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What fosters shippers' rail dispreference? Insights from Indian steel-makers with disparate output volumes

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ABSTRACT

Over time, rail's share of the freight market has steadily decreased and, currently, is significantly lower than that of the road. This study explores what fosters shippers' rail dispreference. The study is conducted in the domain of outbound logistics in the steel-making industry in India. Twenty-one industry experts are interviewed in-depth to capture their perceptions, and their responses are analysed. Of these, seven are industry experts, and the remaining fourteen are logistics managers working across two steel plants, among which the annual output of one is about ten times that of the other. We find that a capacity shortage in the rail sector and the monopoly position of the rail transport provider together foster multiple factors that drive shippers' rail dispreference. Further, shipper firm size moderates the influence of some of these factors, influencing shippers' rail dispreference to a lesser extent in the larger firms than in the smaller ones. The study highlights the realization that while increasing rail capacity is necessary, it is not enough by itself, but must be complemented by targeted policy changes. The study brings to the forefront the roles played by rail capacity shortage, rail monopoly position, and shipper firm size in shippers' rail dispreference.

Article classification: Research paper.

1. Introduction

Rail, the world over, has witnessed steady attrition in its share of the freight market. In the emerging economies, the percentage of freight shipped by rail steeply declined from 1950 to today (Aritua, 2019). For example, in China, rail had about 35% of the freight transportation market share in 1984, but a steady decline saw it plummet to about 10% in 2016, with road garnering about 80% of the share (Pan and Zheng, 2020). In India, rail carried 89% of the freight in 1950-51 and 62% in 1990-91 but only about 27% in 2014-15 (TERI, 2019). The situation in the developed economies is similar. In the European Union, an estimated 75% of all freight is transported by road as against about 18% by rail (UIC, 2019). Even in the US, where rail's share of freight is one of the highest amongst "rich" countries (Economist, 2010), approximately 1.5 trillion tonne-miles of freight are shipped annually, as against over 2.4 trillion

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tonne-miles by road (Association of American Railroads, 2023; BTS, 2018).

Freight shippers in India increasingly prefer the road to the rail (NTDPC, 2014). We use the term *shippers' rail dispreference* to refer to a shipper's decision to use the road to transport their freight, when the rail option is also available. The term subsumes the underlying thought processes driving such a decision. Shippers' rail dispreference is a matter of significant concern to the world since the rail is a more sustainable mode of transportation than the road (Aritua, 2019). The India Transport Report (NTDPC, 2014) substantiates this by comparing the road and the rail on the amount of energy needed, the unit cost of operation, the quantity of carbon dioxide emitted, costs of accidents, and social costs such as congestion, noise, and stress. This problem gains significance given that freight transport accounts for around 10% of energy related carbon emissions and sustainablity of freight transport is becoming increasingly important. Hence, a better understanding of shippers' mindset can help formulate strategies that can reverse their rail dispreference.

Past research in the area typically examines freight shippers' mode choice from a broad perspective that includes several modes and finds that it is influenced by multiple factors that can vary by geography and industry (Cullinane and Toy, 2000; Arencibia et al., 2015). Yet, hardly any study is specifically focused on the erosion of rail's share by the road, with some exceptions being Woodburn (2003), Islam et al. (2016), Choi et al. (2019), Mizutani and Fukuda (2020) and Francisco et al. (2021). Thus, research that directly addresses and explores in-depth, why shippers disprefer the rail to the road, is sparse. Our study is positioned to bridge this gap. Instead of a broad comparative examination of multiple modes, we are focused on rail *vs*. road. To be specific, we address the research question - "What fosters shippers' rail dispreference?" Additionally, we investigate the impact of shippers' size on fostering rail dispreference Baindur and Viegas (2011).

The field of our exploration is scoped to the outbound shipping in the steel-making industry in India. This is explained in Section 2, where we present a background and highlight the research gaps. Section 3 describes the interview-based qualitative methodology we use for this work. Section 4 presents and discusses the findings of the study. Finally, Section 5 highlights the study's research contributions, practical implications, and limitations, and suggests directions for future research De Jong and Ben-Akiva (2007).

2. Background

In this section, the study background is presented in four sub-sections. First an incidence matrix (Table 1) is presented that highlights shippers' rail dispreference as seen in the literature under the broader discussion of freight mode choice in transportation research over the last five decades. Table 1 lists 54 papers representative of the freight mode choice literature, indicating the choice factors considered in each paper, and the study's geography, if applicable. Section 2.1 describes that despite the plethora of studies on mode choice, sparse research has specifically focused on the rail vs. road freight share problem, the key concern of this paper. Section 2.2 details that a majority of mode choice research has been in North America and Europe and that there is more scope for studies in other parts of the world, while Section 2.3 presents the reasons that make India an interesting choice for studying shipper rail dispreference. Finally, Section 2.4 describes the Indian steel-making industry and its structure, the context in which the current study is set.

To shortlist the studies for literature review, we conducted a keyword-based search in the SCOPUS database. The code used in SCOPUS for searching are: "freight AND mode AND choice AND rail AND road". This initial search provided 90 papers. Further, we filtered the papers by subject areas: Social Sciences, Business Management and Accounting, Environmental Science, Decision Sciences, Economics, Econometrics, and Finance and Energy. This resulted in 71 papers. We went through all 71 papers and then further shortlisted 54 studies that included the factors that affect mode choice.

Overall, Table 1 lists 17 factors identified across these papers. The factors are listed from left to right in the descending order of the frequency of occurrence across the different studies. For example, "price" is appears in 46 out of the 52 studies, so it is listed first, while "type of trade" and "regulation" which occur in only 1 study each are listed at the end. The current study is aimed at gaining insights into what drives these factors in the context of shippers' dispreference for rail.

2.1. Sparse research focused on the rail vs. road issue

Very few studies are directly concerned with the modal shift from rail to road and its reverse shift. One such study is Woodburn (2003), which explores potential supply chain changes that can enable rail in Great Britain to capture traffic from the road. Another study, Islam et al. (2016), set in the European Union (EU), explores and makes recommendations on aspects related to service quality, pricing, and capacity that rail in the EU can address, to regain a significant share from the road, by 2050. Choi et al. (2019) use system dynamics models to examine the impacts of two policy measures – containerization and taxation – on enabling the modal shift from road to rail in South Korea. They predict that containerization can drive the shift faster than taxation.

More recently, in a study based in Japan, Mizutani and Fukuda (2020) found that the track access charges paid by JR Freight (JRF) to the JR Passenger companies (JRPs) were too low, causing difficulties in the promotion of a modal shift to rail freight. Though the low access cost was implemented to encourage freight transport, it resulted in a counterproductive development, as it displeased the JRPs and led to an undersupply of rail tracks for freight traffic. This was the because track access charges were considerably lower than actual maintenance costs incurred by the JRPs. With the JRPs and JRF operating as separate entities, cross-subsidization among them was infeasible. Essentially, the JRPs lacked incentives to invest in rail tracks for more freight traffic, hindering new freight market development.

Likewise Francisco et al. (2021), using a case study in the Mediterranean corridor, assess the effect of the introduction of technological innovations into a capacity constrained rail corridor on the corridor's ability to capture market share from road transport.

Table 1
Incidence matrix of papers to geography and factors.

Sl No.	Country/ Region	Study	Price	Speed	Reliability	Frequency	Loss/ Damage	Schedule Flexibility	Distance	Availability	Characteristics of goods	Control/ tracking	Cust-Centricity	Claims Handling	Concern for Environment	Shipment Size	Capability	Type of Trade	Regulation
1	Australia	Hensher et al. (2007)	X	X	X				X										
2	Australia	Puckett and Hensher (2008)	X	X	X				X										
3	Australia	Schrobback et al., 2023	X	X	X	X													
4	Australia	Puckett and Hensher (2009)	X	X	X				X										
5	Belgium	Beuthe and Bouffioux (2008)	X	X	X	X	X	X											
6	Belgium	Vannieuwenhuyse et al. (2003)	X	X	X		X	X		X									X
7	Brazil	De Almeida Rodrigues et al. (2023)		X					X		X								
8	Canada	Wilson et al. (1986)	X	X	X	X	X			X	X					X			
9	Canada and USA	Puckett et al. (2011)	X	X		X			X										
10	Europe	Eng-Larsson and Kohn (2012)	X	X	X						X	X			X				
11	Europe	Kreutzberger (2008)		X					X										
12	Europe	Wiegmans (2010)	X		X														
13	Nordic countries	Ludvigsen (1999)	X	X	X	X	X			X	X	X	X	X					
14	Finland	Punakivi and Hinkka (2006)	X	X	X		X												
15	France	Jiang et al. (1999)				X			X	X						X			
16	Germany	Liedtke (2012)	X																
17	Greece	Moschovou and Giannopoulos (2012)	X		X	X	X			X	X	X	X				X		
18	India	Cook et al. (1999)	X	X	X		X	X		X	X			X					
19	India	Ravibabu (2013)	X	X	X	X	X				X								
20	India	Shinghal and Fowkes (2002)		X	X	X													
21	Indonesia	Arunotayanun and Polak (2011)	X	X				X					X						
22	Indonesia	Norojono and Young (2003)	X	X	X	X	X	X	X										
23	Italy	Bergantino and Bolis (2004)	X	X	X	X	X												
24	Italy	Bergantino and Bolis (2005)	X	X	X	X													
25	Italy	Bergantino and Bolis (2008)	X	X	X	X													
26	Italy	Bergantino et al. (2013)	X	X	X	X	X												
27	Italy	Danielis and Marcucci (2007)	X	X	X	X		X											
28	Italy	Danielis et al. (2005)	X	X	X		X												
29	Italy	Ortolani et al. (2011)	X																

(continued on next page)

Table 1 (*continued*)

Sl No.	Country/ Region	Study	Price	Speed	Reliability	Frequency	Loss/ Damage	Schedule Flexibility	Distance	Availability	Characteristics of goods	Control/ tracking	Cust- Centricity	Claims Handling	Concern for Environment	Shipment Size	Capability	Type of Trade	Regulation
30	Italy and Switzerland	Bolis and Maggi (1999)	X	X	X	X		X											
31	Italy and Switzerland	Bolis and Maggi (2003)	X	X	X	X		X											
32	Portugal	Reis (2014)	X	X	X	X	X	X	X			X	X						
33	Spain	Arencibia et al. (2015)	X	X	X	X													
34	Spain	Feo et al. (2011)	X	X	X	X													
35	Spain	García-Menéndez and Feo-Valero (2009)	X	X	X	X			X						X				
36	Spain	García-Menéndez et al. (2004)	X	X	X	X	X		X						X				
37	Switzerland	Masiero and Hensher (2012)	X	X	X		X		X										
38	Turkey and Germany	Tuzkaya and Önüt (2008)	X	X	X		X	X			X								
39	UK	Fowkes (2007)		X	X		X	X		X		X			X				
40	UK	Jeffs and Hills (1990)	X	X	X			X	X	X	X	X							
41	Ukraine	Bierwirth et al. (2012)	X							X									
42	USA	Abdelwahab and Sargious (1992)	X	X	X						X					X			
43	USA	Bardi (1973)	X	X	X		X			X							X		
44	USA	Krapfel and Mentzer (1982)	X	X	X		X			X									
45	USA	Murphy and Hall (1995)	X	X	X		X							X					
46	USA	Stock and La Londe (1977)	X	X	X	X	X	X				X		X	X				
47	USA	Train and Wilson (2008)	X	X	X														
48	USA	Wang et al. (2013)	X	X					X		X							X	
49	USA, UK and the Netherlands	Holguín-Veras et al. (2011)	X			X										X			
50	–	Bagchi (1989)	X					X		X			X	X					
51	–	Baumol and Vinod (1970)	X	X	X		X												
52	–	Cullinane and Toy (2000)	X	X	X	X	X	X	X	X	X	X	X				X		
53	–	Jerman et al. (1978)		X	X		X					X	X	X					
54	–	Slater (1979)									X		X		X				
		Total Occurrence	**47**	**45**	**42**	**25**	**24**	**15**	**15**	**13**	**13**	**9**	**8**	**6**	**6**	**4**	**3**	**1**	**1**

They find that increases in capacity are enough only to maintain current rail freight market shares but even a heavy investment in technology is not effective for increasing rail market share. These studies improve our understanding of the potential for a road-to-rail modal shift, but more studies are necessary in this area to fully understand the scale and scope of such a change.

2.2. A paucity of mode choice studies outside North America and Europe

Roughly half the mode-choice studies reported in the literature are based in Europe (e.g. Punakivi and Hinkka, 2006; Danielis and Marcucci, 2007; Bergantino and Bolis, 2008; Beuthe and Bouffioux, 2008; Wiegmans, 2010; Eng-Larsson and Kohn, 2012; Liedtke, 2012; Moschovou and Giannopoulos, 2012; Arencibia et al., 2015), while a significant proportion is based in North America (e.g., Abdelwahab and Sargious, 1992; Murphy and Hall, 1995; Train and Wilson, 2008; Holguín-Veras et al., 2011; Wang et al., 2013). Scant mode-choice research pertains to other regions such as Australia (Hensher et al., 2007; Puckett and Hensher, 2008, 2009), India (Cook et al., 1999; Shinghal and Fowkes, 2002; Ravibabu, 2013) and Indonesia (Norojono and Young, 2003; Arunotayanun and Polak, 2011). More research is needed in regions other than North America and Europe to extend the understanding of the association between geographical context and mode choice. Moreover, the studies conducted in Indian context are either in the export containerized shipment (Ravibabu, 2013), or develop quantitive stated preference models (Shinghal and Fowkes, 2002) or do a survey using logistics cost (Cook et al., 1999). Though Shinghal and Fowkes (2002) and Cook et al. (1999) discuss the factors that impact shipping through rail and road, the studies are more than two decades old and do not explore the factors qualitatively. Hence, the choice of India as the geographical context for the current study also addresses this gap in the literature.

2.3. India, an interesting context for a study on shippers' rail dispreference

There has been a close association between India's rapid economic development, its urbanization, and the development of its transport infrastructure over different periods in the country's history; for a detailed overview, see Maparu and Mazumder (2017). Indeed, this has increased the originating freight tonnage in the country, which grew from 82.2 million tonnes in 1950-51 to 2555.35 million tonnes in 2006-07 (NTDPC, 2014). In India, Indian Railways (IR), a Government of India entity, is the sole provider of rail transportation for both passenger and bulk freight movement. The IR's sister-organization, the Container Corporation of India (CONCOR), along with some private providers, offers container-based intermodal freight. Though the abovementioned freight tonnage figures are across six transport modes – rail, road, air, coastal shipping, inland waterways, and pipelines – nearly 99% of the freight was transported by rail and road in the first four decades since 1951; in 2007-08, this figure was 91% (NTDPC, 2014). Though there has been a manifold increase in the volume of freight carried by the IR since 1950, its growth rate has been signficantly lower than that of the road (McKinsey, 2010) resulting in a significant shift of freight share to the road. As a result, the railway carried 89% of the freight in 1950-51, but only about 27% in 2014-15 (TERI, 2019). Over the decades, road transportation, amongst the various modes, was the greatest beneficiary of the increasing rail dispreference of the shippers in India.

The major commodities carried by the IR are bulk commodities: coal, iron-ore, cement, food grains and fertilizer. In 2021, almost 1231 million metric tonnes of freight were carried across a network spanning around 68,000 kms by the IR. Of these, nearly 77.5% of the iron-ore and 58% of coal (production & imports) moved in the country were by the IR. The distance (kilometers per wagon per day) covered for freight operations by the IR varied from 170 to 220 (Railway Board, 2022).

2.4. Steel-making: the industry context

Steel-making is classified as one of India's eight core industries, together known as the core sector (GOI, 2019). Steel-making contributed 17.92 percent to the core industries index (GOI, 2019). In 2018, India's crude steel production was 106.5 million tonnes, making it the second-largest crude-steel producer in the world (Worldsteel, 2019) after China. In 2007-08, iron-and-steel-making accounted for about 12% of the originating freight (by weight) of all commodities transported in India by any mode (NTDPC, 2014). For more details, see Worldsteel (2019).

The Indian steel industry exhibits a diverse and well-structured ecosystem, comprising both public and private players. The industry is dominated by end-to-end integrated steel producers, who own large steel plants equipped with blast furnaces and extensive manufacturing facilities. In addition to them, there is a significant presence of secondary steel producers in India. These include electric arc furnace (EAF) and induction furnace units that utilize scrap and sponge iron as the primary raw material to manufacture steel products. This segment caters to specific niche markets (Competition Commission of India, 2009).

The Indian steel industry operates in a deregulated environment, where the government functions as a facilitator. Its role involves setting policy guidelines and establishing institutional structures to cultivate an environment conducive to enhancing the efficiency and performance of the steel sector (Ministry of Steel, 2023). India's prowess in steel production stems significantly from the abundant indigenous supply of high-grade iron ore and non-coking coal, pivotal elements in the steelmaking process. Additionally, the country boasts an expansive and swiftly expanding steel market, a robust MSME sector, and a youthful workforce, contributing to competitive labor costs Schrobback et al. (2023). To boost domestic steel production, the government introduced the National Steel Policy 2017on May 8, 2017, aiming for the accelerated growth of the steel industry. The policy strives for self-sufficiency in steel and high-grade varieties for strategic uses. By 2030-31, it envisions a crude steel capacity of 300 million tonnes, production of 255 million tonnes, and a substantial per capita consumption of finished steel at 158 kgs, a notable increase from the current 61 kgs (Ministry of Steel, 2017).

Steel, in general, is a good candidate for rail as a preferred mode of transportation owing to its heavier weight, fewer locations, and

Table 2
Comparison between plants.

Plant	Volume shipped (MTPA)	mode share (Rail:Road, Outbound freight)	# Rakes loaded per day
X	1	10:90	3
Y	10	60:40	30

Table 3
List of the interviewed subjects.

Code	Designation	Organization (all in India)
S1G	Director & CEO	An international container terminal
S2G	Chief of a product range	Steel making company 1
S3G	Deputy General Manager	Steel making company 2
S4G	Vice President	Aluminium making company 1
S5G	General manager	Aluminium making company 2
S6G	Head Operations	A rail-based logistics service provider
S7G	General Manager, Strategy	A container-based logistics service provider
S8X	Manager, Commercial	Plant X
S9X	DGM, Inbound Logistics	Plant X
S10X	Manager Logistics	Plant X
S11X	Associate President	Plant X
S12X	Manager, Finance and Commercial	Plant X
S13X	Chief Operating Officer	Plant X
S14X	Deputy General Manager, Production Planning and Control	Plant X
S15X	Vice President	Plant X
S16Y	Corporate Consultant	Plant Y
S17Y	Senior Manager, Vendor Development	Plant Y
S18Y	Chief, Raw Material Management	Plant Y
S19Y	Manager, Contract Administration	Plant Y
S20Y	Manager, Supply Chain Planning	Plant Y
S21Y	Network Analyst, Supply Chain	Plant Y

less time-sensitivity due to long term planning. As per NTDPC (2014), more than 80% of the inbound freight[1] of steel-making in India is transported by rail, about 15% by road, and the remaining uses coastal shipping. However, on the outbound side,[2] only about 20% is transported by rail, while the rest (nearly 80%) is transported by road (NTDPC, 2014), indicating a high degree of shippers' rail dispreference. Hence, this study is scoped to the outbound logistics in the Indian steel-making industry.

3. Methodology

We used in-depth interviews to gather data, since such interviewing can provide in-depth information since more time can be spent exploring topics in a structured yet adaptive way (Gestrelius et al., 2020). We adopted purposive (judgmental) as well as snowball sampling to identify respondents (Kurup et al., 2021), which enables capturing the diversity in the unique context of the study and helps a more thorough and in-depth exploration that cannot be done solely with quantitative methods.

In total, 21 semi-structured in-depth interviews were conducted, divided over three groups of subjects. The first group consisted of seven experts at the industry level that had worked in or interacted with the steel-making industry for 15–35 years and had an in-depth experiential knowledge of transportation in the industry. These subjects are coded S1G to S7G, respectively, in this paper. The other two groups, accounting for the remaining 14 interviews, were at the plant-level and comprised of managers across two integrated steel-making plants in India. Previous research suggests that shippers' preference between rail and road depends on the relative sizes of the shipping firms (Jiang et al., 1999). For this reason, we chose respondents from steel plants having disparate sizes and shipping volumes: Plant X had a throughput of 1 million tonnes per annum (MTPA), while Plant Y's throughput was about 10 MTPA. See Table 2 for a comparison of the two plants on shipping volumes, rail vs. road share and rakes shipped per day and Table 3 for a list of the interviewed subjects.

Eight managers in Plant X were coded S8X to S15X, and six managers in Plant Y were coded S16Y to S21Y, respectively (see Table 2). The 14 managers had work experience that spanned 3–30 years in the sector. They were either directly working in or closely interacting with the transportation and logistics department of their respective organizations and were involved in freight mode related decisions. Therefore, their knowledge of freight transportation in their company, as well as the steel-making industry, was credible and comprehensive to offer relevant responses during the interviews. The criteria used in choosing all subjects included a diversity of background, experience, and knowledge of how freight operates in the steel-making industry.

Due to their geographically dispersed locations throughout India, the first group of subjects (S1G to S7G) was interviewed via

[1] *iron ore, coal and limestone.*
[2] *included finished steel in forms such as sheets, rolls, rods, and billets, as well as pig iron and slag.*

Table 4
Aggregation of factors and exemplary text segments.

S. NO.	FACTORS	EXEMPLARY TEXT SEGMENTS
FACTORS DRIVEN PRIMARILY BY CAPACITY SHORTAGE IN THE RAIL SECTOR		
1	**Volume inflexibility**	•*IR has a policy that an entire rake of minimum 40 to 45 wagons must be booked (S2G)* •*Flexibility in having partial rake load is not there. (S11X)* •*IR also does not permit breaking or unloading the rake at intermediate stations between source and destination (SG2)* •*But because of lack of volume flexibility, I must accumulate 2500 tonnes and then send it to destination. But by road, it (a smaller quantity) has already reached the destination and I am getting the payback (S15X).* •*As of now, materials to Birarajpur are shipped by road but if small rakes are allowed then rail can be used (S21Y)*
2	**Poor delivery speed**	•*Inventory carrying cost is influenced by the time taken to ship. (S1G)* •*One reason why dispatches are made by road sometimes is the tight deadlines that customers require. "Customers' production may stop because of our shipping delays". (S5G)* •*Rail takes longer time for loading and unloading (S17Y)*
3	**Inadequate door-to-door connectivity**	•*Last-mile connectivity is an issue. For example, Ankleshwar, Gujarat is a place at which the goods are transferred from rail to road for movement to different places where rail cannot reach. The "last mile" may be 100–*150 km *long. (S4G)* •*30–40% of material goes in and around Jharkhand but there is no proximity of railway for all customers. So, the country's eastern zone mostly goes by road. (S14X)* •*The rail connection is critical for the steel sector and steel plants always consider the presence of a rail head nearby before finalizing a location.* (S2G)
4	**Schedule inflexibility**	•*The control lies with railways and not with the transport providers themselves and that can be an inconvenience sometimes. (S1G)* •*Schedule flexibility is important as sometimes, rake is not available at all. (S13X)*
FACTORS DRIVEN PRIMARILY BY THE MONOPOLY POSITION OF THE INDIAN RAILWAYS		
5	**Unfavorable pricing**	•*An important factor that matters for rail vs. road choice is the distance of the shipping*$\leq$300 km*, shipper likely to prefer road, but if*$\geq$500 km*, likely to prefer rail. One reason for this is the way rail freight and road freight are structured with respect to distance. (S1G)* •*The rail economics works out well for bulk shipping (S6G)* •*While transporting by railways there are instances of idle capacity as the railway will charge for the capacity of wagons booked. Sometimes due to the physical characteristics (size, shape and volume) of the finished goods, the wagons can't be filled to capacity, leading to idle capacity. When idle capacity is considered for rail, the* per *unit shipping cost of rail may become higher (S20Y)*
6	**Authoritarian customer treatment**	•*Railways is not customer centric. On most occasions we have to suffer from the handed attitude of railways. (S9X)*
7	**Cumbersome claims Handling**	•*The claim and reconciliation processes are much easier with road transport providers than with the Indian Railways (IR). (S5G)*
8	**Infrastructure-related constraints**	•*Rail transport often requires more elaborate infrastructure than road. For example, the presence of railway sidings is necessary to support warehouses and stockyards. (S14X)*

telephone or Skype. The interviews lasted between 20 and 45 min. The questions, which were open-ended and discovery-oriented (Gestrelius et al., 2020), focused on freight transportation in India, how and why shippers choose a given mode, and the associated challenges/opportunities. Interviews with the 14 logistics managers (S8X to S21Y) were conducted face-to-face in a physical setting and lasted between 20 and 70 min. Here, we used the factors found in the literature (Table 1) to elicit the shippers' perceptions of the factors to rail dispreference. Each interview began with the sharing of a written brief description of these factors with each of the subjects.

The subjects were then asked to identify and explain specific factors driving their rail vs. road choice. Typical in-person, verbal questions included – "Your organization currently ships about __ proportion of its outbound freight by road. If it must switch to using rail for this freight, what must the railways change? What matters most?" etc. All interviews were semi-structured, and subjects were encouraged to offer any insight or information they considered relevant (Kurup et al., 2021). Follow-up questions were asked to gain deeper insights, seek clarifications, and ensure the consistency of the responses.

All the interviews were conducted by the same team of two of the authors to reduce inter-interviewer variability. We recorded 11 of the 21 interviews based on permissions from the subjects, while elaborate hand notes were taken for all the interviews. After each interview, the interviewers listened to the audio-recordings (wherever available) in conjunction with the hand notes. In this post-interview phase, the interviewers combined and consolidated the notes, and added insights and possible points to explore in the subsequent interviews. A follow-up with interviewed subjects was pursued if clarifications were needed. The number of interviews within each group was determined by the principle of theoretical saturation, where additional information ceases to add new insights, and researchers see similar points repeatedly emerging.

Data analysis involved a simple, yet rigorous process of systematically and thematically examining the interview notes, identifying and categorizing relevant text segments in terms of factors, noting what drove those factors, and eliciting how and why those factors impacted shippers' rail dispreference. Microsoft Word was used for this. Further, plants X and Y contrast with each other on their sizes (Y's annual output was about ten times that of X), as well as on their rail dispreference: the percentage of outbound freight shipped by rail vis-à-vis the road is about 10:90 in Plant X and about 60:40 in Plant Y. In other words, the smaller plant had a significantly higher rail dispreference than the larger one. Hence, we also examined the interview notes for possible connections between firm size and shippers' rail dispreference.

4. Findings and discussion

What, according to the experts, fosters shippers' rail dispreference? Based on the experts' descriptions followed by our analysis of the interview data, we identified two underlying dimensions that distinguish the rail and the road sectors in India – capacity shortage and monopoly position – which foster multiple factors that drive shippers' rail dispreference. Specifically, we identified eight factors. We first describe the two dimensions (Section 4.1), and then aggregate the eight factors along these two dimensions, with four factors in each dimension (Section 4.2). Table 4 depicts this aggregation, along with exemplary quotes of interviewed subjects from the data.

4.1. Two dimensions on which rail and road differ from each other in India

The rail and the road sectors in India differ along two dimensions: *capacity shortage* in the Indian railway system and the *monopoly position* of the IR. Rail has a severe lack of capacity relative to the demand placed on it (NTDPC, 2014), concerning the total track length available. The shortage is the direct outcome of low levels of investment in rail infrastructure since the fourth five-year plan (1969–1974) in India (Mattoo, 2000). While rail traffic (demand) grew more than 10-fold between 1951 and 2007, rail track length grew only 1.4 times in the same period (McKinsey, 2010). On the other hand, the road sector grew at a much faster rate than rail capacity due to a focused policy and associated investments, thereby not facing a similar shortage (NTDPC, 2014; MORTH, 2016). Second, the IR is the sole player offering bulk freight rail transport in India and, thus, enjoys a monopoly-position in its segment. CONCOR dominates the intermodal freight segment, facing minimal competition from a few private players. In direct contrast, the road sector in India is highly fragmented, with many private and government-owned players vying for shippers' business.

4.2. Two underlying dimensions and eight factors of shippers' rail dispreference

We first describe th e four factors that are primarily fostered by the capacity shortage (Sectio n 4.1.1), and then the remaining four fostered by monopoly position (Section 4.1.2).

4.2.1. Four factors that are primarily fostered by IR's capacity shortage

i. Volume inflexibility: Refers to the lack of flexibility that a transport provider offers to shippers with regards to the minimum consignment volume that the shippers engage and the associated payment. Several subjects mentioned the Indian Railways' (IR) volume inflexibility. Specifically, they quoted IR's policy by which customers need to engage, and are charged for, a full rake, even if their consignment needs only a few wagons. The subjects cited this policy as one of the major reasons for shippers' rail dispreference in the steel-making industry. A full freight rake typically consists of either 40 or 45 wagons depending on the wagon type. For more details, see Saksena et al. (2013).

During the interviews, S8X observed that most of Plant X's consignments were around 5–10 tonnes and only occasionally more than 20 tonnes, while filling a full train rake generally needed 2500–3000 tonnes. On the other hand, it was possible to hire trucks that could be matched with the capacity needed for the smaller consignments. According to S8X, this was the key reason that nearly 90% of Plant X's output was sent by road, and the remaining (about 10%) constituted as bulk consignments, by rail. Most of these bulk consignments were sent to the company's own warehouses or hubs nearest to the destination, from where they were distributed by road to individual customers. S13X echoed this point as well. Plant Y's production levels, on the other hand, ensured that it could engage several full rakes a day; yet, as S21Y observed, there were many consignments that were much less than a full rake, and it made more economic sense to send them by road.

This raised an important question – Why did the IR necessitate loading full rakes? Prior to the 1980s, the IR's policies permitted "piecemeal traffic", or loading less-than-full rakes. However, in the 1980s, the IR simultaneously began to experience a capacity shortage along with a continuously growing demand for transporting bulk commodities, such as the coal needed to run thermal power plants (Mattoo, 2000; IR, 2004; RITES, 2008). Due to these twin developments, the IR responded with the full-rake loading policy. The policy change was not particular to steel-making but was applicable across sectors and drove a large number of less-than-full-rake shipments from rail to road (Mattoo, 2000; RITES, 2008).

In 2005, the IR introduced a mini-rake scheme (IR, 2005), which permitted shippers to hire rakes with a minimum of 20 wagons. For multiple reasons, however, this attempt to reduce volume inflexibility did not induce much outbound steel shipment to switch to rail. First, only covered wagons were permitted on mini-rakes, while finished steel shipments often use flat wagons to facilitate convenience in the loading and unloading of heavy items. Second, the shipping distance was initially restricted to 400 km and later increased to 600 km (IR, 2020), but finished steel in India is often shipped over distances longer than 1000 km. Finally, an additional charge of 5% of the base freight price was levied on shippers during the peak season that lasted from October to June, increasing shipping costs.

Another question that needed to be investigated was – Aren't there freight forwarders in India, who can combine small steel shipments into large ones, to fill a rake? S7G and S15X both explained that such an activity would not be economically attractive for shippers, owing to the extra costs incurred in transporting the cargo from the plants to a common hub and later from a common hub to client premises. There would also be extra handling during the transfers, and the delays involved in waiting for cargo from multiple shippers to accumulate at a hub. These subjects noted that it would be simpler, more convenient, faster, and less expensive to just send the cargo by road directly from the plant to the client's premises. From this, it can also be reasoned that if IR were to offer such a combination service, extra time and circuitous distance would be required to aggregate carload shipments at classification yards for assembly into trains to travel long distances. Here, S15X also pointed out that the IR also does not permit combining multiple types of products – for example, Steel and Foodgrains, or Steel and Chemicals – in a single rake.

ii. Poor delivery speed: Some of the interviewed subjects mentioned that rail shipments were, often, significantly slower than road shipments. According to S1G, rail's lower transportation speed was due to the lack of track capacity, owing to which, the IR prioritized among its shipments. S1G observed that bulk cargo such as fertilizer and coal were given priority over other cargo such as finished products, to meet national interests such as food security and power supply. Other types of cargo were not accorded special priorities.

S16Y observed that freight trains had to compete for capacity with passenger trains, which, as S1G explained, were run on fixed timetables and were prioritized over freight trains. Due to the lack of track capacity, right of way was given to passenger traffic, and freight trains had to frequently stop to let passenger trains get prioritized right-of-passage on the railway tracks (Mattoo, 2000). As a result, the average speed of a freight train in India (at the time of this study) was about 22 km/h versus the maximum permissible speed of 75 km/h. Such low train speed in India elongated the rail delivery times vis-à-vis the road (TERI, 2019), even though the efficiency of road freight transportation in India is also fairly low (TCI, 2015). Thus, while a cargo truck could cover the distance from Bangalore to Tuticorin (a distance of about 600 km in southern India) within 36 h, a goods train might take up to 48 h to cover the same travel distance. Likewise, moving by road from Mundra Port in Western India to Tughlakhabad in Northern India (a distance of about 1200 km) might take four days, while a goods train could take seven days. S1G pointed out that the rail-related delays resulted not only in reducing the velocity of flow in supply chains but also in increased inventory holding costs owing to more inventory in the pipeline.

iii. Inadequate door-to-door connectivity: This factor refers to the extent to which a transport mode can move goods door-to-door between the shipper and the end-customer without involving an intermediate mode or making transfers within the same mode of transportation. Shipping of finished goods by rail often requires another mode of transportation (such as the road) due to lack of railheads at the origin and/or destination locations. However, the capacity shortage in the Indian railway system has resulted in railheads often being at long distances from the origin/destination. In turn, this has meant that the proportion of the journey covered by the road is significantly high. Subject S4G noted that the "last mile" could sometimes be 100–150 km long. Therefore, some subjects commented that it was simpler and more practical to ship the entire distance by road. Here, both S1G and S8X noted that the additional handling due to changing between modes introduced unnecessary delays and increased the potential for damage as well. This inability of rail to provide depth in the connectivity network contributed to the shippers' reluctance to choose rail as the mode of transportation vis-à-vis the road.

iv. Schedule inflexibility: This refers to the lack of leeway in the schedules offered by the transport provider to the shipper. Owing to capacity constraints, the availability of the rail tracks was always under pressure, and a schedule violation by any shipper could mean severe disruptions in the plans of the other shippers. Hence, the IR followed strict scheduling procedures. Beyond the allocated time duration for loading/unloading, the shipper paid heavy demurrage of 6000 Indian Rupees per hour for a 40-wagon rake, which could be increased to six times that amount in the case of excessive congestion (IR, 2016). S10X and S13X in Plant X expressed their displeasure at this system. At the same time, some subjects in Plant Y noted that such issues did not exist with road transport, as the shippers could hire trucks and trailers in a relatively more flexible and responsive manner.

In summary, the findings suggest that the shortage of capacity in the rail system primarily fostered the above-discussed four (of the eight factors) that promoted shippers' rail dispreference in the Indian steel-making sector. It can be reasoned that if the rail system's capacity (length of rail track) was better matched with the demand, the IR would be focused on better utilization of their resources. In turn, this would result in the availability of slack capacity needed for faster transportation, having railheads closer to client locations, offering more flexibility in filling its rakes, and being more responsive to the schedule-related demands of its clients.

Hence the following proposition.

Proposition 1a. *Capacity shortage in the rail system is an underlying driver for factors such as volume inflexibility, poor delivery speed, inadequate door-to-door connectivity, and schedule inflexibility, which in turn increase shippers' rail dispreference.*

4.2.2. Four factors that are primarily fostered by the IR's monopoly position

i. Unfavorable pricing: The subjects perceived that the IR's pricing (freight rate) was not attractive vis-à-vis the pricing for road transportation. S1G reflected on the IR's rigidity by noting that its prices were fixed and non-negotiable. On the other hand, it was possible to negotiate better rates by road with private operators in a competitive playing field. According to SG1, the IR's unfavorable pricing was a result of its monopoly position in the Indian rail sector. Moreover, the IR subsidized its passenger tariffs by increasing its freight rates (Business Line, 2018; Tiwari, 2016). S16Y explained that this policy of the IR made rail transportation less attractive to freight shippers. In addition, the IR's distance-based rate structure resulted in prices that were very high for smaller distances but decreased in the longer distance price bracket. These pricing brackets were unattractive to customers shipping less than 500 km due to better rates available for road transportation. S1G said that typically even shippers with a full rake load preferred rail only for distances greater than 500 km. This point was reinforced by S2G, S8X, S9X, S15X, S20Y, and S21Y.

ii. Authoritarian customer treatment: Subjects observed that IR's authoritarian handling of customers often induced shippers to prefer using road transportation. Some of them perceived that the IR, though excellent in its operations-related discipline and maintenance, was not very customer friendly. Despite its well-defined commercial policies, the IR's customers were confronted with the burden of undesirable bureaucracy. S11X referred to such bureaucracy and the resultant procedural issues as outcomes of the IR's monopoly position in the Indian rail sector. S11X added that smaller customers were ignored. S9X said that Plant X sometimes "suffered" due to the 'high-handed' attitude of the IR. An example given by S9X and S15X referred to the in-motion weigh-bridges that the IR used to weigh the consignment. Sometimes, S15X said, there were notable discrepancies between the IR's and the shipper's measurement readings. However, the IR disregarded the shipper's measurements, owing to which the shipper felt that they were incorrectly overcharged. S15X termed this as the IR's 'monopolistic behaviour.' S11X explained that the IR did not solicit formal feedback from its freight shippers and that service quality was lacking. Summing this up, S5G contended that if the IR was more customer-oriented towards shippers, rail in India could attract more shipments and increase its share of freight.

iii. Cumbersome claims handling: Another factor, which resulted from the IR's monopoly and which the shippers viewed unfavorably, was its cumbersome handling of claims. Claims handling refers to the recovery of shipment-related losses by a shipper from the transport service provider. S15X emphatically noted that claims processing was a "huge negative" of the IR and was often a reason that shippers chose road instead of rail. He described that some shipper organizations had large claims departments only to recover losses from the IR, since the process was cumbersome and bureaucratic. Moreover, any success in recovering a loss, invariably, took a long time. Other subjects (S5G, S9X) concurred. S5G, for example, said that claims and reconciliation processes were much easier and faster with the road transporters than with IR. According to S5G, claims filed with the railways were hardly ever realized owing to the multitude of confusing rules and regulations.

iv. Infrastructure-related constraints: S14X noted that shipping by rail often required more elaborate infrastructure than transportation by road at both the shipper's and the end-customer's facilities. For example, the presence of railway sidings was necessary to support warehouses and stockyards. For loading and unloading, large rail-dedicated physical areas inside factory premises were needed that could not be used for the movement of other vehicles. This rail-dedicated space requirement created additional cost, loss of valuable industrial real estate, and logistical inefficiencies for shippers. Owing to its monopoly position, however, IR had little incentive to invest in constructing separate additional infrastructure for its clients. On the other hand, there were no such constraints for road transportation.

In summary, the findings suggest that the monopoly of the IR was the primary driver for the above mentioned four (of the eight factors) that promoted shippers' rail dispreference in the Indian steel-making sector. It can be argued that in a more competitive playing field with multiple independent service providers, prices would be pushed down, customer treatment and claims handling would be better, and service providers would be more likely to offer their clients better supporting infrastructure.

Hence, we propose.

Proposition 1b. *A monopoly position of the rail service provider drives factors such as unfavorable pricing, authoritarian customer treatment, cumbersome claims handling, and infrastructure-related constraints that, in turn, increase shippers' rail dispreference.*

The interview data also suggest that the size of the shipper firm can influence the effects of some of the factors of shippers' rail dispreference.

4.3. The moderating role of shipper firm size on the influences of the factors

Since the output of Plant Y was about ten times that of Plant X, it allowed us to explore the interview data for differences and similarities in shippers' dispreference for rail arising from their firm sizes. Shipper firm size has been discussed in mode choice research, but the findings and insights are diverse and sometimes conflicting. For example, Jiang et al. (1999) found that larger shippers in France favour rail, but the smaller ones favour road. On the other hand, in a trans-European study, Grue and Ludvigsen (2006) found that medium-sized shippers sent more volumes by rail than the large-sized ones. In a study across Denmark, Norway, Sweden, and Finland, Ludvigsen (1999) noted that larger shippers, owing to a strong market position, enjoy a high quality of intermodal transit. This study showed that larger shippers regularly ship high volumes of freight, and therefore have strong bargaining power vis-à-vis intermodal operators, such as intermodal consortia. The author adds that market power is necessary to induce the intermodal operators to secure the quality level needed by shippers in manufacturing industries. Patterson et al. (2008) found that the larger shipper firms in Canada are more demanding in terms of on-time reliability than smaller ones. In the context of Italy, Bergantino et al. (2013) showed that as firm size increases, the sensitivity to travel time variations decreases, but the sensitivity to the risk of damage and service frequency is more.

The interview data showed that influences of three of the factors – volume inflexibility, schedule inflexibility and supporting infrastructure – on shippers' rail dispreference was less for the larger firm (Y) than for the smaller one (X).

A. A significantly larger output volume meant that Plant Y, being able to fill more full train rakes, could send a substantially greater proportion of its output by rail than Plant X (0.6 *vs.* 0.1). S14X explained that Plant X classified its customers as large, medium, and small, but only about 10% of these customers were in the first two categories. Rail shipping was used only for this 10% of customers where there was adequate volume to engage full rakes. If IR were to become volume flexible in the future, Plant X might be able to increase its rail shipments significantly. At the same time, Plant Y would not be able to increase its rail shipments to the same extent, since it was already sending a large proportion by rail. This finding implies that IR's volume inflexibility drove the larger plant's (Y) rail dispreference to be less than it did for the smaller plant (X).

B. Its smaller output volume meant that Plant X was more affected by rail schedule inflexibility than Plant Y since the IR had an allotment system in which larger volume (revenue) clients were prioritized over smaller ones. Comparing their plant (X) with the bigger ones such as Y, S13X explained that while Plant X would load up to 3 or 4 rakes each day, the number could be as high as 30 rakes for the larger plants. As a result, S10X observed, that while the IR gave Plant X only 7 or 8 h to load a rake, the bigger plants could sometimes get even 16 h on a similar shipment without paying demurrage. Overall, the IR's schedule inflexibility drove the larger plant's (Y) dispreference for rail less than it did for that of the smaller plant (X).
C. Infrastructure-related constraints affected the smaller plant (X) more than it did for, the larger one (Y). As S14X noted, the supporting infrastructure consumed space in a plant's premises and drove up costs significantly, while the larger plants were better positioned due to access to a larger available area. And unlike with the smaller plants, R13X noted, the IR actively participated in maintaining railway yards inside the large plants' premises along with electronic signaling systems, and that, in turn, reduced the extent of rail dispreference in the large plants.

In summary, Plant Y experienced a lesser extent of rail dispreference due to these three factors than Plant X, which is consistent with the observation that as much as 60% of Plant Y's output was shipped by rail, while for Plant X, it was only about 10%. However, for the other five factors – unfavorable pricing, poor delivery speed, authoritarian customer treatment, cumbersome claims handling, and inadequate door-to-door connectivity – the findings did not indicate notable differences in shippers' experience across the two plants. These factors induced shippers' rail dispreference in similar ways for both the plants, which can explain why Y, though ten times larger than X and thereby favoured by the IR's policies in some ways (mentioned above), had to still transport 40% of its output by road. Based on all this, we propose.

Proposition 2. : *The size of the shipper firm moderates the influences of some of the factors*; *such factors foster shippers' rail dispreference to a lesser extent in the larger firms than in the smaller ones*.

5. Summary and conclusion

This work was prompted by a quest to understand the reasons underlying the continuous increase in the shippers' dispreference for a transport mode that is more friendly to the environment (the rail) in favour of the less friendly one (the road). The current study, engaging a qualitative methodology, gathers and collates the perceptions of experts in the Indian steel-making industry, and offers two contributions to the freight mode choice research, by.

1. highlighting how rail capacity shortage and monopoly position of the rail transport provider can drive multiple factors that foster shippers' rail dispreference. Tthis study brings to fore the roles played by these two dimensions in the competition between the rail and the road for market share.
2. proposing that shipper firm size can moderate the influences of some, but not all, of the factors on shippers' rail dispreference. Previous studies recognize that firm size matters to mode choice, yet there have not been in-depth investigations. Our study proposes that firm size not only matters but also moderates factor influences on shippers' rail dispreference.

This study reinforces the usefulness of in-depth qualitative methodologies to mode choice research, which has traditionally relied more on quantitative methods.

The study's insights also bear implications for transport policy and practice. The Indian government is currently in the process of building exclusive rail capacity for freight transport through the Dedicated Freight Corridor (DFC) project. The project, whose first phase, comprising the Eastern and Western corridors, is estimated to cost over 800 billion Indian Rupees, will eventually add over 10,000 route kilometres to the existing 67,368 route kilometres of railway lines in the country (DFCCIL, 2020), and enable the IR to handle significantly more freight. The study's findings imply that adding new capacity, though necessary, may not be sufficient; it *must be* complemented by appropriate improvements in rail freight policies that take the various factors and the shippers' perspectives into account.

Deregulating and opening the rail sector to private players can also help. This is already present to a limited extent for container trains in India but has had its share of problems (see Gangwar et al., 2012; for details). Rail freight deregulation was effective in the U. S.; in the forty-year period between its introduction in 1981 and 2010, freight fares came down by 55%, productivity rose by 172% and rail's share of freight (in tonne-miles) rose to 43% from 35% (Economist, 2010). Thus, it is possible that rail privatization in India will improve shippers' rail experience significantly, though it is likely to evoke new challenges. The accompanying practices must solicit and take shipper feedback seriously, attend to shippers' complaints and concerns, and aim for shipper satisfaction. Such practices have already been introduced in IR's passenger services and have been received with success. Moreover, the IR is also exploring private passenger trains (Sinha, 2020).

A limitation of the current study is its sample, which, owing to practical considerations, involves only 21 subjects, all from a single industry (steel-making) in a single country (India). Moreover, the sample compries only two firms, though with disparate output volumes. This small sample size imposes limitations on the generalizability of the study's findings. To enhance generalizability, it is crucial to have a representative and diverse sample that, ideally, should include a mix of large and small-scale producers, public and private entities, and companies from different regions to encompass the industry's full spectrum. We have tried to address this issue to some extent by interviewing industry experts in the first phase of the study. The industry experts were recruited so that they represented the structure of the Indian steel industry. At the same time, we acknowledge that our findings based on only two steel-making firms has limitations to generalizability. Thus, though the findings have useful implications for both theory and practice, they must be generalized to other contexts with due caution. Even within India, the specific factors that matter vary across industry sectors (e.g., see Shinghal and Fowkes, 2002). Factors such as reliability, capability, type of trade, and regulation did not come up in the current study, but they may matter to shippers' rail dispreference in other industries.

Future research in this area can explore shippers' rail dispreference using similar qualitative approaches across different industries and geographies. Woodburn (2015) mentions that the European transport policy places considerable emphasis on improving rail's competitiveness to decrease shippers' rail dispreference. Likewise, it would be interesting to investigate how rail dispreference changes or re-emerges in other parts of Asia or sub-Saharan Africa. Within India, comparative 'before-after' qualitative studies can explore whether and how the DFC project has an influence on the rail dispreference of shippers. Further, exploring the factors that did not emerge in the current study and comparing insights across countries can advance our understanding of this subject. Another potential research direction is to use confirmatory quantitative approaches to establish the moderation effect of shipper firm size on the factors of rail dispreference. A relevant question is how rail service providers can alter their policies in ways that take into account of shippers' preferences changing with firm size. Future research may also explore shippers' rail dispreference through policy-level studies, analyzing the impact of diverse policies on their transportation choices. Such research promises valuable insights into the factors influencing rail dispreference, enabling recommendations to enhance the rail transportation environment.

Despite the benefits from environmental, economic, and social considerations, rail has steadily lost its share of freight across the world, thus prompting the need for a reversal. A shift from road to rail is certainly desirable from an environmental perspective. It is hoped that researchers and practitioners are encouraged to conduct further insight-driven research on mode choice that can fuel the movement towards more sustainable transportation in the world.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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