

Ministry of Agriculture and Agrarian Reform

NAPC

National Agricultural Policy Center

TRAINING MATERIALS

Economic Development, Agriculture and Macroeconomic Policies

Nadia Cuffaro

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and Agrarian Reform**

Foreword

The present volume is part of the series “Training Materials”, published by the National Agriculture Policy Center (NAPC) with the support of the FAO Project GCP/SYR/OO6/ITA. The series includes notes and handouts produced as part of the training activities carried out at the NAPC by the international experts recruited by the Project. Even though they cannot be considered as comprehensive textbooks, the NAPC decided to make these materials available for a wider public, considering them as a useful reference for the study and the practice of agricultural economics and policy analysis.

The FAO Project, which is generously funded by the Italian Government and executed in close coordination with the Syrian Ministry of Agriculture and Agrarian Reform (MAAR) has been supporting the establishment of a cadre of professional agricultural policy analysts for the NAPC and other institutions involved in the Syrian agricultural policy making process. This undertaking encompassed an intensive training activity articulated over two programs involving, in a five year period, a total of about 130 officials of the MAAR. Each training program comprised a set of intensive courses to provide theoretical background and familiarize with issues, concepts, methods and tools needed to carry out policy analyses. The set of courses was completed by on-the-job research experiences on issues of relevance for Syrian agricultural development, whose results have been published by the NAPC’s Working Papers series. The formal training programs were also accompanied by seminars, shorter intensive courses and participation in research activities, which are still on-going as part of NAPC’s staff capacity building process.

Training was part of a wider undertaking in institutions’ building for agricultural policy analysis. Indeed, the Project has been providing support to the institutional development of the NAPC, its technical capacity to analyze, formulate and monitor agricultural policies, and its capacity to maintain and develop a comprehensive set of statistical information for the economic analysis of policies (the Syrian Agriculture Database).

This volume presents part of the training material of the program of study on “Economic Development, Agriculture and Macroeconomic Policies” delivered by Prof Nadia Cuffaro. The main aim of this training material is to allow the reader to understand the general agricultural policy setting, in a given country, taking into consideration the stage of development and the global economic context faced by that country, together with the interaction between macroeconomic and agricultural sector policies.

In response to this aim this paper provides: a comparative presentation of agricultural systems and global trends in agricultural trade; an introduction to the role of agriculture in economic development (and its implications for strategic orientation of agricultural policies); an overview of the interrelationship between macro and agricultural policies (with a focus on the impacts of macro policies reform programs on the agricultural sector and the consideration of the role institutions’ play). This latter issue is presented within the framework of the so called “New Institutional Economics”.

Damascus, December 2003

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Chapter 1 - Economic adjustment in developing countries

The term “adjustment” has come to mean a set of policy reforms usually made conditional for the receipt of IMF and World Bank finance.

More generally adjustment refers to a set of policy reforms instituted by government and designed to bring about changes in both the direction and performance of economic activity.

A common set of problems has plagued many developing countries since the early 1980s including:

- severe balance of payments deficits
- large levels of external debt
- investment and growth slowdown or even decline

1.1. Endogenous causes of disequilibria

The main endogenous causes of disequilibria were maintenance of overvalued exchange rates, accompanied by excessive government borrowing, including foreign borrowing leading to rising external debt service problems.

Overvalued exchange rates were often pursued in order to cheapen the import price of intermediate goods considered essential as inputs to the development process, or to maintain cheap food supplies to a growing urban working class.

Government borrowing was often incurred to fund social programs. In addition, governments were expected to meet employment objectives, and thus often over-expanded public sector employment.

1.2. Exogenous causes of disequilibria

The main exogenous causes of disequilibria were:

- (i) External economic shocks: international interest rates; international terms of trade;
- (ii) Structural problems
- (iii) Random factors

(i) A major problem for many poor countries has been the accumulation of substantial foreign debts during periods of relatively low international interest rates, for example, after the oil price hikes of the early 1970s, only to see rates rise dramatically during the early 1980s, creating, in some cases, a cycle of debt and further impoverishment.

Many of the poorest countries typically rely on a small number of commodities for their export earnings -commodities for which demand is often stagnant- and import manufactures and

intermediate products. It is difficult to generalize regarding international terms of trade movements because countries vary in the commodity composition of their exports and imports. However data suggest that the purchasing power of the poorest countries' exports has declined over the last two decades.

(ii) Most developing countries inherited a common set of constraints from the period of colonialism which have combined with a set of development objectives to produce in many cases a highly interventionist bias to economic policy. The structural constraints were typically: poorly developed physical infrastructure; very limited marketing services; outside of agriculture, productive and trading activities mainly controlled by non-nationals. The lack of an indigenous private sector stimulated the growth of the public sector, and the tradition of government control of economic activity.

(iii) As for random factors, civil unrest, and population shifts have played a part in the many economic crises affecting the poorest countries.

1.3. Programs

Economic adjustment involved two distinct components: macroeconomic adjustment and structural adjustment.

Macroeconomic adjustment (sometimes referred to as 'stabilisation') refers to policy changes designed to reduce or eliminate budget and external disequilibria. The policy changes involve short-term remedies for current problems and primarily influence the demand side of the economy. Typically a program would include devaluation of the exchange rate, increased taxation and reduced government expenditure, restructuring of foreign debt, elimination of subsidies, decreased wages, restricting domestic credit, government financing through the market (rather than the Central Bank).

Structural adjustment refers to policy changes designed to influence the supply side of the economy in order to ensure that in the long-term the disequilibria which called for stabilization will not re-occur. Structural adjustment policies are wide-ranging and affect the supply side of the economy through changes in the structure of production and measures to ensure a more efficient allocation of available resources.

The emphasis is upon increasing the role of the private sector and market reform so that prices are more in line with market forces. A standard structural adjustment package would include: trade liberalization, market liberalization, privatization of public enterprises, increased efficiency in remaining public sector activities, reform of labor and capital markets, removal of distortions in important economic sectors

1.4. Macroeconomic adjustment

Aggregate demand is the total amount of goods demanded in the economy. Distinguishing among goods demanded for consumption (C), for investment (I), by the government (G), and net exports –i.e. exports (X)- imports (M)

$$AD=C+I +G+X-M \quad (1)$$

The equilibrium level of income (Y) is such that the quantity of output produced -which in turn equals income - is equal to the quantity demanded.

$$Y=AD=C+I+G+X-M \quad (2)$$

Income can either be spent for consumption (C), saved (S) or paid in taxes (T), therefore we can write the equilibrium condition as

$$Y=C+S+T=AD=C+I+G+X-M \quad (3)$$

Rearranging we obtain

$$(M-X) = (I-S) + (G-T) \quad (4)$$

Equation 4 implies that if there is a current account deficit it will equal the sum of deficit in domestic savings plus the fiscal deficit.

Often public sector deficits have been the principal cause of balance of payments deficits. If government spends more revenue than it receives, this spending puts additional income in the hands of consumers. Consumers spend this additional income either on non-tradable goods or on tradables, including imports.

Prices of non-tradables are determined by domestic forces of supply and demand, prices of tradables are determined in the world market. Therefore excess demand for non-tradables results in domestic inflation. Excess demand for tradables result in more imports. If the country is prepared to endure inflation, public sector deficit can be sustained by printing money. But trade deficits may become unsustainable. Macro balance may be secured by policies operating on the fiscal deficit, the saving deficit or the trade deficit single or simultaneously.

Rearrange equation 4 to get:

$$(I + G) - (S + T) = (M - X) \quad (5)$$

We assume that the variables I, G and X are exogenous, that is independent of other variables within the model, while the variables S, T, and M are endogenous, as they depend on income.

Consider the left-hand side. Given the assumptions above, as national income or output rises (I + G) will remain constant, while (S + T) will increase, thus the whole expression will *decline*.

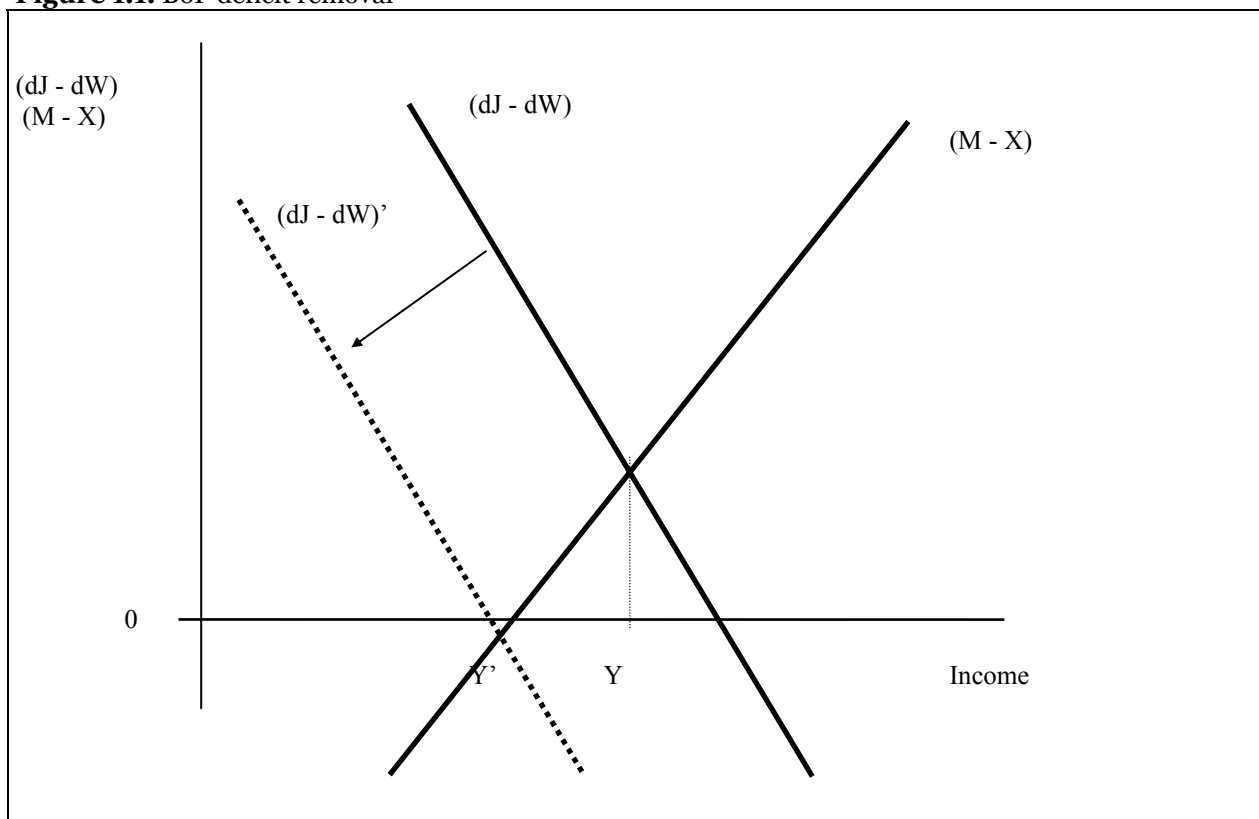
On the right-hand side, as income rises, imports increase while exports remain unchanged. Thus (M - X) is an *increasing* function of national income.

These results are described in figure 1.1, where (I + G) - (S + T) is expressed as (dJ - dW) -or domestic injections minus domestic withdrawals-, and it is a decreasing function of income. The balance of payments deficit is equal to zero at the point where the (M - X) function (which is increasing in income) crosses the horizontal axis. The intersection of the two lines gives us the equilibrium income (Y). In this case equilibrium occurs above the horizontal axis implying that the economy has a current account deficit.

This deficit can be removed through one of the following measures:

- (i) expenditure reduction: (1) a shift to the left of the (dJ - dW) function to (dJ - dW)'- for example through a reduction in government spending (G); (2) through a change in the slope of (dJ - dW) - for example through an increase in taxation (T);
- (ii) expenditure switching: a shift to the right of the (M - X) function. For example through currency devaluation;
- (iii) some combination of expenditure reduction and switching.

Figure 1.1. BoP deficit removal



Source: Rao, 2001

An expenditure-reducing policy reduces the overall level of spending by domestic residents. Some of this reduction in spending will stem from reduced spending on imports, which will in a direct way help a country adjust to an adverse external shock. Expenditure-reducing policies are also important as a way of curbing what would otherwise be the inflationary effects of expenditure switching policies.

Governments can seek to reduce the overall level of spending by residents in three ways: 1. reduce their own spending, cutting government programs or reducing public investment; 2. induce cuts in private consumption by raising taxes or cutting subsidies; 3. private borrowing can be constrained by limits on credit creation by the banking system.

However, all of these policies, in addition to reducing expenditure on imports, reduce demand for domestic goods and thus lead to unemployment and excess capacity. This consequence can be mitigated by combining the policies with expenditure switching policies¹.

The term expenditure switching refers to the spending of both indigenous and foreign residents. Attempts to cut imports without an overall cut in domestic spending require that indigenous residents shift their demand from foreign to domestic products. Attempts to increase exports require that foreign residents do the opposite.

¹ Beyond this common feature, however, the various types of expenditure reducing policies differ in important ways. Cuts in government programs means scaling back or eliminating the objectives of those programs. Tax increases or subsidy cuts strike directly at the living standards of the population and sometimes provoke strong political reactions. Credit restriction is less immediately a source of distress but has serious longer-run consequences because it strikes primarily at investment and thus at the economy's longer-run growth prospects. In some adjustment experiences severe credit restraint has sharply reduced investment as a share of GDP.

The main policy instruments with which governments attempt to switch expenditure are devaluation, on the one hand, and commercial policy -tariff, quotas, export subsidies- on the other.

1.4.1. Devaluation as switching policy

Devaluation implies that, for given world prices, prices received per unit of exports or per unit of import substitute (tradables) in national currency increase relative to prices of non-tradables. Therefore

- (1) Productive resources shift from non-tradable to tradables. Production of these commodities is stimulated
- (2) Consumption demand shifts from tradables to non tradables

Table 1. Devaluation

Commodity	Value per unit at various exchange rates (Syrian pounds per dollar)	
	50:1 US\$10	100:1 US\$5
Exportable at domestic price of SYP 500 per unit	500	1000
Exportable at world price of US\$10	500	1000
Importable at world price of US\$7 per unit	350	700

A depreciation of the exchange rate means that not only does the price of imports increase in terms of domestic currency, but also import substituting commodities become more competitive. For example, devaluation would raise the price of imported cereals and increase demand for domestically produced cereals. The price of domestically produced cereals rises (up to point where it equals the import price) and production increases replacing imports. Similarly, exchange rate depreciation causes the domestic price of exported commodities to fall in terms of foreign exchange and to rise in terms of domestic currency thus stimulating production.

For the rest of the world what counts are prices expressed in foreign currency. Depreciation means that, given the domestic price, the unit price of the exportable, in dollars, decreases (as in the table above (row 1)). Domestic producers and consumers react to prices in domestic currency: for a given world price, devaluation increases the internal price of the exportable (row 2) and of the importable (row 3).

1.4.2. Policy-mix

The main problem of expenditure-switching policies is that they tend to be inflationary. This aspect is very apparent when such policies are pursued by an economy that is operating at or near capacity. Increased demand as exports grow and indigenous residents shift from foreign to home goods will, in this case, push against limited supply and drive up the prices of domestic goods.

Even when the economy is not near capacity, expenditure-switching policies typically have at least an initial inflationary effect on the prices of imported goods. If this increase in import prices leads to a demand for wage increases, and these wage increases are then reflected in domestic prices, the result will be inflationary.

Inflation is undesirable in itself and can, in addition, defeat the adjustment process, as it will lead to a real appreciation of the domestic currency, which will undo the very expenditure-switching effects that were the aim of the policy. If a country then applies further expenditure-switching measures, the process will be repeated and can lead to ever accelerating inflation.

The best answer lies in a combination of expenditure-switching and expenditure-reducing policies. Suppose that inflation would be a problem only if demand exceeded the economy's capacity and the government could calculate the effect of its policies with precision. Governments could fine-tune their policies as follows: use expenditure switching to reduce imports and increase exports by the desired amounts and use expenditure-reducing policies to cut domestic demand by just enough to keep overall demand for domestic products from exceeding capacity. This textbook solution would produce a one time jump in import prices but would then leave the economy continuing to produce at full capacity with an improved trade balance. The policy would not be painless -expenditure-reducing policies involve real costs, and expenditure-switching policies also reduce real incomes- but it would achieve its aims at relatively low cost.

In practice however adjustment programs are almost always more costly and lead to at least a temporary economic downturn and excess capacity and to at least a temporary acceleration of inflation. One reason is uncertainty. Governments are not sure enough about the effect of their policies to fine-tune them and, when they finally decide to adjust to an external shock, often prefer to err on the side of too much adjustment rather than too little. The main reason however, is that inflationary impacts of expenditure-switching policies do not, unfortunately, occur only when the economy is at capacity. To control inflation, countries resort to harsher expenditure-reducing policies that the textbook solution would suggest, and thus suffer recessions and excess capacity.

1.5. Some important definitions

Nominal GDP is simply the sum of the quantities of final goods produced times their current price. Nominal GDP increases over time for two reasons. The first is that the production of most goods increases over time. The second is that the price of most goods increases over time. **Real GDP** is the sum of the quantities produced times their price in the base year.

Inflation is a sustained rise in the general level of prices, in the price level. The inflation rate is the rate at which the price level increases. Macroeconomists typically look at two measures of the price level: the GDP deflator and the consumer price index. **The GDP deflator:** suppose that nominal GDP, $\$Y_t$ increases but that real GDP, Y_t remains unchanged. Then clearly the increase in nominal GDP must be due to the increase in prices. This motivates the definition of the **GDP deflator**,

$$P_t = \$Y_t / Y_t.$$

The GDP deflator gives the average price of the goods included in GDP, thus the final goods produced in the economy. However consumers care about the average price of the goods they consume.

The **consumer price index** gives the cost of a given list of goods and services over time. The list attempts to replicate the consumption basket of a typical consumer.

Macroeconomic 'problems': There is no need to explain why macroeconomists worry about the unemployment rate. We may instead ask why do economists care about inflation and deficits (budget and trade).

If higher inflation meant just a faster proportional increase in all prices and wages (pure inflation), not affecting relative prices, it would not be a problem. But there is not such thing as pure inflation. Economists see high inflation as affecting income distribution, and creating both distortions and uncertainty, making harder for firms to make decisions about the future, such as investment decisions.

Economists care also about budget deficits (the excess of government expenditure over government revenue) and trade deficits (the excess of imports from the rest of the world over exports to the rest of the world) for the same reasons that you care about your own deficit (excess of your spending over your income). When your spending exceeds your income and you are accumulating debt, you know that sooner or later you will have to repay.

A government that runs a deficit accumulates debt over time. Higher debt means higher interest payments on the debt. To finance the higher interest payments the government must either increase taxes or lower spending elsewhere. It may still make sense for a government to borrow if expenditures are unusually high, such as during a war or after an earthquake. Otherwise deficits may be unwise.

A country that runs a trade deficit is buying more from abroad than it is selling abroad, and thus is accumulating debt vis-a-vis the rest of the world. Again this may make sense: borrowing to finance investment, which in turn leads to higher output later, can easily be justified.

Thus the reason economists look and worry about budget and trade deficits is that they may signal a need for painful adjustment in the future.

Openness in goods and financial markets Openness covers three distinct notions:

Openness in goods markets: the opportunity for consumers and firms to choose between domestic and foreign goods. Measures are: ratio of imports or exports to GDP; proportion of total output composed of tradable goods (goods that compete with foreign goods in either domestic or foreign markets)

Openness in financial markets: the opportunity for financial investors to choose between domestic and foreign financial assets (without capital controls)

Openness in factor markets: the opportunity for firms to choose where to locate production and for workers to choose where to work and whether or not to migrate.

Nominal exchange rate (E): in this course we define it as the number of units of domestic currency you can get for one unit of foreign currency. For example when looking at the exchange rate between country A and the United States from the viewpoint of country A (so that the domestic currency is A-currency) E denotes the number of A-currency one can get for 1 dollar.

Exchange rates can change. These changes are called nominal appreciation or nominal depreciation. An appreciation of the domestic currency is an increase in the price of domestic currency in terms of the foreign currency: E decreases. A depreciation is an increase in E.

Nominal exchange rate:	Number of A -currency per dollar
Appreciation of A-currency	Price of dollar in A-currency decreases
E ↓	Equivalently:
	Number of A-currency per dollar decreases
Depreciation of A-currency:	Price of dollar in A-currency increases
E ↑	Equivalently:
	Number of A-currency per dollar increases

(Note that devaluation refers to a discrete reduction in the traded value of a currency in response to deliberate government intervention, whereas depreciation describes the gradual fall in the exchange rate in response to market forces).

Exchange rates can be fully market determined by the interaction of demand for foreign exchange (arises from import demand and capital outflows) and supply of foreign exchange (arises from exports and capital inflows) This is known as flexible exchange rates. If a country's imports exceed its exports and the country experiences an overall deficit in the balance of

payments, the demand for foreign exchange will exceed its supply resulting in a rise in the price of foreign currency (depreciation of domestic currency -a rise in E-).

In contrast, there are fixed rates. In this case the central bank of a country must be ready to sell (buy) foreign currency whenever there is an excess demand (supply) of foreign currency at the official rate. Selling of foreign currencies is possible for a longer period of time if the country has sufficient reserves of such currencies.

Until very recently most developing countries have followed a fixed exchange rate system or some variants of it.

Tradable and non tradable goods Tradables are goods and services which are profitable to either import or export

A commodity is considered

Tradable: importable if $P_d > P_w \cdot (1 + t)$; exportable if: $P_d(1 + t) < P_w$

Non-tradable if:

$$P_w/(1 + t) < P_d < P_w(1 + t).$$

Where t= rate of transport cost

The following factors are the most common reasons for non-tradability:

- (i) Perishability. Highly perishable commodities are expensive to store and transport over long distances because of the high proportion of waste which ensues. Perishability not only depends upon the physical characteristics of the commodity, but also on both the resources and technology available for processing, preserving and storing. These can change over time.
- (ii) Bulkiness Commodities with a low value per unit of weight will be relatively costly to transport, and therefore less viable to trade.
- (iii) Factor and commodity services The services involved in the sale of labour and land but not capital, are usually non-tradable, although there are exceptions. Most commodity services - transport, housing and the majority of services provided by government such as education and health - are, by definition, non-tradable.

The real exchange rate (Country A) ϵ

$$\text{Real exchange rate } \epsilon = \frac{EP_f}{P_d}$$

Where

Pf=price of country B goods in B-Currency

EPf=price of country B goods in A-currency

Pd=Price of country A goods in A-Currency

RER Appreciation and depreciation (from the point of view of country A)

RER:	Price of country <i>B</i> goods in terms of country <i>A</i> goods
Real appreciation:	
<i>A</i> goods are relatively more expensive	Price of <i>B</i> goods in terms of <i>A</i> goods decrease $\varepsilon \downarrow$
Real depreciation:	
<i>A</i> goods are relatively less expensive	Price of <i>B</i> goods in terms of <i>A</i> goods increases $\varepsilon \uparrow$

In empirical estimations, the RER is often proxied as

$$RER = EP_w/P_d$$

where *E* is the nominal exchange rate, P_w is the foreign price index for imports and exports and P_d is the domestic price index, presumably heavily weighted by the home goods sector (as with the consumer price index). Indeed, an important interpretation of the real exchange rate is

$$RER = (\text{Price of tradables}) / (\text{Price of non tradables})$$

The real exchange rate is one of the most important variables for an open economy, since it is a crucial determinant of a country external competitiveness. A depreciation of the RER means an improvement in international competitiveness. RER reflects two possible sources of changes in overall competitiveness. The competitiveness improves if (1) the domestic rate of inflation is lower than the foreign rate for a given *E*; (2) If *E* depreciates for a given ratio of domestic and foreign price levels.

Purchasing Power Parity (PPP) There are two versions of PPP -absolute and relative PPP. The absolute PPP is derived from the 'law of one price' which depends on commodity price arbitrage: buying from low price sources and selling to high price locations in order to take profit from price differentials among different locations. This process ensures that prices of homogenous products are eventually equalized across countries. In a macroeconomic sense, the national price levels will tend to equalize so that

$$\varepsilon = \frac{EP_f}{P_d} = 1$$

and therefore

$$E = \frac{P_d}{P_f}$$

This implies that if the domestic inflation rate is higher than the trading partner's inflation rate, the exchange rate depreciates against the currency of the trading partner.

If the PPP holds² the RER will always be unity, so that any rise (fall) in the foreign price level would be fully offset by an appreciation (depreciation) of the nominal exchange rate.

² Note however that the holding of PPP may be prevented by: different weights used in calculating national price indexes; differentiated products instead of homogeneous products; trade restrictions; non tradability of some goods and services; transport costs.

If RER falls below one, a country competitiveness declines, suggesting that the current nominal exchange is **overvalued**. This can be offset by a nominal depreciation (a rise in E).

Typically, developing countries' nominal exchange rates are found to be overvalued and this is the basis for the World Bank/IMF prescription for a currency devaluation when a country faces a serious balance of payment problem.

In Syria the exchange rate system has undergone considerable change in the last decade. The starting point was a system of multiple and fixed exchange rates, the process was a gradual unification of the exchange rates accompanied by a significant nominal devaluation of the Syrian pound in relation to the US\$ and other currencies. Because of relatively moderate inflation rates the nominal devaluation has also resulted in a devaluation of the real exchange rate. However there may be need for further adjustment

Table 2. The Balance of Payments of a country

Current account		
Exports (of goods and services)	698	
Imports (of goods and services)	804	
Trade Balance (deficit=-) (1)		-106
Investment income received (by A residents on their holdings of foreign assets)	134	
Investment income paid (to foreign residents on their holdings of A assets)	150	
Net investment income (2)		-16
Net transfers received (3) (foreign aid)		-34
Current account balance (1)+(2)+(3)		-156
Capital account		
Increase in foreign holdings of A assets	314	
Increase in A holdings of foreign assets	125	
Net increase in foreign holdings/net capital flows to A		189
Statistical discrepancy		33

The current account deficit of country A implied that the country had to borrow 156 from the rest of the world, or equivalently, that net foreign holdings of A assets had to increase by 156. Capital account transactions describe the way this result was achieved. . The net increase in A foreign indebtedness (net capital flows to A) was $314-125=189$. The net capital flows conceptually should be equal to the current account deficit. In practice however data problems determine a statistical discrepancy between the two (33).

By definition the balance of payments always balances. That is any deficit (surplus) in current account (CA), should be matched by a surplus (deficit) in capital account (KA). More capital can be encouraged by raising the domestic interest rate. However if capital inflows are not sufficient, the adjustment happens through changes in the exchange rate. For example if the deficit in CA exceeds the surplus in KA the exchange rate depreciates, exports increase and imports decrease. However, if a country prevents adjustments in exchange rates (under a fixed or managed exchange rate system) any discrepancy between CA and KA will be matched by changes in official reserves of foreign currencies. A country is said to suffer from a balance of payments crisis when deficits in CA are not matched by surpluses in KA and the country does not have enough reserves to fill the gap. It is at this point that developing countries approach the World Bank and/or the International Monetary Fund (IMF) for external adjustment loans.

Terms of Trade

The terms of trade (TOT) is the ratio of the price of exports to the price of imports: $TOT=P_x/P_m$ where P_x is the export price index (weighted average price of a typical basket of exports) and P_m is the import price index (weighted average price of a typical basket of imports)

Chapter 2 - Agricultural Sector Policies

2.1. The Macroeconomic Environment and Agricultural Price Incentives

Governments affect agriculture directly through sector-specific measures including tariffs, input and credit subsidies, price controls, quantitative restrictions, and government expenditures and taxes. Indirectly, government policies often have unintended effects on agriculture. Policies concerning industrial protection, exchange rates, interest rates and other fiscal and monetary policies can strongly influence the incentives for agriculture vis-à-vis other sectors.

For instance, industrial protectionism penalizes agriculture because it affects negatively its terms of trade with industry, while exchange rate overvaluation penalizes agriculture because most agricultural goods are tradable. The combination of industrial protectionism and exchange rate overvaluation was common in many developing countries before adjustment. This scenario of economic policy implied a ‘macroeconomic bias’ against agriculture.

When agricultural price incentives were studied at the end of the eighties, it was found that direct price interventions generally taxed agricultural exports and protected import substitutes, such as cereals. However, when including the effects of industrial protectionism and exchange rate overvaluation, the result was a stronger negative protection of traditional agricultural exports and a significant reduction or a change of sign in the positive protection to import substitutes.

In a general equilibrium framework, agricultural incentives could be defined in terms of the relative price of agricultural to non-agricultural products.

Both types of goods can be divided into tradable (T) and non tradable (home) (H),

$$\frac{P_A}{P_{NA}} = \frac{\beta P_{AT} + (1 - \beta) P_{AH}}{\alpha P_{NAT} + (1 - \alpha) P_{NAH}} \quad (1)$$

$$\alpha, \beta < 1$$

where P_A is price in the agricultural sector, P_{NA} is price in the non-agricultural sector. The subscripts T and H refer to tradable and home (non-tradable) goods, respectively. Since most agricultural goods are tradable, the value of β is usually taken to be very close to one. The expression simplifies to the following form

$$\frac{P_A}{P_{NA}} = \frac{P_A}{\alpha P_I + (1 - \alpha) P_H} \quad (2)$$

Where we now indicate the prices of the non-agricultural tradable (industry) and non tradable sector simply with P_I and P_H . If we divide both the numerator and the denominator of this expression for P_H we can rewrite it as

$$\frac{P_A}{P_{NA}} = \frac{P_A/P_H}{\alpha P_I/P_H + (1 - \alpha)} \quad (3)$$

The relative price of agricultural goods to non-agricultural goods can change as a result of changes in the price of agricultural goods, non-agricultural tradable goods (industrial) or home goods.

An increase in the price of non-agricultural goods resulting from industrial protection using tariffs or other restrictions will lower the relative price of agricultural products. Industrial protection may also result in higher prices of agricultural inputs such as fertilizer, which will reduce the value added of agriculture. Finally, an increase in the relative price of home goods will adversely affect the relative price of agriculture to non-agriculture, reducing the value of the numerator more than the value of the denominator in equation (3) (since the value of α is usually significantly less than 1).

2.2. Empirical evidence

“Direct policies” refers to the impact of border taxes and other explicit interventions in the agricultural price structure. ‘Indirect policies’ refers to the impact of exchange rates which are distorted by policy away from their equilibrium level.

Trade parity price is the price that would prevail in the domestic price structure under conditions of no policy intervention, i.e. the price level determined by market forces in two markets: the world market for the commodity in question, and the market for foreign exchange (which, given the world price, determines the local currency price).

Nominal Protection Coefficient: ratio of the actual domestic price of a commodity to its trade parity price. Ratios lower than one suggest that producers are taxed and consumers subsidised by policies.

At the end of the eighties studies on the direct and indirect impact of government policies on the nominal protection coefficient associated with various commodities in a number of developing countries showed that these policies often depressed producer prices.

The taxation of agriculture through sector-specific price interventions, and through trade, exchange rate, and other macroeconomic policies was examined for a wider sample of developing countries in studies (by Krueger, Schiff, and Valdés) that had a great influence on thinking about the relationship between agriculture and the macroeconomic environment and on agricultural policy.

Their conclusions were:

- Most countries protected importables. On average, the direct protection of importables was about 18 percent, and the direct taxation of exportables about 16 percent, for an average impact (on the relative price of importables to exportables) of about 40 percent.

These distortions within agriculture increased between the early 1960s and the mid-1980s.

- The indirect tax on agriculture from industrial protection and macroeconomic policies was about 22 percent on average for the eighteen developing countries studied during 1960-85, nearly three times the direct tax from agricultural pricing policies (which was about 8 percent). The total (direct plus indirect) was thus 30 percent.
- Direct price policies stabilized domestic agricultural prices relative to world prices, with an average reduction in variability of 25 percent, and even more when world prices were highly volatile. Indirect policies contributed little, if anything, to price stability.
- Industrial protection policies taxed agriculture more than did real overvaluation of the exchange rate.
- Public investment in agriculture did not compensate for adverse price policies.
- High taxation of agriculture was associated with low growth in agriculture, and low growth in the economy.
- The effect of removing agricultural price interventions was not regressive. In most countries, removing direct (or total) interventions changed the real incomes of the poorer urban and rural groups by less than 5 percent (up or down). More often than not, the rural poor gained from removing the interventions.
- The contribution of agriculture to fiscal revenues has fallen over time, and is, on average, small.

2.3. Evolution of policies

“First generation” reforms associated with structural adjustment were designed to reduce or eliminate the taxation of agriculture. Thus, the fundamental thrust of structural adjustment conformed to the principle of getting the intersectoral price relations in line with world prices.

Almost two decades of experience with macro-economic stabilization and market oriented policy reforms and the consequent, generalized but uneven, pace of withdrawal of the state from economic activities related to food and agriculture have left a number of questions still unanswered or only partly answered.

Reforms were implemented as a response to unsustainable situations, created by a combination of external conditions and ill-focused policies. An issue in evaluating the impact of reforms on different aspects of agricultural and rural development is: “what if reforms were not to take place?” Such a counterfactual scenario, albeit very difficult to construct, may nevertheless lead to a more precise evaluation of the effects of policies put in place to deal with the crisis.

Major issues are:

1) The impact that policy reforms have had on the performance of the agricultural sector and on the level and distribution of incomes, particularly in rural areas.

It was assumed that poverty would be eliminated automatically by unleashing economic growth. Governments were advised to put all of their resources in the sectors likely to produce the greatest economic growth. This led, in the agricultural sector, to emphasis on high-value export crops, commercial farmers, high-potential zones, peri-urban agriculture and areas with a high population density that are well-served by market infrastructure.

Faced with budgetary cuts, resources were withdrawn from traditional food crops, subsistence farmers, and marginal agro-ecological zones and remote areas with a low population density.

2) The design of the reforms themselves, including their intended timing and sequencing.

The design of policy reforms has in most cases adhered to a pre-established, uniform pattern without proper consideration for the particularities of regions and countries. Timing and sequencing of reforms have often been called into question. Fundamental in this respect has been the need for the development of an institutional infrastructure (legislative framework, private property regulations, system of contracts, banking supervision) in parallel with the process of privatization and liberalization. Haste and confidence in the "big bang" approach, the conviction that "getting prices right" would per se lead to efficient market systems may have led to a relative neglect of institutional aspects of reforms. Especially evident is, in this regard, the case of some transition economies. But the same applies to a large number of low-income countries as well.

3) An important issue is the capacity of the private sector to fill the vacuum left by reduced government intervention in the provision of agricultural services and inputs. The public sector role in provision has been generally reduced but the response of private operators –their capacity to replace public intervention in such activities- has not always been timely and effective. Sometimes governments gave exclusive rights to major private or domestic firms, institutionalizing barriers to entry. In other cases, imports were limited to particular brands, resulting in a restricted access by farmers to the broader range of choices available in the international market.

The private sector may not have an incentive to participate in the marketing of agricultural inputs because of thin markets or lack of credit. In many instances there were categories of farmers and rural people damaged or left out altogether due to the disappearance or decrease in public interventions in research and extension, seed, fertilizer and pesticide provision or subsidization, management of market channels, repairs and maintenance of rural infrastructure.

"Second generation" reforms differ from the first in that their explicit goal is poverty alleviation. Market-led economic growth is seen to be a necessary but insufficient condition for poverty alleviation. This involves recognition that governments can play a positive role both in facilitating growth and in improving the conditions of the poor directly: first, by improving the delivery of health, education and social safety nets to the rural poor; second, by providing technical services and economic infrastructure that are neglected by the market, especially in relation to smallholders; and third, supporting the development of proper marketing institutions to ensure that smallholders can actually benefit from integrating into the market. Most of these interventions involve institutional reform.

For the purpose of analysis, developing countries can be divided into three broad categories: (i) those which have not yet undergone structural adjustment, (ii) those which are in the process of implementing "first generation" policy reforms and (iii) those which are making the transition from "first generation" to "second generation" policy reforms.

Most countries in the first category have (or had until now) strong enough growth to resist international pressures to dismantle state control over their economies, particularly in Asia. Most of the second category includes countries from sub-Saharan Africa and Latin America which embarked on agricultural policy reform in connection with structural adjustment. The third category includes African countries which started to implement first generation agricultural policy reforms at the time of structural adjustment and have subsequently gone on to implement comprehensive institutional reforms in the agricultural sector.

2.4. Agriculture in economic development: patterns

The share of agriculture in a country's labor force and total output declines in both cross section and time series samples as incomes per capita increases.

The term structural transformation refers mainly to this change in the sectoral composition of output and employment, with the agricultural sector declining, and the manufacturing and service sector increasing their shares.

At least two mechanisms explain this decline: (1) Because growth is led by demand patterns and because demand for the products of the agricultural sector is inelastic (income elasticity of demand is less-than-unit) the gross value sales by farmers will grow less rapidly than gross domestic product³. (2) During the development process of all the countries that have now high income, technical change in agriculture was very fast. Agricultural productivity, measured by output per laborer or output per hectare, increased so rapidly that the long-run terms of trade declined for farm products. Lower prices thus exacerbated the sluggish demand growth due to low income elasticity. The combination put pressure on agricultural resources to move out of farming and into the more rapidly growing sectors of the economy.

Rapid agricultural growth must precede or accompany general economic growth. There are many reasons for this, but the most obvious is that if agriculture output were stagnant the expansion of the non agricultural sector and consequent increase in demand for food would result in higher food prices, and this in turn would reduce the growth of the rest of the economy. Also, if labor has to move out of agriculture, this additional food must be produced by a smaller number of workers: agricultural productivity growth is a condition for industrialization.

The long term historical record from the process of growth of the presently developed countries shows that the share of agriculture in output declined, but its share in the labor force declined more rapidly. This implies that labor productivity in agriculture (although its level was less than in the rest of the economy), rose more rapidly than in the rest of the economy.

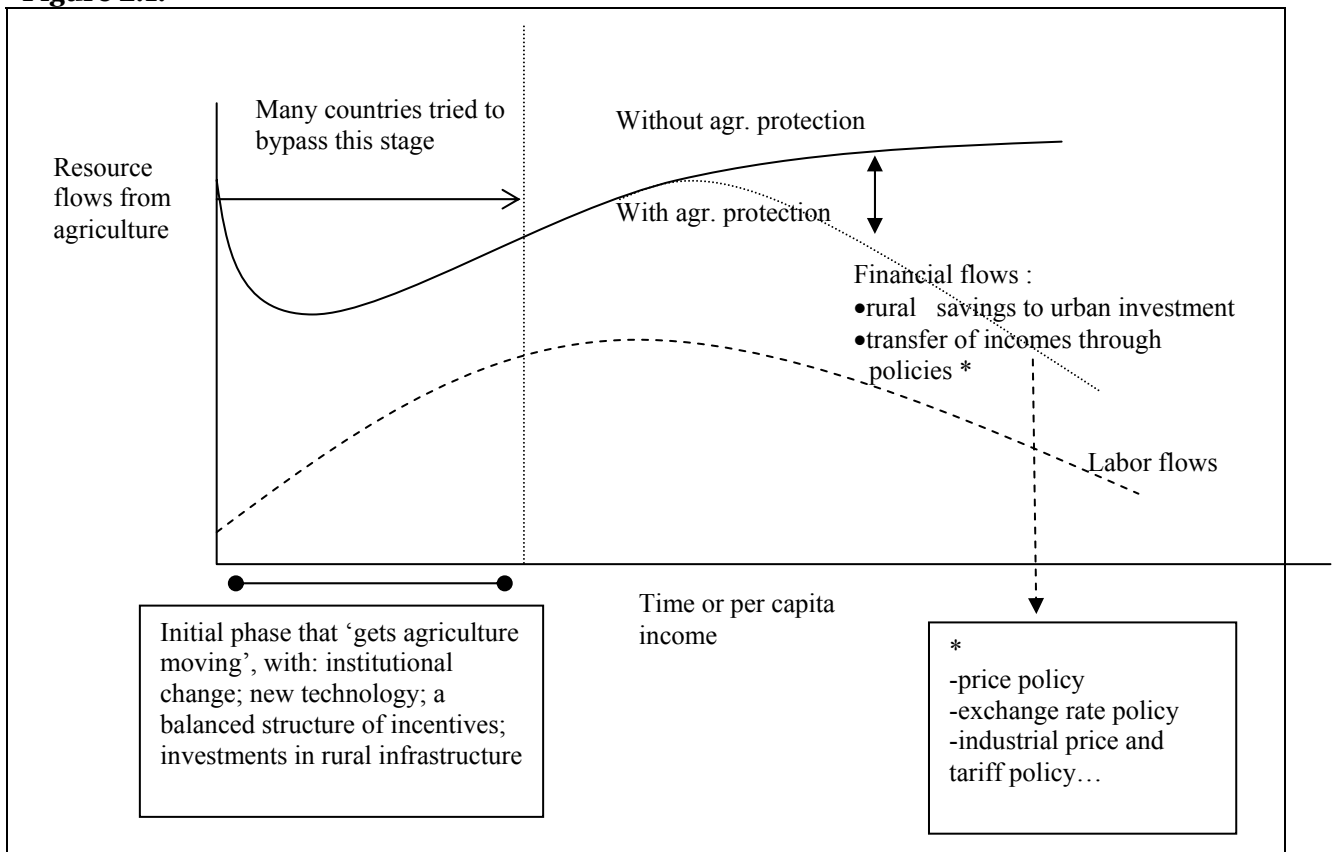
Agriculture contributes to economic development in four crucial ways

1. Expansion of the non agricultural sector is strongly reliant on domestic agriculture, for a sustained increase in the supply of food, and for raw materials used in manufacturing products such as textiles (the 'product contribution')
2. Because of the strong agrarian bias of the economy during the early stages of economic growth, the agricultural population forms a substantial proportion of the home market for the products of domestic industry -producer and consumers goods- (the 'market contribution')
3. Because the relative importance of agriculture in the economy declines with economic growth and development, agriculture is a source of capital and labor to the rest of the economy (the 'factor contribution')
4. Domestic agriculture contributes to the balance of payments either by augmenting the country's export earnings or by expanding the production of agricultural import substitutes.

In summary, the need for rapid agricultural growth and for the decline in the agricultural sector's share of output and the labor force are not contradictory, but the apparent paradox gave rise to a widespread misperception that agriculture is unimportant –that it does not require resources or a favorable policy environment.

³ In a closed economy with constant prices.

Figure 2.1.



Chapter 3 - Economic Growth: industrialization and agriculture

3.1. Growth through industrialization

Early thinking in development economics contained several prevalent strands:

- The desire and drive for modernization;
- the interpretation of industrialization as 'the' route to development;
- the belief in 'import substitution' as a necessary policy to provide protection for new industries;
- the distrust of the private sector and the market and the belief that government should take the leading role in development;
- a distrust of the international economy and pessimism that exports from developing countries could grow.

As a consequence, policies often privileged the third role of agriculture in development, i.e the transfer of capital and labor to the rest of the economy, shifting the internal terms of trade in favor of industry.

We shall discuss here only three issues: import-substitution strategies, the dual economy model and rural-urban migration.

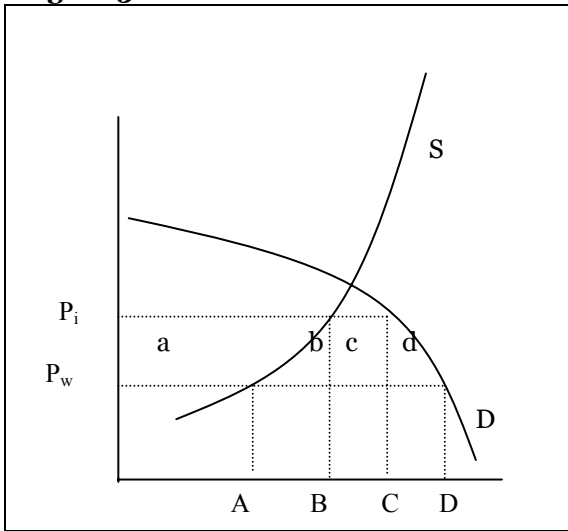
3.1.1. *The 'Infant industry' argument*

It is based on the idea that new industries in developing countries initially cannot compete with imports from developed countries. Governments should temporarily protect such industries, through tariffs or other trade restrictions, until they can sustain international competition.

The effects of a tariff are shown in figure 3.1. Internal price rises (from P_w to P_i). Imports decrease from AD to BC . This reduction is partly due to the decrease in internal demand (CD) partly to increased internal supply AB (Because of the tariffs imports are partly substituted by domestic production that would not be competitive at world price AB).

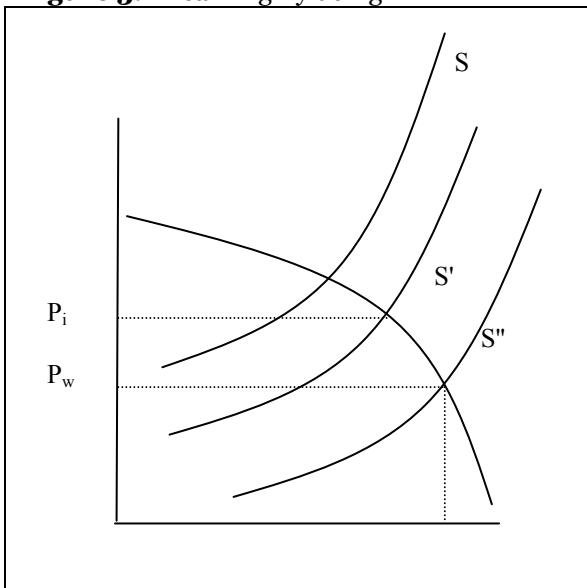
In welfare terms there is a loss in consumer surplus ($a+b+c+d$); producers gain a and the State gains $c (=BC \cdot P_w P_i)$. There is a net social loss of $b+d$.

Figure 3.1 Effect of a tariff



These are however static losses. If there were ‘learning by doing’, the policy could eventually induce a process such as represented figure below.

Figure 3.2 Learning By doing



The ‘Infant Industry’ argument represents perhaps the best case for import substitution. The central question regarding the argument has to do with the credibility of a limited promise. Protection must be limited and must expire at some deadline, whether or not the infant has grown up. However, from the point of view of governments, removal of protection involves loss of political support from industrialists and workers and therefore protection of uncompetitive industries may tend to become permanent.

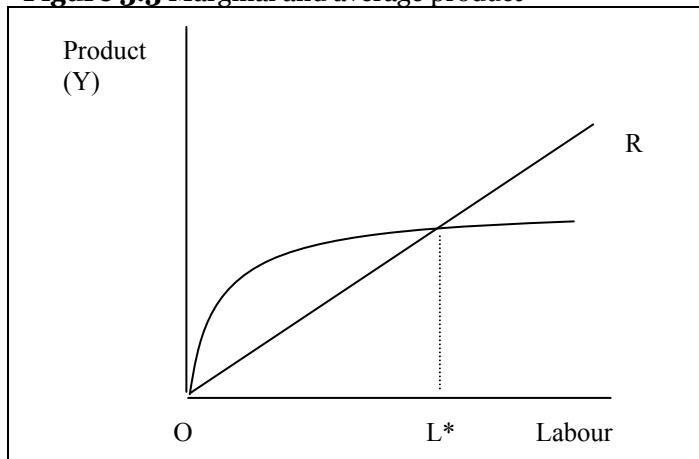
Industrialization based on import substitution on the one hand has been an effective strategy to promote the growth of the manufacturing sector, on the other hand it has not proved to be effective if evaluated in terms of the ultimate objective: per capita income growth.

3.1.2. Dualistic models

There is a typical dynamic of development: in general at the beginning of the development process up to 80% of the labor force could be employed in agriculture and 20% in the non agricultural sectors. In the context of a successful development process these proportions could reverse in a few decades.

The figure below describes the variation of product when the labor input increases, for a given amount of land. Marginal product is decreasing and the additional product of labor beyond L^* is zero. This situation can characterize agricultural systems with high population pressure on land; urban sectors such as small shops, agricultures with high land/labor ratios but high land concentration.

Figure 3.3 Marginal and average product



For a size of the family labor force equal L^* the market salary equals the inclination of the production function at that point, in this case 0. However, Lewis argued that where the production unit is the family the rule is not profit maximization, but a rule such as 'salary equal average product', and this salary would be close to a subsistence level. In figure 3.3 above the salary would equal the inclination of ray OR (every ray from the origin has equation $Y=aL$, where the inclination a is constant and equal to average product $a=Y/L$).

For zero or low values of the marginal product there is supply of agricultural labor at a constant salary close to Y/L and there is no loss of product when workers leave agriculture. In other words, at the subsistence salary there is excess supply of labor, therefore employment outside agriculture can expand without salary increases⁴. In this sense there is 'unlimited supply of labor' in the model.

Suppose the economy has two sectors: modern and traditional (rural) producing the same product.

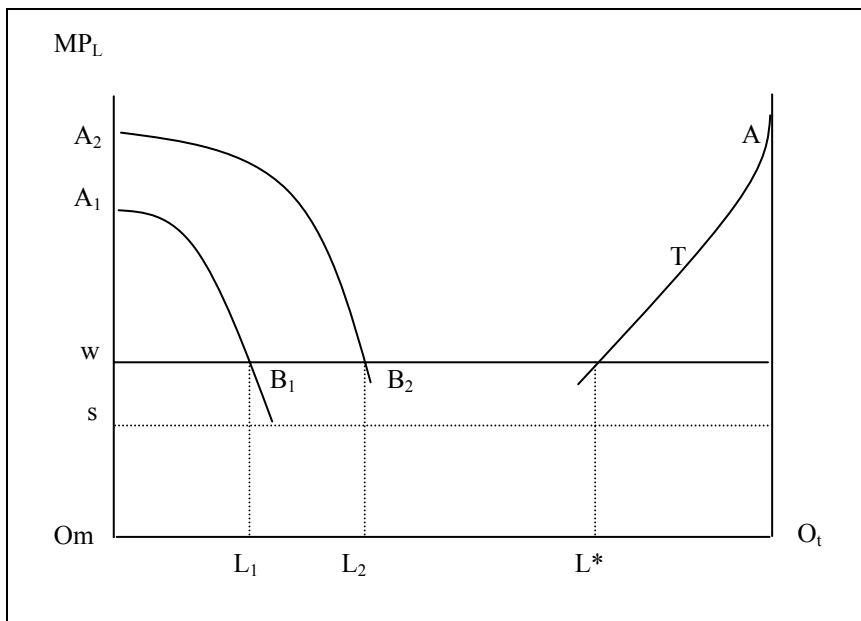
L = total quantity of labor in the economy

O_m = origin for the 'modern sector'

w = salary in the modern sector (higher than the subsistence salary s and rigid downwards)

$A_t B_t$ is the marginal product curve of labor at time one for the modern sector. In order to maximize profits, firms in the modern sector employ $O_m L_t$ units of labor. The rest of the working force, $(L - O_m L_t) = O_t L_t$, remains in the traditional sector. **Figure 3.4** The Lewis model

⁴ The usual hypothesis is that profit maximization implies the rule 'wage equal the value of marginal product'. Therefore the demand curve for labor is the marginal product curve and it is negatively sloped; the supply curve of labor is increasing in wage.

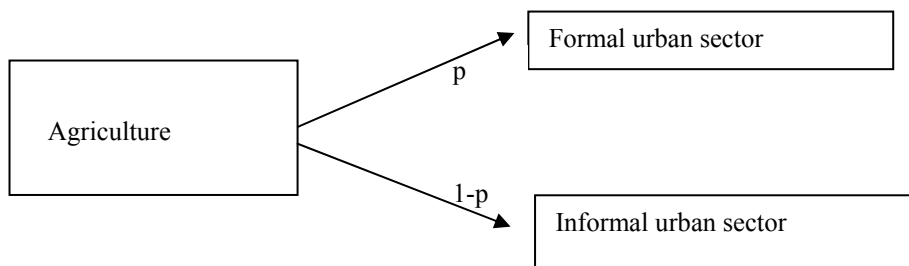


The hypotheses are that (i) Workers do not save, because they are poor; (ii) Landowners do not save, because they prefer luxurious consumption; (iii) Capitalists in the modern sector save and invest all their profits; (iv) Saving is equal to investment. Therefore in terms of figure 3.4, since the capital stock in the modern sector increases (of area $A_1 B_1 w$, which represents total profits), and since we suppose that in general the marginal product of labor increases with the capital stock, the marginal product curve in period two becomes $A_2 B_2$. Employment increases to $O_m L_2$ in the modern sector and decreases to $O_t L_2$ in the traditional sector and total profit in the modern sector becomes $A_2 B_2 w$. This profit is reinvested, with the same effect, growth continues and the modern sector absorbs rural labor.

The salary in the modern sector remains constant until the quantity of labor employed is $O_m L^*$. Beyond this point marginal productivity of the rural sector –represented by the AT curve - is not anymore inferior to the urban salary w and the supply of labor will increase only at a growing salary. Salaries start increasing in both sectors and they stay at the same level. This is the so called ‘turning point’, beyond which the economy begins to resemble a developed economy and the hypothesis of unlimited supply of labor does not apply anymore.

3.1.3. The Harris-Todaro model of migrations

In the model, labor moves from agriculture to the urban sector and enters with probability p the formal urban sector, with probability $1-p$ the informal urban sector.



w_A = salary in agriculture

w_F =salary in the formal urban sector ($>w_A$). This salary is fixed ⁵.

p =probability to find employment in the formal urban sector

$1-p$ =probability to find employment in the informal urban sector

w_I = salary in the informal urban sector.

The expected salary (from migration) is $w_E = pw_F + (1-p)w_I$ and the migration decision depends on the comparison between this salary and w_A .

Probability p depends on the relationship between the level of employment in the urban formal sector L_F and the total number of persons that look for a job

$$p = \frac{L_F}{L_F + L_I}$$

Implications of the model:

1. There is rural-urban migration although there is unemployment in urban areas (the same reasoning can be applied to international migration): people migrate because they ‘hope’ (expect) to find an higher salary job, accepting the risk to remain unemployed.
2. Policies that increase L_F may increase the size of the informal sector. Policies that depress w_A -and more generally result in a comparatively low standard of living in rural areas- will increase migration.

3.2. Growth through industry and agriculture

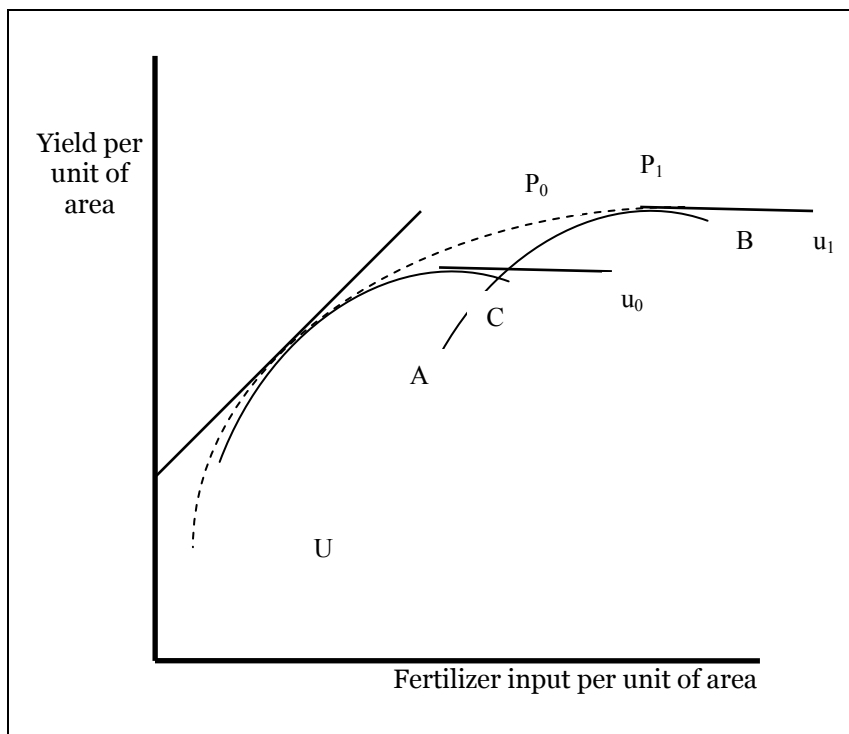
3.2.1. The “Green Revolution”

The term ‘Green Revolution’ is used to indicate the massive introduction of high-yielding varieties of grains, initially developed for production in Mexico (wheat and corn) and the Philippines (rice), in other countries of Asia, Africa and Latin America.

The experiment was originally a response to the threat of food shortages in the Indian sub-continent in the mid-sixties, and it was indeed a successful response. In India the innovation was massively adopted and by the beginning of the seventies wheat production had more than doubled and the country became self-sufficient in wheat. Many other countries, especially in Asia, have followed the Indian example.

The Green Revolution can be described as the shift from point A to point C in figure 3.5, where u_o and u_i represent the fertilizer response curve respectively for traditional and modern varieties of rice and U is the envelope of such response curves, termed the ‘meta-production function’. If the fertilizer-rice price ratio moves from p_o to p_i individual farmers move from A to C if u_i is not available or to B if u_i is available.

⁵ The model assumes that wage in the urban sector is not flexible and too high for market clearing to occur. Explanations are: (1) trade unions; (2) policies such as minimum wage laws; (3) deliberate choice on the part of firms, (e.g. they may pay high salaries to select the best workers).

Figure 3.5. Fertilizer response curves

More in general, in the framework of the induced innovation model, relative price changes induce innovations that save the factor that becomes relatively scarce.

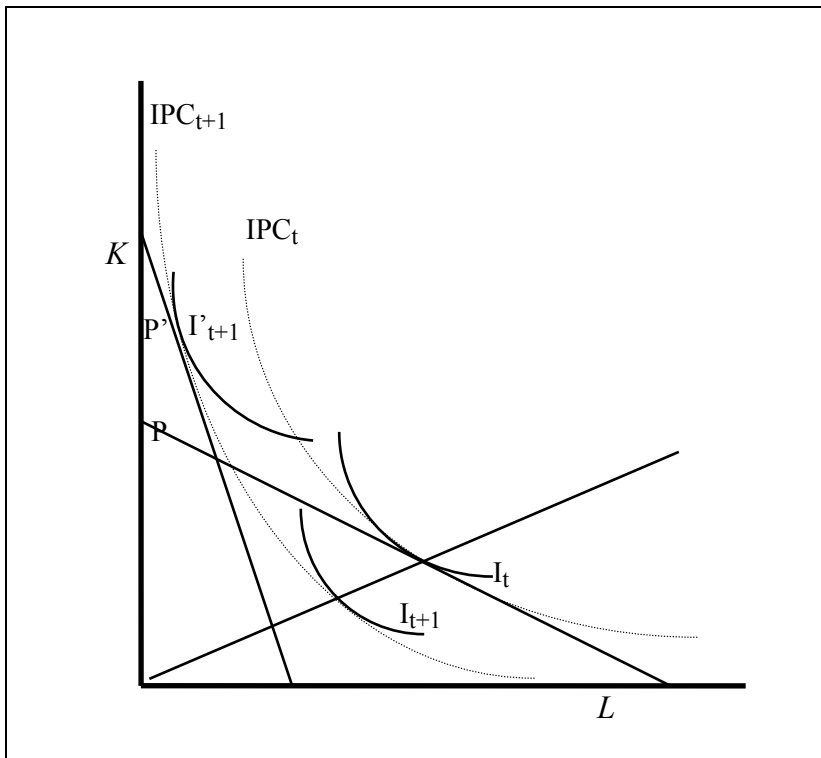
However, the change in technology is obviously more complicated than the figure above shows, and its preconditions are also more complex than the change of the price ratio that triggers a technological response in this figure. In particular, the success or lack of success of the Green Revolution in different countries was linked to two 'preconditions': a good agricultural research system; a good system of water management. In other words, there were some 'institutional preconditions' to the success of the Green Revolution.

3.2.2. The "induced innovation model" (IIM)

This model provides an economic theory of invention and adoption of technologies, whereby relative price changes determine responses by economic agents and research institutions, that guide technological progress towards saving the factors that become relatively scarce.

The IIM moves from the observation that countries with differing factor endowments have followed different paths of technical change in agriculture and provides an explanation of such diversity that belongs to the debate on innovation biases, and specifically refers to the Hicksian notion of induced bias of innovation.

In this framework, the IIM uses the concept of an innovation possibility curve (IPC). At a given time there exist a set of production processes which could be potentially 'invented' given the state of scientific knowledge. Each process can be represented by an isoquant with a relatively small elasticity of substitution, while the IPC can be represented as the envelope of such isoquants. Thus the IPC is a purely technological matter, and it might assumed that, because of advances of basic science, it moves closer to the origin over time, and that such shift is neutral, i.e. is there is no bias in the historical innovation possibilities. The prevailing price ratio determines instead the choice of a particular isoquant (representing a specific production function).

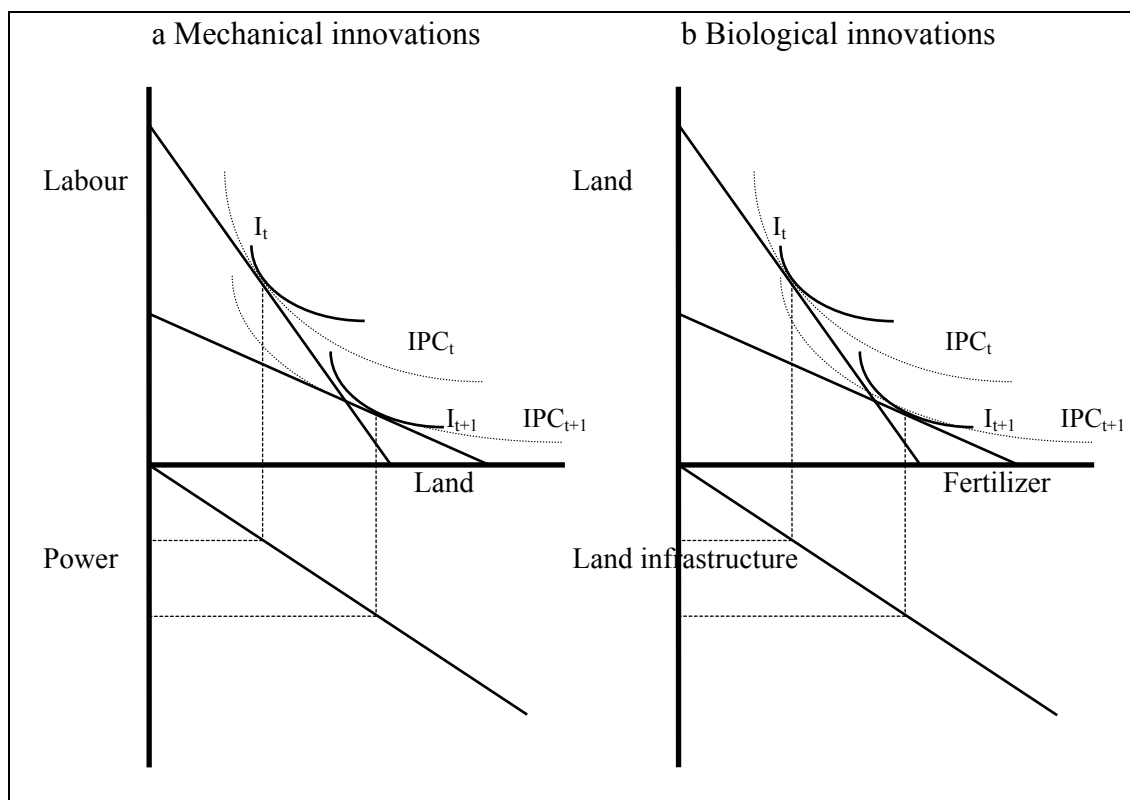
Figure 3.6 Technical progress and the innovation possibility curve

IPC_t is the innovation possibility curve at time t and, given the price ratio P , the optimal choice is the cost minimizing isoquant I_t . At time $t+1$ the new innovation possibility curve is IPC_{t+1} . If the same price ratio prevailed the specific invention chosen would be I_{t+1} , which implies an unchanged factor proportion (in this sense the IPC shift is neutral). However if the prevailing price ratio is P' the technique I'_{t+1} is invented, resulting in a relatively lower use of the factor (labor) which becomes more expensive.

Hayami and Ruttan classify agricultural innovations as being either labor saving or land saving. Mechanical technology is labor saving, in the sense that historically the substitution of land and capital for labor in relatively labor scarce economies has been made possible primarily by the progress of mechanization. Biological and chemical technology is land saving, in the sense that historically the dominant factor for substituting fertilizer and /or industrial inputs for land in land scarce countries has been the development of (high yielding) crop varieties.

The model of induced technical change in agriculture incorporating the concepts introduced above is described in figure 3.7. Figure *a* refers to the invention of mechanical innovations, represented as the switch from technology I_t to technology I'_{t+1} (using relatively less labor and more land-cum-power), as a response to an increase in the relative price of labor. The process described is the invention of machinery that allows a worker to cultivate a larger area. Figure *b* refers to the advance of biological technology, represented as the switch to a technology (I'_{t+1}) using relatively less land and more fertilizer and land infrastructure as compared to I_t , in response to a decrease in the relative price of fertilizer. A new high-yielding variety of a crop, requiring more fertilizer application and more irrigation is the type of innovation described.

Figure 3.7 The Hayami and Ruttan induced innovations model



The IIM is consistent with an extensive body of cross sectional and time series observations. Hayami and Ruttan carry a comparative analysis of the history of agricultural development in Japan and the US between 1880 and 1980, showing that the two countries have experienced similar, high rates of growth of agricultural output and of labor productivity. However, in land abundant US the growth of labor productivity was associated with increases in the land/labor ratio and with the introduction of mechanical innovations; in land scarce Japan the growth of labor productivity was associated with increases in the yield/labor ratio, and with the introduction of biological innovations. Furthermore, the analysis of the growth in labor and land productivity between 1960 and 1980 in a large number of developed and developing countries shows that the lower the land/labor ratios the more labor productivity increase has been associated with high yield per acre, suggesting that innovation has been consistent with the underlying factor endowment.

In summary in this model relative price changes induce innovations that would save the factor that become relatively scarce. But how can price changes influence the whole process of research and innovation? Shifts in relative prices induce farmers to demand innovations that save the factor whose relative price increases. Both the public research system (scientists and administrators) and the private firms supplying modern inputs are supposed to respond by producing the right kind of innovation. Therefore the success of the mechanism requires that the response institutions –in this case the research system–is guided by the movements of relative prices.

3.3. Agricultural Systems

Agricultural systems around the world differ in many aspects. One major reason is that the relative scarcities of the main factors of production in agriculture -land, labor and capital- vary across regions.

Relative scarcities have an impact on:

- a) the prevailing system of property rights;
- b) technical progress.

We discuss the implications of land becoming more valuable on the system of property rights on land in paragraph 4.2.

As for technical progress:

1. Increasing population density leads to use the land more intensely, in the sense that a given plot of land will be left uncultivated for a shorter period of time until annual cropping or multi-cropping prevail (population-induced technical progress).
2. Technical progress will tend to 'save' the factor that becomes scarce. In land scarce countries high yielding crop varieties (biological innovations) have made possible to substitute fertilizers and other industrial inputs for land. In labor scarce economies the progress of mechanization has made possible the substitution of land and capital for labor. In other words labor productivity (Y/L) has been increased either by predominantly increasing Y/T (product per unit of land) or by increasing T/L (with mechanization);

We may simplify the differences linked to factor endowments, distinguishing three groups of countries:

- A. Countries or areas where population density is low, therefore land is abundant, and capital is scarce (land abundant, poor countries)
 - Systems of land use where a given plot of land is cultivated with long intervals
 - Communal property rights have an important role.
- B. Countries or areas where population density is high (land is the scarce factor):
 - Systems of land use with high frequency of cultivation
 - Property rights on land are mostly defined
 - Technological progress has been of the land-saving type
- C. Countries or areas where land and capital are abundant and labor is the scarce factor
 - Property rights are defined
 - Technological progress has been of the labor-saving type (mechanization)

Table

Countries	Arable land		Tractors per thousand agr. workers		Agricultural value added per agr. worker		Food production index (1989-91=100)	
	'79-81	'95-97	79-81	95-97	79-81	96-98	79-81	96-98
Low and middle income								
East Asia and Pacific	0.11	0.11	2	2			67.0	152.1
Latin America and Caribbean	0.32	0.28	25	35			80.4	123.9
Middle East and North Africa	0.29	0.21	12	25			70.1	138.0
South Asia	0.23	0.16	2	5	265	356	70.4	122.1
Sub-Saharan Africa	0.32	0.25	3	2	418	379	78.8	124.3

Source: World Bank, *World Development Report 2001*

A second important dimension of the differentiation between agricultural systems around the world refers to the way agricultural production is organised in terms of: (1) the distribution of ownership of land; and (2) the size distribution of operating farm units. (1) and (2) are of course

closely related. The land tenure system in turn is the product of the different historical circumstances in each country.

The focus on land is justified partly because of its obvious importance to agricultural production and partly because access to other important inputs in agriculture such as credit, irrigation, extension services, etc. is often strongly determined by access to land.

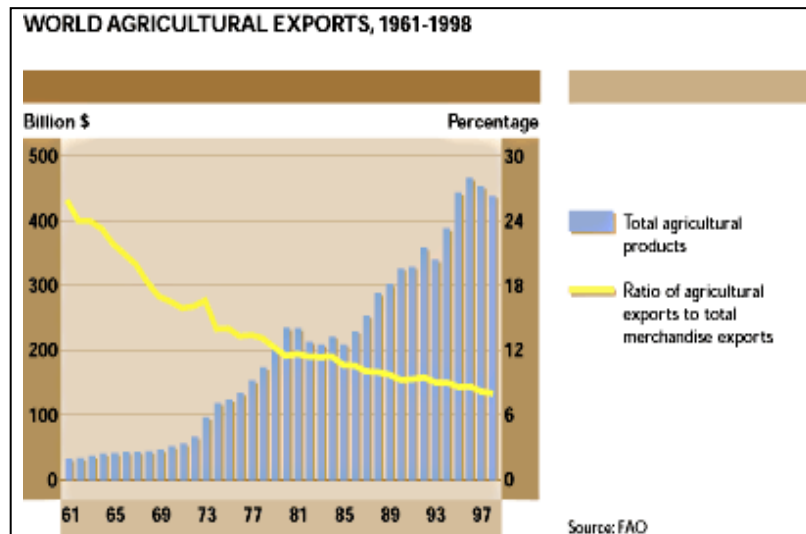
One polar prototype economy is where land tenure does not deeply or permanently differentiate the agricultural population. Here, the population may be treated broadly as a unit (unimodal) for the analysis of many policies. This is true for the case of sub-Saharan Africa other than East/Southern Africa.

Another prototype is the case of dualistic (or bimodal) agrarian systems prevalent in Latin America, Asia and East/Southern African countries. Here, asset ownership differentiates the population strongly: the landless whether farm labourers or non-farm, tenants and smallholders on the one hand, and emergent commercial farmers, large private farmers (ranchers) and estate sector whether private or para-statal.

3.4. Agricultural trade: changing trends and patterns

3.4.1. Declining importance of agriculture in world trade

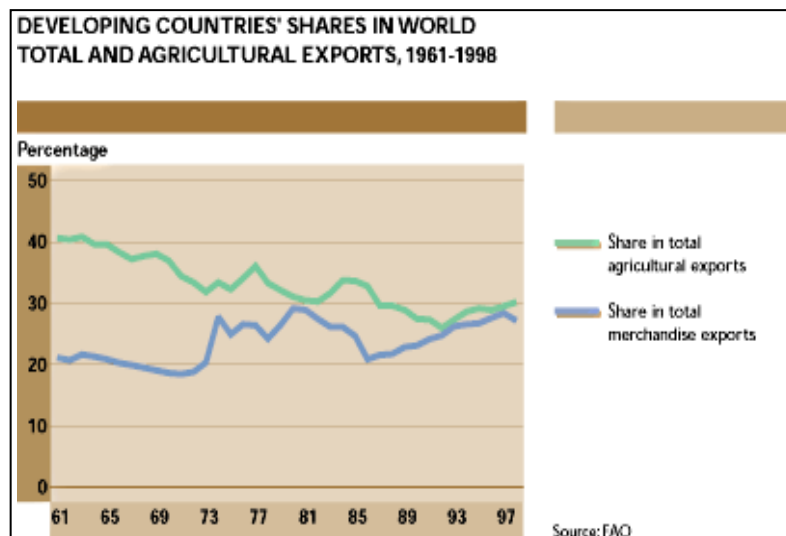
Agricultural trade has expanded significantly faster than agricultural production over the past decades, underlying the growing interdependence and integration of the world's economies. Despite its relative dynamism, however, trade in agricultural products has tended to lag behind trade in other sectors, particularly manufactures. An important factor behind this process has been the decline in agricultural prices relative to manufactures. On a global basis, agricultural exports now account for less than 10 percent of merchandise exports, compared with about 25 percent in the early 1960s (Figure 3.8). The tendency for agricultural trade to lose importance in external trade has been common to all regions, but in the developing country regions the process was particularly pronounced in the 1960s and early 1970s.

Figure 3.8

However, in Latin America and the Caribbean and in sub-Saharan Africa, agricultural exports still finance about one fifth of the total import bill. Economic dependence on agricultural exports has remained very high in many individual countries. In 1998, 12 out of 48 countries in sub-Saharan Africa depended on agriculture for half or more of their total export earnings. In Latin America and the Caribbean, 10 out of 37 countries were in the same situation (four in the Caribbean). Extreme cases, where 70 percent or more of export earnings were agriculture-based, included Belize and Paraguay in Latin America, and Burundi, Côte d'Ivoire, Ethiopia, Kenya, Guinea-Bissau, Malawi, Uganda and the Sudan in Africa.

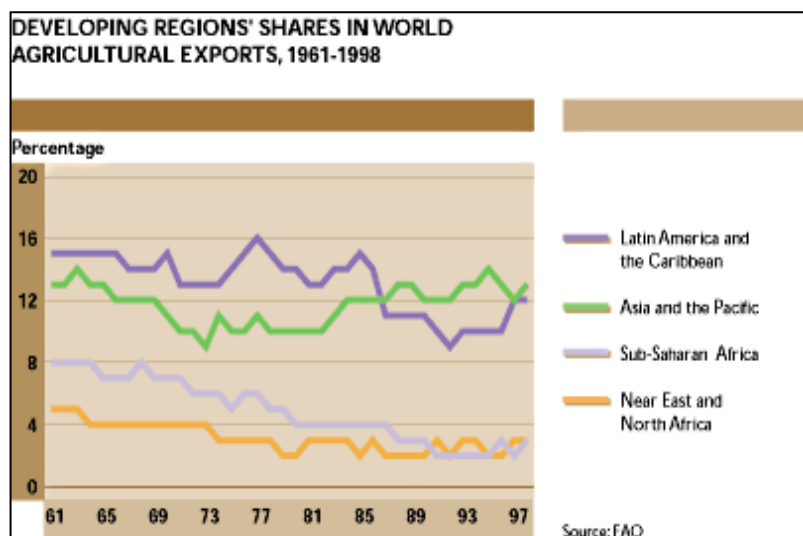
3.4.2. Contracting developing country share in agricultural markets

The regional distribution of world total and agricultural trade has undergone significant changes. While the developing countries gained market share for total merchandise exports between the early 1960s and recent years (from about 20 to more than 25 percent of the world total), their share for total agricultural exports has declined from more than 40 to about 27 percent (Figure 3.9).

Figure 3.9

All the developing country regions, with the exception of Asia and the Pacific, progressively lost world market share for their exports. That Asia and the Pacific has actually increased its share in world agricultural exports since the mid-1970s is all the more remarkable given that this is also the region that has been most successful in diversifying its export base away from agriculture. In contrast, despite the persistently strong agricultural component of its external trade, sub-Saharan Africa's presence in world agricultural markets has tended to lose significance since the early 1970s. Latin America and the Caribbean experienced pronounced market losses after the second half of the 1980s, a period of slow growth in the volume of agricultural exports and of strong decline in export prices (Figure 3.10).

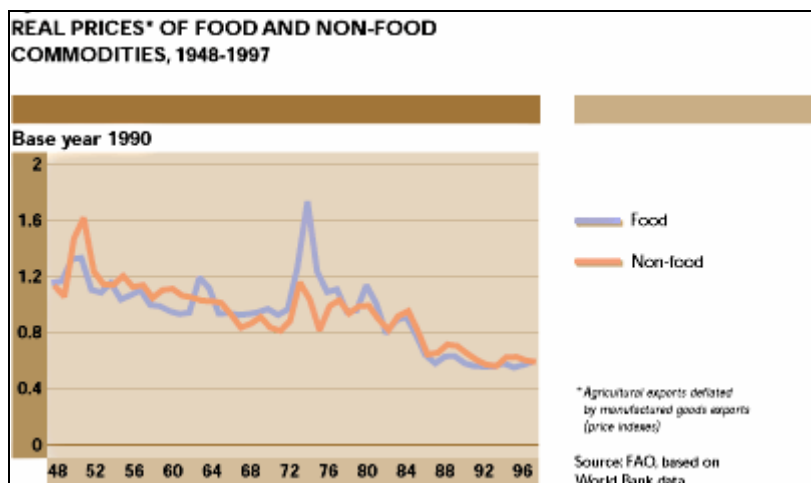
Figure 3.10



3.4.3. *Falling real agricultural prices*

Throughout the 1950s and 1960s international prices of food and non-food products remained relatively stable and only lagged slightly behind those of manufactured goods. The 1970s marked a new period of greater price volatility and divergence between agricultural and manufactured goods prices, with the latter tending to rise significantly faster than the former (Figure 3.11).

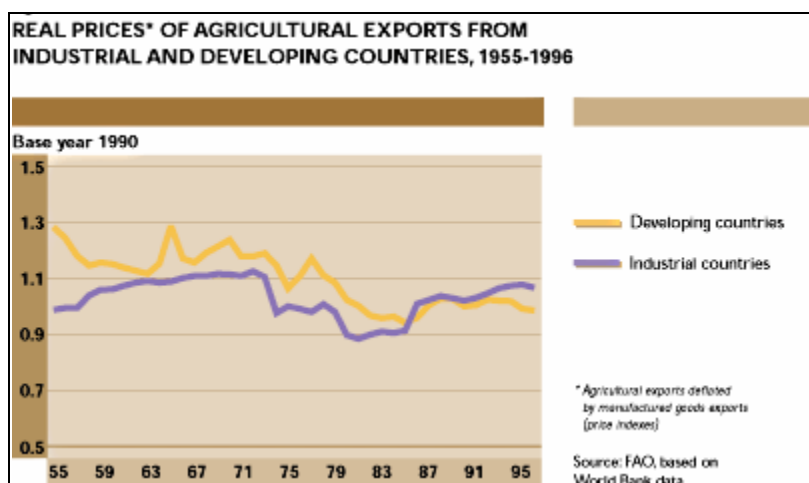
Figure 3.11



As a result, the net barter terms of trade (or "real" prices) of agricultural exports deteriorated markedly (Figure 3.12). The decline in real agricultural prices was more pronounced for the

developing than for the developed countries, reflecting the commodity composition of their exports, with those of temperate products typically exported by the developed countries showing a relatively firmer behaviour than those of tropical products overall.

Figure 3.12



The volumes of exports, by contrast, showed a steady upward trend throughout much of the period. Nevertheless, because of the price increase differential, the current value of agricultural exports rose on the whole much faster in the developed countries than in the developing ones.

3.4.4. *Shifting from primary to processed exports*

An issue of considerable importance is the extent to which the developing countries have been able to shift from exports of non-processed primary commodities towards value-added products. The different developing country regions recorded varying degrees of success on this account. In both Asia and the Pacific and Latin America and the Caribbean the share of processed products in total agricultural exports rose from around 10 percent in the early 1960s to about one third of the total in recent years. This share has risen to considerably higher levels in the more industrialized countries in these regions. Thus, in Argentina and Brazil the comparable figure is about 50 percent, while in Malaysia it is more than 70 percent.

In sub-Saharan Africa, on the other hand, the share of processed products in agricultural exports has remained at about 15 percent throughout the past three decades. Behind this stagnating pattern some countries showed pronounced temporal variations. For most countries in the region, however, the general picture is one of a high and undiminished dependence on a limited range of primary product exports. In the Near East and North Africa, the high share of value-added products in the total generally reflects the strong weight of a few processed products in a relatively small agricultural export base. Processed shellfish and other sea products, as well as canned and preserved fruits and vegetables, accounted for much of the total.

Chapter 4 - New institutional economics (NIE)

4.1. Introduction

There is a variety of institutions.

Macro-level institutions affect behaviour throughout the economy. Examples are legislative law, customary law, contracts, the judiciary and police systems. Micro-level institutions affect incentives in parts of the economy. Examples are: contracts, both implicit and explicit, such as contracts in employment relations (tenancy, lease), insurance contracts, formal organisations (corporations, labour unions, trade associations).

Institutions are not accounted for in a standard neoclassical framework where ‘firms are production functions; markets are signalling devices; contracting is accomplished through an auctioneer; and disputes are disregarded because of the presumed efficacy of court adjudication. The economic purposes served by organisational variety do not arise within –indeed, are effectively beyond the reach of– this framework’ (Williamson).

The 1970s saw the emergence of a theory –generally referred to as ‘new institutional economics’ (NIE)– which sought to extend the neoclassical approach in order to explain institutions.

There are several different strands of NIE theory but we shall briefly overview only four issues:

- 1) Transaction costs
- 2) Property rights
- 3) Imperfect information
- 4) Collective action

4.2. Transaction costs and property rights

Traditional microeconomic theory does not consider the set of activities that normally precede, accompany and follow market transactions, and the associated costs – transaction costs. Within the NIE the concept of transaction costs has become the centre of the analysis of the firm (in Williamson), has enriched the analysis of externalities and is the basis of an approach to the theory of institutions linked mainly to the work of Alchian, Demsetz, North and Thomas.

This strand of theory explains institutions on the basis of the notion of transaction costs and property rights. Institutional arrangements, in this view, are deliberately chosen by individuals on the basis of efficiency criteria. Hence, the emergence and evolution of institutions is viewed as the result of rational responses to changes in the underlying economic conditions.

North and Thomas give the following definition of transaction costs: The transfer of goods between economic units requires the provision of information about the opportunities for exchange (search

costs), the negotiation of the terms of the exchange (negotiation costs) and determining procedures for enforcing the contract (enforcement costs). The costs of providing all the services involved are transaction costs.

In a 1973 article, Alchian and Demsetz define property rights as the socially recognised right to use a resource; they assert that every cost and benefit associated with social interdependencies is a potential externality and that ‘internalising’ such effects refers to a process, usually a change in property rights, that enables these effects to bear (in greater degree) on all interacting persons. Furthermore, such change is not costless; it does involve ‘transaction costs’ (in the sense of the cost of a transaction in the rights between the parties): property rights evolve only when the gains of such change become larger than the transaction costs involved, and this in turn must be because of a change in relative prices. Hence institutional arrangements are deliberately chosen by individuals on the basis of efficiency criteria and the basic source of institutional change is essential and persistent changes in relative prices.

Transaction costs explain the evolution of property rights on land as land becomes more valuable

A system of property rights on land defines the uses of land – cultivation, grazing, hunting, right to plant trees and so on– which a society or group regards as exclusive and who has these exclusive rights. In addition, a system of property rights provides a set of rules governing inheritance and transferability. Property rights are defined and enforced through institutional arrangements that include both formal procedures (courts, police, the legal profession, land surveys, record keeping systems, and titling agencies) and the social customs and attitudes concerning the legitimacy and recognition of those rights.

In land-abundant environments, with shifting cultivation, where labor is the limiting factor and uncultivated plots have no economic value, individual property rights are usually not defined – because the cost of their definition –e.g. the cost of land titling- (transaction costs) would be higher than the benefits. Land tends to be under group control and membership of the group is easily acquired. As population increases and land becomes scarcer, the negative externalities associated with open access increase. The benefits from the definition of individual property rights become larger than the associated costs. Rights are transferred from the group to individuals. This, in turn, provides incentives to adopt the fertility restoring techniques and provide the physical investments (e.g. terracing and tree planting) required by shorter fallow cultivation (internalising the externalities).

Such process of change involves several institutions: the formal legal system, the system of cultural norms and customary law, enforcement mechanisms. In many contemporary developing countries changes at these different levels are not necessarily congruent. A society where the formal legal system contemplates private property might lack the corresponding registration and enforcement mechanism; the transfer of land to another clan or ethnic group may be allowed by the legal system but not by cultural norms.

4.3. Imperfect information

The theory of imperfect information focuses on the consequences of pervasive risks, incomplete markets, information asymmetry and moral hazard. We shall look at this approach in the context of credit markets.

4.3.1. Enforcement problems in credit markets

Private banks and other private moneylenders are usually in the business to make money, and they can only do so if they are repaid. If they are pretty certain that they will get repaid, they will lend a lot of money, but if they are worried about repayment, they will cut back on lending, usually

lending only to low-risk borrowers. Because agriculture is often a high-risk activity, lenders will either not make loans to agricultural households, or will only do so at fairly higher interest rates.

In theory, lenders could adapt to situations where the risk is high. One option is to require collateral that the lender can take in the event that the borrower defaults -, but most farmers have little collateral. Even if they do, this will only work if the contract can be enforced, but if the legal system is corrupt or simply doesn't function well (e.g. long delays) lenders will not be able to obtain the collateral in the event that the loan is not paid

Assume that access to the credit market depends on the level of initial wealth that can be offered as guarantee of repayment (collateral) and that you will repay if condition (1) holds.

$$I(1+r) \leq W(1+r) + F + \lambda\pi \quad (1)$$

I = initial cost of the investment (=loan)

W = initial individual wealth offered as collateral

π =profit from the investment

r = rate of interest

F = Fine or imprisonment for default

λ = probability that profits are confiscated.

The borrower will repay if payment $I(1+r)$ is inferior to the sum of the value of his wealth (collateral) at the end of the period [$W(1+r)$]; plus F ; plus profit π multiplied for the probability λ that it is confiscated. The right side of equation (1) effectively represents the entire cost of 'not paying' and it includes the wealth that was initially offered as collateral.

Rearranging (1) we obtain

$$W \geq I - \frac{F + \lambda\pi}{1+r} \quad (2)$$

A lender will give a loan to an individual only if condition (2) holds. Equation (2) shows that the initial wealth offered as collateral must be greater than the difference between the cost of the investment and the cost associated with the option 'not repay' because it guarantees that this option will not be chosen. Equation (2) implies also that individuals whose initial wealth is lower than W will not have access to the credit market. Note also that the lower F and λ , the higher is the level of initial wealth required. In the extreme case where F and λ were 0 (that is if the social mechanisms that insure the functioning of markets did not exist) there would be no credit, and investment could be only financed out of own wealth ($W = I$).

When you consider the possibility of 'bad behavior' and the role of 'institutions' and norms some individuals can be excluded from a market (in this case the individuals that are excluded are those that are more in need for credit: the poor) or, in an extreme hypothesis, a market could 'disappear'.

4.3.2. Adverse selection and moral hazard

Adverse selection occurs when only one party of a transaction knows things pertaining to the transaction that are relevant. Moral hazard occurs when one party of a transaction may undertake action that affects the other's party evaluation of the transaction but the second party cannot monitor/enforce perfectly.

When lenders have no information on potential borrowers, they will worry that some of the borrowers are “bad risks” and thus more likely to default. If they think that a certain fraction of people will default, they will increase the rate of interest that they charge in order not to lose money. But increasing the interest rate causes two related problems, adverse selection and moral hazard. Adverse selection occurs if raising the interest rate leads less risky people to decide not to take a loan. This implies that the people who are still willing to take a loan are even more risky than the group of “applicants” under the old lower interest rate. It is possible that raising the interest rate will not increase the lenders overall profit.

Consider a moneylender who faces two types of potential customers: the 'safe type' and the 'risky type'. Each type of borrower needs a loan L (of the same size) to invest in some project or activity. The borrower can repay only if the investment produces sufficient returns to cover the repayment. Suppose that the safe type is always able to obtain a secure return R ($R > L$) from his investment. On the other hand the risky type can obtain a higher return R' ($R' > R$), but only with probability p . With probability $(1-p)$ his return is 0.

For the safe type the highest acceptable rate of interest is such that

$$R - (1+i)L = 0 \text{ (net return=0)}$$

and this implies

$$i_s = (R/L) - 1$$

For the risky type the highest acceptable rate of interest is such that

$$p[R' - (1+i)L] + [(1-p) \cdot 0] = 0 \text{ (expected return=0)}$$

and this implies

$$i_r = (R'/L) - 1$$

Since

$$R' > R$$

we have that

$$i_r > i_s.$$

The risky borrower is willing to pay a higher rate of interest than the safe borrower and this interest rate is independent of his probability of success, p . The reason is that bankruptcy yields 0, and in such situation he defaults on the loan anyway, so his expected profits depend only on the 'success' state. In this sense the risky borrower acts as if he does not care about failure. Of course the lender cares. Which interest rate should he set? If he could distinguish among the two he could set two different interest rates. But if he cannot distinguish among the two, setting any price higher than i_s means attracting the 'bad' customer.

Thus the smart thing for lenders to do may be to keep the interest rate low and simply reduce total lending and invest some of their money in non-agricultural pursuits. Note that at this low interest rate the demand for loans may exceed the supply, so some kind of rationing takes place. The reason that adverse selection is classified as an “information” problem is that, if the lender knew which people were “high risk” and which people were “low risk” he could set separate rates for each group, and set those rates in a way to maximize his profit (in part by lending more money). This lack of information on who falls into the different risk categories leads to reductions in lending in rural areas.

Moral hazard occurs when raising the interest rate induces a person to undertake a more risky investment. In many cases farmers can do different things with a loan, and what they do may depend on the interest rate charged. From the point of view of the lenders, they want farmers to

choose low risk projects because that will increase their probability of being repaid. Yet farmers may prefer to take on a more risky project.

Moral hazard is an information problem because the lender does not know which projects the borrower will try, or the lender knows about the projects but does not know which are the risky ones. This type of problems are pervasive also in other markets, in the first place the insurance market (e.g. adverse selection and moral hazard problem in health insurance).

We should distinguish between institutional or formal lenders, government or commercial bank and so on- and informal lenders, village moneylenders, landlords, traders, and shopkeepers. Two considerations typically put formal lenders at a disadvantage relative to their informal counterparts: (1) they lack information regarding the characteristics, history and current activities of their clients, and (2) they cannot accept collateral in some non monetary forms, such as labor or output.

One possible policy response to information problems in rural credit markets is try to put the hidden information of local communities to work in innovative ways. The leading example of small-scale lending or micro-finance is the Grameen Bank of Bangladesh. The Bank lends to groups of people instead of individuals. The entire group is denied future credit if one member defaults. Under such circumstances, group formation will use local information. Would-be members who are bad credit risks will be excluded from the group, leading spontaneously to better targeting. In addition, borrowers will have the incentive to urge each other to take on safer projects. The Grameen Bank is an important institutional innovation in small-scale lending, that can reach very poor individuals.

It encouraged, by example, many other microfinance programs, based on the same model, in Latin America, Africa and Asia, and the United States.

4.4. Collective Action

4.4.1. The "Prisoners' Dilemma"

Suppose there are two prisoners, separately questioned by police about a crime. If they both choose not to confess they are free. Suppose this outcome is worth 10 to each of them⁶ (the 'payoff' is 10). If they both confess they are given only a few months of prison, and this outcome is worth 5 to each of them. But if one confesses and the other does not confess, the one who helped the police is free and gets a money compensation (payoff 15) the other is kept in prison for many years (payoff 0)

You can think of this as a *game*, whose outcomes (payoffs) can be summarized in the form of the following matrix (this is a common device in *game theory*)

Individual	B		
	Strategy	Not confess	Confess
A	Not confess	10 (A), 10 (B)	0 (A), 15 (B)
	Confess	15 (A), 0 (B)	5(A), 5(B)

Look at things from the point of view of B. If she thinks that A will not confess then her best strategy is to confess (she gets 15 rather than 10). If she thinks that A will confess, then her best strategy is to confess, because she gets 5 rather than 0. Therefore B will confess. The same applies to A.

⁶ You should think of these numbers as some 'index' of personal satisfaction.

In this game there is a unique possible combination of strategies (equilibrium), and it is when both prisoners confess. This is a ‘Nash equilibrium’, situation where no individual can improve his outcome by changing strategy, given the strategy chosen by the other ⁷.

Notice that although both prisoners are trying to do their own interest, the final outcome (5,5) is (Pareto) inferior to the situation where both are not confessing (10,10). In *game theory* a strategy like ‘not confess’ is called ‘cooperate’ (the two players cooperate among themselves), a strategy like ‘confess’ is called ‘defect’.

4.4.2. Different types of goods

We analyze goods in terms of two characteristics: rivalry and excludability.

- Rivalry: the extent to which one person’s use or consumption of a good or service reduces its availability to other people.

High rivalry→individual consumption (e.g. food, cars, tractors)

Low rivalry→potential joint consumption (roads, broadcast television, weather forecast, market information)

- Excludability: the ability of suppliers of a good or service to exclude (at a reasonable cost) from consumption of the good or service consumers who are not willing to pay for it

With low excludability there is a free-rider problem:

-A free rider is a person who tries to use a good without due payment

-Whenever a person cannot be excluded from the benefit of a good, each person is motivated not to contribute

4.4.3. Free riding

Suppose that two people have to decide on whether to acquire a good that they use in common (non rival) and that is non excludable (for example a small road that serves both).

The good is worth 6 to each of them and it costs in total 8. Each of them has an initial wealth of 10. If they acquire the good and both contribute (4), each would be left with $10+6-4=12$. If nobody is willing to contribute each will have a ‘payoff’ of 10 (the initial wealth); but there is also another possibility: each may hope that the other will finance the whole cost. In this case the payoff of the individual who contributes would be 8 ($10+6-8$) and the payoff of the other 16 ($10+6$).

We can analyze also this situation as a game, in which there are two players (A, B) and each player has two possible strategies ‘contribute’ ‘not contribute’ (‘cooperate’ ‘defect’).

		B	
		Contribute	Not contribute
A	Contribute	12 (A), 12 (B)	8 (A), 16 (B)
	Not contribute	16 (A), 8 (B)	10 (A), 10 (B)

The problem with this game is that each party has an incentive to avoid contribution. If I believe that the other person will contribute than my payoff from choosing the strategy ‘no contribution’ (16) is higher than if I contribute (12). If I believe that the other person will not contribute than my payoff from the strategy ‘not contribute (10) is higher than the payoff from contributing (8). This game has the same structure as the Prisoner Dilemma. There is only one possible equilibrium in this game, and it is in the bottom right corner, where the non rival, non excludable good is not acquired, although both players would be better off if the both followed the strategy ‘contribute’

⁷ See what happens if, when the players are in the bottom right corner, only one of the two changes ‘strategy’.

(upper left corner). This simple exercise shows that goods with these characteristics may be under-provided.

4.4.4. *The Commons*

Suppose that groundwater is used for irrigation in a village. Overuse of groundwater can reduce the level of water, making it more costly for all farmers to extract water. This is a typical problem of the commons: groundwater is a common property resource, and the costs of using it may not be fully internalized. Suppose that the water can be extracted at two levels –high and low- and that there are two farmers. The revenue (from crop production) for each farmer increases with the use of groundwater: say it is 2000 if the high level is applied and 1000 if the low level is applied. The cost of extraction depends on whether the other farmer’s use is high or low. Suppose that the extraction cost for each farmer is 500 for low and 1300 for high, but that an additional fixed cost of 500 is incurred if the other farmer is extracting high (deeper wells will have to be dug because the other farmer’s action reduces groundwater levels).

If both farmers extract at low level each one will have a payoff of: $(1000-500)=500$.

If both extract at high levels, each has: $(2000-1300-500)=200$

If only one extracts high he has: $(2000-1300)=700$, while the other one has: $(1000-500-500)=0$

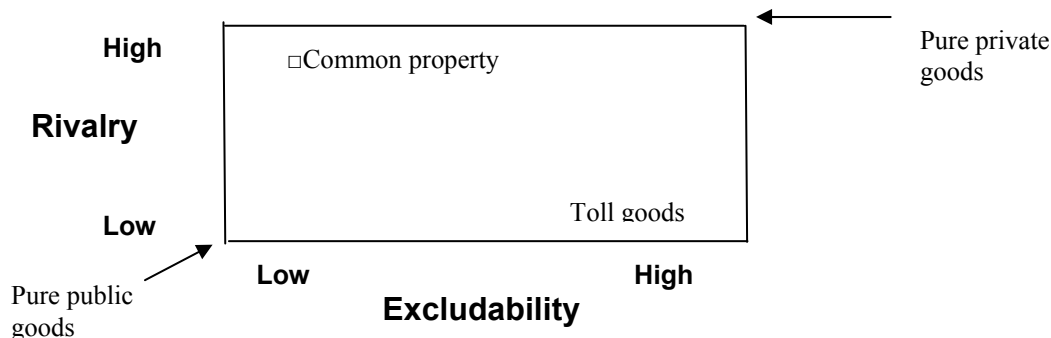
Therefore the payoff matrix for this game is the following

		B	
		Low (cooperate)	High (defect)
A	Low (cooperate)	500(A), 500 (B)	0(A), 700(B)
	High (defect)	700(A), 0(B)	200(A), 200(B)

Again, this situation corresponds to a prisoner dilemma, both farmers will extract high, even though cooperation (collective action) would give a better result (500, 500).

4.5. **Provision of different types of goods**

Goods and services can be classified on the basis of their degree of rivalry and excludability.



The lower left corner describes pure public goods (non-rival; non-excludable); the upper right corner describes pure private goods (rival and excludable). We can also define two other types of goods: some goods, for example a highway, can be used jointly by many people (rivalry is low) but it is also relatively simple to extract a payment for their use (a toll), we can call these toll goods. Some goods, like many natural resources –a lake where people fish, grazing land, are

rival, in the sense that use by some affects the level of use of others-but exclusion can be difficult. We call these goods common property.

Now there is an important relation between the extent to which goods are excludable and rival, and who is in a better position to provide them. The traditional dichotomy is between ‘state or market’. We have however seen that some goods, such as the small rural road in one of our ‘prisoner dilemmas’ –which is a local public good- will be provided only if ‘players’ cooperate between themselves, i.e. provision requires some form of collective action.

More generally we can distinguish between three different ways to coordinate economic activity:

1. Markets

- Coordination by exchange
- Voluntary, one-on-one exchange between two parties

This mechanism is dominant in the private sector

2. Hierarchies

- coordination by command
- authority from top to bottom

This mechanism is predominant in the public sector, (but there are private hierarchies, such as large firms)

3. Collective action

- Coordinated by a common interest

This mechanism is predominant in civil society

The fundamental question for policy is

Which coordination mechanism has a comparative advantage in the provision of different types of goods and services?

The answer depends on the nature of the good or service in question, from the point of view of rivalry and excludability:

		Excludability	
		High	Low
Rivalry	Low	Toll goods	Public goods
	High	Private goods	Common property, local public
		Market	Collective action

- When excludability is high (private and toll goods) then markets are possible;
- When excludability is low (public and common property) then some form of collective action is necessary to overcome free-riders problems;
- When rivalry is low (toll and public goods) then there are often large economies of scale and large organisations (hierarchies) have an advantage in provision. For example in the case of pure public goods where the group of beneficiaries is large (say the entire population of a country) public intervention in the form of state intervention becomes necessary in order to collect taxes, impose sanctions against tax evaders, and use tax revenue to provide the public goods.

We should use these concepts when dealing with strategies for the agricultural sector. Directions of change should be guided by the notion of ‘comparative advantage’ both in the traditional sense of comparative advantage in production and trade and in the institutional context.

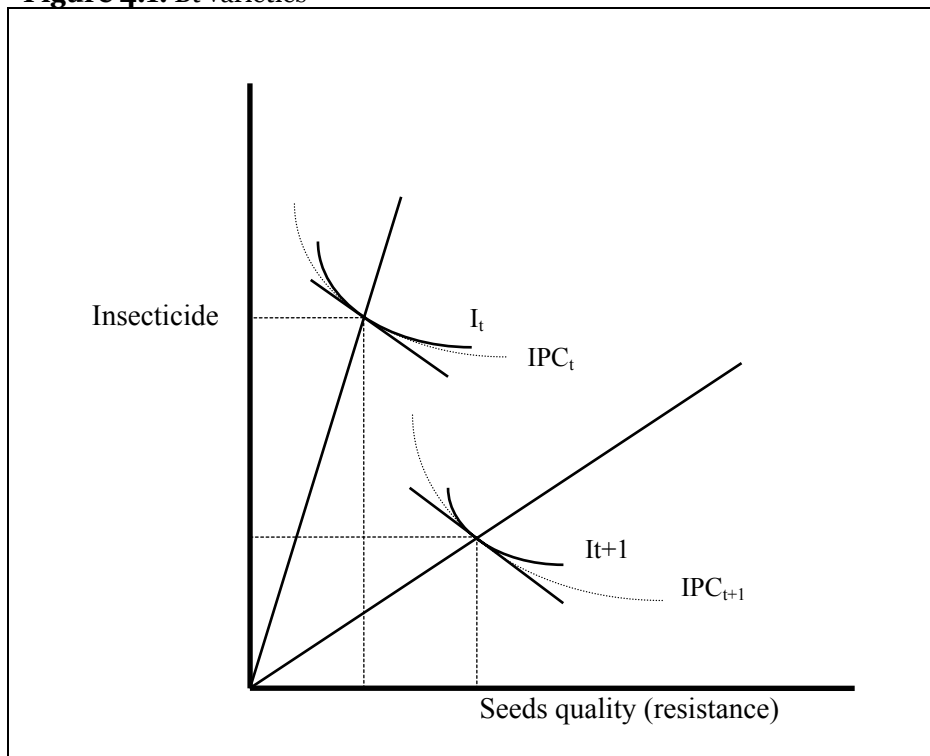
More in general, if good institutions are one of the crucial factors on which successful development depends, then development crucially depends on factors that are controlled in large measure by individual countries themselves.

Conversely, any ‘economic strategy’ such as ‘structural adjustment’ must take into account the institutional structure of a society: the rule ‘one strategy fits all’ is not valid (example: rapid privatisation in a country where there are institutional constraints to the timely emergence of private operators).

4.5.1. *Biotechnology: a case study*

In principle biotechnology could provide answers to many problems of agricultural intensification. Innovations such as the development of an insect or herbicide resistant plant variety⁸ can be represented as a non-neutral shift of the technological frontier. In the case of Bt varieties the technology substitutes a conventional chemical input (insecticide) with seeds incorporating insect resistance.

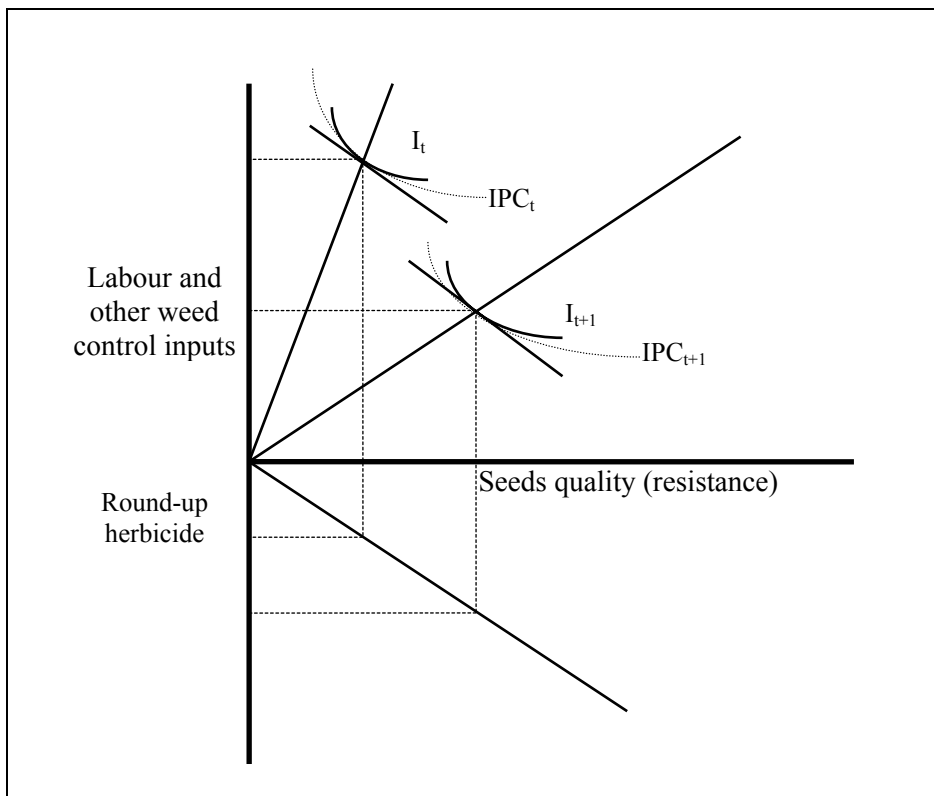
Figure 4.1. Bt varieties



In the case of RR varieties, seeds incorporating resistance to Roundup herbicide substitute for labor and other herbicide management inputs when used in combination with Roundup.

Figure 4.2 RR varieties

⁸ Herbicide tolerant and insect resistant plants are the most widely used agricultural biotechnology innovations. Bt varieties of maize and cotton incorporate a genetic sequence of a micro-organism (*Bacillus thuringiensis*) so that plants produce proteins toxic to certain species of insects. Monsanto’s RR (Roundup-Ready) soybeans incorporate genes that permit the plant to tolerate a very effective herbicide (Roundup) previously developed by Monsanto.



These shifts are produced by the combination of two developments: rapid advances in molecular biology and genetic engineering and the establishment of intellectual property rights (IPRs) on innovations incorporated into seeds.

Historically, with the significant exception of hybrid corn in the US, farmers' free access to plant varieties has been the rule in agriculture. In the US, although legislation protecting plant breeders' IPRs had been introduced since the 1930s, decisive steps in this direction have been linked to modern biotechnology, with the granting of utility patents encompassing living organisms. Specifically, a turning point was represented by the 1980 ruling of the US Supreme Court, in the much-quoted *Diamond vs. Chakrabaty* case.

In the context of limited experience with patent issues in a field entirely new such as biotechnology, the US Court ruled in a 5 to 4 vote that a live, human-made microorganism was patentable. What followed later –a pressure to maximize the number of patents-, has been described as the closing of a global commons –represented by the plant genetic materials– and as very much akin to speculative land grabs.

The complexity that this process has generated in terms of intellectual property rights is illustrated by the case of vitamin A rice, which in 2000 was reportedly based on 70 patents, held by 32 different firms.

Furthermore, biotechnology has allowed the development of many techniques designed to protect property rights. Important examples are RR varieties –where trait expression is linked to the use of a specific herbicide provided by the owner of the trait– and genetic use restriction techniques, known as “terminator genes”, that allow perfect property rights enforcement on seeds, as plants produce seeds that are sterile and must therefore be purchased each season.

Firms carry R&D and offer the new products because with intellectual property rights protection they can appropriate the benefits. The new varieties change the structure of costs for farmers – they reduce some variable costs (e.g. insecticides costs) and increase seed costs –; farmers in the

developed and developing countries adopt the new technology if it is –on the whole– cost reducing, and pay a price premium for the modified seeds.

Biotechnology does substantially reopen the technology gap in agricultural innovations between the developed and the developing countries. As compared to traditional plant breeding it allows responses that are faster, more flexible (i.e. the innovations can fit the needs of many different environments, therefore do not require the set of conditions that limited the success of green revolution varieties to certain regions of the world), more precise (i.e. they produce varieties whose traits correspond more precisely to the research objectives than those obtained through conventional plant breeding) and have the potential to address some of the externality problems of agricultural intensification.

As for the issues that have dominated the public debate, it should be recalled that the possible negative side effects of biotechnology are in many ways analogous to the type of externalities associated with intensive agriculture and it is not clear whether, on balance, problems such as pest resistance and loss of biodiversity may be reduced or amplified with the new technologies. However, while the negative externalities of agricultural practices, such as chemical inputs use, are known, the side-effects of the genetically modified (GM) crops are surrounded by an higher degree of uncertainty, because biotechnology allows genetic crossing among very distant classes of organisms. Uncertainty and the related consumers' diffidence raise the institutional costs of innovations both for the private and for the public sector, since for instance, the safety assessment on GM crops must be more careful than with the outputs of conventional plant breeding.

Given the great potential of biotechnology, one could imagine seeds that eventually provide most of the answers to the problems of poor farmers (low-input agriculture) in unfavourable environments. These 'miracle' seeds could combine increased resistance to pests and to environmental stresses such as drought, and improved nutritional quality. Furthermore, the embodiment of desirable qualities into seeds would reduce both the human capital requirements of farming at the farm level and farmers' dependence on input markets (other than the seed market), both desirable qualities.

In practice however, the impact of biotechnology on the problems of agricultural intensification are largely dependent on the evolution of a number of market structure and institutional issues.

Biotechnology is closely linked to the establishment of intellectual property rights in agricultural innovations – in contrast with the tradition of sharing of genetic materials between public research centres engaged in plant breeding. The establishment of IPRs should foster innovation to the extent that it provides private incentives for R&D. The historical experience of hybrid maize in the US, and other more recent examples, actually show that IPRs definition is associated with very high rates of private R&D investments and of varietal development.

If biotechnology translated solely into greater private investments it would unambiguously contribute to growth. However, past experience shows that IPRs definition resulted in a 'crowding out' of public spending in plant breeding; furthermore biotechnology has been associated with industry concentration.

As for the role of the public sector, the experience with hybrid maize in the US shows that the protection of property rights results in very high rate of investment and variety development and in the dominance of private seed companies. The substitution of public with private plant breeders is an indication of the latter having a competitive advantage over the former. However, in the case of biotechnology, there are also indications that the public sector may have some disadvantages vis-à-vis large biotechnology companies in defending its 'freedom to operate'. Tentative explanations include the fact that its internal decision mechanisms make it costly to negotiate cross-licensing and other agreements, and the fact that public institution would not sue for anti-competitive behavior.

Furthermore, the public research centers have experienced for decades the consequences of financial restraint and have been under pressure to become partially self-financed and to substitute public with industry-provided funds. Biotechnology has increased this pressure ⁹.

On the whole, it seems clear that if the public sector has to retain a distinct role in biotechnology a substantial institutional response is required at the national level and in the international institutions.

From the developing countries' point of view there are a number of issues. The private life-science companies in the developed countries increasingly define the research priorities in agriculture. The private sector is guided by the profit motive and therefore by the extent of the effective demand for innovations, i.e. by the extent of the actual or potential value of the market for seeds. Therefore research includes all the major food crops¹⁰; the "life science" companies should be expected to try to introduce available products (innovations) in many developing countries and to address directly specific developing countries' problems that involve large numbers of non-poor farmers ¹¹.

However, most of the historical failures of agricultural intensification have been related to poverty and/or very unfavorable environments. The low input-low yield equilibrium of smallholder/peasant farming systems in many parts of the developing world is the result of a number of constraints: cash and credit constraints limit the possibility to acquire inputs; poor infrastructure in terms of input supplier networks means that input deliveries may be late and inputs may be of poor quality; poor infrastructure in terms of storage and roads means that output price fluctuation tend to be locally wide. Farmers in these systems use carry-over-planting material. With biotechnology they should eventually buy seeds, but this may happen only if those seeds allow them to overcome some of their economic and natural constraints. The experience with hybrid maize – which requires all the inputs (purchased seeds, fertilizer, pesticides and good rain) at the appropriate time– shows that an innovation which does not address those constraints has a low probability of being adopted.

The public research systems in the developing countries and the international research system have a role in addressing the demand for innovations of poor farmers and the safety concerns of consumers in the 'backward' countries.

With biotechnology the increasingly private good nature of innovations will not allow the type of transfer that has taken place with the green revolution, i.e. it cannot be assumed, like in the induced innovation model, that the IPC be the same world-wide, or it should be expected that the time lag with which the 'frontier' becomes available at no cost to the national research systems in the "backward" countries becomes larger. In the mean time adopting farmers in the 'backward' country pay rents to IPRs that belong to foreign seed companies.

Furthermore, with the exception of a few large countries (including India, China, Mexico and Brazil) developing countries have little research capacity and no regulatory framework to legally acquire and safely release biotechnology products. For example, a recent survey on the management of proprietary technologies within the CGIAR and a group of Latin American national research organizations found that the ability to manage IPRs (ability to obtain clear knowledge or information regarding the type of IPRs established for a particular innovation and the associated restrictions in terms of research and post-research use, ability to seek intellectual property protection for own inventions) was limited both in the CGIAR and in the national research organization studied.

⁹ In the US the role of royalties, grants, contracts and donations from the private sector has substantially increased. Some universities have accepted equity stakes in private companies as payment for the transfer of technology (Zilberman et al.,1999)

¹⁰ Hence, crops that are specific to relatively small areas or poor agricultural environments (e.g. cassava and yams) have been termed 'orphan commodities'.

¹¹ Traxler et al.(1999) quote as an example the development by Monsanto of a genetically modified variety of Bt soybean effective against an important pest in Brazil.

Furthermore it appears that the role of the private sector in terms of biotechnology R&D is still very limited.

Biotechnology actually poses problems of public investment decisions in the developing countries for at least two reasons. One is the opportunity to exploit the technology spillovers – from the developed countries R&D sector– that may easily occur at the process level. The other is the difficulty to develop a substantial private involvement in biotechnology R&D in countries where the size of the market is small (because farmers are poor) and/or IPR enforcement too expensive (because small-farms are prevalent).

Biotechnology requires at least some type of investment in high-skills human capital (in the biological and legal fields) and regulatory frameworks. One may argue that some of these adjustments are no more challenging than those required by the green revolution. For example, it is no less difficult to develop water control in a vast countryside, involving large number of farmers and local institutions than to “produce” PhD students and regulatory frameworks. Both can be obtained on the basis of the institutional build-up in the developed countries, presumably at very low cost. Also, the public research institutions in the developing countries could improve their capability to exploit complementarities and economies of size at the national level and through regional cooperation. On the other hand there may be costs associated with the fact of being ‘policy takers’ in terms of regulatory frameworks for IPRs and safety and the implementation of such frameworks may be difficult.

In conclusions, biotechnology has an enormous potential but poses a set of issues of regulation and institution building, both in the developed and in the developing countries.

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