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Impact of FDI in Urban Mobility: Some Insights From Delhi Metro

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By
Chidambaran G. Iyer
Kannan Kumar



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CHIDAMBARAN G. IYER
chidambaran.iyer@pahleindia.org

KANNAN KUMAR
kannan.kumar@pahleindia.org

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Abstract

Both central and state governments have prioritized metro rail as the mass rapid transit system for the urban transportation needs of the country. Tremendous opportunities that have been generated for manufacturing and services with respect to the metro rail segment, have attracted leading global firms to the Indian market. In this study we focus on the rolling stock system of the metro rail segment. We find that foreign investments have created jobs, skilled our labour force, increased production, used their facilities for exports as well as to service their global orders. This has helped India to be a part of their global value chains in a couple of systems in the metro rail segment. Technical collaboration has helped a local firm learn the technology of production of rolling stock, which has made it competitive and has given a spurt to local manufacturing. Foreign firms supplying equipment to rolling stock manufacturing units have also set up plants in the country. There is evidence of a rolling stock manufacturing ecosystem developing in the country. Regular flow of work, increasing popularity of metro rail, standardisation of specifications, and an accountable urban transport management authority are steps the study identifies to support this developing ecosystem.



1. Background

Economic literature has identified urbanization as an engine of economic growth. It is in this context that India's urbanization needs to be seen. A common need for our huge and economically important cities is transportation. Given our population density and per capita income, personalized modes of transport have already resulted in increased congestion in all our urban centres. One of the systems among available mass urban transit solutions is metro-rail. The working group on urban transport for the 12th five-year plan mentions that for metro rail, a city should have a ridership of at least one million on organized public transport (any mode); population of the city should be greater than two million; and the peak hour per direction traffic should be greater than 15,000 for at least five kilometres (kms) continuous length. The construction and operation of the Delhi metro caught the imagination of city dwellers as well as state governments so much so that metro rail projects are now in various stages of development in almost all the important cities of the country. In order to cater to the surge in metro rail demand, the country has witnessed an increasing trend in foreign direct investment (FDI) in the corresponding sector. It is now well established in literature that developing countries generally prefer FDI over other forms of external finance as they are non-debt creating, non-volatile and their returns depend on the performance of projects financed by investors. FDI also facilitates international trade, and transfer of knowledge, skills and technology. Now with the Delhi Metro being in operation for almost 17 years, this discussion paper throws some light on the impact of FDI in the metro rail segment in India. In particular, we focus on FDI in the rolling stock system of metro rail. The paper is organized as follows, in section 2 we introduce the Delhi Metro and its impact on the metro rail segment in the country, this is followed by a detailed look at the different systems in a metro project. Section 4 offers a peek into the FDI in the railway related components sector, while section 5 of the paper analyses the direct and indirect effects of FDI in the metro rail segment in the country. Section 6 brings out the importance of the viability of metro rail to support the developing industrial sector. Few governance issues are mentioned in section 7 and the paper concludes with some recommendations for the way forward in section 8.

2. Delhi Metro and its impact on the metro rail segment in the country

Goel & Tiwari (2014) note that the first significant mention of a mass rapid transit system for Delhi emerged from a 1969 traffic and travel characteristics study. Since then, many official reports by a wide variety of government departments were commissioned to explore the issues related to technology (underground rail, surface rail, light rail, busbased, etc.), route alignment, and whether urban mass transit was



ultimately the jurisdiction of the National Government or the Delhi Union Territory Government. In 1984, the Delhi Development Authority and the Urban Arts Commission came up with a proposal for developing a multi-modal transport system, which would consist of constructing three underground mass rapid transit corridors, as well as augmenting the city's existing suburban and road transport networks. Following that, the Government of National Capital Territory of Delhi (GNCTD) commissioned Rail India Technical and Economic Service (RITES) Limited, in 1988–89, to study the feasibility of introducing an Integrated Multi-Modal Mass Rapid Transit System for Delhi. The study was completed by RITES in 1991, and recommended a 198.5 km predominantly rail-based network. In July 1994, the Central Cabinet gave the go-ahead, in principle, for the MRTS for Delhi and directed the GNCTD to take up the preparation of a Detailed Project Report (DPR). RITES finalised (May 1995) the DPR for a 55.30 km MRTS comprising rail and metro corridors, for completion by March 2005. The Union Cabinet sanctioned the Delhi MRTS Phase I (Project) of 55.30 km in September 1996, at a total cost of USD 971 million – at April 1996 prices. For implementation and operation of the project, the Delhi Metro Rail Corporation Limited (DMRC) was registered in May 1995 as a joint venture between the Ministry of Urban Affairs and the GNCTD. The metro began operations on an eight kms line in December 2002. Currently, two phases of the metro have been completed while the third phase is expected to be completed by the end of 2020. The network length and project cost of the three phases can be seen in table 1.

Table 1: Phases of Delhi Metro

| Network | Stations | Length (kms) | Cost (Rs. Crore) |
|----------------|-----------------|---------------------|-------------------------|
| Phase 1 | 58 | 65 | 10,571 |
| Phase 2 | 85 | 124.93 | 18,783 |
| Phase 3 | 109 | 160.57 | 41,079* |

*-estimated

Source: Delhi Metro Rail Corporation Limited website, accessed on 13th March 2019.

The impact of Delhi Metro on urban transportation in the country can be gauged from the fact as on 16th February 2019, 585 kms of metro lines were operational in the country. About 600 kms of sanctioned metro lines which are under construction will be operational by 2024, while 1000 kms of metro lines are in the planning stage. Table 2 shows the details.



Table 2: Metro rail in India

| Operational | | Under Construction | |
|----------------------|--------------|--------------------|--------------|
| City | Length (kms) | City | Length (kms) |
| Delhi & NCR | 327 | Delhi & NCR | 23 |
| Noida- Greater Noida | 29.7 | Kolkata | 108 |
| Bengaluru | 42.3 | Bengaluru | 72 |
| Hyderabad | 46 | Chennai | 10 |
| Kolkata | 27.3 | Kochi | 7.5 |
| Chennai | 45 | Jaipur | 2.5 |
| Jaipur | 9.6 | Mumbai | 171 |
| Kochi | 18.2 | Hyderabad | 26 |
| Lucknow | 8.5 | Nagpur | 38 |
| Mumbai Line 1 | 11.4 | Ahmedabad | 36 |
| Gurgaon | 12 | Lucknow | 14 |
| Mumbai mono rail | 9 | Pune | 54 |
| Total | 586 | Bhopal | 28 |
| | | Indore | 32 |
| | | Total | 622 |

Source: Press Information Bureau, 16th February 2019.

This table clearly shows that subsequent to the Delhi Metro, growth in the metro rail segment in the country has literally shot through the roof. This implies that procurements of goods and services for each of the above projects will have generated tremendous opportunities for domestic as well as foreign firms. Before we dwell into the firm level investments and impact, we will first try to understand a metro project.

3. Understanding a metro project

A metro project can, for our ease of understanding, be divided into five major systems. These systems are: Rolling stock; Signalling; Telecommunication; Traction power; and Track. Given the phase wise project cost, ideally, we would have liked to understand the cost of the five systems mentioned above. However, such numbers are not available. To keep our analysis tractable, among these five systems we will primarily focus on rolling stock and to some extent on signalling. Hence, to understand the share of rolling stock and signalling procurement cost in the overall numbers, we use typical break-up of cost across tendering elements in India's metro rail. Table 3 shows a ball park estimate of the size of rolling stock, signalling and telecommunications procurements.



Table 3: Estimated procurement of Rolling stock, Signalling and Telecommunications in Delhi Metro

| Network | Rolling stock (Rs. Crore) | Signalling and telecommunications (Rs. Crore) |
|---------|---------------------------|---|
| Phase 1 | 1,902.78 | 951.39 |
| Phase 2 | 3,380.94 | 1,690.47 |
| Phase 3 | 7,394.22 | 3,697.11 |

Source: Author estimates from Table 1

The accuracy of these estimates can be understood by comparing them with available data for phase 3. Table 4 shows the details of Rolling Stock Contracts Awarded for Phase III as on 17-August 2016.

Table 4: Details of Rolling Stock Contracts Awarded for Phase III* as on 17-August 2016

| Item | Value (Rs.Crore) |
|--|------------------|
| RS-9 tender for 162 cars (SG 2.9 mtr) | 1,331.16 |
| RS-10 tender for 504 cars (SG 3.2 mtr) | 4,318.74 |
| RS-11 tender for 162 cars (SG 3.2 mtr) | 1,497.98 |
| RS-13 tender for 96 cars (SG 3.2 mtr) | 846.25 |
| Total | 7,994.14 |

* indicative, may not be exhaustive. SG implies standard gauge.

Source: Delhi Metro Rail Corporation Limited website, accessed on 13th March 2019.

The purpose of table 3 and table 4 is to give and estimate of the opportunities that have been generated in the rolling stock and signalling & telecommunication segments of metro-rail by the various phases of Delhi Metro. As mentioned earlier, after the Delhi Metro, numerous metro rail projects were initiated across the country, which resulted in a surge in demand. This surge prompted the entry of many foreign firms, which specialize and are world leaders in these segments, into the Indian market, which we briefly turn to in the next section.

4. Foreign investment and presence in metro rail

Ideally one would have liked to understand the foreign investment that has come in the metro rail segment in the country, however, data at such level of disaggregation is unavailable. Table 5 presents FDI flow in railway related components from 2005 till 2016.



Table 5: FDI Equity inflows in Railway related components

| Year | FDI in Rs Million |
|-------|-------------------|
| 2005 | 782.73 |
| 2006 | 1,124.15 |
| 2007 | 297.45 |
| 2008 | 943.63 |
| 2009 | 1,322.62 |
| 2010 | 2,582.71 |
| 2011 | 2,669.94 |
| 2012 | 1,292.23 |
| 2013 | 9,546.49 |
| 2014 | 12,906.22 |
| 2015 | 4,600.76 |
| 2016* | 1,270.9 |

*-Jan to Sep

Source: SIA Newsletters

FDI inflows in the rail related components from 2005 till 2016 September totalled to almost Rs.3,934 crores. It is plausible that a substantial portion of this inflow will have been in the metro rail segment. Though an exact distribution is unavailable - rolling stock, signalling, telecommunication, traction power, and track - are the systems in the metro rail segment where these investments may have been directed.

4.1. Foreign participation in Metro rail segment

Metro rail essentially is a capital intensive and complex technology sector, which implies that companies from developed countries, due to the head start they have received, are the leaders in this segment. Once a project starts, services from firms that specialize in design and consulting are required. In the Indian case, it has been observed that this space has been dominated by foreign firms. Next in the project comes civil infrastructure, in the Indian case it has been observed that civil infrastructure to metro projects in the country has been dominated by large Indian construction companies, with foreign participation in specialized and niche tasks. Work in traction and general services such as track work and electrical and mechanical work is being carried out by Indian contractors, with foreign firms in supply and installation of products (lifts, escalators, automated fare collection systems, surveillance) and track electrification services. Telecom and signalling work in the Indian case have been dominated by foreign firms. Rolling stock also has seen strong foreign presence, though lately, as we will see later, BEMIL Limited has emerged as a worthy domestic competitor. Table 6 gives a snapshot of foreign presence in the Indian metro rail segment, here we list the number of domain level contracts won by foreign firms from 2003 till early 2013.



Table 6: Contracts won by foreign firms in Indian metro rail sector

| Country | Consulting | Civil | Traction and General services | Telecom and Signalling | Rolling stock | O&M | Total |
|----------------|------------|-------|-------------------------------|------------------------|---------------|-------|-------|
| United Kingdom | 17 | 1 | 1 | | | 3 | 22 |
| France | 5 | | 4 | 7 | 3 | 3 | 22 |
| Japan | 12 | 3 | 2 | 2 | 1 | | 20 |
| United States | 12 | | 2 | 1 | | | 15 |
| Germany | | 1 | 3 | 3 | 1 | | 8 |
| Korea | | | 2 | | 5 | | 7 |
| Switzerland | | | 4 | | | | 4 |
| Spain | 1 | 1 | 1 | | 1 | | 4 |
| China | | | 1 | | 1 | | 2 |
| | | | | | | Total | 104 |

Note- Number of contracts from 2003 till early 2013.

Source: UKTI (2013), 'India Metros: A High Value Opportunity for the UK Rail Sector'

The table clearly points out to active participation by foreign firms in the Indian metro rail segment. Ideally, one should dig deep into each of these domains to appreciate the impact of foreign firms in the metro rail segment, which will bring out a much more nuanced domain wise understanding. However, in this discussion paper, we keep our focus limited to the impact of foreign firms in the rolling stock domain.

4.1.1. Foreign participation in rolling stock domain

As per the Press Information Bureau, as of 23rd April 2017, a total number of 1,912 metro coaches were operational with another 1,420 under procurement. It also estimated that 1,600 metro cars will be required by 2020. With each metro car costing approximately Rs. 10 crores, this huge demand has attracted numerous foreign firms in the Indian market. It is plausible that entry of foreign firms in the rolling stock domain may have been in the year 2001 when Delhi Metro awarded its first rolling stock contract for 280 cars. Table 7 presents an indicative list of foreign rolling stock manufacturers currently active in the Indian market.

Table 7: Foreign firms* in the Indian rolling stock market

| Name of firm |
|--|
| Bombardier Transportation India Private Limited (BT) |
| Construcciones YAuxiliar DeFerrocarriles (CAF) India Private Limited |
| Alstom Transport India Ltd. |
| Hyundai Rotem Company |
| CRRC Zhuzhou Locomotive Co., Ltd. |
| Mitsubishi Corporation |

**Indicative list not exhaustive.*



All the above firms have participated in the tenders floated for rolling stock across the country. As per our understanding, only two of the above firms have established manufacturing plants in the country, one has a joint venture or tie up with a local company, one is in plans to set up its manufacturing plant, one firm seem to be content importing rolling stock from its parent firm, while two firms have outsourced the contract to other manufacturers.

5. Effects of foreign investments in rolling stock

5.1. Procurement, Production and Indigenisation

The rolling stock procurement for Delhi Metro has come a long way since 2001, when large parts had to be imported. There has been 90 per cent indigenisation in terms of quantity. As per DMRC officials, besides complete shell manufacturing in the country, almost 20 sub-systems going into the rolling stock are being manufactured in the country. In signalling and telecommunications, 11 sub-systems are being manufactured locally, while in track components there is substantial amount of localization in fastening systems and turnouts & scissor crossovers. Table 8 gives a flavour of the amount of indigenisation in rolling stock ordered by DMRC.

Table 8: Indigenisation in Rolling Stock orders of DMRC

| Type of Stock | Year of Award of Contract | No. of Cars | Indigenisation (%) |
|------------------|---------------------------|-------------|--------------------|
| Rolling stock 1 | 2001 | 280 | 79 |
| Rolling stock 1 | 2008 | 8 | 100 |
| Rolling stock 1 | 2011 | 136 | 100 |
| Rolling stock 1 | 2015 | 96 | 100 |
| Rolling stock 2 | 2007 | 424 | 92 |
| Rolling stock 2 | 2010 | 114 | 100 |
| Rolling stock 2 | 2011 | 76 | 100 |
| Rolling stock 2 | 2015 | 162 | 100 |
| Rolling stock 3 | 2007 | 196 | 98 |
| Rolling stock 3 | 2011 | 40 | 100 |
| Rolling stock 3 | 2013 | 162 | 100 |
| Rolling stock 10 | 2013 | 486 | 75 |

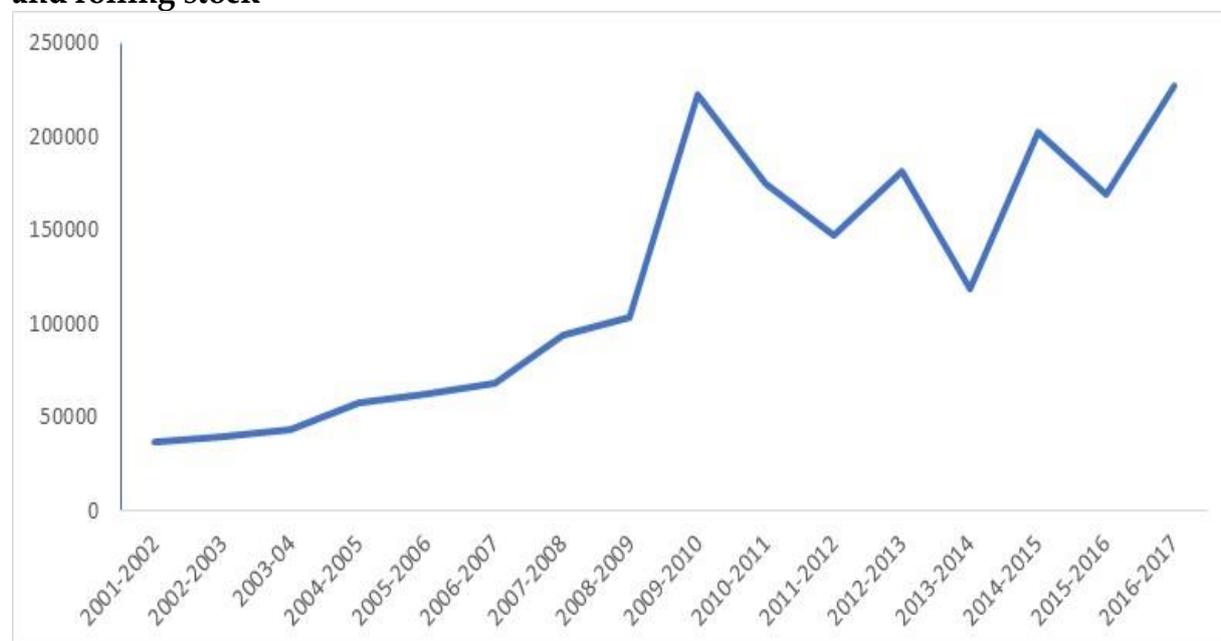
Source: DMRC presentation on Standardisation & Indigenisation, 11th June 2016. Indigenisation in terms of quantity or cars ordered.

For DMRC phase I, II, & III projects 1920 out of 2140 cars were manufactured in India. BEML Limited manufactured 1180 cars while BT manufactured 740 cars. It is clear that within the rolling stock domain there has been spurt in local manufacturing. This is borne out in production data of the Annual Survey of Industries. Figure 1 shows the



trend in net value added in manufacture of railway and tramway locomotives and rolling stock.

Figure 1: Net value added in manufacture of railway and tramway locomotives and rolling stock



* Net value added in Rs. Lakhs

Source: Annual Survey of Industries, MoSPI

Juxtaposing table 8 and figure 1 makes it clear that rolling stock orders have given a fillip to the net value added in manufacture of railway and tramway locomotives and rolling stock in the country. This is a direct effect of investment in the rolling stock segment. In our discussions, it has been noted by stakeholders that few critical and technologically advanced components are yet to be manufactured in the country. However, given the nature of industrialisation, this is to be expected, and if the conditions are right India may be on the path to produce almost all the components within the country. Our study has identified three firms that produce rolling stock in the country, two of them are foreign firms while the third one is BEML Limited, which is a public sector unit. We will now give a snap shot of each of the foreign firms and then turn our attention to the local firm - BEML Limited - which seems to have developed manufacturing capabilities due to technical collaboration with a foreign firm.

5.2. Snap shot of foreign firms

5.2.1. *Bombardier Transportation India Private Limited (BT)*: Among the foreign firms mentioned in table 7, BT has invested Rs 230 crores for a rolling stock manufacturing



plant in Savli, Gujarat. This plant, which is the first coach facility in India to use robotic welding, became operational in 2008. This plant can produce up to 30 cars per month. The company claims that their investment has created 2000 direct jobs and 5000 indirect jobs, and also attracted other world class suppliers and specialist sub-contractors to India, increasing their local content and sourcing. An official confirmed that almost 90 per cent of the value addition in their rolling stock is now done in India. This facility has also exported cars in the years 2012, 2013, and 2014 to Australia, to Brazil in 2013, and to Saudi Arabia in 2015.

The company has also established an engineering centre at Hyderabad that works on its global projects as well as various product engines. The technical centre at Hyderabad also has design capabilities with which it caters to the Asia-Pacific market. Indian engineers who work in the Hyderabad centre thus are able to assimilate cutting edge knowledge, which will in the course of time diffuse and raise the skill level of our technical labour force. In 2015, BT opened an information services global hub and new rail control solutions centre in Gurgaon, which again will be beneficial to the economy for the skills it will diffuse.

5.2.2. Alstom Transport India Ltd.: Alstom has invested 55 million euro for its metro rolling stock manufacturing facility at Sri City by December 2018. In 2015, the company had a production capacity of 120 coaches per year, which by 2018 was being doubled to 240, to be operational by 2019. The company also plans to double the workforce at the plant to 1000. In 2014, Alstom won a contract to deliver 22 six-car trainsets, as well as signalling system, for North West Rail Link, Australia's largest public transport project and first fully-automated metro network. The 22 six-car trainsets were manufactured at the Sri City facility with the last shipment being dispatched in December 2018. Company officials estimate that 60% of the Sri City facility will be used to cater domestic market, while the remaining 40% will be used to cater export market.

The company also has a transport information systems centre and rolling stock engineering centre at Bengaluru. In 2017, nearly 3,000 of Alstom's 4,300 workers in Asia Pacific region were based in India. Of these, 2,000 worked in the engineering centre at Bengaluru. In 2017, about 50% of the Bengaluru centre's work was for international projects, for example, the engineering hub in Bengaluru adapted solutions to the specific needs of Sydney Metro, the rakes of which were manufactured at Sri City.



5.2.3. Other investments

China railway rolling stock corporation (CRRC) has signed a memorandum of understanding with the government of Maharashtra to invest Rs. 1,500 crores over a period of five years to set up a rolling stock manufacturing plant in Nagpur. Subsidiaries of CRRC have won contracts to supply rolling stock to Navi Mumbai, Kolkata, and Gurgaon metro.

5.3. Foreign investments in supply chain to rolling stock

The above two snapshots were of firms that have invested in facilities to manufacture rolling stock in the country. There are numerous foreign firms that have invested in facilities that manufacture equipment that go in to the production of rolling stock. We give two examples:

- Mitsubishi Electric India, a subsidiary of Mitsubishi Electric Corporation, opened a manufacturing plant for traction motors, converter inverter, and static inverter converter, with an investment of Rs 52 crores at Bidadi near Bengaluru in Karnataka. In 2015, the company planned to directly employ 50 employees at this facility. As of 2015, the company claimed to have a market share of 65 % in electrical equipment for rolling stock market.
- CRRC has also invested US \$ 63.4 million in joint venture CRRC Pioneer (India) Electric Co Ltd, for a manufacturing plant in Rewari, Haryana. This plant which started operations in August 2016 manufactures traction motors and alternators.

Economic literature on effects of FDI mentions that domestic firms can raise their productivity by learning from foreign firms. The channel for this learning could either be imitation of technology and work practises or through employing ex-workers of a foreign firm. The learning effect gets magnified in case there is a technical collaboration. For domestic firms in the same product market as the foreign firm, competition is another channel through which spillovers or externalities can occur. A foreign firm using its capacity to cater to the export market could induce the local competitor to enter the export market. Another important channel for spillovers is the creation of forward and backward linkages between a foreign firm and local firm; backward linkages exist when the foreign firm procures from a local firm and forward linkages are established when local firms buy from the foreign firm. We highlight one instance, where we observe that technical collaboration between a local firm and a foreign firm has benefitted the local firm.



5.4. Development of local firm through technical collaboration with foreign firm

The first DMRC contract of rolling stock in 2001 was won by a consortium of Mitsubishi Corporation, Hyundai Rotem and Mitsubishi Electric Company with BEML Limited as a sub-contractor. During the implementation of this order, BEML Limited and Rotem signed a Technical Collaboration Agreement in 2002 and BEML Limited became the first firm in India to indigenously manufacture Metro Cars for DMRC Rolling Stock 1 contract and manufactured 220 Metro Cars. Later, in order to implement the learning from the technical collaboration agreement and indigenise the manufacture of Metro cars, BEML Limited obtained a developmental order from DMRC in 2008-09 to develop eight intermediate cars. The successful completion of this developmental order strengthened BEML Limited as a local producer for Metro Cars. BEML has indigenised the production of car body and bogie. It sources other key components from foreign firms that have a manufacturing facility in India. The company claims that the level of indigenisation in its metro rolling stock manufacturing is over 65%. It is testimony to the company's capabilities and indigenisation efforts that it recently bagged a contract for Rs. 3,015 crores for Mumbai Metro Corridor, in a field that included 6 internationally renowned bidders. This achievement is all the more praiseworthy, when one notes that till now it had supplied metro coaches, only in a joint effort with a foreign firm. The Mumbai metro seems to be the first time when it competed on its own. For the Mumbai Metro, for the manufacture of coaches to happen at its Bengaluru facility, it has sub-contracted the design part to a foreign firm. For development of technologies related to rail and metro rolling stock, the company in 2015 signed a memorandum of understanding with the Indian Institute of Technology, Kharagpur.

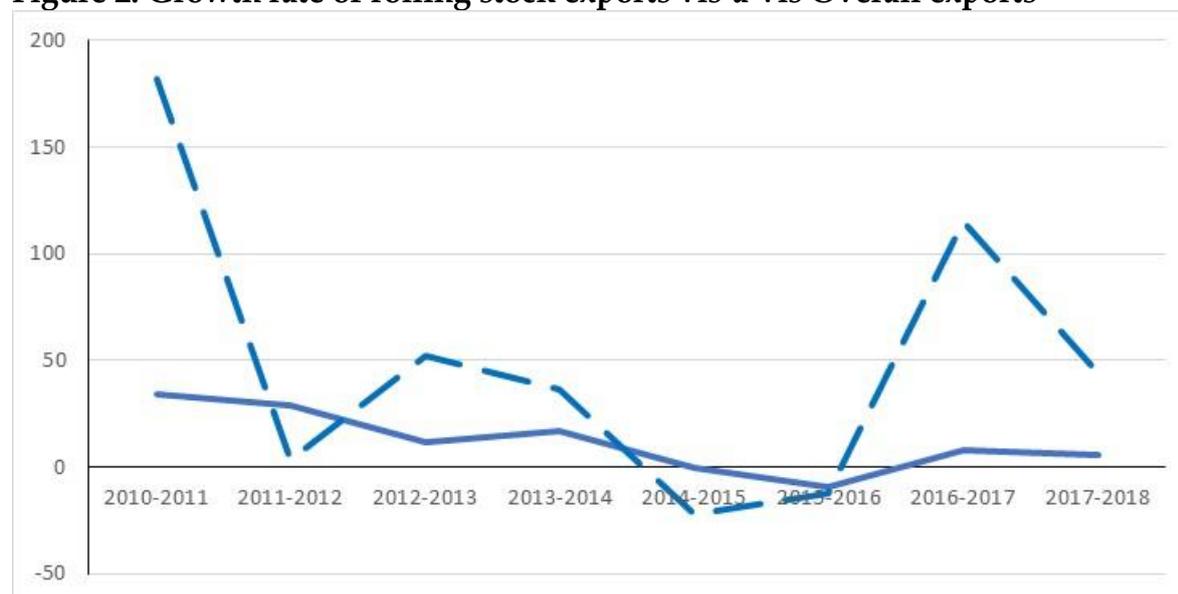
The company, till now, claims to have supplied over 1,100 Metro Cars for various projects in India.

5.5. Exports and entry into global value chains

As mentioned above foreign firms, BT and Alstom have utilized their facility to manufacture and export rolling stock from the country. This has been another positive feature of the foreign investment in the metro rail segment. The main reason for this is availability of large pool of engineers and cheap skilled labour, which keeps production costs in India very competitive. Figure 2 shows the yearly growth rate of exports of rolling stock and components thereof vis-à-vis the growth rate overall exports from the country.



Figure 2: Growth rate of rolling stock exports vis-à-vis Overall exports



Source: Department for Promotion of Industry and Internal Trade (DPIIT), Gol

It can be seen from figure 2 that growth rate of rolling stock exports during 2010-11 till 2017-18, has been performing better than that for overall exports for all but two years. Table 9 shows the share of exports of rolling stock and components thereof in overall exports.

Table 9: Share of rolling stock exports in overall exports

| Year | % share in overall exports |
|---------|----------------------------|
| 2010-11 | 0.0434 |
| 2011-12 | 0.0347 |
| 2012-13 | 0.0473 |
| 2013-14 | 0.0555 |
| 2014-15 | 0.0436 |
| 2015-16 | 0.0422 |
| 2016-17 | 0.0843 |
| 2017-18 | 0.1144 |

Source: Department for Promotion of Industry and Internal Trade (DPIIT), Gol

Table 9 clearly points to a rising trend in share of rolling stock exports. This implies that, with respect to exports, the rolling stock segment seems to be an above average performance sector. The share in 2016-17 is almost twice of that in 2015-16, while there is a 35% rise in its share for 2017-18. In other words, the competitiveness of the sector is better; which, surprisingly is true not only vis-à-vis overall exports but also vis-à-vis engineering goods. As per Economic survey 2017-18, engineering goods had the largest share in our exports for 2015-16 and 2016-17. Within the engineering goods sector, with respect to growth rate, rolling stock segment seems to have done better.



Table 10 shows the export growth rate of the engineering goods sector vis-à-vis the growth rate for rolling stock and components thereof exports.

Table 10: Growth rate in % for exports of Engineering goods and Rolling stock

| Sector | 2015-16 | 2016-17 |
|-------------------|---------|---------|
| Engineering goods | -17.0 | 11.1 |
| Rolling stock | -12.4 | 115.2 |

Source: Economic Survey and DPIIT, GoI

This is in line with earlier research, which has shown that commodity composition of exports in the past few decades, underwent consistent changes in favour of capital and skill-intensive products. The share of these products in India's export basket more than doubled from about 25% in 1993 to nearly 54% in 2010 while the share of unskilled labour-intensive products halved from 30% to 15%. This bias of its export basket towards capital and skill intensive products have provided India with a comparative advantage in relatively poorer regions (Veeramani, 2012).

It is clear that foreign firms in the metro rail segment are using this comparative advantage to export rolling stock from their plants in India. Foreign investments in the metro rail segment in India have also provided us an opportunity to get into their global value chains (GVC). For example, BT exported bogie frames for rail cars to BT Australia, thus some value was added in India. BT also exported bogie frames for Sao Paulo monorail to BT Brazil. As already mentioned in snapshots of BT and Alstom, foreign firms are also using India's talent in engineering and software for their global engineering products, which again is India's entry point to GVCs of the foreign firms.

6. Work orders and popularity of metro rail for viability of investments

The discussion above makes it clear that an ecosystem for manufacture of rolling stock has been established. The local player also has learnt the technology of manufacturing the rolling stock at competitive prices. However, there are certain issues that need to be handled carefully so that the investments that have gone into the segment are protected and the ecosystem thrives.

6.1. Regular flow of orders

It has been recently reported that the global rolling stock industry is facing large overcapacity issues leading to consolidation pressure. Key growth areas will be in urban transport that too in emerging markets (Mckinsey, 2016). Given this situation



and the slew of metro projects in India, many global firms are lining up to serve the Indian market. This can be seen from the fact that the recent expression of interest for providing rolling stock on lease basis for line 5 of DMRC on 12th December, 2017, a record number of 11 applicants qualified for issue of request for proposal documents. Thus, there is huge interest in the Indian market. Since the lowest bidder wins the contract, due policy consideration must be given to firms that have invested in local facilities. In this context, the recent mandatory tender conditions and standardized norms issued by the Ministry of Urban Development is timely. Among others, this order mandates that if the procurement is more than 100 cars, the contractor will manufacture in an independent local facility a minimum of 75% of the tendered cars or partner with Indian manufacturers. This is important as the number of jobs, which have been generated from the investment in the rolling stock segment, can be sustained only if there is a continuous flow of orders to the locally set up facilities.

However, recently, in one of the metro projects, for building two lines, the funding agency for the two lines set a pre-condition that, in all the systems for these two lines, technology of a particular nationality should be used. Given the complexity of these systems, this condition excludes most of the players from participating in the tendering process. This will do no good to the developing ecosystem as well as the investments that have gone into the rolling stock metro rail segment in the country.

6.2. Popularity of metro rail

An important aspect that will ensure the growth of the developing ecosystem is popularity of metro rail. If one looks at the ridership of Delhi Metro, one study mentions that Delhi metro has to improve on the cost per ride, number of rides per year, and intensity of usage (Roy and Shah, 2018). Another study (Goel and Tiwari, 2014) finds that the farebox contributes less than 50% of the total revenue of the Delhi Metro, which has a significant implication on the self-sustainability of metro systems. This leads to the metro systems' dependence on real estate development and, hence, a permanent change in the city's structure. A recent study by the Centre for Science and Environment finds that there is a huge gap between actual ridership and ridership projections for all the metro projects in the country. At 46%, Delhi Metro has the least gap among the two. Thus, there is an immediate need to popularise metro travel; few experts believe that improving the last mile connectivity will be among the numerous measures that need to be taken. A policy push for popularizing metro travel will thus be timely. Needless to add the as ridership increases and finances improve, not only will carbon emissions reduce but also there will be more orders for the ecosystem, which will further benefit the economy.



7. Governance issues

Governance is an important aspect that has direct impact on the popularity of the metros. There are multiple governance issues that have a bearing on the efficiency of the metro rail segment in India. Here we highlight two issues that came up during our discussions with stakeholders.

The operations document for unified metropolitan transport authority (MoUD, 2016) states that, in India, there are multiple agencies responsible for urban transport at the national, state and city levels of government and their programmes, at times, conflict. There exist overlaps and gaps in the functions of these agencies. The multiplicity of responsibilities creates uncertainty and confusion relating to the tasks each agency is mandated to perform, inefficiencies within agencies and wastage of resources. Multiple laws at the Central and State Government levels also affect efficiency of urban transport. This results in a fragmented institutional set up for urban transport. The institutional framework that governs the urban transport system at the city level plays a pivotal role in the success of the system. A weak institutional mechanism, on the other hand, leads to an inefficient system and isolated function of various transport modes. The National Urban Transport Policy of 2006 recommended a Unified Metropolitan Transport Authority (UMTA) that will focus on integrated planning and coordinated management of urban transport. It is beyond the scope of the paper to go into details and the functioning of UMTA for all the urban areas, suffice to say that an accountable UMTA will lead to synergies among the numerous modes of urban transport, which will lead to greater ridership of metro rail.

In few ongoing projects there have been anecdotal evidence of change of specifications to suit certain interests. For our ecosystem to thrive, this arbitrary change in specifications should be avoided. A step in the right direction has been taken with the formation of a committee to look into the standardisation aspect of all the metro projects in the country. This will help all the stakeholders in the system.

8. Way forward

Both central and state governments have prioritized metro rail as the mass rapid transit system for the urban transport needs of the country. Tremendous opportunities that have been generated for manufacturing and services with respect to the metro rail segment, has attracted leading global firms to the Indian market. In this study we focussed on the rolling stock system of the metro rail segment. We found that foreign investments have created jobs, skilled our labour force, increased production, used



their facilities for exports as well as to service their global orders. This has helped India to be a part of their global value chains in a couple of systems in the metro rail segment. Technical collaboration has helped a local firm learn the technology of production of rolling stock, which has made it competitive and has given a spurt to local manufacturing. Foreign firms supplying equipment to rolling stock manufacturing units have set up plants in the country. There is evidence of a rolling stock manufacturing ecosystem developing in the country. However, for this ecosystem to thrive policy needs to ensure that the following points.

- Given the global overcapacity in rolling stock manufacturing, policy needs to ensure that there is regular flow of work to local investments. Though the recent government order is a step in the right direction, implementation of this order will require some skill given the conditions set by foreign funding agencies.
- Standardisation of specifications of metro projects is another step that will help the local ecosystem as well as bring costs down.
- A policy push seems to be in order to increase the ridership of metros. This could be in the form of an accountable UMTA or ensuring seamless access to metro rail.



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