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Golden Decade of Infrastructure Development in India with Special Reference to Metro Rail Network

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Abstract

India has witnessed unprecedented infrastructure development over the past decade. A cornerstone of this transformation is the PM GatiShakti National Master Plan (PMGS-NMP)[1], launched in October 2021, which adopts an integrated, multimodal approach to infrastructure planning aimed at generating strong growth multipliers. Within this framework, high-quality mass transit systems—particularly metro rail corridors—have emerged as a critical pillar. With rapid expansion across cities, India now boasts the world's third-largest metro network.

Moving beyond the conventional focus on output and employment multipliers, this paper is among the first to examine how large-scale urban transport infrastructure affects household financial behaviour in India. Using granular home-loan–level data, we assess the impact of metro connectivity on borrower delinquency and prepayment behaviour across urban neighbourhoods. The underlying mechanism is straightforward: improved access to efficient public transport reduces households' dependence on private vehicles, thereby lowering recurring transportation expenses. This, in turn, eases the burden of servicing EMIs—among the most significant fixed financial commitments for urban households. Our findings reveal economically meaningful improvements in household financial discipline in metro-served areas. In Hyderabad, households located in metro-connected PIN codes exhibit a 1.7% decline in delinquency incidence and a 1.8% increase in prepayment activity. The effects are even stronger in Bengaluru, where delinquency falls by 2.4% and prepayment rises by 3.5%. Evidence from Delhi points to an even larger 4.42% reduction in mortgage delinquency alongside a 1.38% increase in prepayments. Complementary vehicle registration data indicate that these gains are driven by reduced reliance on private automobiles. Beyond improved repayment behaviour, the results also suggest a broad-based reduction in household indebtedness and a decline in average debt burdens. Overall, investments in urban mobility infrastructure over the last decade —particularly metro rail expansion—have translated into stronger household liquidity management and more disciplined borrowing. These behavioural improvements form a critical foundation for household financial resilience and contribute meaningfully to broader financial stability.

JEL classification: D1, G2, L9, R4

Keywords: Metro, Transit, Infrastructure, Household Finance, Mortgage, Delinquency, Prepayment

[1] https://pmgatishakti.gov.in/pmgatishakti/about_pmgati

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1. Introduction

India's aspiration to become a $5 trillion economy and a developed nation by 2047 has placed public infrastructure at the center of its growth strategy. Over the past decade, the country has undertaken an unprecedented expansion in physical and digital infrastructure, reflecting a strategic shift toward a capex-led development model. While the growth effects of infrastructure investment are well documented, considerably less is known about its microeconomic consequences for household financial behavior and credit outcomes—an omission that is particularly relevant in rapidly urbanizing economies such as India.

Public infrastructure operates as a productive public good, generating spillovers that extend beyond direct usage. By reducing transaction costs, compressing economic distance, and improving access to markets and services, infrastructure raises the productivity of private capital and labor. In urban contexts, transport infrastructure plays a pivotal role by shaping commuting costs, residential choices, labor market access, and household expenditure patterns. These channels suggest that infrastructure investments may influence not only mobility and productivity but also household balance sheets and financial resilience.

This paper studies one such underexplored channel: the impact of urban metro expansion on household mortgage repayment behavior. Our analysis is motivated by emerging evidence that sustainable transport infrastructure can alter recurring household expenditures, particularly those related to private vehicle ownership and usage. When mobility costs decline, households experience improvements in cash-flow liquidity, potentially enabling better debt servicing and lower default risk. Understanding this mechanism is of first-order policy importance in countries where urban housing is increasingly mortgage-financed and household leverage is rising.

We build on recent evidence from Delhi (*"Mortgages, Subways and Automobiles"*, Sumit A. et al., 2025), which shows that households gaining access to new metro stations exhibit lower mortgage delinquency and higher prepayment rates. These effects are driven primarily by reductions in vehicle-related expenditures and a substitution away from costly private transport. The findings highlight a novel financial spillover of transit infrastructure: by smoothing household cash flows, metro access improves credit performance and strengthens household balance sheets, with potential implications for financial system stability.

This paper extends that analysis to Bengaluru and Hyderabad—two of India's fastest-growing metropolitan areas that are currently undergoing phased metro expansion. Extending the analysis beyond Delhi is crucial for both identification and external validity. Delhi represents a mature transit system where the benefits of metro access are likely to have been capitalized into housing prices and long-run location choices. In contrast, Bengaluru and Hyderabad are characterized by incomplete and evolving metro networks, allowing us to capture transitional effects at the margin as households actively reoptimize commuting behavior, vehicle ownership and expenditure decisions.

These cities also provide an economically salient setting. Rapid in-migration, IT-led income growth, and binding land constraints have made Bengaluru and Hyderabad among the most expensive housing markets in India. Households in these cities typically face high EMI-to-income ratios, rendering mortgage performance particularly sensitive to changes in non-housing expenditures. At the same time, both cities have historically exhibited heavy reliance on private vehicles—especially two-wheelers and entry-level cars—implying substantial recurring costs related to fuel, maintenance, insurance, and financing. Metro expansion in this context offers a plausibly exogenous shock to mobility costs, enabling us to identify a key behavioral adjustment channel.

Using administrative data on home loans, vehicle registrations, and metro openings, this paper employs a difference-in-differences framework to estimate the causal impact of improved metro accessibility on mortgage delinquency and prepayment behavior. We show that metro expansion leads to a statistically and economically significant decline in delinquency rates and an increase in prepayments. These effects are accompanied by a reduction in new vehicle registrations, particularly among non-transport two-wheelers and light motor vehicles, consistent with a substitution away from private mobility and a decline in durable and recurring transport expenditures.

Our findings contribute to three strands of literature. First, we add to the infrastructure and urban economics literature by documenting a financial channel through which transport investments affect household outcomes. Second, we contribute to the household finance literature by showing how reductions in recurring expenditures—rather than income shocks—can materially improve debt repayment behavior. Third, we speak to the growing literature on macro-financial linkages by highlighting how urban infrastructure can indirectly enhance financial stability through improved household credit performance.

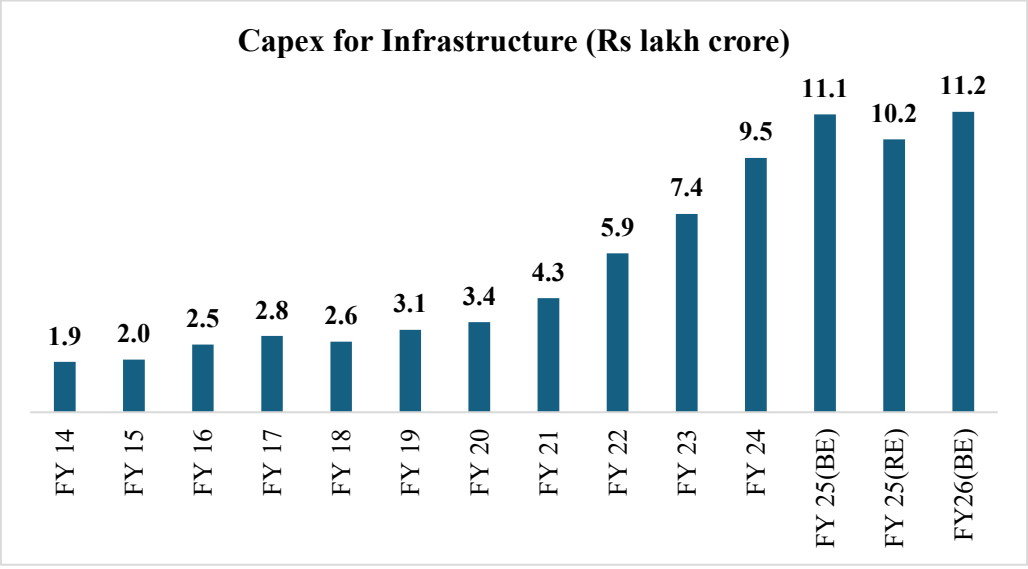
From a policy perspective, our results suggest that metro investments as has been done over the last decade yield returns beyond mobility, environmental sustainability, and productivity. By improving household financial resilience and reducing mortgage risk, urban transit infrastructure can complement housing finance, urban planning, and financial stability objectives. These insights are particularly relevant as India is continuously scaling up metro investments across rapidly urbanizing cities where housing costs are high, transit networks are incomplete, and private vehicle dependence remains pervasive.

The remainder of the paper proceeds as follows. Section 2 discusses the institutional and fiscal enablers of infrastructure development in India. Section 3 documents the progress of infrastructure expansion over the past decade. Section 4 provides an overview of India's metro rollout. Section 5 presents the empirical strategy and results on mortgage delinquency and prepayment behavior. Section 6 concludes with policy implications and directions for future urban planning.

2. Major Enablers of Infrastructure Development

2.1 Expenditure on Infrastructure

India needs a persistent boost of infrastructure investment over the next two to three decades to maintain a high rate of growth. The total infrastructure investment in India has significantly increased with public and private sector contributions shaping the growth trajectory. The thrust to infrastructure remains intact since FY14 and the capital expenditure has increased from Rs 1.9 lakh crore in FY14 (~1.7% of GDP) to Rs 11.2 lakh crore in FY26 (BE), which is ~3.2% of GDP.



Source: Union Budget Documents

The capital expenditure (capex) goes up to Rs 19.8 lakh crore factoring grants to states and CPSE capex, which is almost 5.5% of GDP. The FY26 (BE) numbers are almost 2.8 times the total capex of FY16, indicating Government's endless attention regarding infrastructure development.

Capital Expenditure (Capex) Arithmetic (Rs lakh Cr)											
	FY16	**FY17**	**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25 (RE)**	**FY26 (BE)**
1.Total Capex through Budget	2.5	2.8	2.6	3.1	3.4	4.3	5.9	7.4	9.5	10.2	11.2
2. Grants for creation of capital assets	1.3	1.7	1.9	1.9	1.9	2.3	2.4	3.1	3.0	3.0	4.3
3. Capex by CPSE(IEBR)	3.1	3.4	6.1	6.1	6.4	4.8	4.4	3.6	3.9	3.8	4.3
4. Effective Capex (1+2)	3.8	4.5	4.5	5.0	5.2	6.6	8.4	10.5	12.5	13.2	15.5
5. Capex by budget and CPSE (1+3)	5.6	6.2	8.7	9.2	9.8	9.0	10.3	11.0	13.4	14.0	15.5
6. Grand Total Capex (1+2+3)	7.0	7.9	10.6	11.1	11.6	11.3	12.7	14.1	16.4	17.0	19.8
% of GDP	5.1	5.1	6.2	5.9	5.8	5.7	5.4	5.2	5.5	5.1	5.5
Source: Union Budget Documents											

In this regard it is pertinent to mention the multiplier effect of capital expenditure on output. While various research studies provide different estimates of capital expenditure multiplier (due to diversity in methodologies and timer-period), almost all studies indicate that capital expenditure multiplier is more than 1.0 in the case of India. Bose and Bhanumurthy (2013) estimate the value of capital expenditure multiplier at 2.45. This indicates that an increase in capital expenditure of the government by Rs 1 crore would raise the GDP by Rs 2.45 crores by the end of the year, where both are measured in nominal terms.

2.2 PM GatiShakti National Master Plan (PMGS-NMP)

PM GatiShakti National Master Plan (PMGS-NMP)[2] was launched on 13th October 2021 for providing multimodal connectivity infrastructure to various economic zones. PM GatiShakti is a transformative approach for economic growth and sustainable development. It is designed to bring together various Ministries, including Railways and Roadways, to ensure integrated planning and coordinated execution of infrastructure projects. The initiative aims to provide seamless and efficient connectivity for the movement of people, goods, and services across various modes of transport, thereby enhancing last-mile connectivity and reducing travel time. This project has onboarded 44 Central Ministries and 36 States/UTs so far and a total of 1,652+ data layers have also been integrated. A milestone of assessing 208 big-ticket infrastructure

[2] https://pmgatishakti.gov.in/pmgatishakti/about_pmgati

projects worth Rs. 15.39 lakh crores of various Ministries adhering to PM GatiShakti principles have been achieved (PIB, Feb'25).

India's World Bank Logistics Performance Index (LPI) ranking improved by 6 places from 44 in 2018 to 38 out of 139 countries in 2023. To complement PM GatiShakti, National Logistics Policy (NLP) was launched in September 2022. Over the past three years, NLP has catalysed reforms across the logistics ecosystem, driving improvements in digital integration, skill development, policy alignment, and infrastructure planning. These initiatives have contributed significantly to enhancing efficiency and reducing logistics costs across domestic and international supply chains.

Aligned with the PM GatiShakti National Master Plan, the National Logistics Policy focuses on strengthening soft infrastructure, advancing digitization, fostering human resource development and enabling regulatory reforms. Its key objectives are to reduce logistics costs to global benchmarks, improve India's ranking in the Logistics Performance Index (LPI) to the top 25 by 2030, and establish a robust, data-driven decision support system to ensure an efficient and integrated logistics ecosystem.

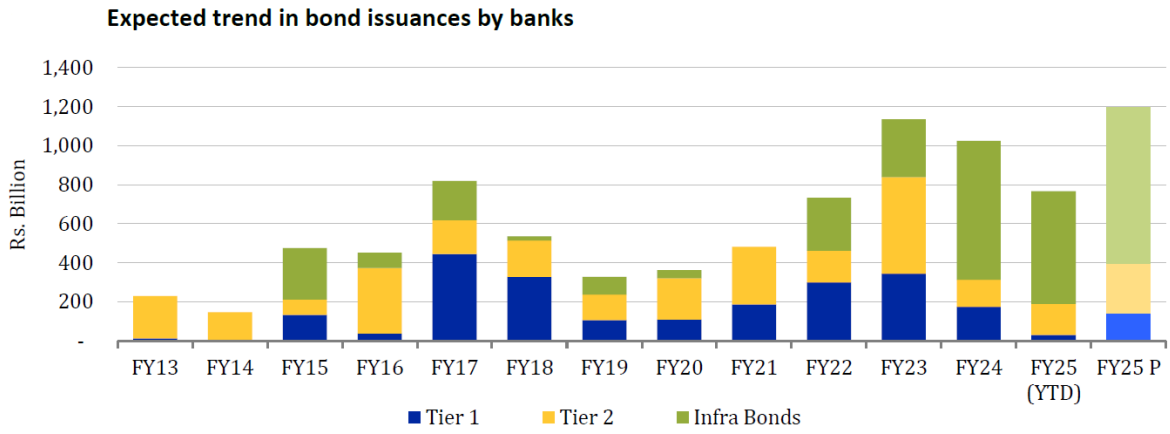
2.3 Infrastructure Bonds

Infrastructure bonds are defined as bonds issued to finance infrastructure projects of public interest such as railways, highways, and airports, among others. It is necessary for emerging economies to develop a market for infrastructure bonds that can raise the capital needed for infrastructure projects. In this regard India has made considerable progress.

ICRA in its press release[3] on September 24, 2024 indicate that, "*In the past, banks' bond issuances were dominated by Tier 1 and Tier 2 instruments to help boost capitalisation metrics, especially when they were facing low profitability amid asset quality challenges. However, from FY2023 onwards, issuances of infrastructure bonds have gained traction, as profitability has improved, thereby limiting the need to raise capital through this route. With availability of a more stable and granular depositors' base, the PSBs have now more wherewithal to provide long-term funding and usually have a larger share in the infrastructure sector than private banks (PVBs). Banking sector advances to the infrastructure sector are estimated at Rs. 13-14 trillion as on June 30, 2024 of which the PSBs have a lion's share of around 75%. Banks are*

[3] https://www.icra.in/CommonService/OpenMediaS3?Key=6e896184-6fc6-4cbf-9f81-4855fd5d489a

expected to continue to fund the infrastructure sector growth and infrastructure bonds remain a key tool for raising long-term resources to fund this portfolio".



Source: AIMIN, ICRA Research; P is projected; FY25 (YTD) – till Sep 20, 2024

2.4 Interest Free Loans for Capital Expenditure

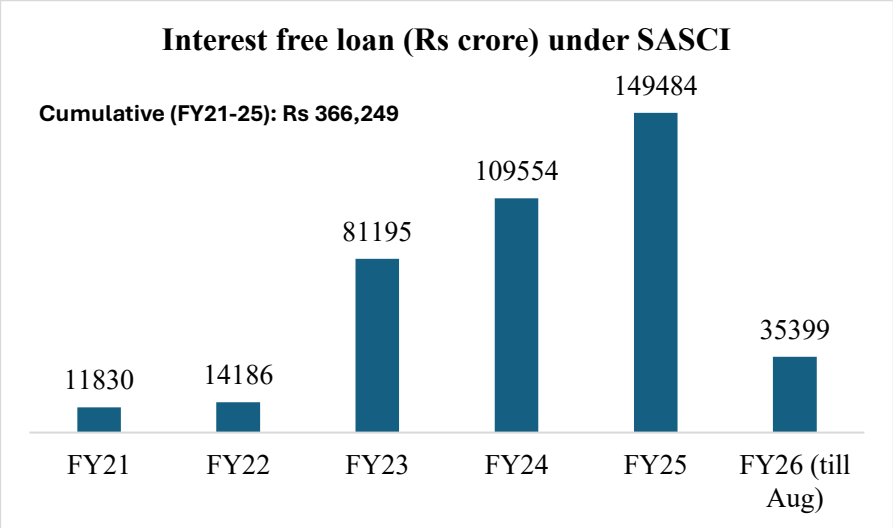
Capital expenditure has a high multiplier effect, enhances the future productive capacity of the economy and results in a higher rate of economic growth. In the financial year FY21, despite the adverse financial position of the Central Government because of COVID it was decided to launch a "Scheme for Special Assistance to States for Capital Expenditure". Under the scheme, financial assistance was provided to the State Governments in the form of 50-year interest free loan. An amount not exceeding Rs 12,000 crore was earmarked for the Scheme for the financial year FY21, and a sum of Rs 11,830 crore was released to the States. The Scheme was continued in the year 2021-22 with an allocation of Rs 15,000 crore of which Rs 14,186 crore was released to the States[4].

In view of the positive response to the Scheme and considering the requests of the State Governments, the Government of India decided to launch a redesigned and expanded Scheme for the year FY23. An amount of Rs 1 lakh crore was allocated for the Scheme for FY23 (of which Rs 14,186 crore was released). Under the Scheme, financial assistance is being provided to the State Governments in the form of 50-year interest free loan for capital investment projects. The loan provided under the Scheme will be over and above the normal borrowing ceiling allowed to the States.

[4] https://sansad.in/getFile/loksabhaquestions/annex/179/AU208.pdf?source=pqals

With an outlay of Rs 1.5 lakh crore, 50-year interest free loans to states for capital expenditure, the Union Budget 2025-26 has continued the fiscal decentralization of capital expenditure started since COVID-19.

Since FY21, the Central government has sanctioned over Rs 3.7 lakh crore as 50-year interest-free loans to States (till FY25), and incentivised increased capex under the Scheme for Special Assistance to States for Capital Investment (SASCI). With this endeavour, 22 states of India have recorded more than 10% growth in capital expenditure from their own resources[5].



State-wise data indicate that top five states (Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan and Maharashtra) accounted for ~45% of cumulative interest free loan (FY21-25).

Interest Free Loans under Scheme for Special Assistance to States for capital expenditure/investment (in Rs crore)							
State	FY21-25		FY26*	State	FY21-25		FY26*
	Rs crore	Share	Rs crore		Rs crore	Share	Rs crore
Andhra Pradesh	19288	5.3%	2010	Manipur	2977	0.8%	0
Arunachal Pradesh	7003	1.9%	0	Meghalaya	5193	1.4%	279
Assam	18582	5.1%	2061	Mizoram	2902	0.8%	0
Bihar	34151	9.3%	3136	Nagaland	3577	1.0%	0
Chhattisgarh	13120	3.6%	1400	Odisha	11539	3.2%	1967
Goa	2743	0.7%	492	Punjab	3588	1.0%	529
Gujarat	14975	4.1%	1434	Rajasthan	24943	6.8%	2669

[5] https://economictimes.indiatimes.com/news/india/rs-3-6-lakh-crore-sanctioned-to-states-as-50-year-interest-free-loans-india-gcc-story-is-transformational-journey-finance-minister-nirmala-sitharama/articleshow/123946970.cms?from=mdr

Haryana	4654	1.3%	0	Sikkim	3591	1.0%	141
Himachal Pradesh	5881	1.6%	452	Tamil Nadu	17189	4.7%	1599
Jharkhand	10786	2.9%	0	Telangana	7749	2.1%	897
Karnataka	13331	3.6%	1556	Tripura	3018	0.8%	293
Kerala	4938	1.3%	657	Uttar Pradesh	46838	12.8%	6066
Madhya Pradesh	35254	9.6%	2618	Uttarakhand	6430	1.8%	380
Maharashtra	21469	5.9%	2230	West Bengal	20540	5.6%	2534
Total					**366249**	**100.0%**	**35399**
Source: Lok Sabha Unstarred Question No. 4087,18 Aug'25, RBI, States Budget documents, MOSPI; * till 11.08.2025							

2.5 Other Initiatives

The government has also instituted many complementary mechanisms to expedite planning, clearances and execution of infrastructure projects. The National Infrastructure Pipeline (NIP) was launched with a forward-looking approach, targeting a projected infrastructure investment of around ₹111 lakh crore from FY20 to FY25. The NIP serves as a centralised platform for hosting projects of states, union territories and central ministries to facilitate their monitoring and review[6]. As per latest data, it encompasses over 15,345 projects and schemes across 62 sub-sectors[7].

The government is bringing in innovative framework for attracting investment in infrastructure projects. Pursuant to the announcement made in the Union Budget 2021-22, the National Monetisation Pipeline (NMP) - listing potential core assets of Central Government Ministries/PSEs for monetization during the period FY22 to FY25 - was launched in August 2021, to boost private investment in brownfield assets. This initiative laid down the framework for monetisation policy and identified a pipeline of potential core assets with an indicative value of Rs 6.0 lakh crore for the period FY22 to FY25[8]. The Government has closed its four-year National Monetisation Pipeline (NMP) programme with total proceeds of Rs 5.8 lakh crore — marginally short of the Rs 6 lakh crore target for FY22 to FY25[9]. Sector-wise, roads, power, coal, and mines led the performance, supported by market-tested models and reforms[10].

[6] https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap06.pdf
[7] https://indiainvestmentgrid.gov.in/national-infrastructure-pipeline
[8] NITI Aayog (2018). Transforming India's mobility: A perspective
[9] https://www.moneycontrol.com/news/business/economy/govt-closes-fy22-25-asset-monetisation-programme-slightly-short-of-target-at-rs-5-8-lakh-crore-13046140.html
[10] https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap06.pdf

Looking ahead, the government is preparing the second leg of its asset monetisation plan. Union Finance Minister in Union Budget 2025-26 stated that "*Building on the success of the first Asset Monetization Plan announced in 2021, the second Plan for 2025-30 will be launched to plough back capital of Rs 10 lakh crore in new projects*".

3. Progress made During Last Decade

India's physical infrastructure has seen rapid progress in the last decade. Either it is highways, airports or railways, India has made stride in very aspect. Almost all major indicators of infrastructure exhibited increase of minimum 2 times in the last decade.

India now boasts the world's largest road network at over 66.71 lakh km (PIB, Jan'24) with National Highways of 1,46,145 km, State Highways of 1,79,535 km and Other Roads of 63,45,403 km.

National Highways play a very important role in the economic and social development of the country by enabling efficient movement of freight and passengers (carrying more than 70 % of freight and 85% of passenger traffic) and improving access to markets. National Highway (NH) network increased by ~60% from 91,287 km in 2014 to 1,46,145 km in 2024.

India's aviation sector is experiencing a meteoric rise, fueled by soaring demand and the government's unwavering commitment to its growth through supportive policies. This dynamic shift has propelled India to the forefront of the global aviation ecosystem, becoming the third-largest domestic aviation market in the world.

By reviving existing airstrips and airports, UDAN (Ude Desh ka Aam Nagrik), launched in 2016, aims to bring essential air travel access to previously isolated communities and boost regional economic development. With a ten-year operational plan, UDAN intends to ensure equitable access to air travel for all Indians. As of April 2025: (i) More than 1.49 crore passengers have benefited from the scheme, (ii) Around 3 lakh flights have operated under the scheme so far, (iii) 625 UDAN routes have been operationalized, connecting 90 airports (including 2 water aerodromes, and 15 heliports) across India[11].

The Maritime Sector in India comprises of Ports, Shipping, Shipbuilding, Ship repair and Inland Water Transport Systems. In India, there are total 12 government owned major ports and approximately 217 minor and intermediate ports. Indian Shipping Industry has over the years

[11] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2124459&reg=3&lang=2

played a crucial role in the maritime sector of India's economy. Approximately 95% of the country's trade by volume and 70% by value is moved through Maritime Transport.

Indian Railways, the premier transport organization of the country is the largest rail network in Asia and the world's second largest under one management[12]. With more than 1.2 million employees, it is the world's ninth-largest employer and India's second largest employer[13]. The daily average number of train services on the Indian Railways network is 11,740 (November 2025) as against 11,283 services operating prior to Covid-19. The daily average number of Mail/Express services on the Indian Railways network is 2,238 (November 2025) as against 1,768 services operating prior to Covid-19. At present, 164 Vande Bharat train services having Chair Cars are operational on the Indian Railways network[14].

Major Indicators	2014 / 2014-15	2024 / 2024-25 or Latest	Times Increase
Highways and Roads			
National Highway (NH) network	91,287 km	1,46,145 km	1.6x
NH with four or more lanes	18,371 km	48,422 km	2.6x
Operational High-Speed Corridors	93 km	2,138 km	23.0x
NH construction pace	12.1 km/day	33.8 km/day	2.8x
Roads completed under PMGSY	4,19,358 km	7,71,950 km	5.9x
Expenditure under PMGSY	₹130,149 crore	₹ 331,584 crore	2.5x
Civil Aviation			
Number of operational airports	74	157	2.1x
Number of aircrafts	400	723	1.8x
Passenger flown domestic	6.03 crore	16.62 crore	2.8x
Passenger flown international	1.88 crore	3.37 crore	1.8x
Cargo carried domestic	3.9 lakh tonnes	8.1 lakh tonnes	2.1x
Cargo carried international	2.5 lakh tonnes	3.2 lakh tonnes	1.3x
Shipping and Ports			
Cargo handling capacity (per annum)	800.5 million tonnes	1,630 million tonnes	2.0x
Rank in International Shipment	22nd	44th	-
Number of employed seafarers	1.17 lakhs	2.85 lakhs	2.4x
Number of ships/vessels	1,250	1,526	1.2x
Turn Around Time (TRT) of major Ports	94 hours	48.1 hours	-
Railways and Metro			
Number of stations equipped with CCTV	123	1051	8.5x
Operational Metro Rail Network	248 Km	1,025 Km	4.1x
Running track line length	90,803 Km	1,09,748 Km	1.2x
Electric route length	22,224 Km	62,253 Km	2.8x

[12] https://indianrailways.gov.in/railwayboard/view_section.jsp?lang=0&id=0,1
[13] https://en.wikipedia.org/wiki/Indian_Railways
[14] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2201557&reg=3&lang=2

Total Wagon capacity	14 million tonnes	20 million tonnes	1.4x
Railway Freight earning	Rs 1.1 lakh crore	Rs 2.0 lakh crore	1.8x
Passenger earnings	Rs 0.4 lakh crore	Rs 1.0 lakh crore	2.2x
Source: Various Government Documents			

4. Metro Rail Revolution in India

From the first tracks laid in Delhi's expanding suburbs in the early 2000s to the bustling, tech-powered networks now weaving more than 20 Indian cities, India's metro story is a symbol of its urban awakening. What began as a cautious step into mass rapid transit has evolved into a nationwide movement, streamlining daily commutes, reducing city congestion and reshaping skylines. The metro is no longer just a mode of transport; it is a lifeline pulsing through the heart of India's growth story, driven by ambition, innovation, and a vision of sustainable urban living. India now proudly stands as the world's third-largest metro network, reflecting its rapid strides in urban transit expansion.

To accelerate urban mobility and ensure sustainable transit solutions, the Government of India has launched several transformative initiatives. These steps[15] aim to ensure that metro projects are sustainable, economically viable, and technologically advanced:

Metro Rail Policy, 2017: The Metro Rail Policy 2017 mandates cities to prepare Comprehensive Mobility Plans (CMPs) and establish Urban Metropolitan Transport Authorities (UMTAs) to guide the development of metro systems with a strong emphasis on sustainability, economic viability, and integrated urban mobility. To qualify for central financial assistance, metro projects must ensure a minimum Economic Internal Rate of Return (EIRR) of 14% and involve mandatory private sector participation through Public-Private Partnerships (PPP).

Make in India for Metro Rail Systems: As part of the ambitious Make-in-India drive, the government has made provisions for domestic procurements of at least 75% of metro cars and 25% of key equipment and sub-systems—a bold step to boost local production and foster self-reliance in the mobility sector. In the last ten years, India has invested nearly ₹2.5 lakh crore (US$ 28.86 billion) into expanding its metro network. This momentum has powered the local manufacturing of metro coaches. Bharat Earth Movers Limited (BEML), a Public Sector Undertaking (PSU) under the Ministry of Defence, has supplied over 2,000 metro coaches

[15] https://www.pib.gov.in/PressNoteDetails.aspx?NoteId=155002&ModuleId=3&reg=3&lang=2#:~:text=Metro%20Rail%20Policy%2C%202017,viability%2C%20and%20integrated%20urban%20mobility.

across cities like Delhi, Jaipur, Kolkata, Bengaluru, and Mumbai as of May 2024 strengthening domestic capabilities and reducing dependence on imports.

Global Partnerships: Global Partnerships are also steering the growth of the Metro Network in the country. One such project, the Mumbai Metro Line 3 (MML-3), which has recently started (all phases), is expected to transform urban transit with a massive investment of ₹23,136 crore (US$ 2.67 billion). A significant share of ₹13,235 crore (US$ 1.53 billion), or 57.2% of the total funding, is being provided as loan assistance by the Japan International Cooperation Agency (JICA). The rest of the funding is being jointly contributed by the Government of India, the Maharashtra State Government/ Mumbai Metropolitan Region Development Authority (MMRDA), making it a strong example of international and domestic collaboration in infrastructure development.

Green Urban Mobility: India's metro rail systems are embracing green innovations. The Delhi Metro has installed a vertical bi-facial solar plant on an elevated viaduct at Okhla Vihar and a 1 MW rooftop solar plant at Khyber Pass depot, pioneering land-free renewable energy use. Other green initiatives like regenerative braking systems, widely adopted across metros, help save power and reduce carbon emissions by converting braking energy into electricity. Additionally, many metro stations in cities like Delhi, Kochi, Nagpur, and Pune have received Indian Green Building Council (IGBC) Certifications, promoting eco-friendly infrastructure. These efforts align with India's sustainability goals and demonstrate the metro's growing role in clean urban mobility.

4.1 Operational Footprint

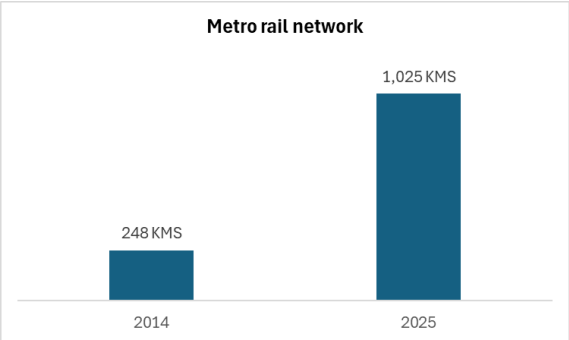
Owing to above initiatives, India's operational metro network has soared from 248 km across 5 cities (in 2014) to 1,025 km across 20 cities by Oct 2025, adding 777 kms in just 11 years. Almost 650 km metro network is currently under-construction stage. Bhopal Metro is the latest one to start operation and is expected to begin its service from 21 December 2025 onwards.

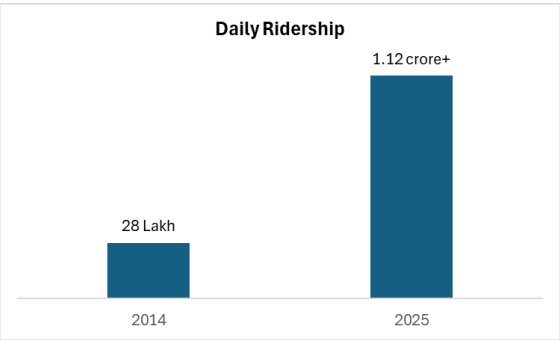
Average daily ridership has climbed from 28 lakh (2013–14) to over 1.12 crore, marking a transformative shift in urban commuting.

Operational Metro Network (in KM)			
City	State	Operational	Under Construction
Agra	Uttar Pradesh	5.2	24.2
Ahmedabad	Gujarat	58.7	9.6
Bengaluru	Karnataka	96.1	79.4

Chennai	Tamil Nadu	54.7	118.9
Delhi	NCR-Delhi	353.2	65.1
Gurgaon	NCR (Haryana)	12.1	28.5
Hyderabad	Telangana	69.2	0.0
Indore	Madhya Pradesh	6.2	27.3
Jaipur	Rajasthan	12.0	0.0
Kanpur	Uttar Pradesh	16.0	16.4
Kochi	Kerala	28.8	10.5
Kolkata	West Bengal	73.4	31.5
Lucknow	Uttar Pradesh	22.9	0.0
Mumbai	Maharashtra	80.0	121.4
Mumbai Monorail	Maharashtra	19.5	0.0
Navi Mumbai	Maharashtra	11.1	0.0
Nagpur	Maharashtra	40.0	41.6
Noida	NCR-Uttar Pradesh	29.7	0.0
Patna	Bihar	3.6	28.9
Pune	Maharashtra	33.0	33.3
Total		**1025.3**	**636.7**
Source: https://metrorailtoday.com/page/metro-rail-projects-in-india			

The pace of commissioning new lines has accelerated ninefold: from 0.68 km/month (pre-2014) to approximately 6 km/month today. The annual metro budget for FY26 is ₹34,807 crore, up more than six times from ₹5,798 crore in FY14.





Source: PIB

4.2 Innovations in India's Metro Rail Network

India's metro systems are not just expanding in size, they are evolving in intelligence. With a strong push toward automation, digitalization, and sustainability, metros across the country are embracing new technologies.

Innovation	Description
Namo Bharat Train	• India's first state-of-the-art high-speed regional train. • Runs at 160 km/h operational speed (design speed: 180 km/h). • Deployed on Delhi–Meerut Regional Rapid Transit System (RRTS)
Underwater Metro	• In 2024, India achieved a major milestone by launching its first underwater metro tunnel in Kolkata, connecting the Esplanade to Howrah Maidan beneath the Hooghly River. • This engineering marvel stands as a symbol of India's growing technological and infrastructural prowess.
Water Metro	• Kochi, Kerala, became India's first city to launch a Water Metro. The Water Metro connects 10 islands using electric-hybrid boats for seamless and eco-friendly transport. • Under the proposed Mumbai Water Metro project, 21 terminals will be constructed covering a 200 nautical mile network.
European Train Control System ETCS Level II Signaling	• World's first ETCS Level II with Hybrid Level III system using LTE radio backbone. • Enhance train safety, speed, and real-time monitoring on the Namo Bharat route.
Platform Screen Doors (PSD)	• Co-developed by Bharat Electronics Limited (BEL) and National Capital Region Transport Corporation (NCRTC). • Boosts passenger safety and minimizes platform-level accidents.
National Common Mobility Card (NCMC)	• Unified One Nation, One Card solution. • Enables seamless travel across metros, buses, suburban rail, tolls, and retail.
QR-Based Ticketing	• Mobile app-based QR tickets simplify and digitize the ticketing experience.
Unmanned Train Operations (UTO)	• Driverless tech is functional across multiple stretches of the Delhi Metro, the first of them being introduced on the Magenta Line in 2020. • Improves efficiency and lowers human dependency.
Indigenous Automatic Train Supervision System (i-ATS)	• Developed locally for the first time in India, ATS provides automatic local and central control and monitoring of train operations and signaling. • Jointly created by the Delhi Metro Rail Corporation (DMRC) and BEL, now active on the Red Line of the Delhi Metro.
Source: PIB Press Release 09 AUG 2025	

4.3 Metro Projects in the Pipeline

India's metro expansion continues to gather pace with a wave of new projects in the planning and approval stages. The aim is to improve last-mile connectivity, support urban growth, and offer cleaner, faster, and more inclusive public transport across emerging and established cities. Some of these upcoming projects are:

List of Approved Metro, Metrolite & Metro Neo Projects in India			
City & State	**Network Length**	**Approval Date**	**Total Cost**
Bhubaneswar Metro, Odisha	26 km	Nov-23	Rs. 5926 crore
Gorakhpur Metrolite Uttar Pradesh	27.41 km	Oct-20	Rs. 4,672 crore
Kozhikode Metrolite, Kerala	13.13 km	Feb-21	Rs. 4,673 crore
Nashik Metro Neo, Maharashtra	32 km	Aug-19	Rs. 2100 crore
Trivandrum Metro, Kerala	21.82 km	Feb-21	Rs. 2,773 crore
Source: https://themetrorailguy.com/metro-rail-projects-in-india/			

5. Case Study on how Metro network Positively Influences Home-Loan Delinquency Behaviour: A Difference-in-Differences Analysis

Public infrastructure forms the foundation on which urban economies grow, shaping productivity, mobility, and access to opportunity. India is entering a decisive phase of urbanisation, with more than 40% of its population expected to live in cities by 2030 as per Economic Survey FY24 making the quality and reach of urban infrastructure more critical than ever. Investments in transport networks, utilities, digital connectivity, and social infrastructure reduces transaction costs, improves market integration, and crowding in private investment. High-quality infrastructure expands the effective labour market, enables firms to operate more efficiently, enhances total factor productivity and raises household welfare through time savings and reduced uncertainty. (Conrad K. & Seitz H., 2006).

The impact of public infrastructure on social and economic outcomes is well documented. Public transits lead to low congestion with individual choices having high marginal impact (Anderson, M.L., 2014). Infrastructure is a powerful public good whose benefits spill into higher incomes, improved quality of life, stronger urban productivity, and substantial fiscal gains that justify large public investment (David A.and Farahani.A., 2017).

Infrastructure investment has a large and persistent multiplier because it relaxes bottlenecks, raises productivity across the economy, and crowds in private investment. By improving the efficiency of production and enhancing household welfare, well-executed infrastructure spending delivers gains far exceeding its upfront fiscal cost, making it one of the most growth-enhancing public expenditures. (Gechert, S., Hallett, A. H., & Rannenberg, A. ,2016).

Furthermore, public transit systems have also shown to have impact on productivity. Research shows that better urban transport can directly raise how efficiently firms operate. When new subway stations open, firms nearby tend to become more productive because employees can commute more easily, arrive on time, and work more efficiently. These benefits are even stronger for firms with a more educated workforce, as improved connectivity helps them make better use of skilled labour. Overall, intra-city transport upgrades translate into noticeable improvements in firm-level productivity. (Chen G. wu W, 2024).

The economic impacts of metro and rail systems operate through network effects and accessibility improvements that extend beyond local station vicinity to influence wider urban systems. Improvements in accessibility reduce generalized travel costs, expand effective labour and consumer markets, and strengthen urban connectivity, which in turn shape land markets, firm behaviour, and spatial economic patterns (Gibbons & Machin, 2005; Levinson, 2025).

But beyond these well-established macroeconomic impacts, public infrastructure also produces a range of indirect behavioural effects at the household level that are often overlooked in policy discussions. By reshaping daily choices, expenditure patterns, and risk exposure, infrastructure investments can influence everything from labour force participation to financial discipline and credit performance. It is in this context that the role of sustainable urban mobility particularly metro systems becomes important, not only as an economic asset but as a mechanism that subtly stabilizes household finances.

Policies that reduce household risk exposure can meaningfully improve financial stability. Currie, Decker, and Hamilton (2023) show that subsidized health-insurance eligibility reduced rent and mortgage delinquency by nearly 25% because households faced lower out-of-pocket expenditure risk and thus fewer liquidity shocks. Their findings illustrate a broader behavioural channel: when policies lower recurring costs, volatility, or uncertainty, households reallocate resources toward timely debt repayment and reduce the likelihood of distress events.

Sustainable urban infrastructure particularly high-quality public transit such as metro corridors can directly influence household financial behaviour by reducing the structural pressures that often lead to delinquency on long-term loans. When cities invest in efficient mass transit, households face a lower need to purchase and maintain private vehicles, which are among the most expensive recurring financial commitments in urban India. A two-wheeler or car loan, along with fuel, insurance, maintenance, and parking costs, can absorb a large share of monthly income, especially for middle-income families servicing a home loan simultaneously. By

enabling reliable, low-cost commuting, sustainable infrastructure effectively frees up liquidity within the household budget, leaving borrowers with greater capacity to meet their EMI obligations on time.

Over time, this reduction in compulsory transportation expenditure can translate into fewer missed payments, lower delinquency risk, and even faster prepayment of outstanding home-loan principal. In this sense, metro expansions and other green mobility investments not only support environmental goals but also act as indirect financial stabilizers for households, improving their repayment resilience and strengthening the broader credit ecosystem.

5.1 Impact of Metro Network on Air Pollution

World Bank[16] indicate that urban areas may account for over 70 percent of global CO_2 emissions, many public policy analysts began advocating for public investment in low-carbon mass transit, particularly in countries that are not yet locked into high-carbon growth paths, as one of the solutions. Plethora of research studies have shown that metro network (or subway) can reduce air pollution substantially. Gendron-Carrier et al., (2022) estimate that for cities with higher initial pollution levels, subway openings reduce particulates by 4 percent in the area surrounding a city center. World bank research (2024) indicates that currently, 192 urban areas are served by subways. After having computed their CO_2 emissions with and without subways with other things equal, the research shows that existing subway systems have cut CO_2 emissions by about 50 percent in those cities, which translates to an 11 percent reduction in all global CO_2 emissions.

Urban metro systems can generate localized improvements in air quality by reducing vehicular emissions. A seminal study on the Delhi Metro examines its impact on transportation-related pollutants during the early phase of operation. Focusing on one of the larger rail extensions, the study finds a substantial 34% reduction in localized carbon monoxide concentrations at a major traffic intersection, indicating a meaningful decline in emissions from road-based transport. (Goel, D. and S. Gupta, 2017).

International studies also document localized air quality improvements following the introduction of urban rail systems. A notable quasi-experimental study on the Taipei Metro exploits the sharp discontinuity in ridership on the system's opening day to identify causal

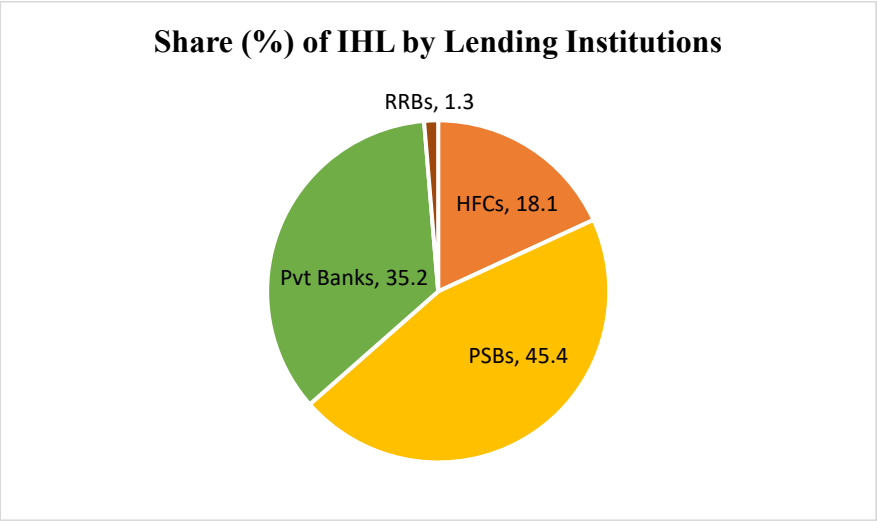
[16] https://blogs.worldbank.org/en/opendata/riding-greener-future-how-widespread-use-subways-could-slash-co2-emissions

impacts on air pollution. The findings indicate that the inauguration of the Metro led to a 5–15 per cent reduction in ambient carbon monoxide concentrations, a key tailpipe pollutant intricately linked to vehicular traffic (Chen, Y. and A. Whalley, 2012)

5.2 India's Mortgage Market

In India, house is not just a roof over head, it is million dreams of the households. To fulfill these dreams, Government has taken several steps and acted as a facilitator to provide affordable housing to both urban and rural areas during the last decade. Some of the major structural reforms, which create demand and supply side interventions, are PMAY-housing for all, implementation of RERA, Goods and Services Tax (GST), interest subvention, tax benefits to both buyers and developers. With all these structural reforms, Indian housing mortgage market is growing rapidly at a CAGR growth of 19% during the last decade and outstanding loans stood at Rs 37.61 lakh crore loans as of end-September 2025, from Rs 9.98 lakh crore in FY15. During the same time, the individual housing loans to GDP (IHL/GDP) ratio has increased to 11.2% from 8.0%.

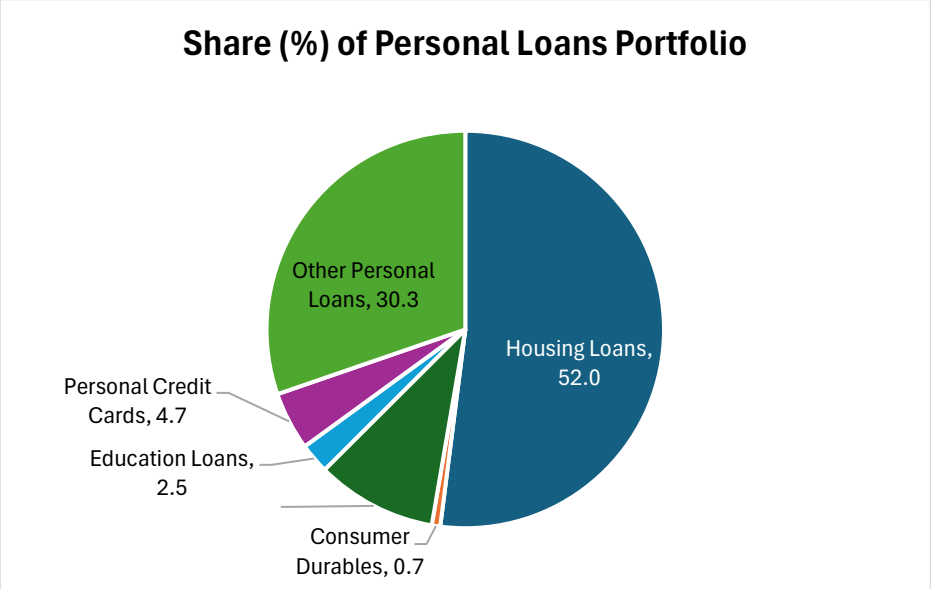
In the Indian housing finance, banks hold a dominant share of 82%, due to their vast network and availability of low cast funds, while HFCs holds around 18% share. As per National Housing Bank (NHB) reports October 2025, Rs 17.07 lakh crore loans held by public sector banks (PSBs), Rs 13.22 lakh crore by private banks (PBs), Rs 49,632 crore by RRBs and Rs 6.81 lakh crore by HFCs.



Source: NHB, RBI, SBI Research

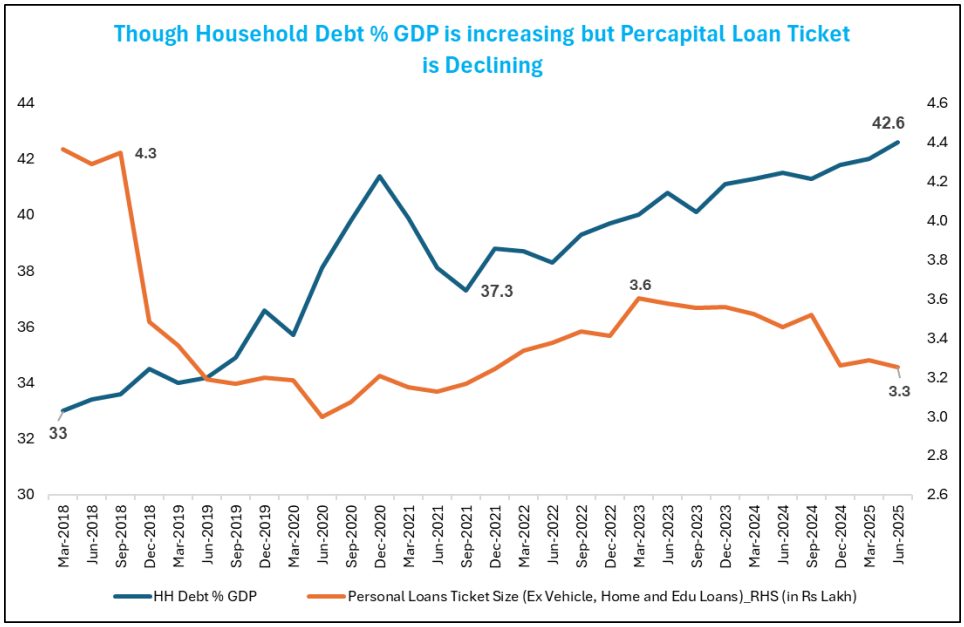
Going forward, the housing finance market is estimated to grow at a CAGR of 15-16% between FY25-FY30 and reach Rs 80-81 lakh crore by FY30, underpinned by long-term structural drives such as improved affordability, rising urbanisation, increasing nuclear families, premiumisation in housing demand, and government initiatives like 'Housing for All'. Further, with the current interest rate easing cycle, when RBI has already reduced repo rate by 125 bps during February to December 2025, the interest cost of the home buyers has reduced significantly, as the loans are linked to external linked benchmarked interest rates which has reduced automatically with the change in repo rate.

The housing loans holds 52% share in personal loans/debt, which are mostly secured and backed by mortgages. Thus, the rise in household debt % GDP to 42.6% in June 2025 from 32.9% in March 2015 is not worrisome at all as two-thirds of the portfolio is of prime and above credit quality.



Source: RBI, SBI Research

By looking at the sector-wise disaggregated data of SCBs indicate that loans amount increased with the increase in number of borrowers from 4.6 crore in March 2015 to 20.8 crore in September 2025. By excluding home loans, and vehicle loans, which are secured, the ticket size has declined to Rs 3.4 lakh in Sep 2025 from Rs 3.6 lakh in March 2020. Thus the household debt increase in overall amount is driven by the growing number of borrowers rather than an increase in average indebtedness. The number of borrowers has increased in the post-covid period mainly due to digitalisation and ease of credit availability through different apps.



Source: BIS, RBI, SBI Research

5.3 A case study of Hyderabad and Bengaluru Metro

Hypothesis: To validate whether the expansion of sustainable urban transit infrastructure alters household financial behaviour through reductions in mobility-related frictions and improvements in economic resilience. We articulate the following testable hypotheses.

H1 (Delinquency Mitigation Hypothesis): The introduction of high-quality public transit infrastructure reduces mortgage delinquency rates as well as delinquency amount in proximate geographies. The underlying mechanism is a relaxation of liquidity constraints and volatility in commuting expenditures, thereby lowering default risk on long-tenure debt instruments. i.e We want to test whether

A. ∂Delinquency rate/∂TransitAccess < 0
B. ∂Delinquency Amount/∂TransitAccess < 0

For the pincodes with intervention. (Intervention here refers to the metro accessibility)

H2 (Prepayment Acceleration Hypothesis): Improved transit access increases mortgage repayment rate. Enhanced spatial accessibility and reduced transport-related costs improve disposable income and household cash-flow stability, enabling borrowers to prepay principal ahead of schedule. Thus, we want to test whether

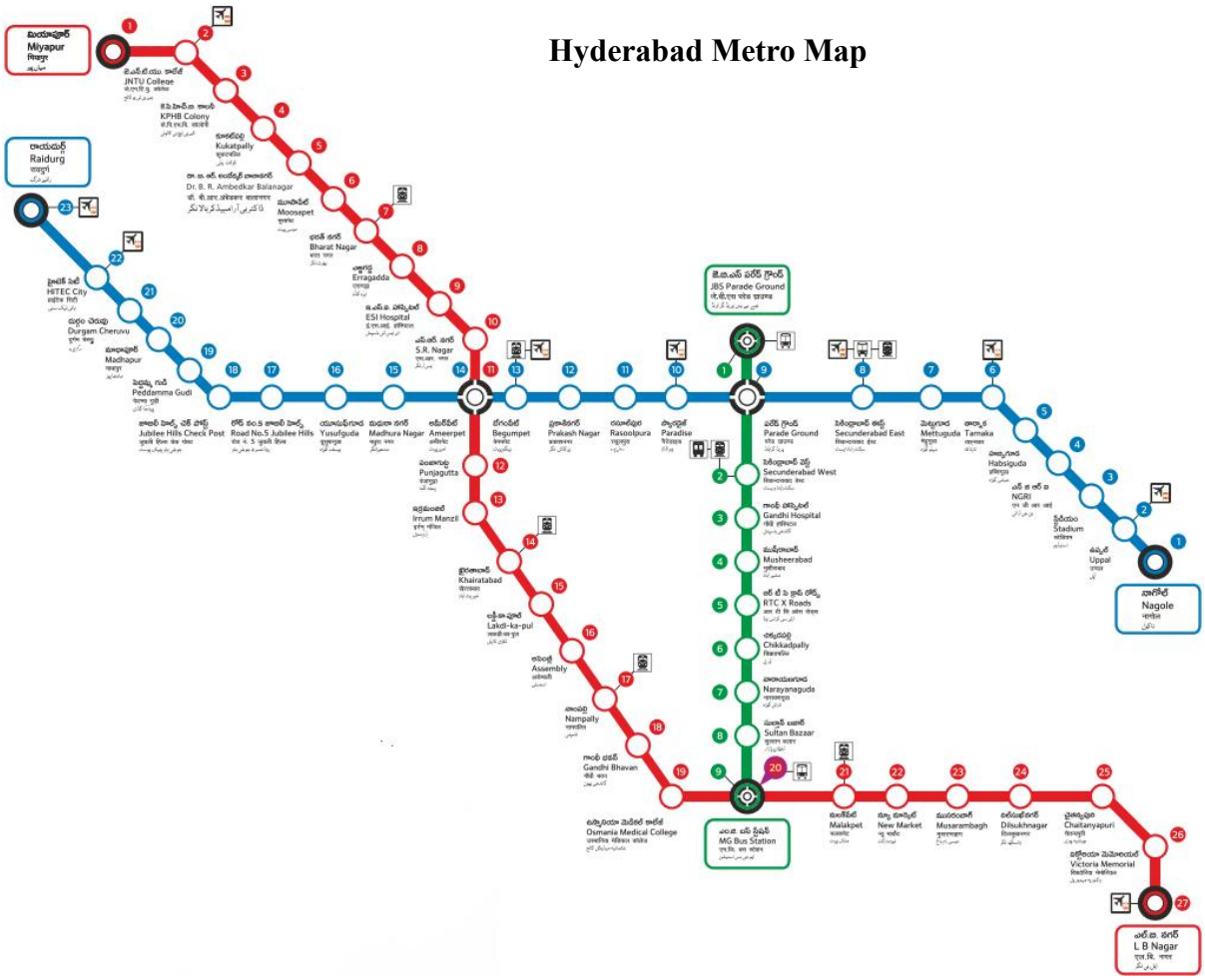
A. ∂Prepayment rate/∂TransitAccess > 0
B. ∂PrepaymAmount/∂TransitAccess > 0

For the pincodes with intervention. (Intervention here refers to the metro accessibility)

H3 (Automobile Dependency Substitution Hypothesis): Transit infrastructure induces a modal shift away from private vehicle ownership, thereby reducing long-term recurring expenditures (fuel, maintenance, insurance). This substitution effect is expected to operate as an indirect channel reinforcing H1 and H2.

The opening of the Hyderabad Metro Red Line from Miyapur to LB Nagar, spanning 28.1 km with 27 fully integrated stations and completed in 2018—marks one of the most transformative additions to the city's urban infrastructure in recent decades. By stitching together dense residential clusters, high-employment corridors, educational hubs, and commercial zones along a seamless, high-frequency transit spine, the corridor significantly reduces travel time, eases road congestion, and enhances last-mile connectivity for nearly every socioeconomic segment. The Red Line effectively acts as a backbone for Greater Hyderabad's urban mobility ecosystem, enabling predictable, low-cost, and environmentally sustainable commuting across the north–south axis of the city. Its integration with feeder services, bus routes, and emerging transit-oriented development (TOD) zones expands the city's usable economic geography—areas that were previously peripheral or poorly connected can now support higher-density housing, retail clusters, and mixed-use commercial development.

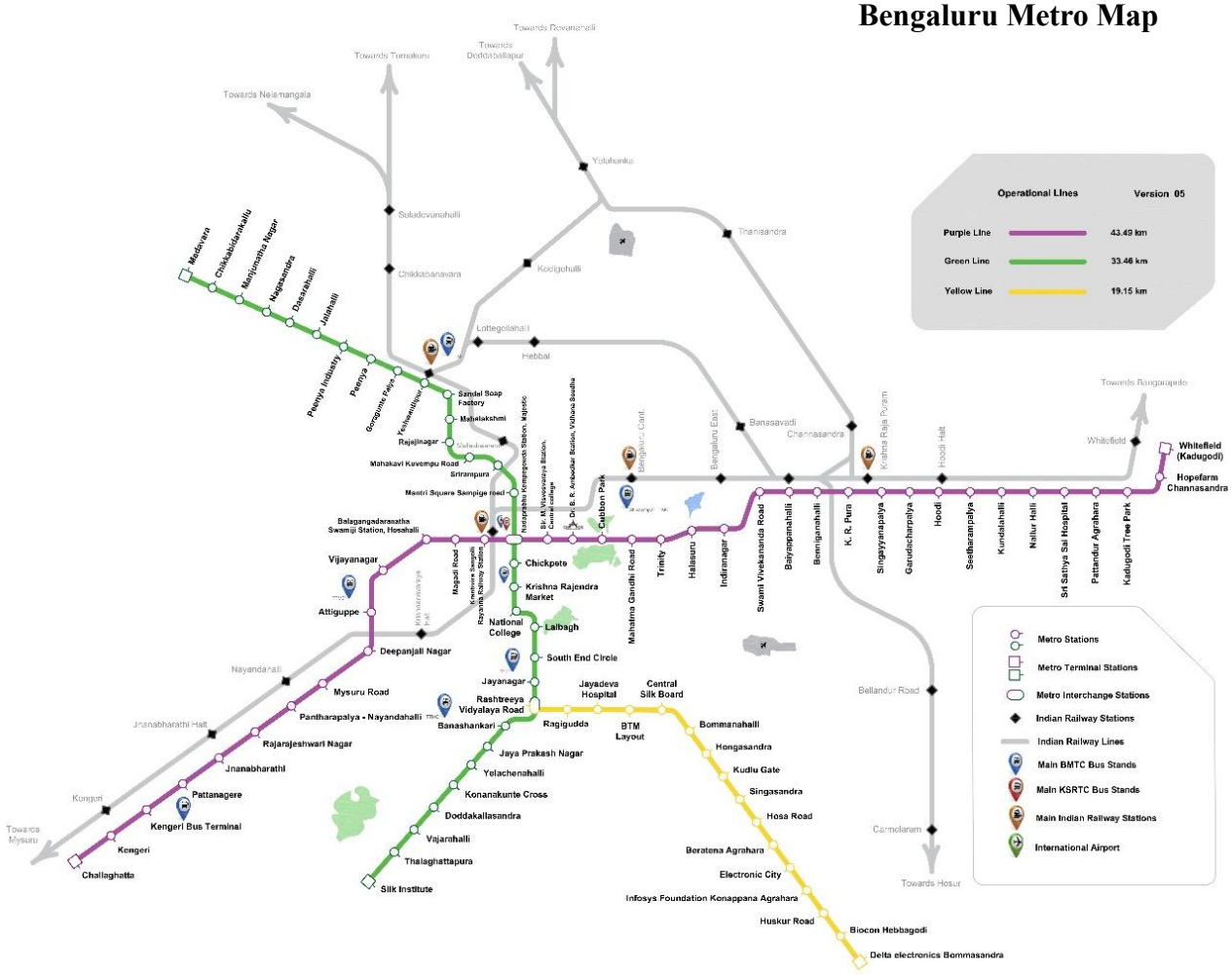
Hyderabad Metro Map



Source: https://ltmetro.com/

The Bengaluru Metro Purple Line, extended under Phase-2 from Challaghatta in the southwest to Whitefield in the eastern IT corridor, has become one of the most consequential pieces of infrastructure shaping the city's urban form. This 13-km stretch with 12 stations, initiated in 2016 and gradually integrated into the broader east–west metro spine, finally links two zones that historically suffered from some of the worst travel bottlenecks in the city—Whitefield, with its dense concentration of IT parks, tech campuses, and growing residential suburbs, and the Mysore Road–Kengeri–Challaghatta belt, which houses large working-class and middle-income communities. By providing a fast, predictable, and fully grade-separated mode of commuting, the expanded Purple Line sharply reduces journey times across these employment hubs, eases pressure on chronically jammed roads like Outer Ring Road, Old Madras Road, and the Whitefield–Mahadevapura corridor, and allows workers to access jobs without being constrained by distance or congestion. In a city where private vehicles once felt unavoidable, the Purple Line offers a genuinely viable alternative, nudging Bengaluru toward a more sustainable and mobility-efficient urban future.

Bengaluru Metro Map



5.3 Impact of Metro on Delinquency and Prepayment

In this analysis, we aim to understand whether living in a metropolitan geography shapes a borrower's delinquency behaviour, using a clean transaction-based reconstruction of repayment stress and a Difference-in-Differences framework that leverages account-level panel variation over time. **Based on empirical evidence from (Agarwal S, et al, 2025) titled Mortgages, Subways and Automobiles, we aim at extending the framework to other cities particularly Hyderabad and Bengaluru.**

We begin by constructing a behaviourally grounded measure of delinquency: for every home-loan account, we compute the mode of all EMI transactions, since borrowers tend to pay a stable EMI amount, and the modal EMI is least distorted by occasional partial payments, reversals, or lump-sum deposits. For each month, we sum all actual payments made by the borrower and compute a net repayment balance as EMI – total payments. A positive balance

indicates the borrower is underpaid and is therefore classified as delinquent, while a negative balance indicates excess payment and is treated as prepayment. From these monthly balances we generate binary indicators Deli_ind and prepay_ind, which take the value 1 if the account is delinquent or prepaid respectively, and 0 otherwise.

To identify the causal impact of metro residence, we divide accounts into treatment and control groups based on their PIN code: accounts mapped to PIN codes in the proximity of metro connectivity constitute the treatment group (treat = 1), while accounts in non-metro regions form the control group (treat = 0). We also designate a post-treatment period using a time dummy (post = 1 for months after a specified cutoff associated with operational, regulatory, or environmental changes relevant to metro borrowers). The DID interaction term treat_post is constructed by multiplying these two dummies, such that treat_post = 1 only for metro accounts in the post period, which allows us to isolate the differential shift in behaviour for metro borrowers after the treatment date relative to the change observed among non-metro borrowers over the same months.

Building on these definitions, our empirical specification employs a high-dimensional difference-in-differences (DID) estimator to recover the Average Treatment Effect on the Treated (ATT or ATET) that is, the causal effect of metro connectivity on repayment behaviour among households actually residing in metro-served PIN codes. In the DID framework, the coefficient on the interaction term treat_post captures the additional change in delinquency or prepayment observed for treated accounts after the metro becomes operational, netting out: (i) all changes over time that simultaneously affect both metro and non-metro borrowers (such as interest-rate cycles, credit-policy shifts, seasonal cash-flow patterns), and (ii) all time-invariant differences across accounts (such as borrower risk appetite, long-run income stability, financial discipline, or historical repayment culture). By absorbing account-level fixed effects, the model restricts identification to within-borrower changes over time, ensuring that the estimated effect reflects how the same borrower's behaviour evolved once metro connectivity became available. Month fixed effects further purge aggregate macroeconomic shocks or institution-wide policy actions.

Thus, the DID coefficient is interpreted as the causal behavioural response of borrowers who gained metro access relative to how they themselves, and a comparable control group, behaved prior to the metro intervention. In practical terms, a negative coefficient on treat_post in the delinquency regression implies that improved commuting efficiency, reduced travel time, and

lower transport volatility enhance borrowers' repayment discipline. Conversely, a positive coefficient on treat_post in the prepayment regression would indicate that metro access relaxes liquidity constraints and frees up disposable income, enabling earlier or more frequent prepayments. In this way, the DID specification provides a clean, policy-relevant estimate of how urban transport infrastructure shapes the financial behaviour of households exposed to it.

This specification corresponds to the equation:

$$\mathbf{Y_{i,\,p,t} = \alpha + \beta\,(Metro_p * Post_{p,t}) + \mu_i + \lambda_t + \epsilon_{i,p,t}}$$

Here, the dependent variable is the natural logarithm of Days Past Due, enabling a proportional interpretation of the treatment effect. The coefficient β is our DID parameter of interest and captures the causal impact of metro residence on delinquency in the post-period, controlling for all fixed borrower characteristics and all aggregate macro-seasonal shocks common to every borrower in that month. $Metro_{p=1}$ if the postal code is within the catchment area of metro. $Post_{p,t}$ equals 1 for periods after the metro in postal code becomes operational. μ_i is account specific fixed effects and λ_t represents time fixed effects.

5.3 Case Study Results: Hyderabad and Bengaluru

Our analysis for Hyderabad indicates that the operationalisation of the 28.1-km Red Line metro corridor generated a clear and economically meaningful improvement in household repayment behaviour in metro-served PIN codes relative to comparable non-metro areas.

The summary statistics for Hyderabad provide a clear descriptive picture of borrower behaviour across the full sample and between metro-exposed (treatment) and non-metro (control) PIN codes. Across all 1,35,180 account-month observations, when comparing groups, accounts located in metro-connected areas have roughly a 37% higher average delinquent balance in treated locations prior to accounting for any causal effects. A similar but milder pattern holds for the delinquency indicator, where 18% of observations in treatment PIN codes are classified as delinquent compared to 15% in control areas.

On the prepayment side, the average prepayment amount is slightly higher for treated accounts by 2%, while the prepayment indicator shows that 38% of treated observations involve prepayment compared to 36% in control PIN codes. These small differences in prepayment behaviour and somewhat larger differences in delinquency levels highlight the importance of applying a causal framework such as DID with fixed effects because the treatment group starts off with slightly higher risk characteristics.

The high-dimensional DID estimates show that the Treat × Post coefficient for log delinquency amount is –0.157, implying that after gaining metro access, borrowers in treated areas experienced roughly a 15–16 percent reduction in the monetary value of delinquent dues, after netting out account-level heterogeneity and all common time shocks. This behavioural improvement is reinforced by the results for the delinquency indicator, where the coefficient of –0.0179 suggests that the treatment group has lower delinquency rate by about 1.8% post-metro relative to the control group. Conversely, metro access appears to ease liquidity frictions and free up disposable income, as reflected in the positive prepayment responses: the Treat × Post coefficient for log prepayment amount is 0.164, indicating a 16% rise in prepayment volumes among treated accounts after the metro opened. The prepayment indicator also rises modestly by 0.018 implying about a 1.8% increase in prepayment rate. Taken together, these results provide compelling evidence that improved connectivity, reduced commuting time, and lower transport volatility associated with the Hyderabad metro have strengthened the financial resilience of borrower households reducing delinquency burdens while simultaneously enabling higher rates of home-loan prepayment.

HDFE regression				
Number of obs = 135,180				
	Log Delinquency (Amount)	Delinquency Indicator	Log Prepayment (Amount)	Prepayment Indicator
Treat * Post	-0.157369	-0.0178852	0.1644	0.0181
	(0.000) ***	(0.001) ***	(0.038) **	(0.0911) *
R-squared	0.4955	0.4723	0.4378	0.4512
Note: Account level and Month level fixed effects have been taken into account				

For Bengaluru, our analysis draws on 94,356 account-month observations, enabling a precise assessment of how the Purple Line Phase-2 metro expansion from Challaghatta to Whitefield influenced household repayment behaviour in metro-served PIN codes relative to comparable non-metro areas. The high-dimensional DID estimates show that the Treat × Post coefficient for log delinquency amount is –0.057, which is statistically insignificant ($p = 0.18$), indicating that although delinquent dues fell slightly for treated borrowers after the metro became operational, the reduction is not strong enough to be distinguished from random variation. However, the delinquency indicator provides clearer evidence of improvement: the coefficient of –0.0247, significant at the 5 percent level, suggests that the likelihood of delinquency

declined by roughly 2.5 percentage points among borrowers residing in metro-connected localities relative to the control group. The responses on the prepayment side are substantially stronger. The coefficient for log prepayment amount is 0.265, significant at the 1 percent level, implying that treated accounts experienced roughly a 26–27 percent increase in prepayment volumes once metro access improved. The prepayment indicator also increases by about 0.035, significant at the 5 percent level, which corresponds to a 3.5-percentage-point rise in the probability of prepayment.

Overall, these results suggest that Bengaluru's metro expansion enhanced borrower liquidity and financial stability, reflected most clearly in the pronounced rise in prepayment activity, while also reducing the frequency of delinquency. The pattern aligns with the intuition that improved mass transit reduces commuting costs and uncertainty, enabling households to redirect savings and time efficiencies toward more disciplined and accelerated mortgage repayment.

HDFE regression				
Number of obs = 94356				
	Log Delinquency (Amount)	Delinquency Indicator	Log Prepayment (Amount)	Prepayment Indicator
Treat * Post	-0.0571431	-0.02471	0.265324	0.035068
	(0.18)	(0.031) **	(0.001) ***	(0.041) **
R-squared	0.3309	0.3393	0.3639	0.3393
Note: Account level and Month level fixed effects have been taken into account				

5.4 Impact on Vehicle Registration

Vehicle registration data have been sourced from the VAHAN database maintained by the Ministry of Road Transport and Highways (MoRTH), which provides standardized, RTO-level information on new vehicle registrations across Indian cities. In the case of Bengaluru, the city's registrations are administered through five principal Regional Transport Offices, i.e., KA-01 to KA-05, corresponding to distinct administrative zones within the urban agglomeration. These RTOs together capture the bulk of private vehicle registrations in Bengaluru and, when aggregated, provide a reliable measure of city-level trends in household vehicle acquisition.

In contrast, Telangana has not yet been fully migrated to the central VAHAN platform, and vehicle registration data for Hyderabad and other districts continue to be maintained largely on the state's standalone transport database. Publicly available Telangana transport statistics typically report cumulative vehicle registration figures rather than high-frequency new registrations, and it is not directly harmonizable with VAHAN's standardized reporting format. Given these institutional and data limitations, Telangana has been excluded from the primary vehicle-registration analysis to preserve cross-sectional consistency and avoid measurement error.

Importantly, the use of Bengaluru VAHAN serves as a key corroborative channel for the core argument linking urban transport infrastructure to household financial outcomes. A key mechanism through which metro expansions influence household credit outcomes operates via reduced dependence on private vehicles and associated expenditures. Vehicle ownership entails large upfront costs as well as recurring expenses such as fuel, maintenance, insurance, parking, and financing charges, all of which place persistent pressure on household cash flows.

Improved subway access leads to a decline in new vehicle purchases, especially in the low-quality and entry-level segments, indicating a substitution away from private transport toward public transit. This reduction in vehicle-related spending frees up monthly liquidity, lowers volatility in household expenditures, and reduces exposure to credit-financed durable purchases. As a result, households are better able to meet scheduled mortgage installments, leading to lower delinquency rates. At the same time, the release of liquidity enables some households to accelerate principal repayments, resulting in higher prepayment rates performance.

The Bengaluru vehicle registration data from KA-1 to KA-5 provides strong supporting evidence for the behavioural channel through which improved urban transport infrastructure can affect household financial outcomes. A clear and broad-based decline is visible across key privately used vehicle categories over time, particularly in Two-Wheeler (Non-Transport) and Light Motor Vehicle (LMV) registrations, which together constitute the dominant modes of personal mobility for middle- and lower-middle-income urban households. Two-Wheeler (NT) registrations, which peaked in 2018, fell sharply in 2019 and further in 2020, representing a cumulative decline of over 41% from the 2018 peak. Similarly, Light Motor Vehicle registrations show a contraction of nearly 24% over two years. These two categories alone

account for the bulk of household vehicle purchases and therefore capture changes in household transport choices and expenditure behaviour most directly.

Importantly, the decline is not confined to a single segment but is observed across multiple personal-use vehicle categories. While some of the later decline reflects pandemic-related disruptions, the downward trend in key segments begins prior to 2020, coinciding with the expansion and densification of Bengaluru's metro network and improvements in last-mile connectivity.

These patterns are economically meaningful because vehicle ownership is one of the most liquidity-intensive household decisions in urban India. A sustained reduction in vehicle registrations therefore implies not only fewer new vehicle loans, but also a structural decline in recurring transport expenditures. This frees up predictable monthly liquidity, reduces balance-sheet stress, and lowers households' exposure to short-term expenditure shocks precisely the conditions under which mortgage delinquency risk declines.

The Bengaluru data thus supports the core mechanism underpinning our hypothesis: improved access to mass transit reduces reliance on private vehicles, which in turn releases household resources that can be redirected toward mortgage servicing. With fewer funds tied up in vehicle purchases and operating costs, households are better positioned to meet scheduled EMI obligations, leading to lower delinquency. At the same time, households experiencing improved liquidity may choose to accelerate repayments, explaining observed increases in mortgage prepayment.

Bengaluru Vehicle Registration KA-1 to KA-5					
Vehicle Type	2016	2017	2018	2019	2020
Light Motor Vehicle	75427	77584	77734	71070	59505
Light Passenger Vehicle	14147	7912	6637	7092	2331
Two-Wheeler (NT)	259658	260671	282608	263958	165245
Source: VAHAN database					

Taken together, the sharp and persistent decline in Two-Wheeler (NT) and Light Motor Vehicle registrations in Bengaluru provides concrete, administrative evidence consistent with a substitution away from private vehicle ownership toward public transit. This substitution operates as a powerful financial channel: by lowering transport-related expenditures and

smoothing household cash flows, it strengthens repayment capacity, reduces mortgage delinquency, and enables higher prepayment. Ignoring this vehicle-expenditure channel would therefore underestimate the full financial and behavioural impact of metro infrastructure on household balance sheets.

5.4 Policy Implications

The findings from this study carry important implications for urban infrastructure policy, housing finance, and financial stability, particularly in rapidly growing Indian cities such as Hyderabad and Bengaluru. By showing that metro expansions lead to lower mortgage delinquency and higher prepayment rates, our analysis highlights that urban transport infrastructure generates substantial financial spillovers at the household level that are typically overlooked in conventional project appraisal frameworks. These results suggest that metro systems should be viewed not only as mobility or environmental interventions, but also as household balance-sheet stabilizers with implications for credit markets and systemic risk.

First, the evidence implies that sustainable urban transport investments can strengthen household financial resilience. Our DID estimates indicate that improved metro access reduces delinquency with a lag while inducing increases in prepayment, consistent with households reallocating freed-up liquidity toward debt servicing. The supporting vehicle registration evidence from Bengaluru shows sharp declines in Two-Wheeler (Non-Transport) and Light Motor Vehicle registrations precisely the categories most relevant for middle- and lower-middle-income households. Since vehicle purchases and operating costs represent one of the largest recurring non-housing expenditures in urban India, reduced reliance on private vehicles releases predictable monthly cash flows. From a policy perspective, this suggests that metro investments indirectly improve repayment capacity by lowering transport-related expenditure volatility, particularly for financially constrained households.

Second, the results have direct implications for housing finance policy and lender risk assessment. Mortgage delinquency and prepayment are key determinants of lenders' portfolio risk, capital adequacy, and pricing decisions. By lowering delinquency and default risk, metro expansions can reduce expected credit losses for lenders operating in well-connected urban areas. This creates a case for incorporating infrastructure accessibility metrics into mortgage risk models, loan pricing, and credit underwriting frameworks. For public-sector housing finance institutions and priority-sector lenders, metro connectivity could be treated as a

mitigating risk factor, potentially enabling more favorable lending terms in transit-served locations.

Third, the findings underscore the importance of integrating transport planning with housing and financial-sector policy. Urban infrastructure is often evaluated in silos, with transport projects assessed separately from housing finance outcomes. Our results suggest that such separation leads to a systematic undervaluation of metro investments. By reducing defaults and foreclosures, metro expansions contribute to financial-sector stability, lower enforcement and recovery costs, and reduce the social costs associated with housing distress. These effects are especially relevant in urban India, where mortgage markets are expanding rapidly and household leverage is rising.

Fourth, these findings strengthen the case for revisiting cost–benefit analysis frameworks used to evaluate urban infrastructure projects. Traditional appraisals typically focus on time savings, congestion reduction, emissions, and local land value appreciation. Our results demonstrate that such approaches omit an important channel: improvements in household financial outcomes and reductions in mortgage delinquency and default. Incorporating these financial spillovers would raise the estimated social returns to metro investments and provide a more comprehensive assessment of their economic value.

Finally, the analysis has implications for intergovernmental financing and federal support for urban infrastructure. Since reductions in mortgage defaults and financial instability generate benefits that extend beyond local jurisdictions affecting banks, housing finance companies, and macro-financial stability, there is a strong rationale for continued central and multilateral support for metro projects. Viewing metro investments as instruments that simultaneously advance sustainability, financial resilience, and inclusive growth provides a more compelling justification for public funding and policy prioritization.

In sum, our findings suggest that metro infrastructure should be understood as a multi-dimensional policy tool, one that not only improves mobility and environmental outcomes, but also strengthens household balance sheets, enhances credit performance, and supports financial-sector stability. Recognizing and incorporating these channels into urban policy design can significantly improve the effectiveness and evaluation of infrastructure investments in India’s cities.

6. Conclusion

This paper highlights the role of expanding metro network on households' financial health against the background of continued infrastructure development in India in the past decade. Juxtaposing granular home-loan data, we evaluate how the introduction of metro connectivity shapes housing loans borrowers' delinquency and prepayment responses across urban neighborhoods in Hyderabad, Bengaluru and Delhi.

Our empirical result from Hyderabad indicates that households residing in metro-served PIN codes exhibit a 1.7% reduction in delinquency incidence alongside a 1.8% rise in prepayment activity. In Bengaluru, the behavioural adjustment is even more pronounced, with delinquency rates declining by 2.4% and prepayment rates increasing by 3.5% following transit expansion. Evidence from Delhi points to 4.42% reduction in mortgage delinquency alongside a 1.38% increase in prepayments. Vehicle registration data from such cities also corroborates our findings.

Instead of walking on a well-trodden path of estimating multiplier impact of capital expenditure for infrastructure on output we have endeavoured to analyse the impact of infrastructure (particularly metro network) of Hyderabad and Bengaluru on households' financial stability. The findings from this study carry important implications for appreciating the impact of growing infrastructure not only on India's macros but also on micros.

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