Slide 1

Introduction to the Policy Analysis Matrix

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Pearson received his B.S. in American Institutions (1961) from the University of Wisconsin, his M.A. in International Relations (1965) from Johns Hopkins University, and his Ph.D. in Economics (1969) from Harvard University. He joined the Stanford faculty in 1968 and retired in 2002.

The Policy Analysis Matrix introduced in this lecture has been described and applied widely in the literature on agricultural development. A concise summary can be found in Eric A. Monke and Scott R. Pearson, *The Policy Analysis Matrix for Agricultural Development* (hereafter *PAM*), 1989, Chapter 13, pp. 261-265. The *PAM* book also addresses each dimension of the approach in detail in earlier chapters. The PAM approach was first developed in 1981 by researchers at the University of Arizona and Stanford University to study changes in agricultural policies in Portugal. The seminal book applying this analytical approach is Scott R. Pearson *et al.*, *Portuguese Agriculture in Transition*, 1987. An empirical application of this framework to rice in Indonesia is found in Scott Pearson *et al.*, *Rice Policy in Indonesia* (hereafter *RPI*), 1991, Chapter 7, pp. 114-120, 131-137.

Slide 2

Central Issues of Agricultural Policy

- competitiveness and farm profits – before and after policy change
- efficiency and public investment – before and after public investment
- efficiency and agricultural research – before and after new technology

The Policy Analysis Matrix methodology provides information to help policy makers address three central issues of agricultural policy analysis (*PAM*, Chapter 2, pp. 17-18).

One issue is **whether agricultural systems are competitive** under existing technologies and prices – that is, whether farmers, traders, and processors earn profits facing actual market prices. Prospective price policies would change the value of output or the costs of inputs and thus the private profitability of the system. A comparison of private profitability before and after the policy change measures the impact of the policy change on competitiveness.

A second issue is the **impact of new public investment in infrastructure on the efficiency of agricultural systems**. Efficiency is measured by social profitability, the valuation of profits in efficiency prices. Successful public investment (in irrigation or transportation) would raise the value of output or lower the costs of inputs. A comparison of social profits before and after the new public investment measures the increase in social profits.

A third issue is the **impact of new public investment in agricultural research or technology on the efficiency of agricultural systems**. Successful public investment in new seeds, farming techniques, or processing technologies would enhance farming or processing yields and thus increase revenues or decrease costs. A comparison of social profits before and after the investment in research measures the gain in social profitability.

Slide 3

Purposes of the Policy Analysis Matrix

- ranking of competitiveness of systems
- ranking of efficiency of systems
- measurement of transfer effects of policies

The three principal purposes of the Policy Analysis Matrix (PAM) methodology are to provide information and analysis to assist policy makers in these three central areas of agricultural policy (*PAM*, pp. 30-31).

The construction of a PAM for an agricultural system allows one to calculate private profitability – a measure of the competitiveness of the system at actual market prices. Similar analyses of other systems permit a **ranking of the competitiveness of agricultural systems at market prices**. The calculation of private profitability or competitiveness is carried out in the first (top) row of the PAM matrix.

A second purpose of the PAM approach is to estimate the agricultural system's social profitability – the result if products produced and inputs used are valued in efficiency prices (social opportunity costs). Complementary analyses of other systems allow a **ranking of the efficiency of agricultural systems**. The calculation of social profitability is carried out in the second (middle) row of the PAM matrix.

The third purpose of PAM analysis is to **measure the transfer effects of policies**. By contrasting revenues and costs before and after the imposition of a policy, one can determine the impact of that policy. The PAM method captures the effects of policies influencing both products and factors of production (land, labor, and capital). The measurement of the transfer effects of policies is carried out in the third (bottom) row of the PAM matrix.

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Identities of the Policy Analysis Matrix

- profitability identity
  - profits = revenues less costs (tradable inputs, domestic factors)
- divergences identity
  - divergences = private prices less social prices

A matrix is an array of numbers (or symbols) that follows two rules of accounting – one defining relationships across the columns of the matrix and the other defining relationships down the rows of the matrix. These accounting relationships are termed the identities of the matrix because they are true by definition (*PAM*, pp. 18-19).

The **profitability identity** in PAM is the accounting relationship across the columns of the matrix. Profits are defined as revenues less costs. All entries in the PAM matrix under the column defined "profits" thus are identically equal to the difference between the columns containing "revenues" and those containing "costs" (including both costs of tradable inputs and costs of domestic factors).

The **divergences identity** in PAM is the relationship down the rows of the matrix. Divergences cause private prices to differ from their social counterparts. A divergence arises either because a distorting policy intervenes to cause a private market price to diverge from an efficient price or because underlying market forces have failed to provide an efficient price. All entries in the PAM matrix under the third row, defined as "effects of divergences," thus are identically equal to the difference between entries in the first row, measured in "private prices," and those in the second row, measured in "social prices."

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Private Profits in the Policy Analysis Matrix

Revenues	Input Costs	Factor Costs	Profits
Private (observed market) Prices			
A	B	C	D

This slide shows only the entries for **the first row of a PAM**, which **contains measures of prices in private prices (the observed market prices)**. The symbol A measures revenues in private prices, the symbol B stands for tradable input costs in private prices, the symbol C represents domestic factor costs in private prices, and the symbol D is private profit.

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Profitability Identity – Private Profits

- private profit: D = (A-B-C)
- competitiveness of agricultural systems
- private benefit-cost ratio:
- (PBCR) = A/(B + C)

In empirical PAM analysis, the revenue and cost categories in private prices (entries A, B, and C) are based on data from farm and processing budgets. The symbol D, profits in private prices, is found by applying the profitability identity. According to that accounting principle, D is identically equal to A - (B + C). **Private profits in PAM thus are a residual discovered by subtracting private costs from private revenues** (*PAM*, pp. 19-20).

The calculation of private profits, from data in farm and processing budgets, measures the competitiveness of agricultural systems. One key result for agricultural policy thus is obtained from the first row of the PAM matrix.

To compare results from agricultural systems that produce unlike outputs, analysts compute ratios (*PAM*, pp. 25-26). The computation of ratios thus avoids having to compare profits per kilogram of rice, for example, with profits per kilogram of soybeans. The comparison of competitiveness of unlike systems is facilitated by computing **the private benefit-cost ratio (PBCR)** for each system and then comparing these ratios across all the systems. The PBCR **is equal to the ratio of private revenues to private costs, or PBCR = A/(B + C).**

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Social Profits in the Policy Analysis Matrix

	Revenues	Input Costs	Factor Costs	Profits
Social (efficiency) Prices	E	F	G	H

This slide shows only the entries for **the second row of a PAM**, which **contains measures of prices in social prices (prices that would result in the best allocation of resources and thus the highest generation of income)**. The symbol E measures revenues in social prices, the symbol F stands for tradable input costs in social prices, the symbol G represents domestic factor costs in social prices, and the symbol H is social profit. Countries achieve rapid economic growth by promoting activities that generate high social profits (large positive H).

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Profitability Identity – Social Profits

- social profit: H = (E-F-G) – efficiency of agricultural systems
- tradable outputs and inputs – world prices
- domestic factors – social opportunity costs
- social benefit-cost ratio: (SBCR) = E/(F + G)

In empirical PAM analysis, the revenue and cost categories in social prices (entries E, F, and G) are based on estimates of the social opportunity costs of commodities produced and inputs used in production. These estimated social (or efficiency) prices then are applied to the original quantities of outputs and inputs (those used in the calculation of private profits in the top row of PAM). The symbol H, profits in social prices, is found by applying the profitability identity. According to that accounting principle, H is identically equal to E - (F + G). **Social profits in PAM thus are a residual discovered by subtracting social costs from social revenues** (*PAM*, pp. 20-22).

The calculation of social profits, from estimates of social prices applied to input-output data in farm and processing budgets, measures the efficiency of agricultural systems. A second key result for agricultural policy thus is obtained from the second row of the PAM matrix.

The social (efficiency) prices for tradable outputs and inputs are the comparable world prices – import prices for commodities that are partly imported (importable) or export prices for commodities that are partly exported (exportable). The value (social opportunity cost) of producing an additional ton of an importable commodity (e.g., rice in Indonesia) is the amount of foreign exchange saved by replacing a ton of imports – given by the import price. Similarly, the social opportunity cost of producing an additional ton of an exportable commodity (e.g., palm oil in Indonesia) is the amount of foreign exchange earned by increasing exports by a ton – given by the export price.

The social (efficiency) prices for domestic factors of production (land, labor, and capital) are estimated also by application of the social opportunity cost principle. **Because domestic factors are not tradable internationally and thus do not have world prices, their social opportunity costs are estimated through observations of rural factor markets**. The intent is to find how much output and income are foregone because the factor is used to produce the commodity under analysis (e.g., rice) rather than the next best alternative commodity (e.g., sugarcane).

To compare social results from agricultural systems that produce unlike outputs, analysts again compute ratios. Comparison of the efficiency of unlike systems is done by computing **the social benefit-cost ratio (SBCR)** for each system and then comparing these ratios across all the systems. The SBCR **is equal to the ratio of social revenues to social costs, or SBCR = E/(F + G).**

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Divergences Identity in the Policy Analysis Matrix

Revenues	Input Costs	Factor Costs	Profits
Private			
A	B	C	D
Social			
E	F	G	H
Divergences			
I	J	K	L

This slide shows all twelve entries for a PAM, given by the letter symbols A through L. It adds a third row termed the Effects of Divergences row. As noted above (slide 3), **divergences arise from either distorting policies or market failures; either source of divergence causes observed market prices to differ from their counterpart efficiency prices** (*PAM*, pp. 22-25). The symbol I measures divergences in revenues (caused by distortions in output prices), the symbol J stands for divergences in tradable input costs (caused by distortions in tradable input prices), the symbol K represents divergences in domestic factor costs (caused by distortions in domestic factor prices), and the symbol L is the net transfer effect (arising from the total impact of all divergences).

In empirical PAM analysis, the effects of divergences (in the third, bottom row) are found by applying the divergences identity. According to that accounting principle (slide 3), **all entries in the PAM matrix under the third row (defined as effects of divergences) are identically equal to the difference between entries in the first row (measured in private prices) and entries in the second row (measured in social prices)**. Therefore, I is identically equal to (A – E), J is identically equal to (B – F), K is identically equal to (C – G), and L is identically equal to (D – H).

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Divergences Identity

- market failures – monopolies/monopsonies, externalities, factor market imperfections
- efficient policy – corrects market failures
- distorting policy – creates divergences
- most efficient outcome – offset market failure, remove distorting policy

One source of divergence is the existence of a market failure. A market fails if it does not generate competitive prices that reflect social opportunity cost and lead to an efficient allocation of products or factors. Three basic types of market failures create divergences. The first is monopoly (seller control over market prices) or monopsony (buyer control over market prices). The second are negative externalities (costs for which the imposer cannot be charged) or positive externalities (benefits for which the provider cannot receive compensation). The third are factor market imperfections (inadequate development of institutions to provide competitive services and full information).

Efficient policy is a government intervention to correct a market failure and thus offset a divergence. For example, successful regulation of a monopoly would reduce seller prices, cause private and social prices to become equal, and increase income.

The second source of divergence is distorting government policy. Distorting policy prevents an efficient allocation of resources to further non-efficiency objectives (equity or security) and thus creates divergences. A tariff on rice imports, for example, could be imposed to raise farmer incomes (equity objective) and increase domestic rice production (security objective), but it would create efficiency losses if the replaced rice imports were cheaper than the costs of domestic resources used to produce the additional rice (as explained in the fifth lecture in this series). Hence, a trade-off would arise, and policy makers would need to assign weights to these conflicting objectives to decide whether to introduce the tariff.

The most efficient outcome could be achieved, in principle, if the government were able to enact efficient policies that offset market failures and if the government were to decide to override non-efficiency objectives and remove distorting policies. If these actions – the introduction of efficient policies and the removal of distorting policies – could be carried out, divergences would be offset and the effects of divergences (measured in the bottom row of PAM) would be zero. In this idealized example, all entries in the bottom row of the PAM matrix – I, J, K, and L – would be zero and the entries in the top row would be identical to those in the second row, i.e., private revenues, costs, and profits would be the same as social revenues, costs, and profits (A = E, B = F, C = G, and D = H).

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Research Inputs for Efficiency and Policy Analysis

- identities, research inputs, and research results
- research inputs – from budgets for systems
  - private revenues (A)
  - private tradable input costs (B)
  - private domestic factor costs (C)
  - social revenues (E)
  - social tradable input costs (F)
  - factor divergences (K)

Of the twelve entries in the PAM matrix, only six need to be data or research inputs. The remaining six entries then can be found as research results by applying the profitability or divergences identities.

Most of the data for the six research inputs are obtained from the activity budgets (farming, marketing, and processing) for each agricultural system. The **data for private revenues (A) and costs (B, C) typically come directly from these budgets**. These budgets usually are based on both secondary data (gathered by other researchers) and primary data (obtained by the field research team).

The **entries for social revenues (E) and social tradable input costs (F) come partly from the system budgets and partly from government documents or industry sources**. Information on input-output relationships (quantities of inputs needed per hectare or per ton of output) typically are assumed to be the same in both private and social analysis and thus are obtained from the system budgets (and then from the first row of PAM). However, social prices differ from their private counterparts if distorting policy or market failures cause divergences. The social prices for tradable outputs and inputs are comparable import or export prices, found in government or industry documentation.

The entries for social valuation of domestic factor costs (G) cannot be observed directly in the field or taken from government or industry documents (because comparable world prices do not exist for factors). Instead, field researchers study rural factor markets to search for the presence or absence of divergences in each factor market – effective distorting policies or significant market failures. Hence, the **entry for factor divergences (K) becomes a research input, which is then used to estimate social factor prices from observed private factor prices**. This empirical procedure is described in the lecture on factor markets.

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Research Inputs in the Policy Analysis Matrix

	Revenues	Input Costs	Factor Costs	Profits
Private	A	B	C	D
Social	E	F	G	H
Divergences	I	J	K	L

The six categories of **research inputs in empirical PAM analysis (A, B, C, E, F, and K) are underlined in the PAM matrix** shown on this slide.

Slide 13

Research Results from Efficiency and Policy Analysis

- research results – from subtraction in PAM
  - private profits (D)
  - social profits (H)
  - output transfers (I)
  - input transfers (J)
  - social factor prices (G)
  - net transfers (L)

Research results in the PAM approach flow directly from application of either the profitability identity or the divergences identity. Since these accounting principles govern the relationships in the PAM matrix, the key results are obtained from straightforward subtraction among entries of research inputs.

The first two results – private profits (D) and social profits (H) – are obtained from application of the profitability identity (revenues less costs equal profits). Private profits (D), a measure of competitiveness, equal private revenues (A) less private costs (tradable input costs (B) and domestic factor costs (C)). Similarly, social profits (H), a measure of efficiency, equal social revenues (E) less social costs (tradable input costs (F) and domestic factor costs (G)). The calculation of social profits (H), however, must await the estimation of social factor prices (G), itself a research result.

The next two results – output transfers (I) and tradable input transfers (J) – are obtained from application of the divergences identity (entries in private prices less entries in social prices equal the effects of divergences). Output transfers (I), a measure of the implicit tax or subsidy on outputs, equal private revenues (A) less social revenues (E). In turn, tradable input transfers (J), a measure of the implicit tax or subsidy on tradable inputs, equal private tradable input costs (B) less social tradable input costs (F).

The last two results – social factor prices (G) and net transfers (L) – are less straightforward. As noted above (slide 10), **social factor prices (G) are found by adjusting private factor prices (C) for observed divergences causing factor price transfers (K)**. Because the divergences identity requires that (C – G) = K, it is also true that (C – K) = G. The final result, **net transfers (L), can be found by applying either the profitability identity (I – (J + K) = L) or the divergences identity (D – H = L)**. The net transfer (L) thus can be interpreted either as the net effect of all divergences or as the difference between private and social profitability. This single measure thus shows the extent to which distorting policies and market failures implicitly subsidize an agricultural system (by transferring resources into the system) or tax that system (by transferring resources away from the system).

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Research Results in the Policy Analysis Matrix

	Revenues	Input Costs	Factor Costs	Profits
Private	A	B	C	D
Social	E	F	G	H
Divergences	I	J	K	L

The six categories of **research results in empirical PAM analysis (D, G, H, I, J, and L) are underlined in the PAM matrix** shown on this slide.