Lancaster University Management School

Lancaster University Management School
Working Paper
2009/026

It Was All Gonna Trickle Down: What Has Growth In India's Advanced Sectors Really Done For The Rest?

Johnes Geraint

The Department of Economics
Lancaster University Management School
Lancaster LA1 4YX
UK

IT WAS ALL GONNA TRICKLE DOWN: WHAT HAS GROWTH IN INDIA'S ADVANCED SECTORS REALLY DONE FOR THE REST?

Geraint Johnes

Lancaster University Management School
Lancaster LA1 4YX
United Kingdom

T: +44 1524 594215
F: +44 1524 594244
E: G.Johnes@lancaster.ac.uk

September 2009

ABSTRACT

A theory is developed in which the extent to which growth in advanced industrial sectors trickles down to other sectors is dependent upon, capital market frictions, migration, and the strength of interindustry linkages. It is shown that perverse results can arise, and that the efficacy of any policies that rely on tricke down is therefore an empirical issue. Using data from India, we investigate whether growth in the advanced sectors generates growth elsewhere in the economy, and find that it does not.

Keywords: growth, development
JEL Classification: O16, O43, O53

The author thanks, without implication, Vudayagi Balasubramanyam and Saikat Sinha Roy for useful discussions. The title is inspired by Ani DiFranco's song 'Trickle Down' which contains the lyrics: 'The president assured us it was all gonna trickle down like it'd be raining so much money'.

Introduction and Received Literature

In many developing countries the recent experience of rapid growth has been concentrated in export sectors where output embodies a high content of skilled labour. An implicit hope is that the fortunes of less skilled workers will rise with the tide. In at least some contexts, however (India comes to mind), such hopes are frustrated, and this is threatening the prospects for further development. Indeed the work of Arndt (1983) suggests that we should not expect the benefits of growth to trickle down.

Masson (2001) develops the model of Harris and Todaro (1970) in order to accommodate schooling decisions. In his model, individuals may invest in education only when they are located in urban areas. Two types of employment are available in the urban areas, one being skilled and requiring schooling, the other being unskilled; in the rural areas, only unskilled agricultural employment is available. Urban wages are set above the marginal product of labour, thus generating some unemployment; in the rural areas the labour market is assumed to clear. Migration responds to the employment probability weighted wage. Individuals who locate in the urban area and wishing to become skilled workers fund their schooling out of a bequest that is left to them by their parents – this bequest in itself yields utility to the parents. The model is used to obtain a long run equilibrium by simulation through several generations of workers. This requires heterogeneity of innate abilities so that a long run explanation can be offered for the observation that some, but not all, workers choose to locate in rural areas. In the absence of an analytical solution it is not clear that there will be underinvestment in education. Nevertheless it is a likely outcome for certain assumed parameter vectors.

Mude *et al*. (2007) explain underinvestment in education in rural areas by appeal to the nature of capital markets in such areas. Children's education is financed by a mix of their own parents' investments and investments made by the village community. If, on completing their education, children migrate to urban areas where the return on their schooling is higher, their parents receive remittances but other investors in their education cannot, since the migrants are assumed to renege on their debt obligations. Consequently village societies will invest in children's education only up to the point where there is no private gain to the child from migrating.

Much of the stimulus for growth in the developing countries over recent decades has come from the processes of liberalisation and globalisation. Trade has increased the demand for these countries' exports, and this has been the case particularly in the production and service industries. Hence, China has grown substantially as a consequence of the expansion of its manufacturing exports; India, meanwhile, has enjoyed rapid expansion of demand for its output of goods and services that embody highly skilled labour, notably in areas such as information technology.

There are two obvious mechanisms whereby the benefits of growth might be expected to be transmitted from an urban production sector to workers in a rural agricultural sector. First, the output of the agricultural sector may serve as an input in the production function of industries located in urban areas, so that, when the latter industries benefit from a positive demand shock, the increased demand is passed on to agriculture. This would be the case if input-output linkages are strong, for example when production industries such as clothing and apparel require inputs from agriculture. It is less obvious that such a mechanism would operate if the expansion in production industries is concentrated in areas of high technology. The second transmission mechanism operates by encouraging migration of workers from the rural agricultural sector to the urban production sector. As the latter sector expands in response to a positive demand shock, wages rise thus making migration more attractive.

Human capital models emphasise the costs associated with such migration and re-training decisions; where these costs are irreducibly high, reallocation of workers will not take place, but this is nonetheless efficient. There may, however, be other factors that hinder workers' movement to the cities – here we shall focus on capital market imperfections that render it difficult for migrating rural workers to relocate to urban areas.

In the remainder of this paper we develop a model that is capable of explaining how these mechanisms operate and which shows how each mechanism might fail. This allows us to identify reasons why, in contrast to China, development in India has been uneven, with the large population of rural agricultural workers missing out on the benefits of economic growth. In clarifying the reasons for such unbalanced development, the workings of the model suggest policy remedies that might be put in place to ensure more even development. We then proceed empirically to test the main implication of the model – that growth in advanced sectors does not necessarily trickle down to other sectors of the economy – for the case of India.

The basic theoretical model is the subject of the next section. This is followed by a section which develops some extensions of the model. The empirical evidence follows, and the paper finishes with a concluding section.

Model

We consider a two period model in which, at the start of the first period, n_r workers are allocated to the rural area and work in agriculture and n_u workers are allocated to the urban area and work in industry (either production or services). For convenience we set $n_r=n_u=1$. At the start of the first period, each worker is endowed with a house which may be traded with an agent who is exogenous to the model at the end of that period. The price of houses in the rural area is given by h_r and the price of houses in the urban area is given by h_u. We initially assume $h_u>h_r$; this is in line with the available empricial evidence.[1]

Suppose that workers' ability, A, is initially randomly distributed within each region over a uniform distribution with supports $(w_{min}, w_{max}]$. Let the productivity of the ith worker in the rural area be given by p_rA_i where p_r denotes the price of rural output. Let the productivity of the ith worker in the urban area be given by $p_u\rho A_i$ where p_u denotes the price of urban output, and ρ is a constant greater than one. It is convenient to assume that $p_u\rho>p_r$ in the first period. Hence, in this period, the productivity of all workers is higher in the urban than in the rural area, reflecting, in part at least, different technologies. Suppose that labour market competition ensures that, within each area, each worker is paid a wage equal to her productivity.

[1] There is a paucity of data on house prices in India, but Liases Foras publishes prices for the Mumbai area on its website (http://www.propertyscience.com). These data indicate that prices in central areas such as Walkeshwar and Napeansea Road are *more than an order of magnitude greater* than those in outlying areas like Kurla and Thane. This suggests that the rural-urban differences in house prices that are characteristic of many economies appear also in India.

At the end of the first period, rural workers may migrate to the urban area so long as they can fund the trading of houses.[2] We assume that this requires a loan that is available only to workers whose first period wage exceeds $\phi(h_u-h_r)$, where ϕ is a constant that measures the availability of loans.

We assume that the price of urban output, p_u, is determined by exogenous factors; we are therefore able to trace through the model the effect of shocking this price, thereby simulating the impact of increased international demand for industrial output following liberalisation. The price of rural output, p_r, however, is assumed to be determined by the value of urban output. Hence in the first period $p_r = \theta p_u \rho(w_{max}-w_{min})/2$ where θ is a constant that measures the strength of inter-industry (or inter-regional) linkages.

At the end of the first period, those who are able to finance a move from rural to urban areas do so. Hence all those rural workers whose first period wage exceeds $\phi(h_u-h_r)$ move, implying that the proportion of rural workers who move is

$$[\theta p_u \rho w_{max}(w_{max}-w_{min}) - 2\phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})^2$$

so long as this lies within the unit interval.

This migration has an impact on total output in each region. Since output in the urban region expands, demand for the output of the rural region, and hence also p_r, increases in the second period relative to the first. Total output in urban and rural areas in the second period is given by

$$Y_{u2} = p_u \rho \ \{1+[\theta p_u \rho w_{max}(w_{max}-w_{min}) - 2\phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})^2\} \text{ x } \{(w_{max}-w_{min})/2 + \{[\theta p_u \rho w_{max}(w_{max}-w_{min}) - 2\phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})^2\} \text{ x } \{[\theta p_u \rho w_{max}(w_{max}-w_{min})/2 + \phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})\}\}$$

and

$$Y_{r2} = \theta p_u Y_{u2} \ \{1-[\theta p_u \rho w_{max}(w_{max}-w_{min}) - 2\phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})^2\} \text{ x } \{(w_{max}-w_{min})/2 - \{[\theta p_u \rho w_{max}(w_{max}-w_{min}) - 2\phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})^2\} \text{ x } \{[\theta p_u \rho w_{max}(w_{max}-w_{min})/2 + \phi(h_u-h_r)] / \theta p_u \rho(w_{max}-w_{min})\}\}$$

respectively. That is, in each region, total output equals the product of three second period terms: (i) price of region-specific output (adjusted in the urban case by the productivity multiplier), (ii) region-specific population and (iii) mean ability of the region-specific population. The above equations may, respectively, be simplified to

$$Y_{u2} = [2\phi(h_u-h_r)+p_u \rho \theta w_{max}(w_{max}-w_{min})][p_u \rho \theta(w_{max}-w_{min})(2w_{max}-w_{min})-2\phi(h_u-h_r)]\{p_u \rho \theta[(w_{max}-w_{min})^3+2w_{max}(w_{max}-w_{min})]-4\phi(h_u-h_r)\}/4p_u^2\rho^2\theta^3(w_{max}-w_{min})^5$$

and

[2] In many models of migration, transport costs play a role. There is little additional insight to be gained from explicitly including these costs in the present model. Intuitively, however, it is easy to understand that high transport costs serve to deter migration.

$Y_{r2} = [2\phi(h_u-h_r)-p_u\rho\theta w_{max}(w_{max}-w_{min})][p_u\rho\theta w_{max}(w_{max}-w_{min})+2\phi(h_u-h_r)]\{p_u\rho\theta[(w_{max}-w_{min})^3-2w_{max}(w_{max}-w_{min})]+4\phi(h_u-h_r)\}/4p_u^2\rho^2\theta^3(w_{max}-w_{min})^5$

The comparative statics of the model are of interest. In particular, we shall investigate how migration and period 2 values of output in each of the rural and urban sectors respond to changes in p_u, ϕ and θ.[3] Unsurprisingly, in view of the nonlinearities in the model, this exercise does not yield unambiguous results. We shall therefore illustrate the operation of the model by way of a simple numerical example.

The partial derivatives of interest[4] are all positive in the case where $w_{max}=15$, $w_{min}=10$, $h_u=10$, $h_r=5$, $p=1$, $\phi=½$, $\theta=½$ and $\rho=1½$. This means that both urban (industrial) and rural (agricultural) output respond positively to changes in the demand for industrial output, credit availability, and strengthening industrial linkages. It is readily seen, however, that changing some parameters changes this result. If, for instance, w_{min} becomes 5 *ceteris paribus*, then all the partials except $\partial Y_{u2}/\partial p_u$ turn negative. Hence in order to understand the way in which the expansion of one sector impacts upon the rest of the economy, we need to know the precise values of the parameters of the model, and that is an empirical issue.

Extensions

It is often the case that rural workers are not in a position to sell property in order partially to finance a move to the urban area. This may be so for two reasons. First, rural workers live in accommodation that is owned by the family who remain in the rural area and continue to live in the property. This situation is easily accommodated within the above model by imposing $h_r=0$, and this does not change any of the substantive results.

Secondly, rural workers' endowments of property (or of other assets, such as wealth with which to finance their children's education) may be low, and the motivation for seeking work in the urban area might be to accumulate enough savings in order to pay for housing (or education) in the rural area. In this case, migration is transitory. Migrant workers in the cities may live in crowded rental accommodation in order to minimise their living costs while remitting a proportion of their earnings to their families in the rural areas. This provides a challenge to the model of the previous section in that in the absence of a capital market friction (since migrants are not seeking to finance purchase of property in the urban area) the model cannot explain why *all* rural workers do not move to the urban areas, given $\phi=0$. Suppose however that we relax the assumption that ρ is a constant, and instead define $\rho_i = \eta + (A_i-w_{min})/(w_{max}-w_{min})$, where $0<\eta<1$, so that the wage premium associated with ability rises with ability in the urban sector. This ensures that only higher ability workers migrate.[5] Solving the model in this case again yields comparative statics whose signs are dependent on the values of the parameters.

---

[3] Changes in ϕ are tantamount to changes in (h_u-h_r) in this model, and so can be interpreted as capturing either a change in the severity of capital market imperfections or a change in the house price differential between urban and rural areas.

[4] $\partial Y_{u2}/\partial p_u$, $\partial Y_{r2}/\partial p_u$, $\partial Y_{u2}/\partial \phi$, $\partial Y_{r2}/\partial \phi$, $\partial Y_{u2}/\partial \theta$ and $\partial Y_{r2}/\partial \theta$.

[5] Such workers would not then migrate back to the rural area – though they may buy housing or schooling for their families in these areas. In reality, of course, there may be return migration. Modelling this would require a richer approach than the current two period model.

Evidence

The key finding of the above theoretical analysis is that the question of whether growth in the urban sector stimulates growth in the rural sector (and, if it does, the extent to which it does) is an empirical matter. In this section we explore this further by examining the determinants of growth, separately by industrial groupings, in India.

Annual data on GDP by sector are available from the Reserve Bank of India.[6] We consider the series for three sectors: agriculture and allied activities; industry; and services. The year on year change in log real GDP by sector is depicted in Figure 1. It is readily observed that the series for agriculture is highly volatile, and has a somewhat lower mean than is the case for the other two sectors. This is confirmed by the descriptive statistics reported in Table 1.

We model the relationship between growth in the three sectors by way of a simple vector autoregression (VAR) of length one.[7] The results, reported in Table 2, indicate that growth in the industrial and service sectors does not feed through into the agricultural sector. Indeed, the only determinant of agricultural sector growth is lagged growth in this same sector; moreover the coefficient on this variable has a negative sign, reflecting the high volatility of agricultural sector growth over this period. In the services sector, meanwhile, there does appear to be some persistence of sector-specific growth. But in no sector is growth significantly affected by past growth in another sector..

A somewhat more refined empirical approach is to focus on agricultural output as a dependent variable and investigate its determinants in a cointegration framework. The cointegrating regression Durbin-Watson statistic associated with a regression of log output in agriculture against log output in (i) industry and (ii) services is 1.49. However, the estimation of a series of equations with the change in log agricultural output as the dependent variable and the lagged residuals from the cointegrating equation as an explanatory variable failed to produce a significant coefficient on the latter variable; a parsimonious example is reported in Table 3, but it should be noted that terms in the growth of industry and of services are not significant in any of the specifications that we tried. This result leaves the evidence that advanced sector growth feeds through into growth in the agricultural sector looking extremely weak.

A further refinement to our empirical approach is to fit a vector error correction model (VECM). First we employ a Johansen (1988) test to establish the number of cointegrating vectors. The results in Table 4 indicate that, at the 95 per cent confidence level there is a unique such vector; at the 99 per cent level, however, there is no cointegrating vector. On the basis that a single cointegrating vector exists, we proceed to model the VECM. The results, reported in Table 5, demonstrate that the coefficients of the cointegrating equation are insignificant. In the short run adjustment equations, no variables are significant in explaining GDP in the industrial sector, and only the lagged dependent variables are significant for the

[6] The website http://www.rbi.org.in/scripts/PublicationsView.aspx?id=10524 reports these data from 1950-51 onwards. We use data for agriculture and allied activities, industry (which includes mining and quarrying, manufacturing, and the utilities) and services (which includes: construction; trade, hotels, transport and communication; finance, insurance, real estate and business services; and community, social and personal services).

[7] Dickey-Fuller tests confirm that the log real sector-specific output variables are all integrated of order one, so that the first difference of each of these variables is stationary.

other two sectors (the coefficient on this variable for agriculture being negative). We therefore conclude that there is no significant interdependence between sectors.

Conclusions

The theoretical model presented in this paper is rich in terms of policy implications. Mobility can be enhanced by reducing house price differentials or by removing imperfections in the capital market. Differentials in house prices are sustained by the restricted supply of housing within reach of the urban centres. Improvements to the urban transport network can serve to increase the radius within which easy commuting is possible, and hence ease the supply constraint. Likewise supply constraints can be eased by liberal planning regimes. The imperfection in the capital market is due to the fact that lenders' willingness to lend is based on past rather than potential income. A market could develop for insurance so that lenders could protect themselves against the risk of default by borrowers whose income does not reach potential. But the development of such a market may need to be fostered especially where lenders may be small, informal organisations such as those considered by Mude *et al*. (2007), where information asymmetries pose difficulties for the insurers. Strengthening the linkages between industries located in urban and rural areas could, through price movements, lead to improved transmission through the economy of the higher income flows due to the growth of the urban sector. Policies that might achieve this include the development of infrastructure, specifically to improve transport. Nevertheless, these observations hold good only to the extent that the model parameters lie within certain bounds. To illustrate, note that a reduction in house price differentials generates increased mobility; this in turn raises aggregate income in the urban area, but the impact on the rural area is ambiguous – it could fall owing to the outmigration of productive workers, or it could rise as a result of industrial linkages. In light of the ambiguous theoretical results, policy needs to be informed by rigorous empirical analysis.

Unfortunately, however, data on population movements are available on only an occasional basis (five or ten yearly), and information about the housing market is yet more skeletal in the context of many developing economies. This being so, the empirical work in this paper has focused upon examining the relationship between growth rates in the three main sectors of the Indian economy. We find empirical support for the idea that growth in the industrial and services sectors has failed to feed through into agricultural sector growth. The theoretical contribution of this paper suggests that the reasons for this may be complex. Further research is needed, but this has to await developments in data collection.

References

Arndt, Heinz W. (1983) The trickle-down myth, *Economic Development and Cultural Change*, 32, 1-10.

Harris, John R. and Michael P. Todaro (1970) Migration, unemployment and development: a two sector analysis, *American Economic Review*, 60, 126-142.

Johansen, Søren (1988) Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, 12, 231-254.

Masson, Paul R. (2001) Migration, human capital and poverty in a dual economy model of a developing country, IMF WP/01/128 available at http://www.imf.org/external/pubs/ft/wp/2001/wp01128.pdf.

Mude, Andrew G., Christopher B. Barrett, John G. McPeak and Cheryl R. Doss (2007) Educational investments in a dual economy, *Economica*, 74, 351-369.

Figure 1

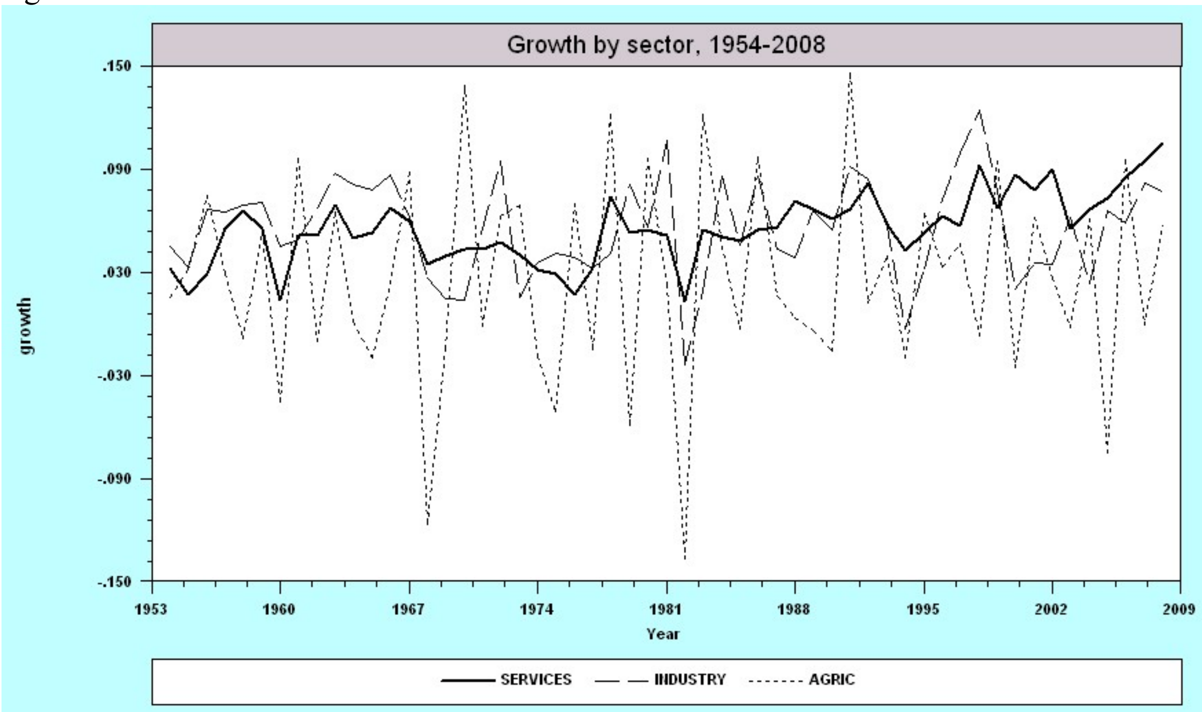
Growth by sector, 1954-2008
growth
.150
.090
.030
-.030
-.090
-.150
1953
1960
1967
1974
1981
1988
1995
2002
2009
Year
SERVICES
INDUSTRY
AGRIC

Table 1 Descriptive statistics for change in log real GDP

Sector	Mean	standard deviation
Agriculture	0.026	0.058
Industry	0.057	0.029
Services	0.057	0.022

Table 2 VAR results

Dependent variable→ Explanatory variable↓	**Δln(agric)**	**Δln(industry)**	**Δln(services)**
Constant	0.041	0.029	0.020
	(1.935)	(2.626)	(3.055)
Δln(agric)$_{-1}$	-0.469	0.073	-0.038
	(3.711)	(1.107)	(0.946)
Δln(industry)$_{-1}$	-0.119	0.111	-0.058
	(0.433)	(0.767)	(0.668)
Δln(services)$_{-1}$	0.086	0.353	0.737
	(0.227)	(1.768)	(6.112)

Note: t statistics in parentheses.

Table 3 Model with Δln(agric)$_{-1}$ as the dependent variable

Variable	
Constant	0.038
	(5.000)
Δln(agric)$_{-1}$	-0.472
	(3.898)
(cointegrating regression residual)$_{-1}$	0.690×10^{-6}
	(0.013)

Note: t statistics in parentheses.

Table 4 Johansen tests for the number of cointegrating equations

Hypothesised number of cointegrating equations	eigenvalue	Trace statistic	5% critical value	1% critical value
≤0		32.632	29.68	35.65
≤1	0.269	15.090	15.41	20.04
≤2	0.188	3.455	3.76	6.65

Table 5 Vector error-correction model

	cointegrating equation		
ln(agric)	**ln(industry)**	**ln(services)**	**constant**
1	0.123	-0.942	-3.143
	(0.20)	(1.46)	
	adjustment coefficients		
explanatory variable	**Δln(agric)**	**Δln(industry)**	**Δln(services)**
lagged residual from cointegrating equn	-0.037	0.013	-0.033
	(1.10)	(0.72)	(3.41)
Δln(agric)	-0.429	0.060	-0.002
	(3.27)	(0.86)	(0.06)
Δln(industry)	-0.011	0.074	0.039
	(0.04)	(0.48)	(0.46)
Δln(services)	-0.367	0.510	0.331
	(0.66)	(1.72)	(2.04)
constant	0.015	0.038	-0.002
	(0.49)	(2.29)	(0.27)

Note: z values in parentheses