Agriculture and Industry: enhancing mutual gains

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Indira Gandhi Institute of Development Research

2003

Preprint from *Decision*, July-December, 2003, Vol. 130, No. 2

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Abstract

There are strong links between agriculture and industry. But does low or high improvement in agricultural productivity give the fastest overall development? In a structuralist two-sector model, the answer is that it depends on the food budget share. An efficient real wage results in a target for the agricultural terms of trade. If relative agricultural price lies above the target inflation occurs. Optimal policies, at high food budget shares, are keeping food prices stable, raising agricultural productivity and industrial demand. A nominal agricultural price rise may lead to a worsening relative terms of trade and lower farm incomes. East Asian economies got the transition right, but in India political economy factors forced an early rise in food prices. Liberalisation offers an opportunity to shift to the optimum policy set. The shift will be more feasible if corporates invest in agriculture. This will increase agricultural productivity, and help revive industrial growth.

JEL classification: O11, O13

Keywords: Food budget share; threshold; sector terms of trade; agricultural productivity

*Acknowledgement: Parts of this paper were presented at M.S. University Vadodara, and at the IGIDR money and finance conference. I thank Pulapre Balakrishnan, T.S. Bishnoi, Romar Correa, Errol D'Souza, Raghabendra Jha, Manoj Panda, V.N. Pandit, and Maya Shah for useful comments. Anamika Gupta, T.S. Ananthi and Lingaraj Panda helped with the word processing.

Agriculture and Industry: enhancing mutual gains

1. Introduction

Industrial performance in India is closely connected to agriculture. Fluctuations in agricultural output normally affect industrial growth in that year and with a lag. There are strong links between the two sectors. The question we analyze in this paper is does low or high improvement in agricultural productivity give the fastest overall development? In a structuralist two-sector model, the answer we get is that it depends on the food budget share. An efficient real wage results in a target for the agricultural terms of trade. If relative agricultural price lies above the target inflation occurs. Optimal policies, at high food budget shares, are stable food prices, raising agricultural productivity and industrial demand. A nominal agricultural price rise may lead to a worsening relative terms of trade and lower farm incomes. The farmer can buy more in real terms when he raises his price less.

Next, we apply the model to compare South with East Asian development. East Asian economies got the transition right, which may be part of the explanation for their more rapid development. In India political economy factors forced an early rise in food prices which harmed development. Is argued that liberalisation and global changes offer an opportunity to shift to the optimum policy set. This will stabilize agricultural prices and stimulate industrial demand. It will also offer a major opportunity for industry to invest in agriculture in new initiatives such as contract farming, increase productivity in agriculture, and boost industrial growth.

At high per capita incomes, food is a small part of the budget; therefore agriculture naturally shrinks with development. It is well accepted that agriculture provides essential resources for development, but there is debate over whether high or low agricultural productivity is more conducive to rapid development. In many countries changes that raised agricultural productivity and released labour and food for industry were a precondition for development. But in dualistic models of development it is the stagnation of the traditional sector that shifts resources to the higher productivity modern sector.

In classical dual economy models[1], with surplus labour, rapid growth requires real wages to be constant at subsistence. As rising profits are saved and invested labor shifts to the sector with higher productivity. Transfer of labor and food from agriculture to industry provides a surplus for development. It is the higher modern sector productivity that is emphasized[2]. But a key feature of such dual economies is that the average household spends the major share of its budget on food. A rise in the relative price of food then raises nominal wages and inflation. Rising agricultural productivity is necessary to break this link.

We demonstrate these issues in a minimalist two-sector macro-model. There is surplus labor so that real wages equal the average product of labor in the traditional sector and the marginal product can lie below this, but nutritional requirements set a target real wage. Demand for food is elastic at low per capita incomes in line with Engel's law, which says that as incomes rise a smaller proportion is spent on food so that income elasticity of food exceeds unity only at low per capita incomes. Analysis is normally restricted to the short-run, or to the steady state where food shares would be low, and transitional dynamics that occur when the elasticities switch, have been neglected. We demonstrate the sensitivity of the comparative static results to this switch. The results are that output is maximised and inflation is minimised on the transition path to the end of dualism, if agricultural productivity and industrial demand are stimulated. Once the budget share of food shrinks, and farm incomes begin to fall, a different policy set will be required.

If agriculture and wages are a source of demand for industry, real wages do not have to be constant at subsistence for rapid development. As wages rise, the increase in units sold may compensate for a fall in profit mark-up, so that the profit rate rises. But if food budget shares are high, labor productivity determines the relative prices that are consistent with the efficient real wage, and this may lie below the relative price that clears the two markets. In this case, agricultural labor productivity determines the actual relative prices, and must rise for a non-inflationary rise in real wages to be possible. The target efficiency wage can itself rise, as a more diversified consumption basket becomes

[1] The classic papers are Lewis (1954) and Ranis and Fei (1961). They spawned an enormous literature.

the norm. These considerations help to understand why the average real wage rate has been rising[3], even in countries, which are far from having absorbed their entire labor surplus and achieved the transition to a developed economy. On average, employers have found it worthwhile to pass on higher productivity to workers. But complementary policies that raise agricultural productivity and keep food prices low are required for wages to rise without adverse effects on output and inflation.

The structure of the paper is as follows. In section 2 a minimalist structuralist macromodel is developed. Section 3 derives the comparative static response to shocks. Section 4 shows how the model can be applied to explain differential rates of development in South and East Asia. Section 5 concludes. Results are derived in the appendix.

2. The Model

The basic short-run dual economy model[4] for a developing country has two sectors. Agricultural output is given in the short-run, and prices adjust to clear the market, while the industrial output is demand determined[5]. That is, variation of output in response to demand clears the market, because of imperfect competition and fixed overheads in industry, prices are set as a mark-up on costs. Demand for industry rises as terms of trade move in favour of agriculture and farm incomes rise. We adapt the short-run model in order to analyse the transition path that abolishes dualism the fastest.

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[2] There is also a literature that underlines the importance of raising agricultural productivity for removing poverty, for example, Lipton, 1977.

[3] The average daily earnings, in 1960 prices, of Indian agricultural laborers grew steadily from 0.88 in 1972-73 to 1.93 in 1993-94 (Vaidyanathan, 2000, Table 2). Thus even labour surplus countries such as India and China have followed Kaldor's stylised facts that income shares tend to remain constant but the wage rate goes up as labour input per unit output falls, thus supporting an efficiency wage argument.

[4] Cardoso (1981) gave a clean formalisation of structuralist arguments, which had originated in Latin America in the sixties. A number of variants have been developed. Our model differs in the emphasis on Engel effects, efficiency wages and the focus on the medium-run transition path. Since the model has been earlier derived from primitives of preference, technology and institutions we do not go into this, and stick to the simplest level of analysis required for our question.

[5] We are considering an economy that has a sufficiently developed modern sector, so that Rao's (1952) criticism does not apply. Rao pointed out that the short-run Keynesian multiplier would not hold in a developing economy because of specific shortages that it would soon run into. In our model industrial output is demand determined, but for this to be sustained over a number of periods, it is important that the expenditure components that are rising include investment.

The variables are: Agricultural output, Q_A, and price P_A, nonagricultural output Q_I, and price, P_I. The level $\bar{w}$, of the real product industrial wage in terms of agricultural goods[6], is set to maximize labour efficiency[7]. Therefore it equals the average product in industry. W is nominal wages.

$$\bar{w} = W/P_A$$

Agricultural labour is also paid its average product, although this may be due to surplus labour. Average product of labour in agriculture may be below that in industry due to skill differences and other cost of mobility. Industrial prices are set as a mark-up[8] on wage costs, where m is the profit share. L_I is labour required to produce one unit of industrial output, and β the trend rise in average labour productivity in industry. Therefore:

$$P_I = [(L_I(1 - \beta))/(1-m)]W$$

Substituting out W from the two equations gives the terms of trade that satisfies the target real wage:

$$P_I / P_A = [(L_I(1 - \beta)\ \bar{w})/(1 - m)]$$

Solving for $\rho = P_A / P_I$, we get:

$$\bar{\rho} = [(1- m) / (L_I(1 - \beta)\ \bar{w})] \quad (1)$$

We assume the average budget share of food is high. The propensities to consume out of total income are c_I for industrial output, and c_A for agricultural output. The fixed consumption propensities imply that the consumption basket of agricultural income earners is similar to that of industrial income earners, but both classes spend a larger share of their income on agricultural goods. Therefore c_A exceeds c_I, and demand for agricultural output rises by a factor ε when P_A rises, and workers attempt to maintain

[6] If the real wage is specified in terms of the price level, the argument changes quantitatively but not qualitatively as long as the share of agriculture in consumption is large; which is an assumption we make here. Therefore we retain the simple specification.

[7] Stiglitz (1974) was an early presentation of the efficiency wage argument. If a worker's output depends upon effort as well as time, profit maximisation equates the average product to the wage rate. Literature validating such wages continues to develop. Blanchard and Katz (1997) argue that the labour demand function is horizontal in the medium-run with changing capital stock, at a level linked to technology and productivity. Increases in the latter are passed on in real wages.

[8] This is a simplification but can be derived optimally from industry structure arguments. In Goyal (1999) the mark-up is derived by the profit maximisation of risk-averse firms in a more general dynamic model. When food prices rise, firms need to offer higher wages to induce the efficient effort level, but because

their consumption of food. Demand for industry falls by the same factor. We call $\varepsilon > 0$ the Engel effect[9]. A percentage of income is saved. Therefore:

$$0 < c_I < c_A < 1$$

$$c_I + c_A < 1$$

Savings are taxed to finance government expenditure *G*. Since industrial output is demand determined, *G* is an exogenous policy decision that raises industrial output to the point where savings generated equal *G*. Now the supply equal to demand or market clearing equation for the agricultural sector can be written as:

$$P_A Q_A = c_A (P_A Q_A + P_I Q_I) + \varepsilon P_A$$

For the industrial sector:

$$P_I Q_I = c_I (P_A Q_A + P_I Q_I) - \varepsilon P_A + P_I G$$

Rewriting with ρ as the dependent variable, the two equations become, respectively:

$$\rho = [c_A / ((1-c_A)Q_A - \varepsilon)] Q_I \quad (2)$$

$$\rho = [(1-c_I)/ (c_I Q_A - \varepsilon)] Q_I - G/(c_I Q_A - \varepsilon) \quad (3)$$

Demand for the product of each sector is a function of income and relative prices. Equations 1, 2 and 3 are graphed in Figure 1. The *AA* (II) curve graphs equation 2 (3) or the combination of ρ and Q_I that yield equilibrium in the agricultural (industrial[10]) market. Equation 1 is graphed as the horizontal line at the level of ρ that satisfies the efficiency wage target; ρ will tend to fall above this line. Below the *AA* curve excess demand for agriculture (ED_A) is positive and ρ will rise. Above the *II* curve excess demand for industry (ED_I) is positive and Q_I will rise.

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output falls the optimal mark-up is constant or rising, so that prices must rise. If the mark-up set is optimal, trying to change it through policy will only induce distortions on the supply-side.

[9] Eswaran and Kotwal (JDE, 1993) is an example of a two-sector general equilibrium model where preferences between food and textiles reflect Engel elasticities.

[10] We rule out the case where the industry equilibrium curve is downward sloping. Rakshit (1989) explores this variant on the grounds that as ρ rises real wages fall and landlords who gain at the expense of profit earners and fixed income groups, spend relatively less on industrial goods. Therefore a rise in industrial output was only possible if agricultural terms of trade fell. This case is relevant in very early stages of development. But as real wages rise, the landlord's share shrinks. Industrial goods are widely consumed in rural areas, by landlords as well as workers, even in labour surplus countries, so that as terms of trade move in favour of agriculture, demand rises for industry. Many market studies support the importance of demand from agriculture for industrial goods. The rural household today demands a varied portfolio of branded industrial goods, ranging from soaps to tractors.

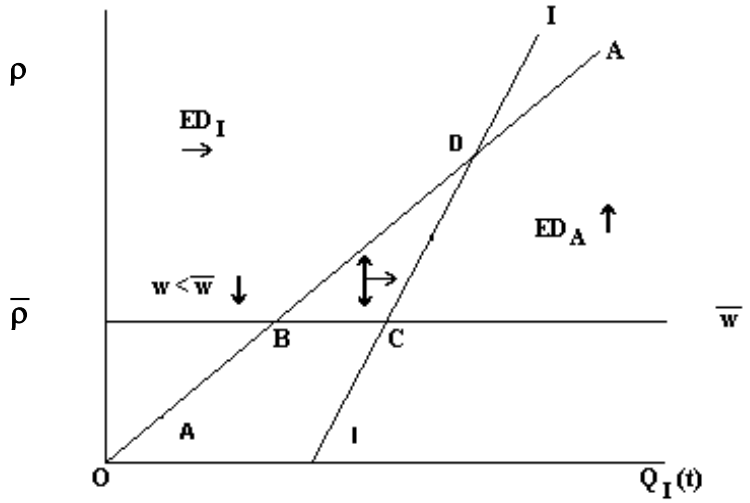

Figure 1: The three equilibrium conditions

Stability requires that the *II* curve (equation 2) is steeper than the *AA* curve (equation 3).

$$\left.\frac{d\rho}{dQ_I}\right|_I > \left.\frac{d\rho}{dQ_I}\right|_A$$

This condition is satisfied as long as savings are positive, since consumption propensities multiplied by savings propensities must be greater than the consumption propensities alone (see appendix A.1). As income rises with Q_I, a greater rise is required in ρ for equilibrium in the industrial goods market compared to the agricultural market. The stability condition ensures that a rise in Q_I will not cause an aggravation of the excess demand for Q_I. Otherwise as positive excess demand for agriculture (ED_A) drives up ρ, excess demand for industry (ED_I) will stay positive and drive up Q_I.

If the variables lie in an area such as *DBC* (figure 1), excess demand for agriculture will raise P_A. But then the real wage target will not be satisfied, so firms will raise *W*, and from equation 1, P_I. Therefore ρ will not rise enough to remove ED_A, and the process will continue as P_A rises again. Agricultural productivity is too low to give a ρ low enough to attain the target efficiency wage. The attempt to raise *W* in order to reach it induces inflation, hence the target wage is not obtained

On the medium-run transition path, Q_A changes. The area DBC can shrink or expand in the next period. Early structuralist theories regarded raising productivity in agriculture as very difficult because of entrenched tenure systems but in the Asian

experience a considerable rise in agricultural productivity was achieved as a result of the green revolution. There are other feasible reforms such as changes in the structure of marketing. Some of these are discussed in Section 4[11]. Shocks to agricultural productivity also shift the position of the *AA* curve.

Since a rise in agricultural prices raises total income, in the model, it raises demand for industry. Income distribution changes with the real wage target. As agricultural incomes and real wages rise with productivity, demand for industrial output rises. This simple analytical framework delivers some interesting results.

3. Variations in Agricultural Output

The endogenous variables are ρ and Q_I, they respond to shocks in the exogenous variables G and Q_A. An agricultural shock leads to a proportional shift in both curves with that in the *AA* curve being greater since $1- c_A = c_I + s > c_I$. The interesting result is that ρ falls but Q_I is unchanged after a favorable agricultural shock if Engel effects are absent; with them Q_I rises and the fall in ρ is moderated.

Comparative static results derived in the appendix are summarized below:

1. A rise (fall) in *G* raises (lowers) ρ and Q_I.
2. A rise (fall) in agricultural output lowers (raises) ρ and increases (decreases) Q_I unless ε is zero in which case Q_I is unchanged.
3. A rise (fall) in agricultural output combined with a calibrated rise (fall) in *G* can leave ρ unchanged and raise (lower) Q_I compared to the original position.
4. Since a rise (fall) in *G* acts to raise (lower) ρ, if the change in *G* is large enough, it can reverse the effects of the changes in agricultural output on ρ in 2 above. The effects of *G* and agricultural output on ρ are in the opposite directions.

Insights from these comparative static results are summarised in Propositions 1 and 2.

[11] Explicitly introducing imports and exports in the market clearing equations 2 and 3 will shift out both II and AA curves under the assumption that food is imported, industrial goods exported and trade is balanced,

Proposition 1: A rise in ρ will be associated with lower Q_I after an adverse agricultural shock, and higher Q_I after a rise in G.
Proof: Point 1 and 2 above.

In the Lewis model a rise in the relative price of agriculture lowers profits and growth. In this model, although a rise in ρ raises industrial demand, if there are no Engel effects the fall in Q_A neutralizes the rise in ρ fully. If ε is zero, since the proportionate rise in ρ equals the proportionate fall in Q_A, agricultural incomes and industrial demand stay constant. But ε is positive because the relatively greater cost of food, after a rise in ρ, lowers demand for Q_I. With positive ε the fall in ρ is less than proportionate to a rise in Q_A, so that agricultural incomes will rise (fall) with a trend rise (fall) in Q_A.
Claim 1: But if ρ rises above $\bar{\rho}$ inflation occurs, this forces a fiscal contraction, which lowers Q_I.
As ρ rises above $\bar{\rho}$, wages fall below target. In a populous democracy governments are very sensitive to inflation, since it is a major electoral issue. If inflation is above a minimum threshold *G* is cut. This lowers Q_I (see point 1).

Therefore although a rise in ρ may not directly lower industrial output, it does lower it indirectly. Fundamentally ρ rises when Q_A is too low, so that the inflationary triangle DBC is positive. A fall in G is one way of closing the triangle, but this harms industrial output.

Proposition 2: If the inflationary triangle exists, a rise in either β or Q_A, or both, can shrink the triangle, without a fall in Q_I.
Proof: If β rises P_I falls from the mark-up equation ($P_I = [(L_I (1 - \beta))/(1-m)]W$) which is derived from the wage-price process. Therefore ρ and $\bar{\rho}$ rise. When $\bar{\rho}$ crosses through point D in Figure 1, the inflationary gap is closed. Alternatively, if Q_A rises so that the AA curve passes through point C the triangle is also closed. Both D and C lie on the *II* curve and therefore are points of maximal Q_I.

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as in Cardoso (1981). The model here is restricted to a closed economy.

But as long as the share of food in the consumption basket is high, a rise in the real efficient and actual wage will require a rise in agricultural productivity.

Proposition 3: A rise in agricultural productivity is one of the conditions that can realise the real efficient wage target in industry. But it is necessary to raise the target wage if agriculture accounts for the major share of consumption.

Proof: The first part follows from Proposition 2. Inflation lowers real wages, so if the inflation gap is closed the real efficient wage target can be attained. A rise in Q_A closes the inflation gap. For the second part, underlying our definition of target wages $\bar{w}$ = W/P_A is the implicit assumption that agriculture accounts for a major share of consumption so that nominal wages need to rise with agricultural prices. From this equation, if P_A falls as agricultural productivity rises, $\bar{w}$ rises unambiguously. If P_A is constant, differentiating the mark-up equation $P_I = [(L_I (1 - \beta))/(1-m)]W$, we get $\delta W/\delta\beta = [-(P_I (1 - \beta)(1-m))/L_I)]\} < 0$ unless $\beta > 1$. Such a high level of β is not feasible.

The results imply that a rise in agricultural productivity is required for raising real industrial wages[12] without inflation. The agricultural wage can rise only if the average product rises in agriculture. If the wage target were specified in terms of the aggregate price level, the new $\bar{\rho}$ would lie strictly above the $\bar{\rho}$ determined by the real product wage. But as long as the share of agriculture in the consumption basket is high and its average productivity lies below that required by the target wage the over-determined area BCD would exist. If most of wages are spent on food real wages cannot rise without inflation, unless food becomes cheaper.

A rise in agricultural productivity makes possible a rise in real product wages such that the target real wage can be reached. It could shift the *AA* curve such that the new equilibrium is at or below the value of ρ that delivers the target wage (figure 2 and

[12] Lewis (1954) had the same conclusion when trade was introduced in his model. Terms of trade were determined by relative labour productivities. He showed that surplus *L* countries should never export their subsistence product. Such a country got more of the gains from trade if its productivity in the subsistence sector rose. But his argument was based on the effect of relative productivities on wages and the terms of trade, ours on sectoral demand and inflation.

A2). Combined with a rise[13] in G the required value of ρ can be exactly reached, with a rise in Q_I. Since the *II* curve also swivels out with the rise in Q_A, but the shift is less than that in the *AA* curve, at the new equilibrium point ρ may lie below $\bar{\rho}$. Then a parallel shift to the II curve, from the rise in G, is feasible without inflation. By itself a rise in G tends to raise both ρ and Q_I. Combined with a rise in Q_A it ensures that ρ stays at $\bar{\rho}$. These arguments lead to:

Proposition 4: The best policy combination to lower inflation and enhance output, for an economy in a positive inflationary triangle, is to raise agricultural availability in the short-term and productivity in the long-term together with stimuli for industrial demand.
Proof: From the comparative static results it is clear that a positive agricultural shock, with Engel effects present, raises Q_I and lowers ρ. When the food budget share is high, the fall in ρ is less than proportionate to the rise in Q_A, so that agricultural incomes rise. A rise in G raises both Q_I and ρ. Therefore a combination of a rise in Q_A and G can be designed such that Q_I is raised and ρ kept at $\bar{\rho}$. This delivers the largest increase in Q_I and agricultural incomes consistent with zero inflation.

Figure 2 illustrates this combination, for the case with no Engel effects. A positive agricultural shock shifts AA out to AA'. In the new equilibrium ρ falls below $\bar{\rho}$, while Q_I is unchanged. A simultaneous rise in G raises Q_I, while bringing ρ up to $\bar{\rho}$. The triangle *BCD* in Figure 1, that leads to inflation is closed. With positive Engel effects Q_I rises even without the rise in G, and the fall in ρ is less than proportionate to the rise in Q_A, but still some rise in G is feasible. When the food budget share is high and the income elasticity of demand for food exceeds unity, agricultural incomes rise with Q_A. A rise in G, bringing ρ up to $\bar{\rho}$, will raise them to the maximum extent possible with zero inflation and the largest non-inflationary rise in Q_I.

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[13] The sustainable short-term monetary fiscal policy is a function of the institutions of a country. Bruno and Sachs (1985) argued that since in America 3 year staggered nominal wage contracts were the norm, monetary policy could be stimulatory. In Germany wages were fixed in real terms so that a tight monetary policy was required. In Latin America high per capita incomes, full indexation and political awareness leads to conflict over income shares resulting in a wage-price spiral. In surplus labour developing countries if wages are fixed in terms of food prices, macro policy can be stimulatory as long as food inflation is moderate and agricultural productivity rises.

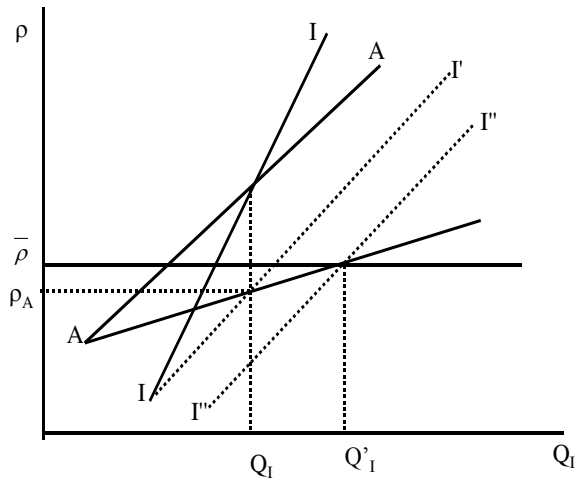


Figure 2: The ideal policy combination

Although Q_A is given in period one, the supply response in period two depends on period one profits, not only terms of trade[14]. Agricultural profits and incomes will rise more with a stable, rather than a rising, ρ when food budget shares are high. In the next section we apply the model and find that differing food price policy may form part of the explanation for differential development.

4. The Political Economy of Incentives for Farmers

Our model suggests that agricultural productivity must be rising for food prices to be stable so that development is most rapid, at high food budget shares. As the latter shrink even if productivity growth concentrates in the modern sector, food prices rise, and agriculture shrinks, this will not harm the development process. When budget shares are high so is the demand elasticity of food, and therefore rising demand for food at stable prices gives the largest rise in farm incomes. Moreover, a rise in absolute prices does not

[14] Empirical studies of farmers' supply response have always used terms of trade because of lack of data on costs. But that is not a restriction on theoretical studies. Sah and Stiglitz (1984) argue for turning the terms of trade in favour of farmers, but their argument depends crucially on a high price response of the rural surplus. We have tried to show that the real profit response should be considered, and raising the agricultural price level will not necessarily turn the terms of trade in farmers' favour.

guarantee a rise in relative prices or terms of trade for farmers. Therefore stable prices are the best incentives for farmers in these conditions. When food budget shares fall, however, even rising food prices and subsidies are not sufficient to maintain farm incomes and prevent agriculture from shrinking.

Although Asian countries were typical labour surplus countries all of them realized the importance of increasing agricultural productivity. The sixties and seventies were the years of the green revolution, concerns about food security and being self-sufficient in food. East Asian countries were the successful developers in this period. Comparing their experience with that of developing Asia illustrates the stylized conclusions of our model[15], because these countries were careful to moderate food price increases and focus on a rise in agricultural productivity as long as food budget shares were high. Only after that were food prices rise and nominal rate of protection in agriculture allowed to rise.

In Japan food budget shares fell below fifty per cent in the post war period, and in Taiwan and Korea in the sixties. In Korea, expenditure on food as a percentage of total expenditure of urban households[16] was 45 per cent in 1960. At around this period, income per farm household as a proportion of income per non-farm household began to fall. In Taiwan it fell from 94.8 in 1966 to 79.1 in 1971 and in Korea it shrank from 99.7 in 1965 to 67.1 in 1970. China reached this stage by the late eighties[17].

Along with budget shares even absolute per capita consumption of rice fell. In Taiwan this was 134.5 kg per year in 1970 but 100.8 in 1980, as diets diversified to include more milk, vegetables and fruit. Nominal rates of agricultural protection, which were negative earlier turned positive in the seventies. East Asia illustrates the shift from

[15] Over 1989-91 the average cereal yield (kg per ha) in East and Southeast Asia was 3.817 (even higher than North America/Oceania's 3.734) compared to 1.919 in South Asia (see Dyson, 1999). This brings out the difference in agricultural productivity.

[16] Statistics for Korea and Taiwan are from Francks et.al (1999).

[17] Expenditures on grain alone were 22.8 per cent of total household expenditures in 1957 but 7.6 per cent by 1987, for an average urban Chinese household. In 1978 average per capita net income in yuan was 133 and share of nonagricultural income was only 7 for an agricultural household. In 1987 the figures were 463 and 25.4 respectively (Lin, 1994). The terms of trade between industry and agriculture had been steadily moving in favor of agriculture from 92.1 in 1951 (1950=100), to 29.6 in 1989, but for the first time they turned adverse and rose to 33.3 in 1993. Over 1986-1995, the average rate of protection for agricultural exports rose from –38.88 to –20.29, and for imports from 26.54 to 38.96 (Yamamoto, H., 2000). These are the trends that we expect at the time of the switch.

taxing to subsidizing agriculture as per capita incomes rise. These countries had taxed[18] agriculture to fund development. Although they kept food prices low, this did not prevent agricultural incomes rising, during the period when food budget shares were high. The governments continued to invest in agricultural infrastructure and other measures to raise agricultural productivity. Farm incomes began falling when development had proceeded sufficiently to lower budget shares below fifty per cent. And then governments turned from taxing to subsidizing agriculture as political pressures mounted to protect farmer's incomes. Since the share of population in agriculture was now small, this was not such a burden. In this period food prices began to rise, and since food was now a small part of the budget, prices could rise without pressure on wages and inflation. Farm populations were also smaller so that the subsidies were a bearable burden.

Table 1: The Impact of Government Intervention in the Rice Market

	Rice Prices (NT$ per kg)			Government collection as % of rice marketed
	Government purchase price	Retail	Wholesale	
1951	0.70	1.29	1.10	55 (1950)
1956	2.56	3.20	2.66	63
1961	2.80	5.86	5.12	53 (1960)
1966	3.17	5.95	5.26	50
1971	4.18	7.19	5.90	38 (1970)
Source: Francks et.al. (1999)				

Taiwan was one of the most successful developers therefore we examine its experience, before the turning point, in more detail. Estimates of agriculture's balance of trade or the difference between its sales to and purchases from the other sectors of the economy amount to 10 per cent of agricultural income in 1956-60. The financing of this transfer is through visible items such as income and savings flows and taxation. But invisible flows through terms of trade effects made up more than 50 per cent of the total. "Fu and Shei…suggest that transfers due to term-of-trade distortions amounted to 6.3 per cent of total agricultural production in 1952-5, 5.8 per cent in 1956-60 and 0.6 per cent in 1961-5, with the terms of trade thereafter beginning to turn in agriculture's favour." (Francks et.al.1999). Rice as the main food crop was the focus of government

[18] In Taiwan over 1956-60 government direct taxes were 15 per cent of agricultural income (Francks, op.cit. pp 170)

intervention. Table 1 documents the effects on rice price in the period. It is clear that rice prices were kept low, and government procurement was a tax at below market price. At the same time, however, the government continued to invest in improving agriculture's infrastructure. The growth of total agricultural output, over the period 1947-74 was 5.1 per cent per annum.

Indonesia, Korea and Thailand (Mitra, 1994) followed similar policies of low food prices, and investment in agricultural infrastructure. And since, with low food prices farm incomes grew most rapidly in this period, it is not correct to call them a tax. Table 2 collects some key facts to link transitions in food price policy to food budget shares in Asia.

Table 2: Profile of Agriculture in Asia

Countries	Farm incomes	Food budget share < 50	Cereal budget shares	Agricultural terms of trade	Transfers from agriculture
Taiwan	94.8(1966), 79.1(1971)	1960s		1965 ↑	(1956-60) 10%
Korea	99.7(1965), 67.1(1970)	1960 (45)			
China	↓ 80s		22.8(1957), 7.6(1987)	↑ 1950s but retail prices, ↑ 90s	
Japan		Post-War			
India		80 (65% of population in 73-74). BS > 50 (95% rural population, 80% urban population in 90s)	38.3 rural 25.7 urban (1993-94)		

Source : Francks et.al (1999), Lin (1994), Eswaran and Kotwal (1993), Shariff and Mallick (1999)

These countries had certain other specific advantages such as equality of land holdings, norms of cooperation having to do with stable rice producing village economies (Hayami, 1998), a high level of education and infrastructure, and export led growth that created urban jobs for rural labor. Countries in South Asia did not share all these. But they also went through a green revolution in the sixties, with large increases in agricultural productivity giving them self-sufficiency in food. Lewisian ideas of a shrinking agriculture were replaced by one where agricultural productivity had to rise to stimulate development. Yet, in the nineties, food still accounted for more than fifty

percent of household expenditure among 95 per cent of rural households and 80 per cent of urban households in India[19]. What went wrong?

One reason was the belief, and its forceful articulation by a dominant farm lobby, that rising agricultural prices, and subsidized farm inputs were essential as incentives for farmers to adopt green revolution technology. The result was persistent low-grade inflation as support prices helped periodically shock the terms of trade above $\bar{\rho}$. The economy remained trapped in the inflationary triangle. The rising agricultural price level did not guarantee a favorable agricultural terms of trade, as nominal wages and industrial prices also rose. Output expansion was below potential. In India the move to subsidizing agriculture came when food budget shares were still high.

The Commission on Agricultural Costs and Prices (CACP) recommends prices to be set; but the Government finally decides. According to the CACP (GOI, 1998), higher prices were set in the seventies, when the green revolution commenced, as incentives to farmers to adopt new techniques. In the eighties the rate of increase was kept low to share the gains of better productivity with consumers. In the nineties as productivity growth slowed more rapid price increases were given. But an indication that prices were set too high is the steady increase in stocks with the Government. The average level rose from 10.1 million tonnes in the seventies to 13.8 in the eighties and 17.4 in the nineties. In July 2002 it peaked at 63 million tonnes (source: Government of India). The distinction between the procurement and support price was lost from the seventies, and the support price, at which farmers could make assured sales, approached the market price. In the nineties it had overtaken the latter. Politicians, influenced by the farm lobby, often granted rates of increase above the recommendations of the CACP. Still both agricultural price and income terms of trade showed more sustained improvement in the eighties compared to the nineties. Table 3 gives a variety of comparative price and quantity indices. The average per annum agricultural growth was 2.8 in the nineties compared to 4 per cent in the eighties. Although the increase in absolute agricultural price level was lower in the eighties output growth was more rapid. This suggests that India is still in the range where elasticity of demand for agriculture is high, so that agricultural incomes rise

[19] Figures from the Indian National Sample Survey, reported in the IGIDR Annual Report, 1998-99, by Swaminathan, M.

more with output increase, even after correcting for the effect of buffer stock and public food distribution policy. More moderate nominal price increase gives better agricultural output and income growth.

Table 3: Price Policy and its Consequence

(percent per annum)

Rate of growth in	**1980s**	**1990s**
WPI primary articles	7.1	9
WPI foodgrains	7.2	11.2
Index nos. of agricultural production	4.2	1.7
Agricultural GDP at (1993-94 prices)	3.8	3.1
Wheat procurement price	8.4	14.3
Index nos. of wheat production	4.7	3.7
Agricultural price terms of trade (range)	+8	+7

Source: Calculated from Economic Survey 2000-01

Agriculture was totally exempt from taxes. But the agricultural lobby got it accepted that agriculture was discriminated against since the import substitution regime in place protected a high-cost industry, and restricted agricultural exports. While support prices were consistently raised, without successfully improving farm incomes, protecting the poor was attempted through an inefficient public distribution scheme. This, and the pervasive input subsidies, was a drain on government finances so that there was a steady falling away of investment in agricultural infrastructure. In terms of our framework, the shift out in AA was not sufficient to close the triangle. As a result agriculture neither provided resources for development nor could be effectively subsidized. Thus poverty and low per capita incomes persist, with more than seventy per cent of the population still in rural areas. Moreover, when there was an adverse agricultural supply shock, *G* was cut, thus lowering inflation, but harming industrial output. The effects of fiscal contractions tend to continue beyond one period.

China in moving to the household responsibility system in 1978 had raised quota (purchase) prices by 17 per cent, but retail prices of grain and edible oil were not changed, and the government bore an increasing subsidy (Lin, 1994). Retail prices were allowed to rise only in the nineties when food budget shares had fallen[20]. These policies

[20] In 1993-94 when grain budget shares were below 7 for China, cereal shares were 24.2 for rural and 14 for urban Indian households (NSSO, 1996). They were at the latter levels for rural China in the fifties. The total food shares for India were respectively 63.2 and 54.7.

worked better in China than in India since agricultural productivity was almost double that in India to start off with, so that the triangle was smaller. Moreover, since China started from a totally repressed non-market system, the price rise was in the nature of an initial realignment. The more important incentives for farmers came from the freedoms given. The rapid expansion in industrial employment for exports helped to raise the average product in agriculture by reducing labor dependent on agriculture.

What can South Asian countries, which have the highest concentration of the world's poor, do now? Initial conditions such as tenurial structures, education and infrastructure are vital but can change only slowly, especially when government has very little money. But the post-Uruguay round world gives some new opportunities to stabilize food prices at world levels, with general productivity correction coming from level of the nominal exchange rate.

Protest from the domestic farm lobby should be muted if international prices are used as a benchmark for grain procurement prices, since they had argued for closer links to world prices earlier when domestic prices were much below international. Their comparative advantage in many crops at current exchange rates, still gives them an interest in liberalisation[21]. They can diversify their crop portfolio and earn a higher average amount by cultivating high value added export and cash crops, while an international parity support price for grains gives them an assured income component, since demand for basic foods is still elastic[22]. This will ensure that enough grains are cultivated to provide essential domestic food security, while allowing a flexible response to changing demand patterns. Domestic demand for cash crops is also rising and corporate support will be essential in improving the marketing infrastructure for export and more generally. Many Indian States are actively encouraging corporate contract

[21] In India agricultural liberalization started in 1994 and will be completed by 2004. WTO permissible aggregate measure of support is 10 per cent; in the Indian case this is currently negative, estimates put it at about –40 per cent. Permissible tariff bindings are at 100 per cent compared to the 30 per cent that are actually in force. Agricultural exports in US Dollars nearly doubled over 1992-1997 compared to 1986-1990, although they slowed in the subsequent period. Imports grew only moderately at about 20 per cent. Sharp rise occurred in exports of meat, dairy, rice, vegetables and fruits, sugar, animal feeds and vegetable oils (see, Panda and Ganesh-Kumar, 2000).

[22] Vaidyanathan (2000) estimates that a 6 per cent annual growth in GDP, and a 2 per cent population growth would give a 4.3 per cent annual rise in domestic demand for agricultural products. In the nineties agricultural output grew at only 2.8 per cent. He uses the elasticity of gross agricultural output to per capita GDP growth of 0.58, implicit in the Indian 8th plan projections.

farming, even amending earlier marketing rules that required all farm produce to be kept in mandis. Banks are willing to lend. Enabling legislation to protect small farmers in contract disputes is also required. Corporates stand to gain since it will lower their raw material cost and improve its quality (Sabarinath, 2003). Thus industry can directly contribute to achieve the required rise in agricultural productivity.

In South Asia[23], crop processing and expansion in other rural non-agricultural employment can provide the multiple activities that were very important in defending rural household incomes in East Asia. If subsidies are lowered in world agricultural markets, although this is a contentious issue, and agricultural exports expand, demand will continue to be elastic even as domestic food budget shares fall.

If relative prices lie in the triangle and are influenced by both the wage target and the market clearing equilibrium, macro policies based on these relations, will be successful in lowering inflation, stimulating development and reducing poverty.

6. Conclusion

Models of development have emphasized the inevitable shrinking of agriculture. But when food budget shares are high, unless average product in agriculture is high, or is rising faster than the average efficient industrial wage, inflation will occur and lead to slowdowns in demand and output. In transition, the optimal policy requires a coordinated rise in agricultural productivity and stimulus to industrial demand that keeps the economy at the non-inflationary terms of trade. In our model, although industrial demand rises with nominal agricultural incomes, a favourable shock to agricultural output gives better results if boosted with an additional demand stimulus. Real product wages can rise only if agricultural productivity rises, although inflation will be moderated if industrial productivity rises. A fall in industrial output after an agricultural shock may be prevented by a suitable policy response. The affect on inflation depends on the new position of agricultural terms of trade relative to that determined by the wage target. Although the trend of real wages, including agricultural wages, has been upward in India, the trend rise

[23] About a dozen Asian countries are still classified as low-income countries and will benefit from the policy set described in this paper.

in agricultural productivity was below that in target real wages, so that inflation and slower industrial growth accompanied the process.

The model offers a new insight on why development was much faster in East compared to South Asia. With the green revolution and the emphasis on food self-sufficiency in the sixties both experienced growth in agricultural productivity. But East Asia successfully kept food prices stable, while South Asia tried to raise terms of trade to boost incentives for farmers to adopt the new technology. Input and consumption subsidies were also given. The resulting budgetary squeeze lowered expenditure on essential infrastructure. The package could not deliver the required rise in agricultural productivity. But agricultural trade liberalization following the GATT Uruguay round offers an opportunity to stabilize domestic grain prices around international prices, in ways that would be acceptable to the powerful domestic farm lobbies. States have realised the necessity of directly involving corporates in order to improve agricultural productivity. Contract farming now offers new opportunities for industry. Industry can step in where policy has failed, help agriculture and itself. Such involvement will improve marketing infrastructure required for cash crops as farmers turn to the latter for exports and for rising domestic demand.

The model can be extended in various ways, for example, explicitly modeling sectoral interaction in an open economy. Empirically, the differential impact of a rise in nominal food prices when food budget shares are high and low can be tested using cross-country data.

Appendix

A.1 Comparative Static Results

The excess demand for agriculture is:

$$c_A Q_I + [(c_A - 1)Q_A + \varepsilon]\rho = 0 \qquad \text{A1}$$

And excess demand for industry:

$$(c_I - 1)Q_I + (c_I Q_A - \varepsilon)\rho + G = 0 \qquad \text{A2}$$

The two endogenous variables are Q_I and ρ = P_A/ P_I. We consider three shocks: to agricultural output Q_A, government consumption G, and a combination of the two.

Taking total differentials, the two excess demand equations can be written as the simultaneous equation system:

$$\begin{vmatrix} c_I - 1 & c_I Q_A - \varepsilon \\ - & + \\ c_A & (c_A - 1)Q_A + \varepsilon \\ + & - \end{vmatrix} \begin{vmatrix} dQ_I \\ d\ \rho \end{vmatrix} = \begin{vmatrix} -c_I \rho\, d\, Q_A - dG \\ -(c_A - 1)\rho\, d\ \ Q_A \end{vmatrix}$$

$$Let \begin{vmatrix} c_I - 1 & c_I Q_A - \varepsilon \\ c_A & (c_A - 1)Q_A + \varepsilon \end{vmatrix} = D$$

D is the jacobian of the partial derivatives of the simultaneous equation system. The sign restrictions discussed in the text ensure that both excess demands slope upward in ρ and Q_I space, and the slope of the II curve is greater than the *AA* curve. This ensures that $D > 0$. Therefore we have:

$$\left|(c_I - 1)(c_A - 1)Q_A + \varepsilon(c_I - 1)\right| > \left|c_A\, c_I\ Q_A - c_A \varepsilon\right|$$

This condition must also hold because the LHS expands into consumption plus savings propensities, which must exceed the consumption propensities on the *RHS*. Expanding the Q_A coefficient on the LHS, we get:

$$c_I c_A - c_A - c_I + 1 = c_I c_A + s$$

and simplifying: $sQ_A > s\varepsilon$

a condition which must hold.

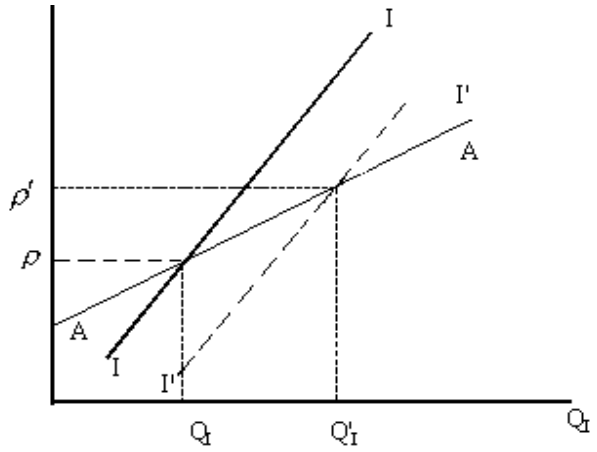
A.1.1 The effect of a shock to G

Using Cramer's rule:

$$\frac{dQ_I}{dG} = \frac{\begin{vmatrix} -1 & c_I Q_A - \varepsilon \\ 0 & (c_A - 1)Q_A + \varepsilon \end{vmatrix}}{D} = \frac{(-1)(-(1 - c_A)Q_A + \varepsilon}{D} > 0$$

$$\frac{d\rho}{dG} = \frac{\begin{vmatrix} c_I - 1 & -1 \\ c_A & 0 \end{vmatrix}}{D} = \frac{c_A}{D} > 0$$

The results are illustrated in Figure A.1



The Figure A1: A shock to G

After a positive shock to government spending, both ρ and Q_I rise.

A.1.2. The effect of a shock to Q_A

$$\frac{dQ_I}{dQ_A} = \frac{\begin{vmatrix} -c_I\rho & c_I Q_A - \varepsilon \\ -(c_A - 1)\rho & (c_A - 1)Q_A + \varepsilon \end{vmatrix}}{D} = \frac{c_I\rho\left((1-c_A)Q_A + \varepsilon\right) - (1-c_A)\rho\left(c_I Q_A - \varepsilon\right)}{D} > 0$$

Without the ε terms the change in Q_A is proportionate to that in ρ, but in the opposite direction, so that agricultural incomes and industrial demand are unaffected and $\frac{dQ_I}{dQ_A} = 0$. With Engel effects, as $c_I\rho\varepsilon + (1+c_A)\rho\varepsilon > 0$, industrial output increases with agricultural output.

$$\frac{d\rho}{dQ_A} = \frac{\begin{vmatrix} c_I - 1 & -c_I\rho \\ c_A & -(c_A - 1)\rho \end{vmatrix}}{D} = \frac{-(1-c_I)(1-c_A)\rho + c_A c_I \rho}{D} < 0$$

This is negative from the stability condition.

Since the absolute value of the coefficients of Q_A in the excess demand for agriculture (Equation A1) exceed those in the excess demand for industry (Equation A2) or 1- $c_A > c_I$, the shift in the *AA* curve after a shock to Q_A

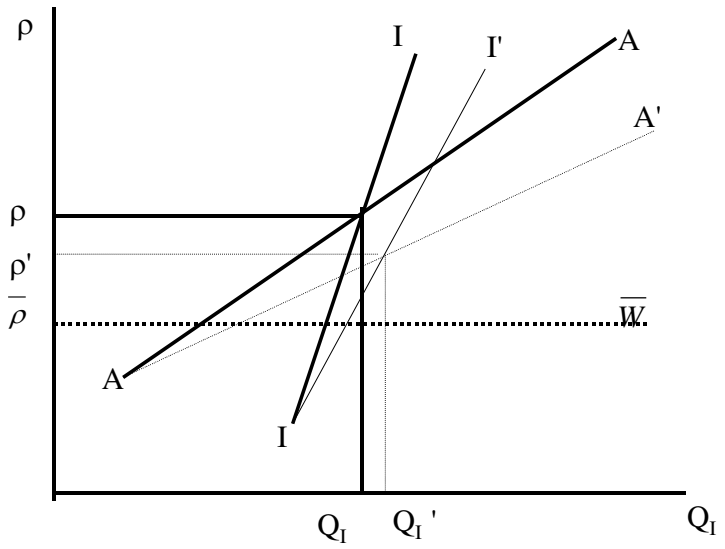


Figure A2: A shock to Q_A

exceeds the shift in the *II* curve. The condition is actually a tautology, since 1- c_A = c_I +s. It arises from the definition of the consumption and savings propensities. It must be that the propensity to consume industrial output out of total income is less than itself plus the savings propensity. But this relationship between the consumption and savings propensities, that affects both the stability condition, the slopes and the relative shifts of the two curves, has the interesting consequence that Q_I moves in the same direction after a shock to Q_A and ρ moves in the opposite direction. Therefore ρ falls while Q_I rises after a positive shock to Q_A. If ε=0, Q_I is unchanged.

A.1.3. The effect of a combined shock, with G and Q_A moving in the same direction.

From A.1.2 we know that a positive (negative) agricultural shock lowers (raises) ρ and raises (lowers) Q_I. But from A.1.1 a positive (negative) shock to *G* raises (lowers) both ρ and Q_I. Therefore if *G* moves in the same direction as Q_A the movement in Q_I would be increased and that in ρ moderated. The combined effect would depend on the relative size of the two shocks. The text (Figure 3) depicts the ideal combination where both Q_A and *G* rise and the net effect is a rise in Q_I and fall in ρ. The worst case is where the government

cuts G after a fall in Q_A, so that Q_I fall steeply and ρ rises, although the rise is less that it would have been without the cut in G.

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