The Analytics of the Agriculture-Industry Relationship in a Closed Economy: A Case Study of India

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The barriers created by stunted agricultural growth for industrial development have constituted a recurrent theme in debates on Indian economic policy. This essay brings out these debates in terms of the disproportionality caused by the disparate rates of industrial and agricultural growth. It examines the continued relevance of the agriculture-industry linkage to understand the stagnation in the farm sector since the early 1990s. Instead of focusing on agriculture per se, the discussion attempts therefore to unravel the links that bind agriculture and industry, both analytically and empirically for India.

There is a consensus among economists that the burden of structural adjustment and fiscal stabilisation has been registered in its most virulent form in agriculture. With a decline in public capital formation in agriculture, the trend annual rate of growth of foodgrains fell to 0.6% per annum between 1994-95 and 2003-04. Trade liberalisation has led to shifts in cropping patterns towards cash crops such as cotton, oilseeds and sugar cane, not only reducing food availability but also increasing the volatility of agricultural incomes. Finally, the low growth of employment in organised manufacturing has pushed vast numbers out of the farms into self-employment for mere subsistence. This article, instead of focusing on agriculture per se, attempts to unravel the links that bind agriculture and industry, both analytically and empirically for India.

In the heyday of planning, the priority accorded to the capital goods sector in the Mahalanobis model did, in the short run, imply a neglect of the consumption goods sector (say, foodgrains). Pilloried for his indifference to the availability of the basic wage goods consumed by the majority, Mahalanobis (1963) responded by stressing the importance of an increase in the output-capital ratio of the small-scale and household industries. If the factory sector were not to trespass into the terrain marked out for the small-scale and household sectors, he deemed the increase in the output-capital ratio as plausible. Curiously neglected in the argument was the role of agriculture. Agriculture could well have played the role assigned to the small-scale and household industries, that of the “bargain sector”. Land reforms in agriculture, in the incipient phase of Indian industrialisation, could have augmented the output of the primary wage good (foodgrains) without the infusion of too much capital. In other words, the output-capital ratio could well have been raised through the simple expedient of institutional reforms in agriculture.

Relegating agriculture into the background in the early planning exercises led to the emergence of wage goods as the binding constraint in the late 1960s and early 1970s. The following closed economy agriculture-industry models incorporate the wage goods constraint explicitly.

1 Closed Economy Agriculture-Industry Models

1.1 Lewis

The Lewis model (1954) laid the foundations on which virtually all two-sector models in India were built. It was ambitious in its agenda – in its prototypical version, it attempted to focus on the process of capital accumulation through which a closed dual
The assumption of “unlimited supply of labour” forges an organic link between the two sectors in the model – the market for labour is integrated and workers were willing to leave an overpopulated agricultural sector for industry at a wage marginally higher than the subsistence income that agriculture offers. The supply price of labour in the urban industrial sector is assumed to be a function of the income earning opportunities in the urban informal sector, which itself is a notch higher than income earned in agriculture (equal to the average product per worker in agriculture). The use of reproducible tangible capital in industry results in the sector being witness to higher labour productivity than agriculture and facilitates the payment of higher wages in industry.

The dynamics of the Lewis model hinge on the transfer of labour from agriculture to industry – since agriculture is saddled with excess labour reserves, the wedge between industrial wage rates and agricultural incomes induces a one-way flow of labour from agriculture to industry. As industry can choose from this “unlimited” supply of labour at marginally higher wage rates, the industrial real wage \(w/P_a\) gets pegged at a constant \(\omega\). Thus, industry faces an infinitely elastic horizontal labour supply schedule, while the demand curve for labour is nothing but the value of the marginal product of labour schedule, determined by technology and the need for capital accumulation (Figure).

Employment would not be offered in the industrial sector unless it produces a surplus over the wages paid. The total output, less the total wages in the industrial sector constitutes the surplus, which capitalists are assumed to reinvest in industry. At constant real wages \(\omega\) and in the absence of technical change, the reinvested surplus increases the demand for labour (pushing out the “marginal product of labour” schedule) and thus leads to greater employment. The capital widening which occurs in industry at the beginning of each round of production is an iterative process, finally leading to the draining away of the pool of surplus labour. The model ceases to apply as we approach the Lewisian turning point.

The steady state in the generic Lewis model can be defined as a situation where the barter terms of trade \(P_s/P_i\) between the two sectors remain constant (the barter terms of trade are defined as the ratio of two prices: the prices received by the agricultural sector divided by the prices received by the industrial sector). If we assume that the supply of the agricultural surplus is exogenously given and the real wage rate in industry \(w/P_i\) remains constant, the maximum sustainable industrial employment would be equal to the agricultural surplus divided by the real wage.

Any attempt to accelerate the pace of industrialisation by raising the level of employment in industry beyond this maximum would be scuttled by the barter terms of trade turning against industry. The increase in industrial employment which is part and parcel of an acceleration in the industrialisation process, would raise the demand for food and cause a rise in foodgrain prices.

In these circumstances, if real wages are to remain constant (by assumption because they are already virtually at subsistence), money wages would have to increase in the same proportion as foodgrain prices. If industrial prices are competitive and remain unchanged and real wages constant, the product wage in industry \(w/P_i\) would increase as the barter terms of trade turn against industry \([w/P_i = (w/P_a)(P_a/P_i)]\). In the Lewis model, the increase in the product wage squeezes profit margins, reducing industrial savings and investment – this stalemate ends only when the maximum level of industrial employment is reduced to the exogenously given agricultural surplus divided by the real wage rate.

1.2 Kalecki

Kalecki (1975) can be interpreted as narrating the Lewisian story with a twist – the Lewisian conclusions are radically altered. Unlike Lewis, Kalecki assumes the existence of excess capacity in the industrial sector and thus cost-determined industrial prices. However, in both Lewis and Kalecki, agricultural prices are demand determined. Industrial prices with a built-in mark-up over prime-costs could be represented as \(P_i = (w_i/l_i)(1+\mu)\), where \(w_i\) is the nominal wage rate in industry, \(l_i\) represents the labour requirement per unit of output in industry, \(P_i\) is the domestic price per unit of industrial output and \(\mu\) the mark-up over prime cost per unit of industrial output. The entire Lewisian analysis gets transformed by the imposition of this assumption: as industry attempts to expand (by employing more workers) at a pace more rapid than that sustainable by the extant agricultural surplus at the existing irreducible real wages \(w/P_a\), agricultural prices increase because of excess demand for foodgrains. In this scenario, money wages must increase pari passu with an increase in the agricultural price index because the real wages are virtually at the subsistence level.

The twist in Kalecki’s “wage price spiral” story owes itself to his assumption about cost-plus pricing in industry: as money wages increase, so do industrial prices; consequently, the terms of trade between agriculture and industry remain fixed. Thus, a rise in money wages does not lead to a profit squeeze in Kalecki but merely stokes inflationary tendencies in industrial prices.
1.3 Kaldor

Kaldor (1975) neglects the supply side terms of trade link between agriculture and industry to emphasise that industrial output is essentially demand constrained because of cost-plus pricing by industry. By assuming cost plus prices, he freezes the terms of trade between agriculture and industry. He thus asserts, as in a simple Keynesian model with endogenous consumption and exports, that the equilibrium level of output in the industrial sector is determined by the level of autonomous surplus generated in the agricultural sector.

For expositional simplicity, we can set up Kaldor’s intersectoral model as a version of a textbook Keynesian two-country model. Assuming that balance of trade exists between the two sectors, the value of agriculture’s exports to industry must be equal to that of industry’s exports to agriculture. Thus,

\[ P_i X_{i,a} = P_a X_{a,i} \]

where \( X_{j,k} \) represents the sales of sector \( j \) to sector \( k \) ...

If industry’s induced demand for its own output is \( (\alpha_i P_i X_i) \) where \( X_i \) is total industrial output, and \( \alpha_i < 1 \), then

\[ P_{i} – X_{i,a} = P_i (X_i – \alpha_i X_i) \]

Substituting (2) into (1), we obtain:

\[ P_i X_i (1 – \alpha_i) = P_a X_{a,i} \]

Clearly, we can solve for \( X_i \) as

\[ X_i^* = \frac{1}{P(1 – \alpha_i)} X_{a,i} \]

Here \( X_i^* \) represents the equilibrium industrial output, \( P = P_i / P_a \) represents the terms of trade and \( X_{a,i} \), the autonomous agricultural surplus which agriculture “exports” to industry. Kaldor himself characterised the equilibrium in his two sector model as

\[ \alpha_i = (1/m) d_1 \]

(Kaldor 1975: 354) where \( \alpha_i \) is the equilibrium industrial output, \( [(1-m) \omega] \) is the induced demand for industrial products by industry and \( d_1 \) is the autonomous demand for industrial products by agriculture. The terms of trade, in the background, are assumed as fixed.

It is vital that we realise that the terms of trade, \( P \), cannot play the role of the equivocating variable in equation (2). To demonstrate that, let us reiterate the two assumptions made by Kaldor with regard to the industrial sector: one, following Kalecki, there is mark-up pricing in industry. Thus,

\[ P_i = (w_i \lambda_i)(1+\mu), \]

where symbols have their usual interpretations ...

Dividing through by \( P_a \), we obtain

\[ P = (\omega \lambda_i)(1+\mu) \]

where \( P \), the terms of trade between the two sectors ...

Kaldor’s second unstated assumption is that the “real wages” in industry \( \omega \) cannot be reduced, that the nominal wages must increase to neutralise an increase in food prices \( P_a \). It follows then that the terms of trade between the two sectors are frozen at \( P \) and with the surplus from agriculture \( X_{i,a} \) treated as autonomous, \( X_i^* \) must play the equilibrating role in equation (3).

To reiterate, two conclusions can be drawn from (3) – first, if industrial prices are cost determined, then it is easy to show that the terms of trade \( P_i / P_a \) are structurally determined and inflexible (unlike in Lewis). From equation (3), again contrary to the Lewisian tradition, it is evident that a parametric shift in the terms of trade in favour of agriculture would provide a fillip to industrial growth by augmenting agriculture’s purchasing power. Second, agricultural surplus is the autonomous variable in equation (3): it is the prime element regulating the magnitude of effective demand which, in turn, determines the level of industrial output.

Bhaduri (2003) amends Kaldor’s model by recognising the fact that in a closed economy, the existence of an exogenously determined agricultural surplus merely constitutes potential demand; this agrarian surplus must be “realised” as purchasing power (by being bought by industry) to serve as effective demand for industrial goods. The quantum of agricultural surplus, Bhaduri emphasises, could well be exogenous; but its realisation into effective demand/purchasing power is determined by industrial demand (Bhaduri 2003: 588). If the realised agricultural surplus is indeed the binding constraint, any increase in its magnitude should result in an expansion of industrial output (via the multiplier). Bhaduri transforms Kaldor’s model into a two sector model with Keynesian “trade feedback effects”, where the two sectors grow in tandem, reinforcing and reinvigorating each other’s growth impulse, by resolving each other’s potential realisation problem.

2 A Reprise in the Indian Context

The barriers created by stunted agricultural growth for industrial development have been a recurrent theme in debates on Indian economic policy. We attempt to briefly bring out these debates in terms of the disproportionality caused because of the disparate rates of industrial and agricultural growth. The argument, relevant even today, amounts to the following: assume that agricultural supply is (price) inelastic and there is a real wage floor in terms of agricultural prices in industry. If there is an excess demand for foodgrains at the prevailing agricultural prices, then the wage goods constraint is binding – it places a ceiling on both industrial employment and thus industrial growth.

Despite the modest rates of agricultural growth in the 1950s, the Indian economy witnessed a rapid rate of industrial growth in the high noon of planning (1950-65). This had as much to do with rapid public and private investment as access to foodgrains through the aid granted by the United States via PL 480. In the mid-1960s, the Indian economy suffered from a double blow – as aid began to dwindle, the economy suffered from two severe droughts in 1964-65 and 1965-66. The wholesale price index (wpi) which had increased to 127.4 in 1962-63 with 1952-53 as the base climbed rapidly to 254 in 1973-74 with 1961-62 as the base; food prices almost trebled between 1961-62 and 1973-74 (Chaudhuri 1978: 91). For an entire decade, starting from the mid-1960s, many thought that the wage goods constraint manifested itself through industrial stagnation.

The Manne-Rudra model (1965) was one of the first to investigate the feasibility of an ambitious investment programme in the face of a wage goods constraint. Like all other consistency models, the model was solved in two steps – the principal components of gross domestic expenditure were translated into final demands for individual commodities. This exogenously specified demand is now used to derive the sectoral targets consistent with the input-output structure of the economy. In matrix form,

\[ X = AX + F \]

and thus \[ X = (I - A)^{-1} F, \]

where \( F \) is the vector of final
demands, A the input-output matrix and X the vector of gross sectoral outputs.

The distinguishing feature of the Manne-Rudra model was the approximation of the production structure of the economy through a block angular (3x3) matrix consisting of the machinery and metals (MM) sector, the food and fibre (FF) sector and the universal intermediates (UI) sector. The block angularity of the input-output matrix suggests that a paucity of agricultural output shall have an immediate effect on household consumption (the FF sector) but only insignificant second order effects on the investment (MM) and intermediate goods (UI) sectors. The upshot of the argument was that the wage goods constraint could be neglected in determining the output of machinery and steel. This result would be reversed in a block angular “closed loop” model (Tendulkar 1974: 61), which did not ignore the links between the production structure, the resulting income distribution and the sectoral composition of final demand.

The two successive droughts of 1965-66 and 1966-67 nullified the predictions of the Manne-Rudra model – the shortfall in agricultural output stoked an inflationary surge and forced a reduction in real public investment. Contradicting the Manne-Rudra model, the curtailment of public investment was clearly a recognition of the binding character of the wage goods constraint.

We briefly touch upon four models that focused on the wage goods constraint that the Indian economy was subject to in the mid-1960s. Patnaik (1972), in probably the most institutionally nuanced picture of the period, sought to explain the elimination of excess demand for wage goods if there was a floor to industrial real wages (w/P). In a model consisting of the State, landlords and industrial capitalists, a wage goods constraint manifests itself through an ex ante “disproportionality” in the economic system: the private sector has more savings than it is willing to invest and the State has less savings than it is willing to invest. In any given period, the stalemate is broken and equilibrium re-established through the State curtailing its expenditure in order to not erode real wages beyond the existing floor. The “inflationary barrier” that the State faces is thus political – in order to not alienate the working classes through a wage squeeze, it is prepared to sacrifice industrial growth.

Bose (1989) sought to explain the inverse relationship between the price of foodgrains and the demand for an industrial mass consumption good, say textiles/clothing. He envisages a three sector scenario – the industrial sector is split into a mass consumption goods sector (clothing) and an investment goods/luxury goods sector. Capitalists and landlords are assumed to consume only luxury/investment goods.

In the starkest (and the simplest) scenario he envisages, urban workers split their constant money wages between food and clothing, and their demand for food is price inelastic. This implies that the demand for clothing consists of the residual money wage bill – wages that remain after the purchase of a minimum quantity of food per head of employed workers. In these circumstances, the demand for clothing is a decreasing function of the food price. Not only that, if the demand for food is completely price inelastic, the marketed surplus of foodgrains determines the maximum employment that can be sustained by the industrial sector. Finally, what determines the equilibrium level of output of the mass consumption good in any given period, in the presence of fixed food supply? Consider an exercise in comparative statics: normally, an increase in autonomous investment, through the multiplier, would increase induced expenditure on, and the output of, the clothing sector. However, since a part of the ensuing increase in wages (following an increase in investment) is spent on food, the price of food rises because of its fixed supply. Consequently, there is an adverse impact on output and employment in the clothing sector.

The Lewisian terms of trade story was used to explore the decade of that industrial stagnation in India by Chakravarty (1974). He argued that industrial atrophy in India, in the decade 1965-75, was a consequence of the terms of trade shift in favour of agriculture. The increase in the product wages which attended the terms of trade shift ([w/P] = (w/P) (P/P)) led to a profit squeeze in industry – what followed was industrial stagnation because of a decline in industrial savings and investment. Chakravarty’s critics have carped about the patent unreality of Lewis’ institutional specifications (for example, neither the urban industrial sector nor the rural industrial sector were homogeneous) in the Indian context. More damaging for Chakravarty, however, was the definite increase in the real consumption wage in industry, beginning in the early 1960s. In Lewis, the assumption of constant real wages in industry followed as a consequence of the reservoir of labour available to industry at real wages marginally higher than those that prevailed in agriculture.

The hiatus between agriculture and industry, for Mitra (1977), could be traced to the “primitive socialist accumulation” debate that raged between Prebrazhensky and Bukharin in the USSR of the 1920s. The decade of industrial stagnation that began from the mid-1960s followed the shift in the terms of trade in favour of agriculture: in turn, that resulted in a reduction in expenditure on industrial mass consumer goods as industrial and agricultural workers found their real wages being squeezed because of an increase in the price of wage goods. Mitra’s argument, however, did not hinge on the inelasticity of agricultural supply – it was rooted in a political economy tradition which harked back to the primitive socialist accumulation debate. In particular, Mitra argued, that the State, representing the interests of the landlords, was instrumental in tilting the terms of trade against industry.

It should be emphasised that the models discussed above are first and foremost models: they present a stylised picture of the Indian economy without concerning themselves with the minutiae. It would seem that the wage goods constraint was not binding in the 1950s because of the access to pl 480. Between the mid-1960s and the mid-1970s it was seen as one of the significant contributors to industrial stagnation.

However, by the late 1960s, in a bid to prop up agricultural production through the new seed-fertiliser-irrigation technology of the Green Revolution, the government set a price floor for foodgrains in terms of cost-plus procurement prices. An increase in the relative supply of foodgrains, it was hoped, would result in food security for the poor through the release of subsidised food stocks through the Food Corporation of India
In the circumstances, a pertinent question rises: why did this price floor not thwart industrial growth in the 1980s and the 1990s?

The changed nature of India’s economic integration with the global economy stands out amongst a plethora of changes that the Indian economy witnessed in the 1980s: the access to international liquidity provided by cash-rich international banks, was used by the government to stimulate industrial demand. The resulting “disproportionality” between a buoyant industry and a stagnant agriculture was suppressed by severing the link between foodgrain production and foodgrain supply through imports. The elbow room provided by foodgrain imports was buttressed by three other structural changes which attenuated the agriculture-industry link (Chandrashekhar 2007). These changes, evident even in the 1980s, gathered a new momentum in the 1990s.

First, the Indian economy has been significantly more “open” in the 1990s. In economies open to trade and investment flows, rapid diffusion of product and process innovations is the norm. As these innovations respond to factor proportions in the metropolitan economies, the pattern of industrial growth in India has been such that the employment elasticity of output has fallen through the 1990s: it was an abysmal 0.08 implying that a 12% increase in manufacturing output leads to a mere 1% increase in employment in manufacturing. The number of those employed in organised manufacturing in 2003, despite sporadic increases in the 1990s, remained stuck at 6 million vis-à-vis the 6.1 million employed in 1981.

Second, there has been a pronounced shift away from agro-based industries. As the sectoral input-output demand matrices computed by Sastry et al demonstrate (Sastry et al 2003: 2392), a unit increase in industrial output in 1968-69 would have raised agricultural demand by 0.247 units; this figure, which had fallen to 0.104 in 1989-90, further declined to 0.087 in 1993-94.

Finally, the services sector led growth that the economy has witnessed should neutralise the tendencies noted above. Indeed, the incremental capital-output ratio for the services sector in the 1980s has been 3.72, the corresponding figures for the first half of the 1990s and the decade 1995-96 and 2004-05 were 3.84 and 2.43 respectively (Rakshit 2007: 110). These figures are lower than the incremental capital output ratios (icor) for the economy as a whole and certainly less than the iconic industry for the same periods. Simultaneously, however, between 1987-88 and 1999-2000, the rate of growth of output in the services sector has been higher than the rate of growth of employment (Rakshit 2007, Table 11b), entailing a decline in the labour coefficient for services. Thus, the services sector cannot negotiate the imbalance between agriculture and industry – this is evidenced by the fact that the ratio of the input prices paid by agriculture to the output prices received by agriculture (an index of the terms of trade P d/P i) has fallen through the 1990s (Chandrashekhar 2007, Chart 4).

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