25 Economic Growth and Poverty Reduction in India: A (Neo-) Kaldorian Analysis

Rolf Kappel[1] and Pradeep Agrawal[2]

Abstract

Building on our previous work in the Swiss National Centre of Competence in Research (NCCR) North-South programme, we analyse the determinants of India's historically exceptional economic growth and poverty reduction since the early 1980s. In a first step, we confirm and augment the Kaldorian hypothesis that the manufacturing sector is the 'engine of growth'. Regression analyses and causality tests for the 16 largest states of India strongly indicate that both the manufacturing sector and the modern, IT-related service sector act as India's engines of growth. In a second step, we run causality tests on income growth and poverty reduction. The results clearly support the hypothesis that the direction of causality is from income growth to poverty reduction, rather than the other way round. The results illustrate how important it is for the Indian government to continue to follow policies and institutional reforms that promote economic growth in order to reduce poverty.

Keywords: Economic growth; poverty reduction; Kaldor's laws; growth of manufacturing and IT services.

25.1 Introduction

It is generally agreed that India set off on a new path of economic growth in the 1980s. The average annual growth rate of the gross domestic product (GDP) from independence to the end of the 1970s was around 3.5%. This rose to more than 5% in the 1980s and has been more than 6% since the early 1990s (Panagariya 2004). While the exact timing and policy causes of this marked acceleration are highly contested (Wallack 2003; Panagariya 2004; Rodrik and Subramanian 2004), there is little dispute about which sector acted as the main engine of growth (Dasgupta and Singh 2005). This is the first question on which the article at hand focuses. We use regression analyses and, as regressions are limited in their capacity to determine the direction of causality, we also use causality tests to check the hypothesis that the growth rates of manufacturing and modern services related to information and communication technologies (ICT) are the main determinants of overall economic growth. In previous research within the framework of the Swiss National Centre of Competence in Research (NCCR) North-South programme, Agrawal and Dash (in preparation) found some indirect evidence for this hypothesis. They demonstrated that since the early 1990s Indian exports, with high growth rates for manufacturing products and services, had Granger-caused overall economic growth. The same results were obtained for export-promoting or liberalisation phases in 10 other developing countries (Agrawal and Parida, in preparation).

The second question addresses the link between economic growth and poverty reduction. The evidence from a broad body of literature leaves no doubt that the overall GDP growth has an important impact on (income) poverty reduction. At the same time, poverty reduction contributes by definition to overall economic growth. Therefore, we carry out causality tests in order to answer the question of which effect dominates. Again, there are results from previous work within the NCCR North-South which support the hypothesis that causality moves mainly from income growth to poverty reduction. Schmid (2007) shows, among other things, that in 10 of the 15 largest Indian states the impact of income growth on poverty exceeds that of development expenditures – as an effect of either the size or the poverty elasticity of these expenditures (or both). Moreover, he demonstrates that, combined with education, employment in the manufacturing and modern service sectors is an important route to escape poverty. In our study, we attempt to analyse the direction of causality between income growth and poverty reduction more directly.

We use two data sets for the econometric work. The first contains the state domestic product (SDP) and all sector production data (value added) for the 16 largest Indian states. The data are taken from the Indian Central Statistical Office (CSO), and the period covers the years from 1980 to 2005.[3] The second data set contains the headcount ratios of poverty, which are derived from the National Sample Surveys (NSS). The data, taken from Ravallion and Datt (1995), cover the 14 largest states of India and the period between 1986 and 1994.

The article is organised as follows: Section 25.2 summarises Kaldor's theoretical framework and empirical results. Section 25.3 gives a brief overview of sector development and overall economic growth in the 16 largest states of India since 1980. Section 25.4 presents the regression results for the link between the growth of different sectors and the overall growth of SDP. Section 25.5 presents the results of testing Granger causality for the hypothesis that manufacturing and modern services have a strong effect on overall economic growth. Section 25.6 applies three different methods to test causality between income growth and poverty reduction. Section 25.7 offers conclusions.

25.2 Kaldor's laws

In a seminal contribution to our understanding of the growth process, Nicholas Kaldor (1957, 1966, 1968, 1975) contended that the manufacturing sector is the engine of growth for the economy as a whole. Kaldor argued that this is above all due to increasing returns to scale in manufacturing. Referring to the works of Adam Smith (1904), Alfred Marshall (1920), and Allyn Young (1928), Kaldor saw the interaction of static and dynamic economies of scale at the enterprise and industry levels as the main driving force of the growth of production and productivity. Larger plants and machines, increasing specialisation and division of labour, 'Marshallian' labour pooling, cost-reducing agglomeration effects, learning by doing, high demand elasticity for manufacturing products, market growth through exports, and innovation and other spill-over effects were elements of his understanding of increasing returns to scale.

Kaldor presented and tested his ideas in the form of three closely related hypotheses, which were later called 'Kaldor's laws'. The first law states that manufacturing growth has a dominant impact on overall GDP growth. The second law, also called the 'Verdoorn law' (Verdoorn 1949), postulates a close link between production growth and productivity growth in manufacturing: the higher the growth of production in manufacturing, the higher the growth of productivity in this sector. The third law combines the first two and deals with the impact of manufacturing growth on overall productivity growth. Once the process of industrialisation is underway, Kaldor argued, employment is shifted from agriculture and low-productivity services to industry. This sector transformation leads to increasing industrial shares of GDP without jeopardising growth and levels of production in agriculture and services. In other words: industry-driven transformation towards a 'mature' economy induces productivity growth in the other sectors.

Kaldor tested his hypotheses using growth data for 12 industrialised countries for the period of 1953/54–1963/64. The regressions supported his hypotheses, which – in his opinion – explained the then low growth performance of Britain compared to that of other member countries of the Organisation for Economic Co-operation and Development (OECD). In Kaldor's view, Britain suffered from 'premature maturity' in that sector transformation was more advanced there than in other industrialised countries: the engine of growth had run out of steam. In the meantime, of course, we have learned that this conclusion is not tenable. 'Mature' economies can grow at high rates, and modern (endogenous) growth theory explains why (Romer 1986; Lucas 1988). Nonetheless, the story of manufacturing growth and sector transformation is still relevant to all countries that are in the process of industrialisation. Apart from a lively discussion of the general validity of these laws (e.g. Rowthorn 1975; Parikh 1978; McCombie 1981; Leon-Ledesma 2000), Kaldor's work has inspired a number of studies that found empirical evidence supporting the hypotheses when applied to developing countries (Kappel 1990; Bairam 1991; Hansen and Zhang 1996; Necmi 1999; Dasgupta and Singh 2005; Libanio 2006).

25.3 Income and sector growth in Indian states

In the search for India's engine of growth since the 1980s, it is impossible to ignore the fact that the growth of service production is as high as, or even higher than, that of manufacturing production. Table 1 presents compound sector growth rates for the 16 largest states of India since 1980. To a considerable extent, this growth pattern is attributable to India's spectacular growth performance in 'modern' services related to ICT. It is interesting to note not only the growth of the ICT sector in a narrow sense, but also that of the large array of modern services based on these technologies: services in finance, insurance, transport, and communication, as well as a plethora of other business and engineering services are growing at exceptional speed. From a Kaldorian point of view, this raises an important question: does the modern service sector exhibit similar characteristics regarding economies of scale to those observed in the manufacturing sector? At first sight, it would appear plausible to answer this question in the affirmative. Average costs of ICT-based services arguably decline with increasing size of the operation, and these services hold a tremendous potential for increasing specialisation and division of labour. Moreover, labour pooling, cost-saving learning by doing, and agglomeration effects can be noticed in many Indian urban service centres. At the same time, we observe that the demand elasticity for ICT-based services is high, that permanent product and process innovation is a characteristic feature of the trade, and that ICT-based services are internationally tradable at low and still declining transaction costs. Hence, instead of testing only the effect of manufacturing growth on overall economic growth, we extended the scope of our research to include testing a sort of 'neo'-Kaldorian hypothesis that both manufacturing and modern services act as engines of growth in India.

Table 1 shows that the growth performance of Indian states has varied widely since the early 1980s. The four most dynamic states, with annual SDP growth rates above 6% (Gujarat, Karnataka, Maharashtra, Rajastan), present a stark contrast with the four least dynamic states, where annual SDP growth rates were around 4% or less (Assam, Bihar, Orissa, Uttar Pradesh). The data on per capita state domestic product in Table 1 (columns to the far right) illustrate that these variations in growth rates indeed led to a divergence of per capita income in the 16 states under examination. Regression Equation (1) corroborates that average income grew faster in the richer states than in the poorer ones:

$$\text{(1)} \quad \text{sdppc80–05} = \underset{(3.520)}{1.907^{***}} + \underset{(3.354)}{0.119^{***}} \text{ qsdppc80} \ (R^2: 0.45),$$

where sdppc80–05 = annual growth rate of per capita SDP, and qsdppc80 = level of per capita SDP in 1980 (in 1000 Indian Rupees). Note that t-values are given in parentheses, and *** indicates a p-value < 1%, that is, both parameters are significant on the 1% level.

Table 1

Compound growth rates for state domestic product and sector output (1980–2005), with average incomes for 1980 and 2005. The compound growth rates are calculated as least-squares growth rates: $\ln x_t = a + b_t$, with x being the variable and t being time. If b* is the least squares estimator of b, then growth rate $r = (e^{b*} - 1)$ 100.

	sdp	man	ser	agr	sdppc80	sdppc05
Andhra Pradesh	5.84	7.89	7.16	2.69	5.321	15.259
Assam	3.45	3.37	4.42	1.70	5.076	8.593
Bihar	3.49	3.12	5.38	–0.37	2.149	4.369
Gujarat	6.26	8.44	9.88	2.09	7.289	21.844
Haryana	5.79	7.83	6.45	3.31	8.551	20.478
Himachal Pradesh	5.85	13.48	6.23	2.22	6.246	16.862
Karnataka	6.41	7.59	7.91	2.98	5.419	16.061
Kerala	5.41	4.60	6.40	3.00	6.069	16.369
Madhya Pradesh	4.78	6.25	5.78	2.65	3.981	9.626
Maharashtra	6.57	5.99	7.87	3.62	7.897	21.700
Orissa	4.04	4.52	6.06	0.30	4.365	8.970
Punjab	4.70	7.02	7.54	1.23	9.360	19.377
Rajasthan	6.26	6.70	7.79	3.60	4.126	11.701
Tamil Nadu	5.83	4.62	7.52	2.78	5.833	16.346
Uttar Pradesh	4.38	6.16	5.01	2.50	4.195	7.293
West Bengal	6.08	4.94	7.26	4.68	5.360	14.473
Average	5.32	6.41	6.79	2.44	5.702	14.332
Standard deviation	1.01	2.41	1.31	1.22	1.810	5.200
Coefficient of variation	0.19	0.38	0.19	0.50	0.320	0.360

Key: sdp = state domestic product; man = manufacturing; ser = services; agr = agriculture; sdppc80 = per capita state domestic product in 1980; sdppc05 = per capita state domestic product in 2005. Per capita state domestic products are indicated in 1000 Indian Rupees, based on constant prices.

As a consequence, the maximum income differential between states rose from a ratio of 4.3:1 to 5:1, and the coefficient of variation increased by about 20%. In other words, the last quarter-century was a period of income divergence among Indian states.

25.4 Regression analyses for Kaldor's first law

In its simplest form, Kaldor's first law can be tested with the following equation:

$$(2) \quad sdp = a_0 + a_1 \, man,$$

where sdp = growth rate of state domestic product (SDP), and man = growth rate of manufacturing production (value added).

Growth rates are annualised (compound) rates for a given period of time. However, as Kaldor himself and many other authors have noted, such a regression may lead to spurious results, because manufacturing output is part of GDP. Therefore, Equation (2) is often substituted by:

$$(3) \quad n\text{-}man = a_0 + a_1 \, man,$$

where n-man = growth rate of non-manufacturing SDP, and man = growth rate of manufacturing production.

Various authors have argued that this linear function may not be adequate, because the effect of manufacturing growth on growth of the rest of the economy may vary, depending on the size of the manufacturing sector (e.g. Kappel 1990; Hansen and Zhang 1996). Above all, this is to be expected in developing countries in which the process of industrialisation is in full swing. Equation (3) can be modified to incorporate the size of the manufacturing sector as a proportion of SDP in the initial year:

$$(4) \quad n\text{-}man = a_0 + a_1 \, (qman_0 / qsdp_0) \, man = a_0 + a_1 \, manw,$$

where n-man = growth rate of non-manufacturing SDP, $qman_0$ = level of manufacturing production in the initial year, $qsdp_0$ = SDP in the initial year, man = growth rate of manufacturing production, and manw = growth rate of manufacturing production, weighted.

We use Equations (3) and (4) for cross-section ordinary least-square estimates for the 16 Indian states listed in Table 1. In addition to testing the effect of manufacturing growth, we estimate these two equations for services, agriculture, traditional services, modern services, manufacturing plus traditional services, and manufacturing plus modern services. Table 2 shows

Table 2

Sector shares of SDPs in 1980.

	man	ser	agr	sert	serm	mansert	manserm
Andhra Pradesh	0.095	0.405	0.390	0.244	0.161	5.321	0.257
Assam	0.097	0.407	0.423	0.338	0.069	5.076	0.166
Bihar	0.051	0.358	0.583	0.257	0.101	2.149	0.145
Gujarat	0.199	0.249	0.375	0.090	0.159	7.289	0.358
Haryana	0.137	0.339	0.511	0.233	0.106	8.551	0.244
Himachal Pradesh	0.032	0.509	0.337	0.385	0.125	6.246	0.157
Karnataka	0.153	0.378	0.398	0.231	0.148	5.419	0.301
Kerala	0.109	0.495	0.286	0.356	0.139	6.069	0.248
Madhya Pradesh	0.108	0.396	0.386	0.264	0.132	3.981	0.239
Maharashtra	0.258	0.446	0.232	0.242	0.204	7.897	0.462
Orissa	0.104	0.326	0.484	0.219	0.107	4.365	0.211
Punjab	0.096	0.232	0.575	0.114	0.118	9.360	0.275
Rajasthan	0.140	0.442	0.363	0.267	0.175	4.126	0.316
Tamil Nadu	0.311	0.423	0.241	0.275	0.148	5.833	0.458
Uttar Pradesh	0.091	0.399	0.458	0.267	0.132	4.195	0.223
West Bengal	0.207	0.440	0.272	0.271	0.169	5.360	0.376
Average	0.137	0.390	0.420	0.253	0.137	5.702	0.277

Key: man = manufacturing; ser = services; agr = agriculture; sert = traditional services; serm = modern services; mansert = manufacturing plus traditional services; manserm = manufacturing plus modern services.

the relative size of these sectors for the initial year (1980). At that time, India's SDPs had the typical sector composition of a low-income country: on average, agriculture and traditional services were the largest sources of income, with about 40% and 25%, respectively, while manufacturing and modern services contributed no more than 14% (each) to SDP.

In the subsequent discussion, we present regression results for two time periods: the entire study period, 1980–2005, and a sub-period, 1987–2005. As mentioned in section 25.2, the year in which the shift in Indian GDP growth occurred has not yet been determined beyond any doubt. Wallack (2003) shows in her analysis of national growth rates that with a 90% probability the shift occurred between 1980 and 1987. Based on GDP data, her point estimate with the highest F-value is 1980; using GNP (gross national product) data, it is 1987. In both data series, however, the F-values peak in

1980 and 1987 and are numerically very close. Therefore, Wallack's results are ambiguous. Rodrik and Subramanian (2004) maintain that the shift originated in the early 1980s. However, they also state that the "key change that unleashed the animal spirits of the Indian private sector" (Rodrik and Subramanian 2004, p 2) was the national government's new attitude towards business after Rajiv Ghandi had come to power in 1984; that would make 1987 the more likely candidate for the shift in growth rates. Panagariya (2004) also tends to see 1987 as the decisive year, because the average annual growth rate of 5.6% between 1987 and 1991, when the balance of payments crisis hit and initiated India's 'new economic policy', was significantly higher than in the previous decade (4.4%). In light of these considerations, it makes sense to analyse the data for the two periods mentioned above.

Table 3 shows the results for regressions of sector growth on growth of the rest of the economy. We present results for manufacturing, services, and agriculture. The regressions with agricultural growth indicate that the performance of this sector has no discernible effect on non-agricultural growth. While simple manufacturing growth rates do not explain non-manufacturing growth, weighted sector growth rates are highly significant and explain slightly more than 60% of the variance in non-manufacturing growth. Hence, these results support Kaldor's first law. However, regressions with service

Table 3

Regressions of sector growth on overall growth, manufacturing, services, and agriculture, 1980–2005 and 1987–2005.

Equation	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Variable	n-man 1980–2005	n-man 1980–2005	n-ser 1980–2005	n-ser 1980–2005	n-agr 1980–2005	n-agr 1980–2005
Intercept	4.453*** (5.96)	4.122*** (5.28)	0.766 (0.67)	1.063 (1.21)	7.187*** (10.98)	6.885*** (10.54)
man	0.111 (1.02)					
manw		1.824*** (4.67)				
ser			0.509*** (3.09)			
serw				1.206*** (3.72)		
agr					–0.109 (–0.45)	
agrw						0.041 (0.06)
N	16	16	16	16	16	16
R^2	0.07	0.61	0.41	0.49	0.01	0.00

Equation	(1)	(2)	(3)	(4)	(5)	(6)
Variable	n-man 1987–2005	n-man 1987–2005	n-ser 1987–2005	n-ser 1987–2005	n-agr 1987–2005	n-agr 1987–2005
Intercept	4.122*** (5.928)	3.745*** (7.92)	1.015 (0.81)	0.322 (0.36)	6.574*** (9.34)	6.802*** (10.51)
man	0.202 (1.65)					
manw		1.744*** (3.79)				
ser			0.441** (2.52)			
serw				1.245*** (4.39)		
agr					0.009 (0.03)	
agrw						–0.319 (–0.376)
N	16	16	16	16	16	16
R^2	0.16	0.51	0.31	0.58	0.00	0.01

Key: n-man = non-manufacturing SDP; n-ser = non-service SDP; n-agr = non-agriculture SDP; man = manufacturing; manw = manufacturing, weighted (multiplied with manufacturing share of SDP in 1980); ser = services; serw = services, weighted; agr = agriculture; agrw = agriculture, weighted. Note that t-values are given in parentheses, and p-values are indicated as follows: *** p-value < 1%; ** p-value < 5%; * p-value < 10%.

growth indicate similar effects. Simple growth rates in service production explain about 40%, and weighted growth rates about 50% of non-service growth. The second part of Table 3, for the years 1987–2005, illustrates that the explanatory power of service growth even exceeds that of manufacturing growth in this sub-period.

It is interesting to remember that Kaldor also obtained high correlations and significant parameters when regressing service growth on GDP growth. However, as the parameter of service growth was practically 1, and the intercept of the regression was not significant, he concluded that causality does not run from service growth to GDP growth, but the other way round (Kaldor 1966, p 13). In the present context, where ICT-based services may act as an engine of growth similar to manufacturing, we must address a different question: does the relationship between growth of modern services and growth of the rest of the economy differ from the relationship of growth of traditional services to growth of the rest of the economy? Regression results in Table 4 suggest that the impact of modern services on growth of the rest of the economy is indeed stronger than that of traditional services. Even

Table 4

Regressions of sector growth on overall growth, traditional services, and modern services, 1980–2005 and 1987–2005.

Equation	(1)	(2)	(3)	(4)
Variable	n-sert 1980–2005	n-sert 1980–2005	n-serm 1980–2005	n-serm 1980–2005
Intercept	3.828*** (4.46)	2.194*** (2.59)	1.476 (0.78)	2.494*** (4.16)
sert	0.156 (1.28)			
sertw		1.683*** (3.26)		
serm			0.480* (1.85)	
sermw				2.443*** (4.27)
N	16	16	16	16
R^2	0.10	0.43	0.139	0.56
Variable	n-sert 1987–2005	n-sert 1987–2005	n-serm 1987–2005	n-serm 1987–2005
Intercept	3.946*** (4.57)	1.543*** (1.58)	1.371 (0.769)	2.234*** (3.35)
sert	0.155 (1.30)			
sertw		2.018 (3.64)		
serm			0.459 (2.01)	
sermw				2.168 (4.24)
N	16	16	16	16
R^2	0.10	0.49	0.22	0.56

Key: n-sert = non-service (traditional) SDP; n-serm = non-service (modern) SDP; sert = traditional services; sertw = traditional services, weighted; serm = modern services; sermw = modern services, weighted. Note that t-values are given in parentheses, and p-values are indicated as follows: *** p-value < 1%; ** p-value < 5%; * p-value < 10%.

parameters of non-weighted growth rates of modern services are significant at conventional levels, and the explanatory power of weighted growth rates of modern services is about 10 percentage points higher than that of traditional services.

Which impact results from the aggregation of manufacturing and modern services? Table 5 shows that these two sectors taken together are really dominant drivers of overall growth. The weighted growth rate of manufactur-

Table 5

Regressions of sector growth on overall growth, manufacturing plus traditional services, manufacturing plus modern services, 1980–2005 and 1987–2005.

Equation	(1)	(2)	(3)	(4)
Variable	n-mansert 1980–2005	n-mansert 1980–2005	n-manserm 1980–2005	n-manserm 1980–2005
Intercept	3.687*** (3.32)	1.164** (2.28)	1.244 (0.94)	2.611*** (6.60)
mansert	0.092 (0.99)			
mansertw		1.202*** (4.23)		
manserm			0.515* (2.64)	
mansermw				1.113*** (5.65)
N	16	16	16	16
R^2	0.02	0.56	0.33	0.69
Variable	n-mansert 1987–2005	n-mansert 1987–2005	n-manserm 1987–2005	n-manserm 1987–2005
Intercept	3.463*** (2.64)	2.318*** (2.34)	–0.091 (0.09)	2.213*** (5.96)
mansert	0.212 (1.05)			
mansertw		0.904 (2.52)		
manserm			0.706 (4.69)	
mansermw				1.156 (7.28)
N	16	16	16	16
R^2	0.07	0.32	0.61	0.79

Key: n-mansert = non-manufacturing plus non-service (traditional) SDP; n-manserm = non-manufacturing plus non-service (modern) SDP; mansert = manufacturing plus traditional services; mansertw = manufacturing plus traditional services, weighted; manserm = manufacturing plus modern services; mansermw = manufacturing plus modern services, weighted. Note that t-values are given in parentheses, and p-values are indicated as follows: *** p-value < 1%; ** p-value < 5%; * p-value < 10%.

ing cum modern services explains about 70% of the growth of the rest of the economy (almost 80% for the sub-period 1987–2005). The effect of the growth of manufacturing together with traditional services on the growth of the rest of the economy is significantly lower. All in all, the regression results support not only Kaldor's hypothesis, but also the hypothesis that the modern, ICT-based service sector acts as an engine of growth.

25.5 Tests of the direction of Granger causality

As explained in the introduction, 'traditional' regression analyses have their limits in determining the direction of causality. Therefore, we extend our empirical work to submit Kaldor's first law to Granger causality tests. Using the same panel data as before, we examine whether the growth of the manufacturing and other (sub-)sectors Granger-causes the growth of the rest of the economy.

Following Granger (1969), a time series Y_t is said to be Granger-caused by another series X_t if past and present values of X_t help to improve the forecasts of the Y_t variable. This is the case if Equation (5) holds true:

(5) $$MSE\ (Y_t \mid \Omega_t) < MSE\ (Y_t \mid \Omega_t'),$$

where MSE = conditional mean square error of the forecast of Y_t, Ω_t = set of all relevant information up to time t, and Ω_t' = set of information excluding past and present X_t.

The conventional Granger causality test involves specifying a bi-variate p^{th}-order vector auto regression (VAR) as follows:

(6a) $$Y_t = \mu + \sum_{i=1}^{p} a_i Y_{t-i} + \sum_{j=1}^{p} b_j X_{t-j} + U_t$$

and

(6b) $$X_t = \mu' + \sum_{i=1}^{p-1} c_i Y_{t-i} + \sum_{j=1}^{p-1} d_i X_{t-j} + U_t' ,$$

where X and Y are variables as explained above, μ and μ′ are constant drifts, and U_t and U_t' are error terms. More generally, Equation (6a) may include any number of additional relevant variables to explain Y_t. Furthermore, when using panel data as in the present case, state-specific fixed effects (constants that vary from state to state) are also allowed in order to take account of state-specific variations. The null hypothesis that X_t does *not* Granger-cause Y_t amounts to testing the following equation:

(7) $$b_1 = b_2 = \ldots = b_n = 0.$$

Table 6

Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	n-man	n-man	n-ser	n-serm	n-serm	n-manserm	n-manserm
cons	0.333*** (18.84)	0.0363*** (13.77)	0.041*** (3.36)	0.069*** (8.53)	0.038*** (3.67)	0.029*** (13.77)	0.036*** (16.84)
n-man1	−0.347*** (−7.33)	−0.100 (−1.17)					
n-man2	−0.226*** (−3.33)	−0.009 (−0.08)					
n-man3	−0.899* (−1.79)	0.192** (0.086)					
man1	0.084*** (3.12)	−0.104** (−2.21)					
man2	0.0498 (1.52)	−0.102* (−1.74)					
man3	0.0755*** (2.81)	-1.317*** (−2.73)					
n-ser1			−0.530*** (−10.00)				
n-ser2			−0.139** (−2.29)				
n-ser3			−0.124** (−0.228)				
ser1			0.001 (0.02)				
ser2			0.126 (1.37)				
ser3			0.221** (2.41)				
n-sert1				−0.539*** (−9.91)			
n-sert2				−0.109* (−1.80)			
n-sert3				−0.099* (−1.85)			
sert1				−0.015 (−0.34)			
sert2				0.075* (1.72)			
sert3				0.042 (0.94)			
n-serm1					−0.511*** (−9.8)		
n-serm2					−0.093* (−1.66)		
n-serm3					−0.066 (−1.29)		

serm1					0.193*** (2.87)		
serm2					0.049 (0.73)		
serm3					0.173*** (2.47)		
n-manserm1						–0.518*** (–11.97)	–0.030 (–0.71)
manserm1						0.255*** (4.71)	–0.100* (–1.86)
N	327	327	342	341	341	375	375
F^2	5.93***	3.88***	2.39*	1.26	5.28***	7.43***	0.17
R^2 within	0.34	0.15	0.33	0.35	0.41	0.35	0.10
R^2 between	0.06	0.03	0.61	0.85	0.45	0.66	0.88
R^2 overall	0.33	0.14	0.31	0.31	0.38	0.32	0.09

Key: n-man = non-manufacturing SDP; n-ser = non-service SDP; n-serm = non-service (modern) SDP; n-manserm = non-manufacturing plus non-service (modern) SDP; man = manufacturing; ser = services; n-sert = non-service (traditional) SDP; sert = traditional services; serm = modern services; manserm = manufacturing plus modern services. 1, 2, and 3 denotes time lags of 1, 2, and 3 years. Note that t-values are given in parentheses, and p-values are indicated as follows: *** p-value < 1%; ** p-value < 5%; * p-value < 10%.

Causality tests, sector growth and growth of rest of SDP, 1980–2005.

This can be tested by standard methods, such as an F-test. Similarly, the null hypothesis that Y_t does *not* Granger-cause X_t (reverse causation) amounts to testing Equation (8):

$$(8) \qquad c_1 = c_2 = \dots = c_n = 0.$$

The results of testing Granger causality are presented in Table 6. The estimates are for the period of 1980–2005; they use non-weighted variables[4], and they incorporate fixed effects for the 16 states. In all cases we present results with optimal time lags, which turned out to be 3 years in Equations (1) to (5) and 1 year in Equations (6) and (7). Year dummies were included in all equations but are not reported in Table 6. The F-values in the lower part of Table 6 refer to the probability that parameters b_i of Equation (7) are not zero.

Equation (1) in Table 6 shows that growth of manufacturing Granger-causes growth of the rest of the economy. At the same time, Equation (2) indicates that there is a much weaker feedback from the rest of the economy to manufacturing. Equation (3) illustrates that there is weak causality going from growth of services to growth of the rest of the economy. Equations (4) and (5) indicate that growth of traditional services has no effect on growth of the rest of the economy, while growth of modern services strongly Granger-causes non-service growth. Equation (6) illustrates that growth of manufacturing plus modern services has a strong impact on growth of the rest of the economy, but that there is no discernible reverse causality (Equation 7). All in all, these results corroborate the conclusions from the regression results previously discussed. The estimates indicate that modern, ICT-based services allow for static and dynamic economies of scale similar to those in the manufacturing sector. Hence, the traditional version of Kaldor's first law can be extended to modern services: both manufacturing and ICT-based services act as engines of growth. India is a good example of a developing country in which a two-pronged process of modernisation and sector transformation is in full swing.

25.6 The effect of economic growth on poverty reduction

It is broadly agreed that higher economic growth is associated with more rapid poverty reduction (see, for example, Dollar and Kraay 2002). However, the direction of causality between these variables remains to be established clearly as it has important policy implications, as noted in section 25.1. In the present section, we attempt to determine the relationship between changes in real per capita SDP (sdppc) and changes in the headcount ratio (hcr), the percentage of people living below the national poverty line. We analyse the direction of causality between economic growth and poverty reduction by using co-integration, Granger causality, and error variance decomposition (EVD) techniques. At this point we must emphasise that the data we use for the headcount ratios are not available for every year. We interpolated the missing data by assuming a constant growth rate in poverty reduction over the missing years. Although the SDP figures were available for every year, they were interpolated for the corresponding years for which headcount ratios were missing, using the same calculations as for the poverty data. We are fully aware that this procedure limits the quality and validity of our results. We tried to make the best of the limited data, and are confident that the method applied minimises the inevitable bias of the results.

As a general procedure of causality and co-integration analysis, we first examine the stationarity of the GDP and poverty series. The two variables used are the log of the per capita real SDP (lsdppc) and the log of the headcount ratio of poverty (lhcr). The results of an Augmented Dickey-Fuller

(ADF) test for unit roots (not reported here) show that the variables sdppc and hcr are non-stationary in their log form, but stationary in the first differences of the logs, that is, in their growth rates. Using the Johansen and Juselius maximum likelihood method, we can reject the null hypothesis of no co-integrating vector at the 5% significance level (results not reported here). The presence of a single co-integrating vector proves the existence of a long-run equilibrium relationship between per capita SDP and headcount ratio.

Since it is difficult to determine the direction of causality in the case of a single co-integrating vector, we apply the vector error correction method (VECM), which includes the error term derived from the co-integration equation. Table 7 illustrates that the error terms in both equations of the VECM are statistically significant at the levels of 10% and 5%, respectively. This indicates a bi-directional causality between per capita SDP and headcount ratio. Regarding adjustments in the short run, we find that the lagged values of income growth (dlsdppc) have a significant effect on poverty reduction (dlhcr). However, there is no reverse causality, that is, the lagged dlhcr-terms have no significant effect on income growth. These results indicate, in other words, that causality goes from per capita income growth (dlsdppc) to poverty reduction, where the lagged values of dlsdppc are significant and have the correct (negative) sign. Overall, this evidence suggests that the direction of causality is mainly from income growth to poverty reduction, although there is also some evidence of possible bi-directional causality.

Table 7

Results of vector error correction estimates.

Error correction	dlhcr	dlsdppc
Residual	–0.112690* (–1.61493)	–0.047239** (–1.78654)
Constant	0.023392 (1.47259)	0.018905 (3.14077)
dlhcr1	–0.213896* (–1.63714)	0.028612 (0.57793)
dlhcr2	–0.097508 (–0.77405)	0.065322 (1.36844)
dlsdppc1	–1.017078** (–2.39302)	0.015371 (0.09544)
dlsdppc2	–0.714778* (–1.63675)	0.134276 (0.81143)

Key: dlhcr = change rate of headcount ratio; dlsdppc = change rate of state domestic product (income) per capita. Note that t-values are given in parentheses, and p-values are indicated as follows: *** p-value < 1%; ** p-value < 5%; * p-value < 10%.

Given the importance of the issue involved, we tried to analyse the direction of causality in two additional ways. As both series, dlsdppc and dlhcr, are stationary, we can also apply a Granger causality test. The result, in the form of an F-test for parameters b_i being zero, strongly indicates that causality goes from income growth (dlsdppc) to poverty reduction (dlhcr). The null hypothesis that income growth does *not* reduce poverty has a probability of 0.015 (F-test 3.98) and must be rejected, while the null hypothesis that poverty reduction does *not* Granger-cause income growth has a probability of 0.626 (F-test 0.63) and cannot be rejected.

In addition, we also use the vector auto regression (VAR) technique to test the direction of causality. The VAR model resembles a set of simultaneous equations in which all variables – in our case per capita income growth (dlsdppc) and poverty reduction (dlhcr) – are treated as endogenous. The variance decomposition of the estimated equations (not reported here) then shows the extent to which the variables are explained by their own shocks and by

Table 8

Results of variance decomposition.

Period	Variance decomposition of impact on dlsdppc (%)		Variance decomposition of impact on dlhcr (%)	
	dlsdppc	dlhcr	dlsdppc	dlhcr
1	100.0	0.0	0.1	99.9
2	99.8	0.2	19.0	81.0
3	99.3	0.7	19.4	80.6
4	97.9	2.1	21.8	78.2
5	97.9	2.1	22.2	77.8
6	97.8	2.2	22.5	77.5
7	97.8	2.2	22.5	77.5
8	97.8	2.2	22.5	77.5
9	97.8	2.2	22.5	77.5
10	97.8	2.2	22.5	77.5
11	97.8	2.2	22.5	77.5
12	97.8	2.2	22.5	77.5
13	97.8	2.2	22.5	77.5
14	97.8	2.2	22.5	77.5
15	97.8	2.2	22.5	77.5

Key: dlhcr = change rate of headcount ratio; dlsdppc = change rate of state domestic product (income) per capita.

shocks from the other variables in the system. It is evident from the results of the error variance decomposition shown in Table 8 that the percentage change of per capita income growth (dlsdppc) is almost entirely explained by its own shock in the first period; the results illustrate that even after 15 periods, the income growth rate (dlsdppc) is explained largely (97.8%) by its own shock, and only to the tune of 2.2% by the change in the poverty ratio. However, if we look at the results of variance decomposition of dlhcr, we see that the change in the headcount ratio of poverty after period 6 is explained partly by its own shock (about 77.5%), and partly by the shock of the growth rate of per capita income (about 22.5%). These results complement the finding of the previous tests that causation goes above all from economic growth to poverty reduction.

25.7 Summary and conclusions

India's historically unprecedented economic growth rates since the 1980s are mainly driven by the growth of manufacturing production and of modern, ICT-based service production. Both the results of traditional regression analyses and causality tests for the 16 largest states of India support and extend Kaldor's first law that manufacturing is the main engine of growth. It seems that the production of modern services exhibits opportunities for economies of scale similar to those in manufacturing production. Moreover, several types of causality tests strongly indicate that economic growth is the major determinant of poverty reduction. Indian states with high growth rates of per capita SDP also had high reduction rates in their headcount ratios. Taken together, we have substantial evidence that India's accelerated growth of manufacturing and modern service production has contributed considerably to the reduction of poverty.

Although the exact year of the marked change in India's growth performance is not (yet) clear, the shift certainly occurred in the 1980s. There can be no doubt that the improved performance was caused by changes in the mindsets of politicians in the early 1980s and subsequent reforms of microeconomic and macroeconomic policies. The deregulation of the industrial sector, the liberalisation of domestic markets, the opening of the economy, and a firmer commitment to internal and external stability were and still are the fundamental ingredients of India's recipe for economic success (e.g. Kappel 2004; Panagariya 2004). By all means, the central government and the governments of the states of India must continue on this route. To prevent further discrepancies in economic welfare on the state level, the governments of the least developed states should try to accelerate policy reforms in the direction outlined above.

These conclusions do not imply that governments should not continue to tackle poverty through direct measures of poverty reduction. It goes without saying that economic and social interventions directly targeting the poor are indispensable elements of a successful poverty reduction strategy. However, we have solid evidence that an environment of sound institutions and policies that promotes overall income growth enforces and complements the effects of direct interventions to a considerable extent. As mentioned in section 25.1, the poverty-reducing effect of overall income growth surpassed the effect of development expenditures in 10 out of 15 Indian states during the 1980s and 1990s. Moreover, combined with improved education, the employment of workers in manufacturing and service production is an important route to escape poverty (Schmid 2007). Hence, India should try to keep its rates of accelerated modernisation and sector transformation as high as possible for as long as possible. The poor will benefit substantially, particularly if these efforts are complemented by efficient, direct measures of poverty reduction.

Endnotes

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[1] Rolf Kappel is Professor for Development Economics and Director of the Centre for Development and Cooperation (NADEL) of the Swiss Federal Institute of Technology Zurich (ETH Zurich). His teaching and research focuses on the areas of economic and institutional reforms in developing countries, economic relations between industrialised and developing countries, environmental and resource policy in developing countries, and strategic issues in development policy. He travels widely to developing countries for teaching and research projects and on consultancies for development agencies.
E-mail: rolf.kappel@nadel.ethz.ch

[2] Pradeep Agrawal is Professor of Economics at the Institute of Economic Growth in Delhi, India. His current research interests include macroeconomics, development economics, international economics, industrial economics and organisation, and applied econometrics.
E-mail: pradeep@iegindia.org

[3] All data used in this article are for Indian fiscal years, which run from 1 April to 31 March.

[4] Estimates with weighted variables yield very similar results and are not reported here.

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