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New Technologies, Employment and Inequality in the Indian Economy

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Abstract

New technologies arrived in manufacturing and services sectors of India's economy in the aftermath of the economic reforms of the 1990s. In the 2000s, technological change increased employment of high-skilled labour and reduced employment of low-skilled labour (often in absolute terms) in these two sectors. Unlike in developed economies, however, technological change has not reduced employment of middle-skilled labour in absolute terms.

Technological change, of course, was not the only factor driving skill upgrading in India's economy in the 2000s. There was capital deepening in all sectors of the economy. In manufacturing and services, capital deepening was associated with technological change. In other sectors, capital deepening was an autonomous process and caused a relative shift in employment towards high-skilled labour through capital-skill complementarity. Structural change – change in the composition of value added – has also been of a kind that led to skill upgrading by causing a relative shift in employment towards middle-skilled labour. Overall, the process of skill upgrading has been associated with very slow growth of aggregate employment.

Technological change has contributed to growth of income inequality but quite modestly. It increased wage-income inequality by increasing 'employment inequality' but has not increased capital's share in GVA. Capital deepening, on the other hand, increased both 'employment inequality' and capital's share in GVA, though only modestly. All this implies that the principal contributor to the growth of income inequality in India has been the structural change associated with services-led growth.

ABOUT THE AUTHORS

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Dr. Balwant Singh Mehta has worked extensively in the areas of Information and Communication technology for development, labour, employment and child well being. He has contributed several papers on these themes to various reputed National & International journals and books. His contributions to social research is acknowledged by several international organizations through fellowships and other awards such as the International Amy Mahan Fellowship in ICT4D (2010-11), by University of PompeuFabra, Barcelona; South Asian ICT4D Research Fellowship (2009-10) from Singapore Internet Research Centre, Nanyang Technological University, Singapore; and the International Development Research Centre India Social Science Young Research Award (IDRC-SSRA) in 2009.

CONTENTS

New Technologies, Employment and Inequality in the Indian Economy

Ajit K. Ghose[1] and Balwant S. Mehta[2]

INTRODUCTION

The process of technological change that has been under way in advanced economies since the early 1980s has aroused deep concerns about its consequences for employment of humans.[3] The near-consensus view among economists is that the rapidly advancing new technologies - as exemplified by industrial robots, computer-controlled machines, and artificial intelligence - are to a high degree automation technologies and are also highly skill-biased. By enabling capital to be substituted for labour in a wide range of tasks, these technologies can potentially throw many humans out of jobs. Being highly skill-biased, moreover, they bring job losses for the low-skilled and job growth for the high-skilled thereby causing sharp increases in the skill premium in wages. The overall consequence of these developments is rapid and sustained growth of income inequality.

Automation, of course, is not a new phenomenon; it has been a feature of technological change at least since the industrial revolution. It is widely held, however, that automation figures much more prominently in current technological developments than it ever did in the past. Similarly, though skill-bias has been a characteristic feature of technological change through much of the twentieth century, the new technologies are thought to be far more skill-complementary than the technologies of the past.[4] It is these distinctive characteristics of the currently ongoing technological change that have given rise to the concerns about its consequences for employment and income inequality. And the observed developments in the advanced economies over the past few decades show that the concerns are not unfounded.

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1. Visiting Professor, Institute for Human Development, New Delhi.

2. Senior Fellow, Institute for Human Development, New Delhi.

3. Some scholars and popular writers have even projected an apocalyptic vision of the future of work: an ever-increasing automation of tasks currently carried out by humans and the consequent redundancy of human labour. See, for example, Brynjolfsson and McAfee (2014), Ford (2015) and Frey and Osborne (2017).

4. See Goldin and Katz (1998), Acemoglu (2002) and Atack, Margo and Rhode (2019).

Since developing countries do not produce technologies but import them from developed countries, technological change in developing economies cannot but be similar in nature to that in developed economies in any given period. Thus, technological change in developing economies in recent periods, to the extent that it has occurred, must have involved adoption of the same new technologies as in developed economies. So, the concerns about the consequences of technological change for employment and inequality that arose in developed economies must arise in developing economies too. Indeed, the consequences are expected to be more serious in developing economies where the skill composition of the labour force is vastly different.

To what extent have the new technologies arrived in developing economies? The answer is: we do not know. Studies looking into technological change and its effects in recent periods in developing economies are hard to find. Assuming that the effects of technological change on employment and income inequality in developing economies are similar to those in developed economies, we can deduce the nature and extent of technological change from observed trends in employment and income inequality in given periods. Using this methodology, one study finds that, by the end of the 1980s, the new technologies may have arrived only in a few middle-income countries of Latin America.[5] This, however, is hardly surprising in view of the fact that the new technologies began to be adopted in advanced economies only in the early 1980s; their adoption in developing economies could only begin much later.

Have the new technologies arrived in India and, if yes, what consequences for employment and income inequality have they produced? There are a few studies that address the question but they focus exclusively on the organised manufacturing sector, which is unhelpful.[6] We seek to address the question in the context of India's aggregate economy in this paper. Since lack of empirical evidence makes direct observation of technology adoption virtually impossible, we focus on trends in skill structure of employment and income inequality – the trends that should reflect the effects of skill-biased technological change – in recent periods.

The structure of the paper is as follows. We begin with a brief review, in the next section, of the experience of developed economies. This provides a view of

5. See Berman and Machin (2000).

6. Abraham (2010), Berman et al (2005), Kapoor (2016), Mani (2017), Vashisht (2017) and Vashisht and Rani (2019).

the potential effects of the new technologies on employment and inequality in developing economies if and when these technologies are imported and put to use. In the section that follows (the central part of the paper), we examine the recent trends in employment, skill structure and income inequality in India's economy and consider the role that technological change may have played in generating these trends. The paper ends with our concluding observations in the final section.

NEW TECHNOLOGIES, EMPLOYMENT AND INEQUALITY: THE EXPERIENCE OF DEVELOPED ECONOMIES

It was in the 1980s that the new computer-enabled technologies began to spread through the economies of the developed world. Thus, there is more than three decades of experience to be observed and analysed. And there is by now a fairly large literature on the nature and consequences of technological change in these economies. A number of clear facts about the effects of the new technologies on employment and income inequality emerges from this literature.

First, the new technologies have brought widespread automation of routine tasks - manual and cognitive tasks that are accomplished by following precise and well-defined procedures and hence are easily codifiable.[7] Machines have thus been replacing workers who had previously been engaged in performing such tasks. Robots and computer-controlled machines have been replacing production and craft workers in manufacturing. And computer programmes and artificial intelligence have been replacing service workers in accounting, clerical/secretarial work, logistics and customer services. The new technologies have thus caused job losses in sectors and industries that were intensive in routine tasks. Most of the routine-task-intensive jobs, it turns out, paid middle-level wages and were held by middle-skilled workers. So, the new technologies clearly had adverse consequences for employment and wages of middle-skilled workers.

Second, the new technologies have proved to be highly skill-complementary, i.e., complementary to humans in executing non-routine tasks that involve problem-solving skills (non-routine analytic tasks) and complex communication skills (non-routine interactive tasks). Thus, the new technologies have brought rapid job growth for highly-educated workers engaged in abstract, creative, problem-solving, and coordination tasks. In concrete terms, this has meant rapid growth of employment

7. See Autor, Levy and Murane (2003), Berman, Bound and Grilliches (1998), Berman, Bound and Machin (1998) and Machin and van Reenen (1998).

of high-skilled workers in managerial, professional and technical occupations. The new technologies, therefore, have increased employment of the highly-educated at the expense of employment of the middle-educated.[8] So, the skill bias of the new technologies appears to have been absolute (growth of employment of the high-skilled combined with decline of employment of the middle-skilled) whereas the skill bias of earlier technologies had been relative (rapid growth of employment of the high-skilled combined with slow growth of employment of the middle-skilled and low-skilled).

Third, the new technologies have had little direct effect on low-skill-low-wage jobs in transportation, construction and mining. The reason is that these jobs have relatively low routine-task content. Technological change has also been of little relevance for low-skill workers in community and personal services. The jobs of restaurant service workers, domestic help, retail sales workers, security guards, janitors, gardeners, cleaners, home health aides, care workers, hairdressers and delivery workers, for example, have remained unaffected by the new technologies. Overall, technological change *per se* has left low-skill-low-wage employment relatively unaffected in advanced economies.[9]

Fourth, the new technologies have had the effect of increasing the skill premium in wages (the ratio of high-skill wage to low-skill wage) essentially because they have led to accelerated growth of demand for the highly educated together with decline of demand for the middle-educated. Rising skill premium together with rising employment of the high-skilled and declining employment of the middle-skilled led to growing concentration of labour-incomes in a small group of top earners so that the labour-income inequality increased sharply. Both the extent of the increase in the skill premium and the extent of increase in labour-income inequality, however, appear to have been conditioned by the prevailing labour market institutions and tax systems in particular economies.[10] Thus, the increase in labour-income inequality has been far more significant in Anglo-Saxon countries (with weak labour market institutions – trade unions and regulations – and low top tax rates) than in continental Europe (with strong labour market institutions

8. Autor, Levy and Murane (2003), Berman, Bound and Griliches (1998), Berman, Bound and Machin (1998) and Machin and van Reenen (1998).

9. Autor (2015), Autor, Levy and Murane (2003), Autor and Dorn (2013); and Michaels, Natraj and van Reenen (2014).

10. Alvaredo et al (2013), Piketty (2014).

and high top tax rates).[11] The share of the top 10 per cent of wage-salary-earners in total wage-salary-bill, for example, increased from around 28 per cent in 1980 to around 36 per cent in 2007 in the United States, while it increased from 26 per cent to 27 per cent in France during the same period.[12]

Fifth, the new technologies benefited capital at the expense of labour in the aggregate. In the period since the early 1980s, capital's share of national income steadily increased while labour's share declined in all advanced economies.[13] The basic explanation for the decline in labour's share is to be found in the decline of relative employment and wages of middle-skilled labour.[14]

Sixth, the rising share of capital income, which always accrues principally to the richest, combined with rising inequality in the distribution of labour incomes to bring about rapid growth of income inequality in all advanced economies in the post-1980 period.[15] The growth of income inequality, once again, was sharper in the Anglo-Saxon countries such as the US and the UK than in the countries of continental Europe essentially because the growth of labour income inequality was sharper in the former than in the latter. In the United States between 1980 and 2007, capital's share of national income increased from 20 per cent to 26 per cent, labour income share of the top 10 per cent of earners increased from 28 per cent to 36 per cent, and income share of the top 10 per cent of population increased from 35 per cent to 50 per cent.[16] In France during the same period, capital's share of national income increased from 16 per cent to 25 per cent, labour income share of the top 10 per cent of earners increased from 26 per cent to 27 per cent, and income share of the top 10 per cent of population increased from 31 per cent to 33 per cent.[17]

Seventh, by increasing earnings inequality, the new technologies indirectly increased the demand for low-skill services through spill overs from consumption

11. Acemoglu (2002), Alvaredo et al (2013), Berman, Bound and Machin (1998), Machin and van Reenen (1998), Piketty (2014).
12. Piketty (2014), Supplementary Tables (available online: piketty.pse.ens.fr/capital21c.)
13. See Autor and Solomons (2018), Autor et al (2017), Dao et al (2017), Karabarbounis and Nieman (2014) and Piketty (2014).
14. Dao et al (2017).
15. Acemoglu (2002), Alvaredo et al (2013), Atkinson, Piketty and Saez (2011), Piketty (2014).
16. Piketty (2014), Supplementary Tables (available online: piketty.pse.ens.fr/capital21c.).
17. Piketty (2014), Supplementary Tables (available online: piketty.pse.ens.fr/capital21c.)

of the rich.[18] As the high-skilled gained in terms of jobs and earnings, the rising opportunity cost of their time translated into rising expenditure on market substitutes for home production activities, thereby increasing the demand for services of restaurant workers, domestic help, security guards, janitors, gardeners, cleaners, home health aides and care workers (for example). On the supply side, at the same time, declining employment in routine-task-intensive occupations forced middle-skilled workers - including new entrants and those displaced from routine task-intensive jobs - to seek employment in such low-skill services. Thus, the new technologies had the indirect effect of inducing rapid growth of low-skill-low-wage jobs in services.

To sum up, technological change since the early 1980s have brought about two interrelated developments in advanced economies. The first relates to employment of humans. The new technologies have not had the overall effect of reducing aggregate employment; as a matter of fact, aggregate employment grew in all developed economies.[19] What the new technologies have engendered is job polarisation. Both high-skill-high-wage jobs (or 'lovely' jobs) and low-skill-low-wage jobs (or 'lousy' jobs) have grown while middle-skill-middle-wage jobs (or 'decent' jobs) have been lost.[20] The second development relates to income inequality. By increasing capital's share of national income as also by increasing labour income inequality, the new technologies have stimulated sustained growth of income inequality. Ironically, it is the growth of income inequality that drove the growth of 'lousy' jobs thereby ensuring growth of aggregate employment.

The magnitudes of these effects of technological change were conditioned by the labour market institutions and tax systems prevailing in different countries. Both job polarisation and inequality growth were lower in the countries of continental Europe, which had strong labour market institutions and high marginal tax rates, than in the Anglo-Saxon countries, which had weak labour market institutions and low marginal tax rates.

18. Mazzolari and Lagusa (2013), Autor and Dorn (2013).

19. Autor and Salomons (2018).

20. Autor (2015), Autor and Dorn (2013), Goos and Manning (2007), Goos, Manning and Solomons (2009, 2014), Michaels, Natraj and van Reenen (2014).

TECHNOLOGICAL CHANGE, EMPLOYMENT AND INEQUALITY IN INDIA

The Context

India, like most developing countries, has been and remains an importer of technologies from developed countries. This dependence on technology imports lends certain particular characteristics to the process of technological change in India's economy. In the first place, technological change, which involves imports of capital goods embodying the currently available technologies developed in the advanced countries, is greatly facilitated by openness of the economy. Second, labour supply conditions in India's economy play no role in determining the characteristic of technological change. Since the technologies imported from developed countries are necessarily skill-biased, technological change in India is also invariably skill-biased even though India has abundant supplies of unskilled / low-skilled labour. Third, the demand for technology imports depends on the pattern of output growth in India's economy; faster-growing industries and sectors experience faster technological change. The pattern of output growth, in turn, depends on changes in the structure of exports (which reflects the pattern of external demand) and in income distribution (which determines the pattern of domestic demand). Changing composition of output or structural change, in other words, is an important determinant of the pace and pattern of technological change.

Given this context, we can plausibly suppose that the economic reforms of the 1990s, which opened up India's hitherto quasi-closed economy to international trade and capital flows, ushered in a period of rapid technological change.[21] But the reforms also had the unusual effect of stimulating rapid growth of exports of high-skill services, which then emerged as the lead-sector in the growth process. India's services-led growth in the post-reform period came to be associated with growing inequality of income distribution. The structure of exports together with the structure of domestic demand driven by the growing income inequality produced systematic shifts in the composition of value added towards capital-and-skill-intensive products and industries.[22] In other words, there was what we might call skill-biased structural change, which, moreover, must have had a determining influence on the process of technological change through technology imports so that we can expect technological change to have been more significant in the

21. Vashisht (2017) provides evidence of acceleration in technological change in organised manufacturing in the post-reform period.

22. See Ghose (2022) for a discussion.

case of skill-intensive products and industries. Thus, *a priori* reasoning suggests the hypothesis that concurrent processes of structural change and technological change might have led to highly significant skill-upgrading of employment in India's economy in the post-reform period. In what follows, we empirically explore this hypothesis by examining the nature and sources of change in the skill structure of employment in India's economy during the period 1999-2017.[23]

TECHNOLOGY, EMPLOYMENT AND SKILL STRUCTURE, 1999-2017

Data and Definitions

Our analysis of changing skill structure of employment in India's economy is based on statistical data derived from the surveys of employment and unemployment conducted by the National Sample Survey Organisation (NSSO). For our analysis, we use the unit-level data from two surveys: the Employment-Unemployment Survey (EUS) for 1999-2000 and the Periodic Labour Force Survey (PLFS) for 2017-2018.[24] We have also used the unit-level data from the EUS for 2011-2012 but only to check if the trends during 1999-2011 differ in any important respect from the trends during 2011-2017. As we find the trends to be almost identical (see Appendix Table 1), we choose to focus on developments over the longer period 1999-2017 for our analysis.

In studying the skill structure of employment, we define three broad skill-groups: low-skilled, middle-skilled and high-skilled. Low-skilled persons are either not literate or literate with up to primary-level education. Middle-skilled persons have above-primary and up-to-secondary education. And high-skilled persons are those with above-secondary education. Admittedly, education is an imperfect indicator of skill and each of the categories defined above includes less skilled and more skilled persons. But there is no better indicator of skill available not just in India but in almost all countries of the world. All the studies on developed economies reviewed above use education as the indicator of skill.[25]

23. In India, the reference periods for employment and national accounts statistics are 1999-2000, 2000-2001, and so on. Throughout this paper, we shall use 1999 for 1999-2000, 2000 for 2000-2001, and so on. The period of analysis could have been extended to 2020 but we have chosen not to do this as our focus is on long-term trends. In the period after 2017, India's economy experienced random shocks and growth slowdown.

24. We follow the standard practice of combining the ratios and proportions derived from the employment surveys with estimates of population derived from the Censuses to produce estimates of absolute numbers in labour force.

25. In some studies, non-manual workers are taken to be skilled while manual workers are taken to be unskilled and the ratio of wage of non-manual workers to that of manual workers is used as an indicator of skill intensity. These, too, are highly imperfect indicators.

Empirical measures of skill-structure of employment are derived for the aggregate economy, six broad sectors of the economy, ten sub-sectors of manufacturing and nine sub-sectors of services. Apart from data on employment, the paper also uses data on Gross Value Added (GVA), capital stock and labour's share in GVA; these data are taken from the KLEMS India Database maintained by the Reserve Bank of India.[26]

Changing Skill Structure of Employment

The data on changes in skill structure of employment are presented in Table 1. There clearly was very substantial skill upgrading; the share of low-skilled employment in total employment declined significantly throughout the economy while the shares of middle-skilled and high-skilled employment increased significantly. Quite remarkably, low-skilled employment actually declined in absolute terms not just in the aggregate economy and the broad sectors (the exception being construction) but also in many of the sub-sectors of manufacturing and services (see Appendix Table 2). On the other hand, almost all sectors and sub-sectors increased employment of high-skilled workers more than that of middle-skilled workers.[27] Thus, India's economy has witnessed what we might call *absolute* skill upgrading (involving absolute decline of low-skilled employment) to distinguish it from *relative* skill upgrading (involving only a decline of low-skilled employment share).

Clearly, the pattern of change in skill structure of employment in India's economy has been quite different from that in advanced economies. Low-skilled employment, which declined in absolute terms in India, actually increased quite rapidly in advanced economies. Middle-skilled employment, which increased in India, declined in absolute terms in advanced economies. Only with respect to demand for high-skilled labour has India's experience been similar to that of advanced economies; high-skilled employment recorded rapid growth in both. Job polarisation of the kind observed to have occurred in advanced economies has not occurred in India.[28]

26. These data are available online (rbi.org.in/Scripts/KLEMS.aspx).

27. The employment share of the middle-skilled declined in some sub-sectors of manufacturing and in quite a few sub-sectors of services but middle-skilled employment in absolute terms did not decline anywhere.

28. Vashisht (2017) argues that there has been job polarisation in organised manufacturing.

Table 1
Changes in Shares of Skill Groups in Total Employment (Expressed in Ratios), 1999-2017

	Low-skilled	*Middle-skilled*	*High-skilled*
Agriculture-forestry-fishing	**-0.192**	**0.132**	**0.060**
Mining-quarrying	**-0.283**	**0.151**	**0.141**
Manufacturing	**-0.192**	**0.093**	**0.099**
Utilities	**0.169**	**-0.254**	**0.085**
Construction	**-0.164**	**0.122**	**0.042**
Services	**-0.137**	**0.000**	**0.137**
Economy	**-0.221**	**0.108**	**0.113**
Sub-sectors, manufacturing			
Food-beverage-tobacco	-0.162	0.079	0.083
Textiles-apparel-leather	-0.156	0.090	0.066
Petroleum products	-0.333	0.167	0.166
Metal Products	-0.162	0.069	0.093
Machinery & equipment	-0.146	-0.044	0.190
Chemicals & pharmaceuticals	-0.280	0.066	0.214
Rubber & plastic products	-0.022	-0.044	0.066
Non-metallic mineral products	-0.233	0.137	0.096
Wood and products of wood	-0.193	0.162	0.031
Other manufacturing	0.015	-0.014	-0.001
Sub-sectors, services			
Trade	-0.148	0.029	0.119
Hotels & restaurants	-0.139	0.040	0.099
Transport & storage	-0.195	0.123	0.072
Communication services	-0.047	-0.243	0.290
Financial services	-0.029	-0.083	0.112
Business services	-0.065	-0.162	0.227
Public administration & defence	-0.092	-0.088	0.180
Education & health	-0.033	-0.106	0.139
Other services	-0.303	0.120	0.183

Note: Employment refers to persons aged 15 years or more who were employed according to usual status (i.e., worked for at least 30 days in a year).

Source: Authors' estimates based on unit-level data from the NSSO surveys.

The available evidence also suggests that it was change in the demand for skills that brought about the observed change in the skill structure of employment in India's economy during the period under study; change in the supply of skills had

little to do with it. For, the skill structure was changing in a context where the growth of employment fell far short of the growth of labour supply (Table 2). Thus, between 1999 and 2017, aggregate employment increased by about 59 million (or by 0.8 per cent per annum) while the non-student population – the pool of potential workers - increased by 234 million (or by 1.9 per cent per annum). In each of the skill categories, too, the growth of non-student population was invariably much larger than the growth of actual employment. Employment of the low-skilled declined by 60 million while the size of the non-student population remained unchanged. Employment of the middle-skilled increased by about 62 million while the non-student population increased by 125 million. And employment of the high-skilled increased by 57 million while the non-student population increased by 108 million.

Table 2
Skill Structure of Employment, Labour Force and Non-student Population in the Aggregate Economy

	Shares (ratios)			*Numbers (millions)*			*All*
	Low-skilled	*Middle-skilled*	*High-skilled*	*Low-skilled*	*Middle-skilled*	*High-skilled*	
1999							
Employment	0.676	0.226	0.098	263.7	88.3	37.9	**389.9**
Labour force	0.663	0.232	0.105	264.6	92.7	41.7	**399.0**
Non-student population	0.686	0.221	0.093	408.3	131.7	55.3	**595.3**
2017							
Employment	0.455	0.334	0.211	204.1	149.8	94.7	**448.6**
Labour force	0.435	0.334	0.231	207.5	159.3	110.7	**477.5**
Non-student population	0.493	0.310	0.197	408.8	257.0	163.7	**829.5**

Note: Employment refers to persons aged 15 years or more who were employed according to usual status (i.e., worked for at least 30 days in a year). Unemployment refers to persons aged 15 years or more who did not find work even for 30 days in a year though they were available for work. Non-student population refers to persons aged 15 years or more who are not attending educational institutions.

Source: Authors' estimates based on unit-level data from the NSSO surveys.

The data in Table 2 also imply some noteworthy differences in the manner of adjustment of actual labour supply (labour force) to labour demand (employment) between the less skilled and the more skilled and these are explicitly brought out by the data in Table 3. For the low-skilled, actual labour supply adjusts almost fully to demand so that the labour force participation rate simply trails the employment rate. For the middle-skilled and the high-skilled, actual labour supply also adjusts

to demand but only partially. Thus, the labour force participation rate moves in the same direction as the employment rate but not to the same extent so that the unemployment rate also works as an adjustment variable. Throughout the period under study, the employment rate declined for all skill categories and it declined faster for the low-skilled than for the middle-skilled and the high-skilled. And yet, for the low-skilled, the labour force participation rate remained close to the employment rate so that the unemployment rate remained insignificant. For the middle- and high-skilled, labour force participation rates declined less than employment rates so that unemployment rates increased significantly.

Table 3
Employment, Labour Force and Unemployment by Skill-groups

	Low-skilled	*Middle-skilled*	*High-skilled*	*All*
1999				
Employment rate (%)	64.6	67.0	68.5	**65.4**
Labour force participation rate (%)	64.8	70.4	75.4	**67.0**
Unemployment rate (%)	0.3	4.7	9.1	**2.3**
2017				
Employment rate (%)	49.9	58.3	57.8	**54.1**
Labour force participation rate (%)	50.8	62.0	67.8	**57.6**
Unemployment rate (%)	1.6	6.0	14.5	**6.1**

Note: Both employment rates and labour force participation rates are estimated with reference to non-student population.

Source: Authors' estimates based on unit-level data from the NSSO surveys.

Sources of Change in Skill Structure of Employment

What were the factors driving the shift in skill structure of employment in the economy? Two possible factors - skill-biased technological change and skill-biased structural change - have already been mentioned. A third possible factor is capital deepening; given pervasive capital-skill complementarity, increased capital intensity of production tends to be associated with increased demand for skilled labour and reduced demand for less skilled labour.[29] A fourth possible factor is product upgrading. When industries are defined at a high level of aggregation (as we do

29. On the basis of his analysis of the experience of advanced economies in the early twentieth century, Griliches (1969) shows that capital and skills are intrinsically complementary.

here), we cannot assume homogeneous products within industries. Nor can we assume that products remain the same over time. Production within an industry might shift from (older) low-skill-intensive products to (newer) high-skill-intensive products, perhaps in response to demand shifts and/or price changes.[30] Such shifts also lead to skill upgrading within industries.

A first step towards identification of particular sources of change in the skill structure of employment is a decomposition of the change in employment share of each of the skill groups into within-industry (or within-sector) and between-industry (or between-sector) components. The within-industry component should capture the change in demand for skills associated with technological change or capital deepening or product upgrading or some combination of the three. The between-industry component should capture the change in demand for skills attributable to structural change.

We use the following decomposition for low-skilled employment:

$$\Delta LSE = \Sigma \Delta LSE_i . PW(PAV)_i + \Sigma \Delta PW_i . LSE(PAV)_i$$

Where LSE is share of low-skilled employment in total employment, PW is share of industry or sector in aggregate GVA, the subscript i (=1…n) indicates particular sectors or industries in the economy, PAV indicates period average, and Δ indicates change over the period under consideration. The first term on the right-hand side shows within-industry change while the second term shows between-industry change.

Similar decompositions are used for changes in middle-skilled employment (MSE) and high-skilled employment (HSE):

$$\Delta MSE = \Sigma \Delta MSE_i . PW(PAV)_i + \Sigma \Delta PW_i . MSE(PAV)_i$$

and

$$\Delta HSE = \Sigma \Delta HSE_i . PW(PAV)_i + \Sigma \Delta PW_i . HSE(PAV)_i$$

These decompositions are carried out for the aggregate economy (with six sectors), the manufacturing sector (with ten sub-sectors) and the services sector (with nine sub-sectors).

30. Ghose (2022) argues that, In India, product upgrading occurred in response to demand shifts driven by growing income inequality.

Table 4
Decomposition of Change in the Shares (ratios) of Skill-groups in Total Employment during 1999-2017

	Change (actual)	*Within-industry change*	*Between-industry change*
Low-skilled			
Economy	-0.221	-0.158	**-0.063**
Manufacturing	-0.192	-0.181	**-0.011**
Services	-0.137	-0.138	**0.001**
Middle-skilled			
Economy	0.108	0.051	**0.057**
Manufacturing	0.093	0.055	**0.038**
Services	0.000	-0.015	**0.015**
High-skilled			
Economy	0.113	0.106	**0.007**
Manufacturing	0.099	0.126	**-0.027**
Services	0.137	0.154	**-0.017**

Source: Authors'estimates.

The results of the exercise, presented in Table 4, suggest the following. First, the decline in demand for low-skilled labour occurred almost entirely within industries. Only at the level of the aggregate economy did structural change – basically a shift in value added from agriculture to non-agriculture – play a role in reducing the demand for low-skilled labour. Second, the increased demand for high-skilled labour in the aggregate economy as also in manufacturing and services was due entirely to within-industry developments; structural change had no role to play. Third, the increased demand for middle-skilled labour in the aggregate economy as also in manufacturing is explained as much by within-industry developments as by structural change. In services, within-industry developments lowered the demand for middle-skilled labour while structural change increased it with the result that there was zero growth of demand overall.

Clearly, skill upgrading in India's economy was primarily a within-industry phenomenon.[31] Structural change was skill-biased to a very limited extent and it caused a relative shift of employment towards the middle-skilled. We can thus infer that skill upgrading during the period under study was driven by some combination

31. Studies of developed economies using this kind of decomposition have systematically found within-industry changes to account for bulk of the aggregate changes in skill demand.

of skill-biased technological change, capital deepening and product upgrading within industries. Separating out the contribution of each of these three factors is a difficult task, however. We cannot directly observe technological change and product upgrading within industries for lack of data. We only have data on capital stock so that we can directly observe the growth of capital intensity of production within industries. Besides, we must recognise that the three changes are closely interrelated. As technological change occurs through addition of capital goods embodying more advanced technologies, it involves capital deepening. Shifting production from low-skill-intensive products to high-skill-intensive products also requires adoption of newer technologies and hence capital deepening.[32]

If we define capital intensity as the capital-labour ratio (i.e., the ratio of capital stock to employment), we observe capital deepening to have been substantial in almost all sectors and subsectors of the economy (Appendix Table 3). But if we define capital-intensity as capital-output ratio (i.e., the ratio of capital stock to GVA), we find capital deepening to have been substantial only in sectors other than manufacturing and services. We interpret this to mean that capital deepening was associated with technological change and product upgrading basically in manufacturing and services.[33] It was in sectors such as 'mining and quarrying' and 'construction' – sectors that are unlikely to have experienced technological change or product upgrading to any significant extent – that capital deepening appears to have involved substitution of capital for labour and contributed to skill upgrading within industries through capital-skill complementarity.

These results are broadly in line with the findings of a recent study of the experience of a set of developing economies.[34] The study presents evidence to show that, in developing economies, capital deepening, when unaccompanied by technological change, causes a relative shift in employment towards high-skilled labour but generally does not reduce the employment of low-skilled labour in absolute terms. The same study also shows that technological change in developing economies, involving imports of capital goods that embody the technologies in

32. Capital deepening need not always be accompanied by technological change or product upgrading; it may mean mere substitution of capital for labour. In this case, capital productivity declines so that the capital-output ratio rises.

33. If K is capital stock, L is employment and Y is GVA, then K/Y = (K/L)/(Y/L). When a rise in capital-labour ratio is associated with technological change and hence accompanied by a rise in labour productivity, the rise in capital output ratio is smaller than the rise in capital-labour ratio.

34. See Conte and Vivarelli (2007).

use in advanced economies, increases the employment of high-skilled labour and often reduces the employment of low-skilled labour in absolute terms. In India, capital deepening in 'mining and quarrying' and 'construction' increased the employment share of high-skilled labour but also increased the employment of low-skilled labour in absolute terms. In manufacturing and services, on the other hand, technological change not only increased the employment share of the high-skilled but also often reduced the employment of low-skilled labour in absolute terms.[35]

In sum

The observed trends in the skill-structure of employment in manufacturing and services strongly suggest that the new technologies arrived in these sectors of India's economy in the aftermath of the economic reforms of the 1990s. Technological change, product upgrading and capital deepening have been simultaneous processes in these sectors, which have increased the employment of high-skilled labour and reduced the employment of low-skilled labour. In other sectors ('mining and quarrying' and 'construction' in particular), there was capital deepening, which, through capital-skill complementarity, caused relative shifts in employment towards skilled labour. Taken together, these developments have seriously worsened the overall employment situation in India's economy, which has relatively abundant supplies of low-skilled labour.

Technological Change and Income Inequality

Income inequality has been increasing in India since the early 1990s (Appendix Table 4). And it increased quite rapidly between 1999 and 2017. The question we ask here is whether and how technological change may have contributed to this growth of income inequality.

In developed economies, technological change increased income inequality through two routes. It increased labour-income inequality by increasing the skill premium and by engendering job polarisation. And it increased capital's share in national income. If this experience is any guide, it is likely that similar developments have occurred in India too, given our finding that the new technologies have arrived here.

35. The insignificant increase in low-skilled employment in services is explained by structural change.

Technology and Labour-income Inequality

The sketchy data that we have available on wage-earnings per worker do not suggest rising skill premium during the period under study (Tables 5 and 6). The finding seems to be at odds with the general impression that skill premium has been increasing. Nevertheless, it may not be wide off the mark in view of the fact that skills have apparently been in excess supply.[36]

Even if there has not been any increase in skill premium, however, wage-income inequality must still have increased because of the growing 'employment inequality': declining employment of the low-skilled, growing employment of the middle-skilled and rapidly growing employment of the high-skilled. And both technological change and capital deepening have increased the 'employment inequality' and hence increased the wage-income inequality. An illustrative exercise, the results of which are presented in Table 7, makes this amply clear. In carrying out this exercise, however, we have assumed all workers to be wage-workers. In reality, nearly half of the workforce is in self-employment. Thus, we are effectively assuming that the distribution of incomes from self-employment has been and remains the same as that of wage-incomes. While this assumption may not be entirely valid, it is quite likely that the inequality of distribution of incomes from self-employment has moved in the same direction as the inequality in the distribution of wage-incomes. We conclude that technological change and capital deepening have increased labour-income inequality essentially by increasing the 'employment inequality'.

Table 5
Nominal Wage Earning (Rupees) per Regular Employee per Week

	Low-skilled	*Middle-skilled*	*High-skilled*
Average			
1999	467 (0.368)	725 (0.571)	1270 (1.000)
2017	1230 (0.395)	1741 (0.560)	3111 (1.000)
Median			
1999	350 (0.308)	510 (0.449)	1135 (1.000)
2017	1000 (0.417)	1300 (0.542)	2400 (1.000)

Note: Figures in parentheses are ratios of earning of the high-skilled.
Source: Authors' estimates based on unit-level data from NSSO surveys.

36. As widely observed, both the skill premium (the ratio of wage of non-production workers to that of production workers) and the share of non-production workers in total wage bill increased in organised manufacturing. See, for example, Berman et al (2005), Abraham (2010), Kapoor (2016) and Vashisht (2017). Organised manufacturing, however, accounts for a minuscule proportion of employment in India's economy and the trends observed in the sector cannot be generalised for the aggregate economy or even for the manufacturing sector.

Table 6
Nominal Wage Earning (Rupees) per Regular Employee per Week

	1999	*2017*
Administrative, executive and managerial	1895 (1.000)	4395 (1.000)
Professional, technical and related	1289 (0.690)	3242 (0.738)
Clerical and related	987 (0.521)	2769 (0.630)
Sales and service	580 (0.306)	1740 (0.396)
Production, transport and other	605 (0.319)	1521 (0.346)

Note: Figures in parentheses are ratios.

Source: Authors' estimates based on unit-level data from NSSO surveys.

Table 7
Distribution of Aggregate Labour Income: Hypothetical Scenario

	Low-skilled	*Middle-skilled*	*High-skilled*	*All*
1999				
Actual number in employment	263.7	88.3	37.9	389.9
Hypothetical earning per employed	1	2	3	1.4
Share (%) in total earning of all employed	47.6	31.9	20.5	100.0
2017				
Actual number in employment	204.1	149.8	94.7	448.6
Hypothetical earning per employed	2	4	6	3.5
Share (%) in total earning of all employed	25.9	38.0	36.1	100.0

Source: Authors' estimates.

Technology and Capital Income

How has capital's share in GVA changed? We have some data on labour's share in GVA available (Appendix Table 5). These data, however, need to be interpreted with due caution. A large part of India's workforce is in self-employment and estimation of labour's share in income of the self-employed necessarily requires use of assumptions and imputations.

The data suggest only a small decline in labour's share in the context of the aggregate economy during the period under study (Table 8).[37] Even this small

37. A recent study [Basu and Veeramani (2021)] shows that, between 1992 and 2007, labour's share declined quite significantly in the aggregate economy as also in manufacturing and services, but then it increased after 2007.

decline seems to be explained mainly by the declines in agriculture, in mining and quarrying, and in construction, i.e., in sectors that have not experienced skill-biased technological change though they have experienced very substantial capital deepening.[38] Labour's share recorded a small increase in manufacturing and a small decline in services; these are sectors that did experience skill-biased technological change. Decomposition exercises[39] show that, in the case of manufacturing, the between-industry increase was as important as the within-industry increase, while in the case of services, the between-industry decline actually overwhelmed the within-industry increase (Table 8).

Table 8
Trends in Labour Share in GVA

	Labour share (ratios)			*Within-industry*	*Between-industry*
	1999	*2017*	*Change*		
Agriculture-forestry-fishing	0.558	0.553	-0.005		
Mining-quarrying	0.370	0.295	-0.075		
Manufacturing	0.289	0.305	0.016	0.008	0.008
Utilities	0.256	0.356	0.100		
Construction	0.793	0.758	-0.035		
Services	0.554	0.529	-0.025	0.014	-0.039
Economy	0.515	0.500	-0.015	-0.014	-0.001

Source: Authors' estimates based on data available from KLEMS-India Database.

Thus, in both manufacturing and services, technological change seems to have led to a small increase in labour's share; skill upgrading apparently increased the labour-cost of production. In manufacturing, change in output composition also increased labour's share; the sub-sectors in which labour's share had been high tended to grow faster. In services, on the other hand, change in output composition reduced labour's share; the sub-sectors in which labour's share had been high tended to grow slower.

Thus, the observed small decline in labour's share in the aggregate economy, which implies a small increase in capital's share, is attributable principally to capital

38. Between 1999 and 2017, the ratio of capital stock to workforce recorded a threefold rise in agriculture, a fivefold rise in mining and quarrying and a fourfold rise in construction.

39. The formulation used for the decomposition exercises is: $\Delta LS = \sum LSi.\ PW_i\ (PAV) + \sum LS_i\ (PAV).\ \Delta PW_i$, where LS is labour's share, Δ indicates change over the period, PW is share of sector / sub-sector in GVA, and PAV indicates period average.

deepening in sectors that did not witness significant technological change. There is no evidence to suggest that technological change *per se* increased capital's share in GVA to any significant extent during the period under study.[40]

In Sum

We conclude that technological change contributed only very modestly to the growth of income inequality in India by increasing the labour-income inequality. Unlike in advanced economies, however, technological change does not seem to have increased capital's share in GVA in India's economy and has not increased income inequality through this route.

CONCLUDING OBSERVATIONS

New technologies arrived in manufacturing and services sectors of India's economy in the aftermath of the economic reforms of the 1990s. In the 2000s, technological change increased employment of high-skilled labour and reduced employment of low-skilled labour (often in absolute terms) in these two sectors. Unlike in developed economies, however, technological change has not reduced employment of middle-skilled labour in absolute terms.

Technological change, of course, was not the only factor driving skill upgrading in India's economy. There was capital deepening in all sectors of the economy. In manufacturing and services, capital deepening was associated with technological change. In other sectors – agriculture, mining and quarrying, and construction – capital deepening was an autonomous process and caused a relative shift in employment towards high-skilled labour through capital-skill complementarity. Structural change – change in the composition of value added – has also been of a kind that led to skill upgrading by causing a relative shift in employment towards middle-skilled labour.

Overall, the process of skill upgrading has been associated with very slow growth of aggregate employment. It is not just that the employment of low-skilled labour, which has been and remains in abundant supply, has been declining absolutely but also that the growth of demand for middle-skilled and high-skilled labour has been falling short of the growth of their supplies even though these supplies have not been abundant.

40. There is evidence to suggest that capital's share increased significantly in organised manufacturing. See, for example, Basu and Veeramani (2021), Jayadev and Narayan (2018) and Maiti (2019).

Technological change has contributed to growth of income inequality but quite modestly. It increased wage-income inequality (which, in India, is only one component of labour income inequality) by increasing 'employment inequality' but has not increased capital's share in GVA. Capital deepening, on the other hand, increased both 'employment inequality' and capital's share in GVA, though only modestly, and thus contributed to growth of income inequality. All this implies that the principal contributor to the growth of income inequality in India has been the structural change associated with services-led growth.

These conclusions, it has to be said, are somewhat tentative and more research is required to firmly establish them. This paper, hopefully, will provide both the inspiration and the guidelines for future research.

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APPENDIX TABLES

Appendix Table 1

Changes in Shares of Skill Groups in Total Employment (ratios), 1999-2011 (Period 1), 2011-2017 (Period 2), 1999-2017 (Period 3)

	Period 1			*Period 2*			*Period 3*		
	Low-skilled	*Middle-skilled*	*High-skilled*	*Low-skilled*	*Middle-skilled*	*High-skilled*	*Low-skilled*	*Middle-skilled*	*High-skilled*
Agriculture-forestry-fishing	**-0.118**	**0.081**	**0.037**	**-0.074**	**0.051**	**0.023**	**-0.192**	**0.132**	**0.060**
Mining-quarrying	**-0.167**	**0.058**	**0.109**	**-0.116**	**0.093**	**0.032**	**-0.283**	**0.151**	**0.141**
Manufacturing	**-0.073**	**0.031**	**0.042**	**-0.119**	**0.062**	**0.057**	**-0.192**	**0.093**	**0.099**
Utilities	**0.317**	**-0.308**	**-0.009**	**-0.148**	**0.054**	**0.094**	**0.169**	**-0.254**	**0.085**
Construction	**-0.055**	**0.040**	**0.015**	**-0.109**	**0.082**	**0.027**	**-0.164**	**0.122**	**0.042**
Services	**-0.085**	**-0.021**	**0.106**	**-0.052**	**0.021**	**0.031**	**-0.137**	**0.000**	**0.137**
Economy	**-0.128**	**0.058**	**0.070**	**-0.093**	**0.050**	**0.043**	**-0.221**	**0.108**	**0.113**
Sub-sectors, manufacturing									
Food-beverage-tobacco	-0.067	0.025	0.042	-0.095	0.054	0.041	-0.162	0.079	0.083
Textiles-apparel-leather	-0.061	0.018	0.043	-0.095	0.072	0.023	-0.156	0.090	0.066
Petroleum products	-0.333	-0.333	0.666	0.000	0.500	-0.500	-0.333	0.167	0.166
Metal Products	-0.020	0.011	0.009	-0.142	0.058	0.084	-0.162	0.069	0.093
Machinery & equipment	-0.109	-0.014	0.123	-0.037	-0.030	0.067	-0.146	-0.044	0.190
Chemicals & pharmaceuticals	-0.175	0.066	0.109	-0.105	0.000	0.105	-0.280	0.066	0.214
Rubber & plastic products	0.051	0.011	-0.062	-0.073	-0.055	0.128	-0.022	-0.044	0.066
Non-metallic mineral products	-0.077	0.033	0.044	-0.156	0.104	0.052	-0.233	0.137	0.096
Wood and products of wood	-0.079	0.066	0.013	-0.114	0.096	0.018	-0.193	0.162	0.031
Other manufacturing	0.085	-0.040	-0.045	-0.070	0.026	0.044	0.015	-0.014	-0.001
Sub-sectors, services									
Trade	-0.100	0.002	0.098	-0.048	0.027	0.021	-0.148	0.029	0.119
Hotels & restaurants	-0.130	0.041	0.089	-0.009	-0.001	0.010	-0.139	0.040	0.099
Transport & storage	-0.092	0.049	0.043	-0.103	0.074	0.029	-0.195	0.123	0.072
Communication services	-0.043	-0.329	0.372	-0.004	0.086	-0.082	-0.047	-0.243	0.290
Financial services	-0.026	0.036	-0.010	-0.003	-0.119	0.122	-0.029	-0.083	0.112
Business services	-0.080	-0.102	0.182	0.015	-0.060	0.055	-0.065	-0.162	0.227
Public administration & defence	-0.060	-0.107	0.167	-0.032	0.019	0.013	-0.092	-0.088	0.180
Education & health	-0.025	-0.097	0.122	-0.008	-0.009	0.017	-0.033	-0.106	0.139
Other services	-0.212	0.070	0.142	-0.091	0.050	0.041	-0.303	0.120	0.183

Source: Authors' estimates based on unit-level data from the NSSO surveys.

Appendix Table 2

Change in Employment (number in million), 1999-2017

	Low-skilled	*Middle-skilled*	*High-skilled*	*All*
Agriculture, forestry and fishing	**-73.9**	**18.3**	**10.4**	**-45.2**
Mining and quarrying	**-0.8**	**0.2**	**0.2**	**-0.4**
Manufacturing	**-4.5**	**8.3**	**6.7**	**10.5**
Electricity, gas, water	**0.6**	**0.3**	**0.7**	**1.6**
Construction	**16.4**	**14.9**	**4.1**	**35.4**
Services	**2.6**	**19.5**	**34.7**	**56.8**
Total	**-59.6**	**61.5**	**56.8**	**58.7**
Sub-sectors, manufacturing				
Food Products, Beverages and Tobacco	-1.7	0.6	0.7	-0.4
Textiles, Apparel and Leather Products	-0.3	3.3	1.6	4.6
Coke & refined petroleum products	-0.1	0.0	0.0	-0.1
Metal Products	-0.2	0.8	0.7	1.3
Machinery and Equipment	-0.2	0.5	1.4	1.7
Chemicals and pharmaceuticals	-0.4	0.2	0.5	0.3
Rubber & plastic products	0.0	0.0	0.1	0.1
Other non-metallic mineral products	-0.6	0.6	0.4	0.4
Wood and of products of wood	-2.4	0.2	0.0	-2.2
Other manufacturing	1.4	2.1	1.3	4.8
Sub-sectors, services				
Trade	-0.6	6.7	7.8	13.9
Hotels & restaurants	1.2	1.7	1.1	4.0
Transport and storage	0.3	5.9	2.5	8.7
Communication services	0.0	0.2	3.4	3.6
Financial services	0.0	0.3	2.5	2.8
Business services	0.0	0.0	2.1	2.1
Public administration and defence	-1.2	-1.7	0.1	-2.8
Education and health	0.3	0.4	10.0	10.7
Other services	2.6	6.0	5.2	13.8

Source: Authors' estimates based on unit-level data from NSSO surveys.

Appendix Table 3
Capital Deepening, 1999-2017

	Ratio of K/L 2017 to K/L 1999	*Ratio of K/Y 2017 to K/Y 1999*
Agriculture, forestry and fishing	2.677	1.273
Mining and quarrying	4.705	2.007
Manufacturing	2.613	0.883
Electricity, gas, water	1.093	0.974
Construction	3.691	3.083
Services	2.268	0.995
Total	3.016	1.115
Sub-sectors, manufacturing		
Food Products, Beverages and Tobacco	3.190	1.038
Textiles, Apparel and Leather Products	3.640	0.835
Coke & refined petroleum products	11.641	2.103
Metal Products	2.479	1.158
Machinery and Equipment	2.643	0.693
Chemicals and pharmaceuticals	2.385	1.048
Rubber & plastic products	2.713	0.789
Other non-metallic mineral products	3.122	1.045
Wood and of products of wood	3.610	1.452
Other manufacturing	0.301	0.401
Sub-sectors, services		
Trade	9.422	3.137
Hotels & restaurants	4.181	2.171
Transport and storage	1.181	0.516
Communication services	1.955	1.024
Financial services	0.938	0.628
Business services	6.595	1.661
Public administration and defence	4.505	1.189
Education and health	4.809	1.989
Other services	1.062	1.193

Source: Authors' estimates based on data available from KLEMS India Database.

Appendix Table 4
Trends in Income Inequality, 1992-2017

	Share (%) of income		
	1992	*1999*	*2017*
Per cent of population			
Top 1 per cent	10.3	15.1	21.7
Top 10 per cent	36.0	40.5	57.1
Middle 40 per cent	44.2	40.9	29.8
Bottom 50 per cent	19.8	18.6	13.1

Source: World Inequality Database.

Appendix Table 5

Trends in Labour Share in GVA, 1999-2017

	Labour share (ratios)			*GVA share*		
	1999	*2017*	*Change*	*1999*	*2017*	*Change*
Agriculture-forestry-fishing	**0.558**	**0.553**	**-0.005**	**0.273**	**0.150**	**-0.123**
Mining-quarrying	**0.370**	**0.295**	**-0.075**	**0.047**	**0.029**	**-0.018**
Manufacturing	**0.289**	**0.305**	**0.016**	**0.154**	**0.181**	**0.027**
Utilities	**0.256**	**0.356**	**0.100**	**0.023**	**0.023**	**0.000**
Construction	**0.793**	**0.758**	**-0.035**	**0.068**	**0.080**	**0.012**
Services	**0.554**	**0.529**	**-0.025**	**0.435**	**0.537**	**0.102**
Economy	**0.515**	**0.500**	**-0.015**	**1.000**	**1.000**	**0.000**
Sub-sectors, manufacturing						
Food-beverage-tobacco	0.402	0.337	-0.065	0.020	0.018	-0.002
Textiles-apparel-leather	0.409	0.470	0.061	0.017	0.023	0.006
Petroleum products	0.083	0.076	-0.007	0.014	0.016	0.002
Metal Products	0.248	0.308	0.060	0.026	0.025	-0.001
Machinery & equipment	0.299	0.306	0.007	0.023	0.045	0.022
Chemicals & pharmaceuticals	0.252	0.208	-0.044	0.025	0.022	-0.003
Rubber & plastic products	0.168	0.325	0.157	0.006	0.007	0.001
Non-metallic mineral products	0.298	0.256	-0.042	0.011	0.011	0.000
Wood and products of wood	0.241	0.314	0.073	0.005	0.003	-0.002
Other manufacturing	0.446	0.457	0.011	0.007	0.011	0.004
Sub-sectors, services						
Trade	0.481	0.473	-0.008	0.085	0.119	0.034
Hotels & restaurants	0.562	0.581	0.019	0.009	0.011	0.002
Transport & storage	0.533	0.538	0.005	0.040	0.050	0.010
Communication services	0.305	0.452	0.147	0.008	0.017	0.009
Financial services	0.350	0.326	-0.024	0.053	0.061	0.008
Business services	0.416	0.453	0.037	0.031	0.087	0.056
Public administration-defence	0.798	0.875	0.077	0.064	0.056	-0.008
Education & health	0.690	0.699	0.009	0.033	0.051	0.018
Other services	0.586	0.586	0.000	0.112	0.085	-0.027

Note: The figures for 1999 are simple averages of figures for 1998, 1999 and 2000, and the figures for 2017 are simple averages of the figures for 2016, 2017 and 2018.

Source: Authors' estimates based on data from KLEMS India Database.

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