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The Indian Journal of Labour Economics
An Organ of the Indian Society of Labour Economics

ISSN 0971-7927
Volume 63
Number 1

Ind. J. Labour Econ. (2020) 63:161-176
DOI 10.1007/s41027-019-00201-9

Springer

The Indian Journal of Labour Economics (2020) 63:161–176
https://doi.org/10.1007/s41027-019-00201-9

RESEARCH NOTE

'Make in India': The Components of a Manufacturing Strategy for India

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Published online: 30 January 2020

Abstract
The share of manufacturing in India's GDP was only 16% in 1991 and has remained stagnant at that level until 2018. Employment in manufacturing has also remained stagnant at under 12.8% of the workforce. One reason is that India has not had a coherent industrial policy in place since 1991. Meanwhile, some 100 countries in the world have adopted industrial policies, especially since the global economic crisis of 2008. The paper begins by spelling out the reasons why India needs an industrial strategy. It goes on to spell out eight elements of what would constitute a manufacturing strategy for India, which would address the concerns of large corporates and small and medium enterprises, as well as micro-enterprises. We would argue that such a strategy will lay the foundations for an inclusive growth strategy for India, which will also create growing jobs for an increasing labour force.

Keywords Manufacturing · Small/medium enterprises · Trade policy · Skills · R&D · Innovation

1 Introduction

Although India's GDP growth rate since independence has consistently increased decade by decade, industry (including manufacturing, construction, etc.) accounts for only 25% of GDP (in 1950, it was 8%). The manufacturing sector contributed in 2017 only about 16% to the GDP, stagnating since economic reforms began in 1991. By contrast, in some Asian economies, the share of industry has exceeded 30–40%, while that of manufacturing 20–30%.

No major country in the world has managed to reduce poverty or sustain growth over long periods of time without the manufacturing sector becoming the lead sector, driving economic growth. Manufacturing is the engine of economic growth because, in addition to higher productivity, the manufacturing sector offers greater

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opportunities for economies of scale, for embodying technological progress, and generates forward and backward linkages that create positive spillover effects in the economy. The growth in services after growth in manufacturing is very different in nature. Manufacturing processes induce the services sector to produce high-end activities like R&D; in the absence of manufacturing, however, services remain low-end activities.

Between 2004–2005 and 2011–2012, the overall employment in manufacturing in India increased only from 55.2 million to 61.3 million—an increase of only 5.1 million new jobs (while organised employment in manufacturing had grown during this very period by 4.7 million new jobs). Thus, between 2004–2005 and 2011–2012, the growth of employment in the manufacturing sector in unorganised sectors decelerated (Thomas 2019). Employment in manufacturing actually fell by 9 mn between 2011–2012 and 2017–2018—which is unprecedented in India's history (Mehrotra and Parida 2019).

We argue that in the absence of a well-articulated, well-defined industrial strategy, which itself must be part of a nation-wide planning framework (with its state-wise components), the transformation of India into a major manufacturing nation remains out of the question. However, this must not be interpreted to mean that we can go back to protecting manufacturing in the way India did before 1991.

2 Why an Industrial Strategy/Policy for the Twenty-First Century?

In almost all East Asian and Southeast Asian countries, industrial policy was planned and executed as part of 5-year or longer-term plans. In fact, it was precisely because these countries had planning institutions—which went hand in hand with industrial policy—that the East/SE Asian countries managed to steer policies through turbulent times in the global economy, thus sustaining growth. They did not, unlike much of Latin America/Caribbean (LAC) or sub-Saharan Africa (SSA), experience 'lost decades' in the 1980s and 1990s. In the latter, industrial policy was abandoned—with the result that structural transformation in these regions was slow.

UNCTAD (2018) found that over 100 countries have in the second decade of the new millennium articulated industrial policies. For the benefit of sceptics, we deliberately start with the *theoretical justification by mainstream economists for industrial policy.* There are plenty of sceptics in India itself, who want the Indian state to steer clear of a 'command and control' economy that harks back to pre-1991 days. However, no one believes that the Southeast or the East Asian countries were or are 'command and control' economies. What characterised them were industrial policies, with agile bureaucracies. Even neoclassical economists accept government intervention in case of market failures (Lall 1996).

There are several justifications for an industrial policy. The first is the need to *coordinate complementary investments* when there are significant economies of scale and capital market imperfections (Chang 2003). Second, industrial policies are needed to address *learning externalities*, such as subsidies for industrial training. In fact, industrial policy was reinforced by state investments in human capital, particularly general academic as well as vocational education/training aligned with the

industrial policy, in most East Asian countries (Lee and Mehrotra 2016; Mehrotra and Acharya 2017). However, the lack of such investment in human capital (education, vocational skills or health) has been a major constraint on India being able to attract foreign investment.

Third, the state can play the role of *organizer of domestic firms into cartels* in their negotiations with foreign firms or governments—a role that has become particularly relevant in the twenty-first century after the big business revolution of the 1990s (following mega-mergers and acquisitions among TNCs) (Nolan 2003). In fact, one of the objectives of China's industrial policies since the 1990s has been to support the growth of such firms.[1]

Fourth, the role of industrial policy is to not only prevent coordination failures (i.e. ensure complementary investments) but also *avoid competing investments* in a capital-scarce environment (Rodrik 2002). Excess capacity will lead to price wars, adversely affecting profits of firms—either leading to bankruptcy of firms or slowing down investment, both of which have been happening often in India, e.g. in the airlines sector since the entry of private airlines in 1993, which have seen a bloodbath with five new airlines going under in the last 10 years. Even worse, price wars in the telecom sector in India have slowed profits (even caused losses), which hampers investment in mobile/Internet coverage in rural India where access to mobile phones, let alone broadband Internet, needs rapid expansion, and yet the digital divide between rural and urban India persists.

Fifth, industrial policy can ensure that the *industrial capacity installed is as close to the minimum efficient scale as possible* through policy measures such as investment licensing, forced mergers and export requirements. Choosing too small a scale of capacity can mean a 30–50% reduction in production capacity (Chang 2003); there is plenty of evidence for this phenomenon in India, as demonstrated by the unbridled growth of the unorganised segment in manufacturing. This is another role industrial policy performed in East Asia. The missing middle among Indian enterprises we have discussed elsewhere (Mehrotra 2016; Mehrotra et al. 2014) is nothing short of a failure of the industrial strategy. A major factor contributing to the missing middle phenomenon was the reservation of products exclusively for production in the small-scale and cottage industries (SSI) sector from the 1956 Industrial Policy. There were still 500 products in 2005 in this category, i.e. a full decade and a half after economic reforms were launched. Thereafter, the reservation of products of small firms was cut sharply to 16 products.

Finally, when *structural change is needed, industrial policy can facilitate* that process. In a fast-changing market, losing firms will resist and block structural changes that are socially beneficial but that will make their own assets worthless. Under those circumstances, industrial policies must help such firms. East Asian governments prevented such firms from undermining the process of structural change.

[1] This fact is especially notable for China, given that it was a much later addition to the 'flying geese' model of East Asian industrial growth, in which Japan was the leader, Korea and Taiwan were in the second tier, with Malaysia, Singapore, Hong Kong all following. China joins the 'flying geese' only after the mid-1990s.

The East Asian miracle was very much founded upon export-oriented manufacturing, which employed the surplus labour released by agriculture, thus raising wages and reducing poverty rapidly. The economic reforms of 1991 did lead to a significant rise in India's exports to GDP ratio (to 25% of GDP by 2014). From 2014 to 2018, there has been an absolute fall in US dollar terms in merchandise exports. Never high, India's global export share is much lower when compared with other export-oriented emerging economies like China (13.2%), South Korea (3.1%), Mexico (2.3%) and Singapore (2.1%). In this quest for increased exports, economies of scale are critical.

While the most severe effects of open-economy policies on India's manufacturing were felt from the early 2000s onwards, those effects had begun in the 1990s. In manufacturing, the simple average tariff fell from 126% in 1990–1991 to 36% in 1997–1998 and then to 12.1% in 2014–2015 (Singh 2017). Tariffs were reduced to well below the upper bound of rates permissible under WTO rules.

This is not to doubt the significant positive impact on the economy resulting from the economic reforms of 1991 (Ahluwalia 2002, 2006; Panagariya 2008); however, although manufacturing output grew in absolute terms, its share has been stagnant for over 25 years. At the same time, GDP growth in India was led by the services sector. Within the services sector, communications, software and air transportation experienced high growth since the early 2000s, accompanied by a sharp rise in import demand for manufacture—computer hardware, telecom equipment and aircraft. So, economic liberalisation, while contributing to services growth, had the reverse effect on the manufacturing side.

If evidence is still needed that the state's role will be critical to growth in manufacturing in India, the state's role in the success story of India's IT industry must be put on record (Shankar 2017). The government invested in creating high-speed Internet connectivity of global standards with the USA for the IT software parks. Second, the government then brought trade-in services into the regulatory framework of imports and exports, allowing the IT industry to import duty-free both hardware and software. Third, the IT industry was able to function under the Shops and Establishment Act, hence not subject to the 45 laws relating to labour and the onerous regulatory burden these impose. Finally, the IT sector had the benefit of low-cost high-value human capital in scientific and technical education. These offer insights into the potential for industrial policy.

We turn now to the instruments that must form part of India's industrial strategy at the current conjuncture.

Table 1 Tariff rates by unprocessed, semi-processed and processed goods (%), 1990–2015. *Source*: Pathania (2017)

	1990–1991	1993–1994	1995–1996	1996–1997	1997–1998	2010–2011	2014–2015
Unprocessed	107	50	27	25	25	22.5	23.5
Semi-processed	122	75	44	38	35	8.6	9
Processed	130	73	43	42	37	12.2	13.6

3 India: Essential Elements of an Industrial Strategy for the Twenty-First Century

In India, there was no national manufacturing policy between 1991 and 2011 (as we noted above).[2] The 1991 Industrial Policy reduced the barriers to entry for private industry (ending industrial licencing, deregulation, abolishing the monopolies/restrictive trade practices act and attracting FDI), reduced the sectors reserved for the public sector from 17 to 8 (apart from beginning disinvestment in the public enterprises) and significantly reduced import duties. This remained the thrust of policies for over 2 decades.

3.1 A Trade-Cum-Industrial Policy

From 2001 onwards, India's manufacturing was not helped by the spate of free trade agreements that were signed by India, which led to what is known as an inverted import duty structure. This duty structure has the following features: a higher duty on intermediate goods compared to final/finished goods, with the latter often enjoying concessional custom duty under some schemes. Since 2012 FICCI has complained to government (FICCI 2012–2018). On account of these factors, the trade deficit in the case of manufacturing on account of the sustained global/import competition was 44% of manufacturing GDP during 2008–09 to 2010–11).

Hence, we are making a case for an integrated trade-and-industrial policy, which means that the Ministry of Commerce and Industries and the Ministry of Finance (MOF < which takes a final view on taxes) will need to work together on such an integrated trade-and-industrial policy.

Inverted duty structure (IDS) constitutes negative protection in India's merchandise industries. This is because if the effective rate of protection (ERP) is positive in the presence of IDS, then the latter may not affect domestic industries as the structure of tariff is still giving them protection.[3]

[2] India's first industrial policy was formulated in 1956. Thereafter, the industrial policies were reformed from time to time through statements in 1973, 1977, 1980 and 1991.

[3] As per the conventional method, ERP is defined as the percentage excess of domestic value added due to imposition of tariff and non-tariff barriers over free trade value added at international prices.

A study of effective rates of protection in Indian manufacturing, with a view to examining the effect of IDS (Pathania 2017), shows that, as per the value-added statistics, inverted duty structure exists in paper and paper products, chemical and chemical products, pharmaceuticals, computer, electronics and optical products, machinery and equipment and other transport equipment for the majority of the years under consideration. The higher the extent of positive protection, the lesser is the chance of IDS (Pathania 2017).

Table 1 shows the fall in tariff rates imposed on imports of processed, semi-processed and unprocessed goods during the years 1990–1991 to 2014–2015. However, it should be noticed how the situation completely reversed after 1997–8 through the Noughties, leading to IDS.

The one sector studied that did not face an IDS prospered in India was automobiles. In this sector, most final goods are under the negative list of imports; components are not. Most-favoured-nation tariff rates were high for importing vehicles in completely built-up form. However, duties are quite low for the completely knocked down version which promoted local assembling of vehicles. Not surprisingly, India became one of the largest manufacturers of motor vehicles in the world—two wheelers, three wheelers, cars, trucks and buses.

The government has taken note of the issue and taken some action since the budget for 2014–2015. However, the existing FTAs contain long-term contractual obligations, which cannot simply be tailored or modified. Although the government can consider invoking the 'safeguard clause' (embedded in most FTAs permitting countermeasures to guard a domestic industry facing 'threat of serious injury' from substantial imports), maintaining symmetry between applying the safeguard measures and striving for the objective of trade liberalisation is always a challenge.

The Goods and Services Tax does attempt to deal with the issue of IDS in a specific clause. The law provides for refund of unutilised input tax credit (ITC) where credit accumulation is on account of inverted duty structure, subject to certain riders. However, we do not believe that this action is sufficient to counteract the pervasive and persisting effects of IDS across a range of sectors. Much more serious action is required. All that GST has managed to do is neutralising the negative protection, and possibly levelling the playing field, but levelling the playing field for the potential domestic manufacturer cannot lead to a manufacturing sector investment boom, whether Indian or foreign led.

3.2 Packages for Specific Industries (Not Enterprises)

The most labour-intensive manufactures are food processing, leather and footwear, wood manufacture and furniture, and apparel and garments. These product groups account for 50% of employment in manufacturing in India. Unfortunately, however, it is the unorganised segment of the enterprises in these labour-intensive manufacturing firms that employs most workers, not the organised segment. Only 32% of all employment in manufacturing is in the organised sector, and this is even more so in labour-intensive manufacturing (Mehrotra and Parida 2019). Perhaps, this could be one reason for their relative neglect.

In addition to the usual problems that beset all manufacturing (e.g. poor infrastructure, uncertain electricity, the poor record of the Indian state on 'ease of doing business' until recently), each of these sectors has special problems and each deserves a government package of policies.

Garments and apparel in 2016 received a package, as did the leather sector in 2017. However, close on the heels of these packages came demonetisation of high-denomination currency notes (in November 2017). The cow slaughter ban disrupted the cattle trade in the country, and leather production collapsed (just as beef exports, in which India was the world's largest exporter, fell). All unorganised sector producers suffered, including these sectors. The government policy packages for these sectors came to nought as a result. Hence, these and other labour-intensive sectors (wood and furniture, food processing) deserve consistent support over long periods of time, for them to compete internationally, as jobs in these sectors are vacated by China.

High-end, technology- and skill-intensive large-scale manufacturing will also need greater attention of industrial strategy-making/implementation. Our argument is that policy must go beyond the traditional labour-intensive sectors. Electronics are not very labour-intensive as final products. But seen in terms of the component and supply chain, it is a sector that creates a lot of jobs.

3.3 Addressing the 'Missing Middle' by Cluster Development for Micro-, Small and Medium Enterprises

One purpose of the industrial policy is for the government to encourage scale economies, by encouraging the growth of small firms into bigger ones—to fill the missing middle. A serious policy for the development of modern industry clusters has to be put in place, which requires a focus on brownfield (not just greenfield) sites. Cluster programmes are administered by several ministries [textiles, leather, food, MSME, heavy industry (auto)] under various names and different terms and conditions. This fragmentation of policy must end. Serious planning for clusters across the country requires industrial planning, both at the federal level and at the state level.

There are 1400 modern industry clusters in India spread throughout the country, but cluster development could be facilitated because they constitute a geographically concentrated set of activities. In addition, there are nearly 4500 traditional activity clusters producing artisanal products (handloom, handicraft and other traditional single-product group clusters) using old technologies, characterised by low productivity and low earnings, with a large number of self-employed or own-account workers. Most of India's unorganised manufacturing, which accounts for 40% of manufacturing GDP and over 50% of exports, is located in these clusters.

We propose that a Cluster Stimulation Cell at the apex level in the MSME Ministry should be created to promote Cluster Associations. But this kind of cell will need replication at the state level, given that there are over 5500 clusters around the country, and mechanisms found to make them operationally effective at the district level. This will require an infusion of funds. Mehrotra and Biggeri

(2007) showed how effective cluster development has been in China's industrial development (as well as in late-industrialiser Italy).

The 1400 modern clusters are in urban locations mostly. So the first government action is that the poor infrastructure in these urban locations has to be addressed (on that see the next subsection).

Second, India's Cluster Development programme, which took off only in 2005, will need much more than <Rs. 1000 crores per annum, which is the budget of the Ministry of Micro, Small and Medium Enterprises, for the 5500 clusters in India. Also notable is the biased nature of the MSME Ministry's incentives (Mehrotra et al. 2014). Financial and non-financial incentives are given to support micro- and small capital investment enterprises, but these incentives end the moment these micro- and small enterprises become medium-sized ones. Growth of tiny firms into medium-sized enterprises is disincentivised by the government. Growth of firms is not seen by policy makers as a positive development, although we know that even among MSMEs, the larger the firm, the higher its labour productivity (Mehrotra and Giri 2019).

Finally, the modern industry clusters will need much greater access to institutional sources of credit. The limited resources of the Small Industries Development Bank of India (SIDBI) cannot suffice. The public sector banks are diffident about lending to micro- and small establishments (on account of lack of trust, low capacity of firms to prepare bankable projects and the high transaction costs of dealing with a large number of small borrowers). The crisis of Non-Banking Finance Companies has not helped MSMEs.

The RBI has for long required state banks to allocate 40% of lending to Priority Sector Lending (PSL)—18% to agriculture and 22% to MSMEs. However, it might be necessary that the smallest segment (micro-enterprises) are not crowded out, which could result from the inclusion of medium enterprises in the 22%. Hence, a target of 7.5% of PSL lending to micro-enterprises could be added. Also, it is proposed that the priority sector lending status may stay with them for up to 3 years after they grow out of the category of MSMEs so that MSMEs do not remain SMEs merely to be eligible for priority sector status.

However, as important as credit in raising cluster productivity is skills. Education enrolments have improved dramatically over the past 7 years: the primary net enrolment rate was 97% already in 2007, and between 2010 and 2015, the secondary (classes 9–10) enrolment rate grew from 58 to 85% (with gender parity) and even further since then. However, at the local cluster level, there are few vocational education or training centres available. With vocational education/training focused at the cluster level, these newly educated youth, especially girls, will be able to get employment at the cluster level, close to their homes.

With the rise in education levels, there may be other opportunities that government should promote. These brownfield clusters could benefit hugely from the spread of the Internet. Online trade is an example. Technology can enable clusters of business to form in underdeveloped, rural areas. For instance, in China, rural micro-e-tailers started in 2009 on Taobao.com Marketplace, one of the largest online retail platforms in China owned by Alibaba. These clusters—called 'Taobao Villages'— spread rapidly, from just 3 in 2009 to 2118 across 28 provinces

in 2017 (World Bank 2018). India's 5500-odd clusters can benefit from similar activities.

3.4 Aligning Urban Development with Manufacturing Clusters

Modern industry clusters cannot grow without better infrastructure. Urban planning needs alignment with planning for cluster development. Given the fact that 99% of unregistered and 95% of registered enterprises are micro-enterprises, they are concentrated in the small towns (< 0.5 million) and nearby villages. Indian manufacturing has been becoming rural slowly, but could become more urban. For that to happen, India's urban infrastructure must improve.

But the real question is: In which class of cities must it improve? Of India's urban population, half live in small towns of < 0.5 million; for a low–middle-income country like India, it is difficult to find resources to provide quality infrastructure in a large number of small towns. Only 27% of India's urban population live in middle-tier cities (those with a population between 0.5 and 4 million). By contrast, nearly half of urban residents in China live in similar middle-tier cities, and only a quarter in small towns (The McKinsey Global Institute 2014). It is in these middle-tier cities that infrastructure investment should be concentrated.

It is the brownfield sites of modern clusters that must grow for manufacturing output/employment to expand in India. What is important is that *the cities/towns chosen are such that the Cluster Development Programme of MSME is also implemented in such a town. Also needed is synergy in the planning for Clusters and the infrastructure (AMRUT) programme, so that the objective of industrial development with job creation is one of the outcome objectives.*

Moreover, infrastructure for clusters alone may not suffice. For India, Murty and Soumya (2006) estimated that increasing infrastructure investment by 0.5% of GDP will boost growth by 1.8% in the medium to long run. Investment in infrastructure gives rise to three types of jobs—direct, indirect (through backward and forward linkages) and induced jobs (when economic activity takes off in response to the availability of infrastructure). Induced job creation is over a long term unlike direct and indirect job creation which is temporary, i.e. for the time that the infrastructure is being created.

The 2017–2018 Economic Survey stated that India will require $4.5 trillion worth of investments until 2040 to meet its growing infrastructure needs. It noted that current trends suggest India will fall short by 0.6 trn. During the 11th Plan, the private sector contributed 36.6% of the PLan's overall infrastructure investment of $475 billion. Infrastructure investment rose from an average of 5% of GDP during 2002–2007 to 7% of GDP during 2007–2012. After that, infrastructure investment has tended to become slow, as bank NPAs have risen. The main form of infrastructure investment that has sustained is roads and highways, as well as public housing in rural areas.

Therefore, by providing infrastructure in areas that have the potential for rapid urbanisation, policy makers can leverage agglomeration economies to boost net

employment.[4] Based on the economic activity, in a study, IDFC Institute (2019) identified three types of regions, viz. services region, industrial region and agro-allied region. After a survey of 2500 firms, it found that 61% of the firms in the agro-allied region stated that roads were a problem. The second most common problem (for 33%) of firms was electricity. Around 28% of agro-allied firms state that water supply is an issue. The most important infrastructure issue for industrial firms was roads (for 84% of the firms).

What needs to be kept in mind is that Indian firms tend to be very small. As we noted elsewhere (Mehrotra and Giri 2019), over 99% of Indian units are micro-enterprises; worse, they tend not to grow. A key factor behind the lack of firms' growth is poor hard infrastructure.

3.5 Industrial Corridors to Engage in Global Value Chains and to Meet Export and Domestic Demand for Manufactures

The development of industrial corridors is a part of the area- or cross-state planning process. India was largely by-passed by the trade in networked products (NPs), where it exports only $25 billion (0.5% of global trade in NPs).

Like in automobiles, India could become a preferred destination for assembly of electronics, telecom hardware, electrical machinery, computers and office machines, if it made a strategic plan (like the Automotive Mission Plan 2006–2016) to increase its exports.

One effective policy instrument that integrates industry, infrastructure, urban services and the institutional and regulatory edifice and which India is pursuing is the development of economic or industrial corridors. Five such corridors have been conceived, each of which has industrial city development provided for (the Delhi–Mumbai Industrial Corridor, Amritsar–Kolkata, Bengaluru–Mumbai Economic Corridor, Chennai–Bengaluru and finally the Vizag–Chennai Industrial Corridor).

The use of Economic Corridor Development (ECD) as a planning tool is old, but turning it into a multidimensional concept and using it for planned spatial economic development emerged in the early 1990s in both Asia and Europe. However, the ECD idea is to 'consolidate the fragmented governance mandates of the various authorities under one zonal or cluster management entity that allows businesses to operate seamlessly and efficiently' (Mitra et al. 2016).

The big bottleneck in India for the development of such export processing zones or corridors relates to the availability of land in a country with 44% of its workforce still in agriculture (Mehrotra and Parida 2019) and density of population that is very high by international standards. As Shankar (an ex-Secretary, DIPP) argues: 'If the Centre in partnership with the States had taken the lead in assembling land and investing adequately and had got the private sector to come in only where it could, the outcome could have been quite different'.

[4] (CSO categorises each infrastructure into transport, energy/power, communication, irrigation, drinking water supply, sanitation and storage).

3.6 Mineral Development as a Foundation

India has great potential for the discovery of minerals as the Indian landmass consists of crustal elements that are ancient. India has ample resources of minerals (Kumar and Ganeshan 2015), but presently mining accounts only for around 2% of the GDP. As a major resource for development, extraction and management of minerals must be integrated into the overall industrial strategy. A 1% increase in the growth rate of mining leads to an increase of 1.2–1.4% in the growth rate of industrial production (contributing 0.3% to the growth rate of India's GDP).

However, India's imports of non-fuel minerals are much higher than their exports. Moreover, small-size mines dominate the industry. In addition, mining in India is largely public sector driven, with public enterprises accounting for around 66% of the value of mineral production; the rest depends on medium and small mines that are largely privately operated (Ministry of Mines and FICCI 2013).

However, little is currently being spent on the exploration of minerals in India. If governments, Union or state, nor the PSUs are able to invest on the scale required, then foreign and private firms will need to be incentivised. However, the government can well claim that 100% FDI has been permitted in mining.

Given the widespread regulatory failure, there is a need to create an independent mining regulatory authority for oversight at the central and state level to restore investor confidence. Primary regulatory responsibility must lie with the state governments. Clearly, mining is not attracting foreign investment. In addition, there have been repeated violations by existing mining companies (Indian and foreign), as well as governments of social and environmental impact assessment guidelines. As part of its industrial policy, the Union government will have to rethink its mining policy. In August 2017, Supreme Court of India judgment found the mineral policy outdated and made the case for a new policy.

Several issues are important (as found in TERI studies). First, the data from Geological Survey of India geological mapping should be available in a Geographic Information System environment to facilitate entrepreneurs to take investment decisions for exploration.

Second, The Mines and Minerals (Development and Regulation) Amendment Act, 2015, has made auctions as the only mode of granting mineral concessions. This implies that the Indian Bureau of Mines and the State Directorates of Mining need to have the capacity to undertake mineral resource estimate and reserve valuations. This requires their capacity building.

Third, mining has both backward and forward linkages which need to be encouraged. This can be done by allowing free transfer of concessions including mining leases and by giving a slight preference to value addition and end use when calling bids for mineral deposits. Fourth, scientific human resources including knowledge at the frontiers of geoscience have already emerged as a bottleneck. The country will need more mining engineers, geologists, geophysicists, geochemist and geoinformatists (Kumar and Ganeshan 2015).

Finally, new attention is needed for the rehabilitation of areas and people uprooted by mining. The MMDR Act 2015 provides for the creation of a District Mineral Foundation in every district. These foundations should deliver on rehabilitation of

old mines as well as affected peoples; otherwise, affected people will agitate to ask mines to be closed.

3.7 Creating a Design Capability and Innovation Institutional System

India also has many strengths in R&D, but it still lacks the key ingredients of a national innovation system.

India's well-developed R&D infrastructure is the key to success as a leading offshore research location. However, government R&D has largely focused on defence and space, which cornered 26% and 18% of Central Government R&D, respectively, (Herstatt et al. 2008).

Major challenges remain in India's incipient national innovation system. The creation of a 'Learning Society' (Stiglitz 2014) needs some extensions in India—to ensure 'learning by doing'. Three such extensions are needed. First, manufacturing capacity must increase across the board in many sectors beyond automobiles and pharma. However, the absence of an industrial policy has prevented India from becoming a manufacturing hub, leaving innovation stunted and total factor productivity lower than its potential. The second challenge is that multiple failures in the entire education system have led to poor educational outcomes for the current workforce. The third challenge is an underfunded R&D system that has no way to convert patents into commercially viable technological solutions. Let us deal with the latter two challenges in turn.

For the science, technology and innovation (STI) infrastructure created over 70 years ago to lead to inclusive growth, the education and learning levels of the workforce must improve. A new education policy alone is not sufficient.

What is needed is a much greater private and public investment in education; 4% of GDP on public spending on education will not suffice.

Second, structural shifts are needed to align industrial policy to education/skills policy for India to become a serious science, technology and innovation hub in such areas as Industry 4.0. However, this also requires millions of 15–18-year-olds to be diverted into VET and a focus on STEM in higher education.

In India, VET is very much government driven and supply driven. What is needed is a demand-driven and employer-led and industry-financed (not mainly government-funded) VET system (Mehrotra 2014, 2016; MSDE 2016; chapter on Employment & Skill Development). Such a poorly educated workforce is being given short-term training (at most 3-month-long vocational training by the National Skill Development Corporation publicly funded private training providers), which has failed to improve their employability. (See the report to Ministry of Skill Development of the Sharda Prasad Committee, 2016, of which this author was a member.)

India allocates only 0.7% of GDP to R&D, while China invests 1.8%, the USA 2.9% and Japan 3.4%. India currently underspends even relative to its income level. In addition, most other countries, especially East Asian countries like China, Japan and Korea, have seen dramatic increases in R&D as a percentage of GDP as they have become richer. India, on the other hand, has seen only a slight increase (Ministry of Finance 2018, Economic Survey).

Despite spending only 0.72% on R&D, there has been an impressive growth in scientific publications (6th in the world) and patents filed (7th) (Ministry of Finance 2018). But increased government R&D expenditure will not make India a 'learning and innovation society'. The challenge is to transform knowledge/technologies into commercially attractive solutions through entrepreneurial communities. It is sobering that 90% proposals do not clear initial peer-review evaluations for the lack of novelty and poor translational potential. The result is that government efforts to provide downstream support like setting up technology parks, incubators and incentives for start-ups (all of which have characterised such Union government initiatives as Startup India, Atal Innovation Mission,) are unlikely to yield results.

Low total R&D expenditure alone is one problem; its distribution across corporations (44%), public research institutes (52%) (i.e. CSIR labs) and universities (4%) is another problem. The global average for corporates' share is 71% of total R&D spending, of public research institutes the lowest at 12% and 17% for universities. India needs to increase allocations to universities (Forbes 2016).

Another problem, Forbes argues, is that the most successful periods of rapid industrialisation across countries—Japan in the 50s and 60s, South Korea and Taiwan in the 70s and 80s, China since 1990—have been accompanied by significant imports of technology, considerably higher levels than in India until the Noughties. Much innovation happens without formal R&D. R&D started to contribute significantly to Korean and Taiwanese industrialisation only in the 80s, and to China's only in the 2010s. Industrial development must precede the choice of investing in R&D. However, these insights give us no idea what is to be done to ensure private firms invest more in R&D (Mani and Nabar 2016). We have a manufacturing structure focused on skill-intensive and capital-intensive sectors—sectors which require constant innovation and constant and substantial investment in innovation to be competitive over time. So one hopes the incentive that drives firms worldwide to invest in R&D will drive Indian firms as they become global: that they will otherwise be put out of business by competitors.

3.8 Labour Law Reform as a Corollary of Industrial Policy

One reason organised manufacturing jobs have not grown is the plethora of central labour laws (47 reduced to 35 through repeal over the 2014–18) that apply, in addition to over 100 state government labour-related laws (Planning Commission 2013). There is a very strong case for simplification and rationalisation of at least central laws into four labour codes (which have been put up on the Ministry of Labour & Employment website over 2016–2018, and one has been passed).

One way forward is that a social security mechanism is put in place for 93% of the Indian workforce that is without any social insurance. For the organised sector, the paradigm of joint contribution by the employer and the worker has been the universal operating principle from the early days of industrialisation. But in India, this ends up acting as a disincentive for low-wage workers and their low-profit employers to enter the organised sector. Therefore, it is critical that social insurance is ensured progressively to all, regardless of employment. This would require that for the

poorest informal workers, the government meets the premium cost of old age pension, death/disability insurance and maternity benefit. For those above the poverty line, a contributory system should be put in place, which is mandatory and statutory in nature, unlike the voluntary, scheme-based mechanisms in place (Mehrotra 2016). We have argued elsewhere that the fiscal costs of such a social insurance mechanism are well within reasonable limits.

If such a social insurance system was supplemented by a minimum income guarantee, as well as universal healthcare, the stakeholder consultations relating to reforming labour laws would be marked by less acrimony and are likely to be resolved. That would serve the interests of all workers (current and potential), through job creation in the formal sector (which is already growing, since the Goods and Services Tax became universal) (Ministry of Finance 2018; Mehrotra 2019).

The real advantage of such a social insurance system would be to do away with the distinction between the workers in the organised and unorganised sectors and to create a regulatory regime which provides for a smooth transition from a micro- to small enterprise, and even to medium enterprise, and finally to a large enterprise. This, in turn, would generate more jobs over time in the organised, formal sector.

4 Concluding Remarks

The planning function in India's central government must be revived with a view to devising and implementing a national industrial strategy. This requires that there is much greater recognition in the top leadership that without a serious manufacturing strategy, and policies to match the strategy, India will never become a major manufacturing nation. A quarter century without such a strategy has meant that the manufacturing share of GDP and employment has barely grown at all. There are only just over two decades left for India's demographic dividend to run out (by 2040), and without an industrial strategy, India cannot realise the dividend.

The eight elements of an industrial strategy that India urgently needs (as outlined above) are in addition to the focus on improving ease of doing business (on which there has been an appropriate focus in recent years) or encouraging foreign direct investment. Moving towards a more protected economy is not the way forward, while the strategic use of tariffs to prevent dumping by foreign firms is appropriate. Even more importantly, the real effective exchange must not be allowed to appreciate (as it has over 2014–2018 by 20%).

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