Scott Pearson is Professor of Agricultural Economics at the Food Research Institute, Stanford University. He has participated in projects that combined field research, intensive teaching, and policy analysis in Indonesia, Portugal, Italy, and Kenya. These projects were concerned with studying the impacts of commodity and macroeconomic policies on food and agricultural systems. This effort culminated in a dozen co-authored books. These research endeavors have been part of Pearson’s longstanding interest in understanding better the relationships between a country’s policies affecting its food economy and the underlying efficiency of its agricultural systems.

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.

For convenience in teaching the PAM approach, all of the costs of primary domestic factors of production – wage, interest, and land rental costs – are considered together in the matrix column titled domestic factor costs. However, each factor market and sub-market is studied separately in the empirical application of PAM. In practice, there are separate columns of data entries for each type and quality of factor (e.g., skilled male labor).

Domestic factor costs are treated differently from tradable input costs because there are no international prices for domestic factors that appropriately establish their social opportunity costs. A portion of some domestic factors, such as labor and capital, is mobile and receives employment abroad. But the opportunity costs of these factors are set in domestic markets not in international markets. Wage, interest, and land rental rates are determined mostly by domestic supply and demand for factors, not by opportunities to employ factors overseas. Factors thus are not fully tradable internationally, and there are no international factor prices that can serve as good approximations of domestic opportunity costs.

This absence of world prices for factors means that social (or efficiency) prices for factors have to be approximated. The approach used in PAM analysis is to find the social prices of factors by adjusting the observed private prices for divergences. 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 then is used to estimate social factor prices from observed private factor prices (slide 10, lecture 2).
In PAM analysis, **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 \( C - K = G \) (slide 12, lecture 2). In empirical application of PAM, the entries for \( G \) cannot be observed directly or found by using international prices. Hence, the entries for \( C \) and \( K \) are research inputs and those for \( G \) are research results.

**Fragmentation in Factor Markets**

- **fragmentation** – separation of factor sub-markets – immobility, no free entry/exit
- **immutable fragmentation** – regional land markets
- **causes of fragmentation in factor markets**
  - market imperfections – institutions, information
  - policy distortions

**Fragmentation** is the separation of factor sub-markets caused by immobility of factors or lack of free exit and entry. When fragmentation occurs, a factor sub-market is not well integrated and differing factor prices are observed from one fragment of the market to another.
In seeking to find the extent of factor transfers (K), the PAM researcher’s task is to identify the causes of factor market fragmentation.

All factor markets are fragmented to some degree, by geography or types of actors. Some fragmentation is immutable. Regional land markets differ by distance from urban centers or ports, agro-climatic zone, soil quality, and slope of land. In some regions land has higher agricultural productivity than in others. Differing land rental rates reflect these physical differences and agricultural productivities and are not necessarily indicative of imperfections in the land markets.

Other fragmentation is caused by factor market failures. In rural areas of developing countries, institutions to assist the provision of factor services often are in short supply or entirely missing. Imperfect capital markets, for example, arise when banks or other providers of financial intermediary services are poorly represented in rural areas. In other instances, the lack of reliable information networks cause factor markets to fail to operate efficiently. Rural laborers seeking daily work need to know where employment can be found.

Much fragmentation is caused by distortions, policies that cause the costs of factors to be higher (taxing factor use) or lower (subsidizing factor use) than their efficient, market-determined costs. Some governments in developing countries enact regulations to set ceilings (usually for interest rates) or floors (usually for wage rates) for factor prices in hopes of speeding development or redistributing income. Other governments tax or subsidize factor use. Legislated employer contributions to pension or health care plans for their employees increase the costs of hiring labor and tax labor use. Subsidized interest rates decrease the cost of borrowing capital for those who benefit from them.

**Slide 5**

**Empirical Study of Factor Markets**

- consider each factor market separately
- search for likely market failures
- study impacts of distorting policies
- identify extent of fragmentation
The concept of fragmentation is useful for empirical study of factor markets. The researcher begins by separately considering each factor market and its sub-markets (e.g., skilled and unskilled, male and female laborers constitute four sub-markets within the labor market).

Next within each factor sub-market, the researcher looks for the causes and extent of fragmentation. If fragmentation is immutable, such as within regional land markets, it is noted but not included as a source of divergence in land rental rates.

Other fragmentation can be caused by divergences – market failures or distorting policies. The often complicated task for the field researcher is to try to sort out how much of the observed fragmentation is due to market failures – lack of institutions or information – and how much is due to distorting government policies – regulations or taxes/subsidies.

An illustration of factor transfers in a Portuguese wheat system is given in PAM, pp. 232-233 and Box 12.4, p. 234 (slide 10, lecture 3).

**Slide 6**

**Factor Price Determination**

- demand for factors – varies with factor and output prices and with factor productivity
- supply of factors – determined by individual decisions to provide labor (labor-leisure trade-off), capital, or land services
- factor market equilibrium – price determined simultaneously by demand for and supply of each factor

The demand for factors of production is mostly a derived demand. Some factors are hired directly by people who benefit from the factor services, but most factors are used in the production of other goods and services. Therefore, the demand for factors varies with changes in factor and output prices and with the productivity of factors in production processes. Firms demand factor services only to the extent that it is profitable for them to employ the factors. Higher factor prices thus translate immediately into lower demand by firms for the services of the more costly factors.

The supply of factors is determined by individual decisions of factor owners to provide factor services. Each individual capable of providing labor or management skills establishes how much he or she will be willing to work at various rates of remuneration (known as the labor-leisure trade-off). Owners of capital (savers) decide how much they will save and make available to others (borrowers) at various rates of interest. Similarly, owners of land decide how
much land they will rent out according to the rental rates they will receive. In all three instances, more factor services will be offered at higher rates of return for those services.

Price determination in factor markets then takes place in a manner similar to that discussed for goods (lecture 4). The factor market is in equilibrium when the amount of factor services offered at a given factor price equals the amount of those services demanded at that price. **Price formation thus is a simultaneous process determined by the joint actions of the willingness of factor owners to provide factor services and the desire of firms and others to hire those factors.** The factor price will be determined efficiently unless the market is fragmented by the presence of market failures or distorting policy.

**Slide 7**

<table>
<thead>
<tr>
<th>Estimation of Factor Prices</th>
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<tbody>
<tr>
<td>- observe private market prices</td>
</tr>
<tr>
<td>- identify extent and causes of fragmentation</td>
</tr>
<tr>
<td>- natural – immutable</td>
</tr>
<tr>
<td>- market failures – changeable, if better institutions</td>
</tr>
<tr>
<td>- distortions – policy induced</td>
</tr>
<tr>
<td>- compare factor prices across fragments</td>
</tr>
<tr>
<td>- check freedom of entry/exit in fragments</td>
</tr>
</tbody>
</table>

The social (efficiency) prices for domestic factors of production (land, labor, and capital) are estimated 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) (slide 7, lecture 2).

The empirical estimation of social prices of factors of production involves making a series of educated guesses. The estimated parameters are at best approximations. Formal modeling procedures cannot give reliable estimates for developing countries.

The **process of approximating social factor prices begins by observing and collecting private market prices for each type and quality of factor of production** used in the agricultural system under analysis. These data on private factor prices then are entered in box C in the PAM.
The next step is to **identify the extent of fragmentation of factor markets and its causes – natural (immutable), market failure (changeable with institutional development), and distortion (policy-induced)**.

Fragmentation results if the prices for one type of factor differ across sub-markets. **PAM field researchers need to compare prices for the same type and quality of factor across separated (fragmented) markets to identify the extent of fragmentation**.

Important evidence of the existence or lack of market failures is obtained by checking the degree of freedom of entry or exit of factors in the fragmented markets. **If providers of factor services can easily move into and out of sub-markets, it is unlikely that monopolies or monopsonies are responsible for the differing factor prices**.

If market failures do not seem to be causing the fragmentation, the divergence must be caused by distorting policy. The researcher then searches for the existence of enforceable policies that would cause the market fragmentation. After identifying the market failures and distorting policies (the entries in K in the PAM), the social factor prices (G) are found by adjusting the observed private factor prices (C) for the divergences (K), since \( G = (C - K) \) (slide 9, lecture 3).

**Slide 8**

![Estimation of Social Wage Rates](image)

- classify by categories – gender, age, skill
- search for market failures, policy distortions
- correct market wage rates for divergences
  - effectiveness of minimum wage laws
  - effectiveness of trade unions in raising wages

To compile detailed farm budgets, **PAM researchers classify labor into categories according to gender (female or male), age (child or adult), and skill level (unskilled, semi-skilled, skilled, or managerial)**. The key issue is whether labor productivity differs enough between categories to cause differences in equilibrium wage rates. The observed data on private wage rates (multiplied by the labor input coefficients) are then entered into box C in the PAM.
The next step is to search for the existence or lack of market failures and of policy distortions in each labor sub-market. Quantitative estimates of these divergences are then entered in box K of the PAM as a research input.

Two types of market failures that might affect rural labor sub-markets in developing countries are monopsonies or oligopsonies (where one or a few large hiring firms collude to depress wage rates) and trade union power (where an organized group of workers legally forces wages upward). Easy entry and exit of laborers in each sub-market is strong evidence of the ineffectiveness of market power exercised by either hiring firms or trade unions.

Two types of distorting policies that might affect rural labor sub-markets in developing countries are minimum wage laws (discussed above in slides 6 and 7) and pension and health insurance taxes (where the government requires employers to contribute to their employees’ pension and health plans and thus raises the cost of hiring labor). These kinds of policies are widespread in developing and developed countries, but they often are not well enforced in agriculture (except in plantations and processing plants). Policies that do not change labor costs, because they are not widely enforced, are ineffective and can be ignored in PAM analysis.

Estimation of social wage rates is discussed in PAM, pp. 203-207 and illustrated for Portuguese agriculture in Box 11.3, pp. 206-207.

Slide 9

<table>
<thead>
<tr>
<th>Estimation of Private Interest Rates</th>
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<tbody>
<tr>
<td>- private interest rates – sources of credit</td>
</tr>
<tr>
<td>- family savings (farm, off-farm) – lowest</td>
</tr>
<tr>
<td>- formal credit market (banks) – moderate</td>
</tr>
<tr>
<td>- informal credit market (kiosks) – higher</td>
</tr>
<tr>
<td>- money lenders (local) – highest</td>
</tr>
<tr>
<td>- subsidized credit – rarely representative</td>
</tr>
</tbody>
</table>

Both private and social interest rates need to be estimated in PAM analysis. During each interview with a farmer, trader, or processor, it is desirable to seek information on sources of credit and on the private interest rates paid with each credit source. Four sources of agricultural credit are commonly found in developing countries.

Farm household savings, from on-farm and off-farm activities, often provide most finance in farming because they usually are the lowest cost.
Formal credit market institutions, such as commercial and government banks and other financial institutions, typically offer relatively little lending to small-scale farmers and traders, although their interest rates are moderate. These institutions are under-represented in rural areas and have high collateral requirements.

Kiosk-owners and other traders that sell fertilizer and related agricultural inputs often are an important source of credit for farmers, although with quite high interest charges. Informal credit flows between farmers, on one side of the transaction, and traders or suppliers of labor services, on the other, can vary across seasons so that farmers are borrowers in one part of the year and lenders in another.

Local money-lenders generally are the most expensive source of agricultural credit. Because their interest charges can exceed 10 percent per month, farm households avoid money-lenders for agricultural production and use them mostly in family emergencies.

Some governments offer subsidized agricultural credit. The subsidized interest rates are rarely representative of the private interest rates facing farmers because the subsidy programs typically fail to reach most farmers. PAM field researchers need to ascertain the effectiveness of subsidized credit programs to judge the rate of subsidy for representative farmers in the agricultural systems under study (and thus the entry in box K in the PAM).

Slide 10

Estimation of Social Interest Rates

- classify capital by categories – working capital, investment capital
- capital market failures usually widespread – private interest rate thus a poor approximation
- use arbitrary rule of thumb – from social returns to capital in other countries

Capital costs in PAM analysis are classified into two categories – working capital and investment capital. Working capital is the finance that a farmer, trader, or processor needs to cover cash costs of production (purchased inputs, hired labor, storage) within a production year. Investment capital refers to expenditures on assets that provide productive services for periods longer than one year. With investment capital, costs are incurred in one (or a few) year(s) but benefits (or productive services) are spread over a number of future years.
Capital market failures are usually widespread in developing countries because of the shortage of financial institutions in rural areas. The observed private interest rates (previous slide) thus typically are a poor approximation of the social interest rates even if the government does not intervene with distorting policies, such as rural credit subsidies or interest rate ceilings. 

Because of the complexity of possible market failures and distorting policies affecting rural credit markets, it is virtually impossible to measure the extent of these divergences. In PAM analysis (and in most other applications of social benefit/cost analysis), researchers are forced to adopt a different approach to estimate social interest rates. In principle, the social return to capital is represented by the rate of return on the next public or private investment that would be undertaken with additional investment funds. In practice, to estimate the social rates of interest for working capital and for investment capital, PAM researchers use an arbitrary rule of thumb – the experience of other developing and developed countries when they were at similar levels of development as the country in question.

Estimation of social interest rates is discussed in PAM, pp. 200-203 and illustrated for Portuguese agriculture in Box 11.2, pp. 204-205.

**Slide 11**

<table>
<thead>
<tr>
<th>Estimation of Social Land Rental Rates</th>
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<tbody>
<tr>
<td>• social valuation of land – social profit (H)</td>
</tr>
<tr>
<td>from best alternative use of land (with land costs excluded) – land a fixed factor</td>
</tr>
<tr>
<td>• in PAM analysis – social profit (H) typically estimated as returns to land and management – unless alternatives studied</td>
</tr>
</tbody>
</table>

**Land is a fixed factor in agricultural production.** Unlike labor and capital, which are mobile and can move to alternative activities, land is immobile. Unless the land happens to be located near an urban center and has residential or industrial uses, the opportunity cost of land planted to one crop (or cropping rotation) depends on its value in growing the next best alternative crop. Farmers allocate their land according to the relative profitability of various crops (along with household food needs and risk). The value of agricultural land in land sales markets or in land rental markets depends on its productivity and hence its profitability for farmers who might buy or rent in the land.

The social valuation of land follows the social opportunity cost principle (slide 15, lecture 2). From the point of view of the country, the social land rental rate is found by estimating the
social profit (H) of the land in its best alternative use when all costs of land are excluded. For example, the social cost of using a plot of land to grow rice in one season is found by estimating the foregone social profit from not planting that land to the next most profitable crop (e.g., sugarcane). However, this approach requires the researcher to identify the best alternative crop and to carry out a full PAM analysis on it.

If it is not practical to study the alternative crops that might substitute for the crop of primary interest, a different approach can be taken in PAM analysis. Profitability is redefined to include returns to land and management (rather than only returns to management). Land costs then are omitted from both private and social calculations. Because of the difficulty and expense of studying alternative crops to estimate social land rental rates, many PAM analysts adopt this modified approach.

Estimation of social land rental rates is discussed in *PAM*, pp. 207-209 and illustrated for Portuguese and Mexican agriculture in Box 11.4, pp. 210-211.

Slide 12

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**Factor Price Estimation for Indonesian Agriculture – Labor**

- rural labor – social prices approximated by private prices
  - distortions are minimal
  - fragmentation is limited

- urban labor – private wages exceed social wages
  - minimum wage
  - social legislation

Estimation of social factor prices can be illustrated with reference to an ongoing series of PAM analyses of Indonesian agriculture carried out by researchers from CASER (CASER project papers). A comparative PAM study of rice systems in Indonesia, carried out in the late 1980s by Stanford’s Food Research Institute, is reported in Scott Pearson *et al.*, *Rice Policy in Indonesia* (hereafter *RPI*), 1991, Chapter 7, pp. 115-120, 131. An empirical study of the rural labor market in Indonesia by Rosamond Naylor is found in *RPI*, Chapter 5, pp. 58-85.

Both the Stanford and the CASER studies find minimal divergences affecting rural labor markets in Indonesia. Distortions are insignificant, because the minimum wage legislation is not enforced in agriculture and has limited impact elsewhere in the Indonesia economy. Fragmentation across labor sub-markets is minor, because of free entry and exit across sub-markets, good information on job opportunities, and widespread use of labor contractors.
Therefore, the private wage rates for all categories of rural labor are good approximations for the social wage rates (in PAM terms, K is minimal, so G about equals C).

This conclusion does not hold true in the urban labor markets in which much of the post-farm processing and marketing take place. The wage rates for all categories of labor in the urban markets are influenced by two kinds of policy distortions, although not by market failures. Minimum wage legislation is enforced in urban markets, but the distortions are very small since the minimum wage rate is not much different from the comparable market wage rate. In the urban labor markets, social legislation (for pensions and medical insurance) is enforced and causes somewhat higher labor costs. Adjustments thus are made for these distorting policy impacts (in PAM terms, K is slightly positive, reflecting a small tax on labor, so G is less than C).

Slide 13

Factor Price Estimation for Indonesian Agriculture – Capital and Land

- investment capital – social interest rate – 10-15 percent plus rate of inflation
- working capital – social interest rate – 15-20 percent plus rate of inflation
- land – valued at social profit of best alternative use of land – if possible

The CASER and Stanford studies also provide current and historical estimates of social prices for capital and land in Indonesian agriculture.

For capital investment, the private interest rates vary widely (among different financial intermediaries, types of borrowers, and locations). Based on the experience of other countries at comparable stages of development, the social interest rate for capital investment in Indonesia is likely to be about 10-15 percent per annum (plus the rate of inflation).

For working capital, the private interest rates also vary widely. From other countries’ experiences, the social interest rate for working capital in Indonesia is likely to be about 15-20 percent per annum (plus the rate of inflation).

The private land rental rate in Indonesian agriculture differs according to land quality and location (usually reflecting the private profitability of farming). Where possible, the social land rental rate is found by valuing land at the social profitability of the next best
alternative crop (or cropping rotation). Otherwise, private and social profitability are re-defined to include the returns to land and management.

Slide 14

Note to Lecturers – Supplemental Slides

- The following five slides could be omitted, since this lecture is long and complicated
- If time permits, you might choose to include the two slides on labor market distortions (after slide 5) and leave out the three on capital market distortions
- It is best not to omit the last two slides on estimation of factor prices in Indonesia
Some distorting polices are regulations intended to raise the prices of factors of production. A typical example is a minimum wage law. To favor laborers (an equity objective), governments enact minimum wage laws. But unless the higher costs of labor are reflected in high labor productivity, firms hiring labor will be forced to use less labor in their production processes. The minimum wage regulation thus creates inefficiencies and is a distorting policy.

In developing countries, a minimum wage policy usually is enforceable only in large, urban firms, in government service, and on plantations. These firms are known as the formal sector. The policy is not enforceable in small urban firms and in small-scale agriculture, the part of the economy known as the informal sector.

The minimum wage policy increases the cost of labor for firms in the formal sector. Firms facing higher wage payments then hire less labor, either by reducing production or by replacing labor with capital equipment or other inputs. Some workers lose their jobs. At the same time, the higher minimum wage rate creates a greater demand for employment among those who want to give up some of their leisure. The result is an excess supply of labor in the formal labor market.

The minimum wage law creates labor market fragmentation by introducing a policy-induced difference between the formal and informal wage rates. Some of the laborers who have lost their formal sector jobs will shift to the informal sector to seek work (even though they will receive a lower wage rate). This increase in the supply of laborers in the informal market lowers the wage rate there. The minimum wage law thus fragments the labor market in two ways – directly, by raising the wage rate in the formal sector, and indirectly, by lowering the wage rate in the informal sector (because it causes some laid-off workers to shift to the informal sector).
The distortion in the labor market caused by introduction of a minimum wage policy is illustrated in the diagrams in this slide. **Before the policy is enacted, it is assumed that laborers can move freely between the formal and informal sectors.** The two sub-markets thus are integrated and the wage rate is identical in the formal market, the informal market, and the integrated market.

The minimum wage law then is introduced and is effective only in the formal labor market. The minimum wage rate set by the policy is higher than the equilibrium wage rate. **At the higher minimum wage rate, an excess supply of labor is created in the formal market** (because firms lay off some of their workers and some laborers enter the market looking for jobs at the higher wage rate).

Initially, the minimum wage legislation has no impact on the wage rate in the informal labor market since the law is not enforceable there. However, **some workers who have lost their formal sector jobs seek employment in the informal sector**, shifting the supply of labor rightward in that sector. **This action thus lowers the wage rate in the informal sector** and creates a further distortion, even though the minimum wage legislation is not enforced in that sector.

The equilibrium wage rate in the informal market can be approximated by adjusting upward the observed wage rate, using the ratio of formal to informal employment.
Distortions in Capital Markets

- reduced cost of capital – interest rate ceiling
- creates excess demand for credit – need to ration capital in formal credit market
- not enforceable in informal credit market
- causes fragmentation in credit market – some excess demanders shift from formal to informal market, raising interest rate there

Other distorting polices are regulations intended to lower the prices of factors of production. A typical example is an interest rate ceiling. To favor borrowers (an equity objective), governments enact interest rate ceilings. But the interest rate ceiling creates a disincentive for saving and encourages investment in projects with low rates of return. The interest rate ceiling thus creates inefficiencies and is a distorting policy.

In developing countries, an interest rate ceiling usually is enforceable only in large, mostly urban financial institutions. These firms are known as the formal capital market. The policy is not enforceable in the multitude of small lending firms and for individual money-lenders, known as the informal credit market.

The interest rate ceiling decreases the cost of credit for firms in the formal credit market who are fortunate enough to receive loans. But the supply of credit is reduced because fewer savings are made at the lower interest rate. At the same time, the lower cost of credit creates a greater demand for borrowing. The result is an excess demand for credit in the formal credit market.

The interest rate ceiling creates credit market fragmentation by introducing a policy-induced difference between the formal and informal interest rates. Some of the borrowers who have lost their formal sector loans will shift to the informal sector to seek credit (even though they will have to pay a higher interest rate). This increase in the demand for borrowing in the informal credit market raises the interest rate there. The interest rate ceiling thus fragments the credit market in two ways – directly, by reducing the interest rate in the formal credit market, and indirectly, by increasing the interest rate in the informal sector (because it causes some borrowers who have lost their formal sector loans to shift to the informal sector).
The distortion in the credit market caused by introduction of an interest rate ceiling policy is illustrated in the diagrams in this slide and the following one. **Before the policy is enacted, it is assumed that lenders and borrowers can move freely between the formal and informal credit markets.** The two sub-markets thus are integrated, and the higher interest rate in the informal credit market is explained by the greater transactions costs of lenders relative to those in the formal market (because of small loans, low collateral, and high risks of default).

The interest rate ceiling then is introduced and is effective only in the formal credit market. The interest rate set by the policy is lower than the equilibrium interest rate if bribery and corruption are minimal and the policy is enforced. **At the lower interest rate, an excess demand for credit is created in the formal market** (because the supply of savings is reduced and the demand for credit is increased). However, if the rules for allocating credit are lax and corruption is widespread in rationing credit, the effective interest rate could rise to levels at or above the initial equilibrium interest rate in the formal credit market.
Initially, the interest rate ceiling has no impact on the interest rate in the informal credit market since the law is not enforceable there. However, some borrowers who have lost their formal sector loans seek to borrow in the informal sector, shifting the demand for credit rightward in that sector. This action thus raises the interest rate in the informal sector and creates a further distortion, even though the interest rate ceiling is not enforced in that sector.