institutions—which are often characteristic of developing country economies—further influence factor prices. If factor market imperfections exist along with distorting factor policy, both O and S and possibly W are positive components of K. The net transfer, L, thus combines the effects of distorting policy (I, J, and the S part of K) with those of factor market failures (the O part of K) and efficient policies to offset them (the W part of K).

The net transfer caused by policy and market failures (L in the matrix) is the sum of the separate effects from the product and factor markets, $L = (I - J - K)$. (Positive entries in the two cost categories, J and K, represent negative transfers because they reduce private profits, whereas negative entries in J and K represent positive transfers; hence, J and K are subtracted from I, a positive transfer, in the calculation of the net transfer, L.) The net transfer from distorting policy is the sum of all factor, commodity, and exchange-rate policies (apart from efficient policies that offset market failures).

The net transfer can also be found by a comparison of private and social profits. These measures of the net transfer must by definition be identical in the double-entry accounting matrix, $L = (I - J - K) - (D - H)$. Disaggregation of the total net transfer shows whether each distorting policy provides positive or negative transfers to the system. The PAM thus permits comparison of the effects of market failures and distorting policies for the entire set of commodity and macroprice (factor and exchange-rate) policies. This comparison can be made for the complete agricultural system and for each of its outputs and inputs.

2.1.4. Comparisons among Agricultural Systems Producing Different Outputs

The entries in PAM allow comparisons among agricultural systems that produce identical outputs, either within a single country or across two or more countries. In the accounting

matrix, all measures are given as monetary units per physical unit of some commodity. If interest focuses solely on a comparison of one wheat system with another, for example, the matrix entries provide all information necessary for the analysis. Comparisons can be drawn readily by construction of PAM entries for two or more different systems that produce the same quality of wheat. (If necessary, premiums or discounts can be used to correct for quality differences.) Further comparisons can be made between the wheat systems in one country and those in other wheat-producing countries; social exchange rates, incorporating corrections for differential inflation not otherwise offset by exchange-rate changes, are used to convert the other countries' currencies into domestic currency.

Comparisons between wheat and barley-or apples and oranges are another story, however. To permit comparisons among systems producing different outputs, some common numeraire must be generated. One technique involves the expression of all values relative to a constraining domestic factor resource, such as land. A more common method uses ratios. Both the numerator and the denominator of each ratio are PAM entries defined in domestic currency units per physical unit of the commodity. Therefore, the ratio is a pure number free of any commodity or monetary designation.

Private Profitability

For comparisons of systems producing identical outputs, private profits, $D = (A - B - C)$, indicate competitiveness under existing policies. Construction of a ratio is required to permit comparisons among systems producing different commodities. Direct inspection of the data for private profits is not sufficient. Profitability results are residuals and might have come from systems using very different levels of inputs to produce outputs with widely varying prices. This difficulty might not be apparent in wheat versus corn example, but it would arise in a comparison of a wheat system with one producing a high-value crop, such as strawberries. This ambiguity is inherent in comparisons of private profits of systems producing different commodities with differing capital intensities.

The problem is circumvented, by construction of a private cost ratio (PCR)-the ratio of domestic factor costs (C) to value added in private prices (A - B); that is, $PCR = C/(A - B)$.

Value added is the difference between the value of output and the costs of tradable inputs; it shows how much the system can afford to pay domestic factors (including a normal return to capital) and still remain competitive—that is, break even after earning normal profits, where $(A - B - C) = D = 0$. The entrepreneurs in the system prefer to earn excess profits ($D > 0$), and they can achieve this result if their private factor costs (C) are less than their value added in private prices ($A - B$). Thus they try to minimize the private cost ratio by holding down factor and tradable input costs in order to maximize excess profits.

Social Profitability

Social profits measure efficiency or comparative advantage. For a comparison of identical outputs, results can be taken directly from the second row of the PAM matrix—social profits equal social revenues less social costs, $H = (E - F - G)$. When social profits are negative, a system cannot survive without assistance from the government. Such systems waste scarce resources by producing at social costs that exceed the costs of importing. The choice is clear for efficiency-minded economic planners: enact new policies or remove existing ones to provide private incentives for systems that generate social profits, subject to non efficiency objectives.

When systems producing different outputs are compared for relative efficiency, the domestic resource cost ratio (DRC), defined as $G/(E - F)$, serves as a proxy measure for social profits. No new information beyond social revenues and costs is required to calculate a DRC. The DRC plays the same substitute role for social profits as does the PCR for private profits; in both instances, the ratio equals 1 if its analogous profitability measure equals 0. Minimizing the DRC is thus equivalent to maximizing social profits. In cross-commodity comparisons, DRC ratios replace social profit measures as indicators of relative degrees of efficiency.

Policy Transfers

Transfers are shown in the third row of the PAM. If market failures are unimportant, these transfers measure mainly the effects of distorting policy. Efficient systems earn excess

profits without any help from the government, and subsidizing policy ($L > 0$) increases the final level of private profits. Because subsidizing policy permits inefficient systems to survive, the consequent waste of resources needs to be justified in terms of nonefficiency objectives.

Comparisons of the extent of policy transfers between two or more systems with different outputs also require the formation of ratios (for reasons analogous to those offered in the discussions of private and social profits). The nominal protection coefficient (NPC) is a ratio that contrasts the observed (private) commodity price with a comparable world (social) price. This ratio indicates the impact of policy (and of any market failures not corrected by efficient policy) that causes a divergence between the two prices. The NPC on tradable outputs (NPCO), defined as A/E , indicates the degree of output transfer; for example, an

NPC of 1.10 shows that policies are increasing the market price to a level 10 percent higher than the world price. Similarly, the NPC on tradable inputs (NPCI), defined as B/F , shows the degree of tradable input transfer. An NPC on inputs of 0.80 shows that policies are reducing input costs; the average market prices for these inputs are only 80 percent of world prices.

The effective protection coefficient (EPC), another indicator of incentives, is the ratio of value added in private prices ($A - B$) to value added in world prices ($E - F$), or $EPC = (A - B)/(E - F)$. This coefficient measures the degree of policy transfer from product market-output and tradable-input-policies. But, like the NPC, the EPC ignores the transfer effects of factor market policies. Hence, it is not a complete indicator of incentives.

An extension of the EPC to include factor transfers is the profitability coefficient (PC), the ratio of private and social profits or $PC = (A - B - C)/(E - F - G)$, or D/H . The PC measures the incentive effects of all policies and thus serves as a proxy for the net policy transfer, since $L = (D - H)$. Its usefulness is restricted when private or social profits are negative, since the signs of both entries must be known to allow clear interpretation.

A final incentive indicator is the subsidy ratio to producers (SRP), the net policy transfer as a proportion of total social revenues or $SRP = L/E = (D - H)/E$. The SRP shows the proportion of revenues in world prices that would be required if a single subsidy or tax were substituted for the entire set of commodity and macroeconomic policies. The SRP permits comparisons of the extent to which all policy subsidizes agricultural systems. The SRP measure can also be disaggregated into component transfers to show separately the effects of output, input, and factor policies.