Making China's Urban Transportation Boom Sustainable

Zhirong Jerry Zhao

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About the Author

Zhirong "Jerry" Zhao is Associate Professor of Public Administration at the University of Minnesota, where he teaches in the Hubert H. Humphrey School of Public Affairs. His research focuses on public budgeting and finance, particularly how local governments generate sufficient revenue under ever-increasing constraints, how state and local fiscal structures affect the pattern and effectiveness of public service delivery, and how public and nonprofit organizations interact with each other in budgetary and service decision-making.

Zhao holds a PhD in Public Administration from the University of Georgia and earned bachelors and master's degrees in Urban Planning from Tongji University (China). In his earlier career as an urban planer, he did many projects for local governments across China, and published journal articles and book chapters on urban renewal and historical preservation. As a public administration scholar, he has published in the *Journal of Public Administration Theory & Research, Public Administration Review, Publius – Journal of Federalism, Public Finance Review, Public Budgeting & Finance, and Municipal Finance Journal*, among others.

He has led projects supported by the Lincoln Institute of Land Policy, the Cargill Foundation, the Minnesota Legislature, and the Minnesota Department of Transportation, and has provided consulting services for the World Bank, the National Governors Association, and the National Conference of State Legislatures. In 2013, Zhao was elected to the Executive Committee of the Association for Budgeting and Financial Management.

Zhao has been a visiting scholar at Peking University-Lincoln Institute and the Chinese University of Hong Kong. He is also a Distinguished Visiting Professor at Shanghai University of Finance and Economics, and a Senior Research Fellow at the Shanghai Institute of Finance and Law.

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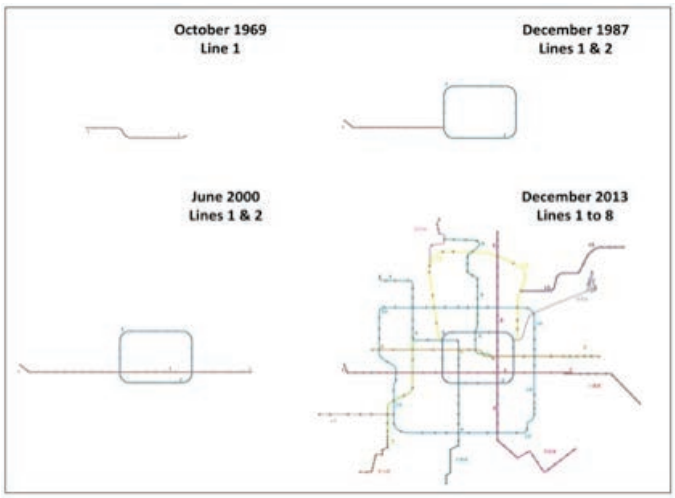
Introduction

China's economic takeoff of recent decades has been accompanied by the dazzling growth of the nation's transportation infrastructure. China's total highway mileage had reached a staggering 4.2 million kilometers (km) (2.6 million miles) by 2012, expanding from just 126,675 km (78,712 miles) in 1949.[1] Railroads in operation increased from 22,900 km (14,229 miles) in 1952 to 98,000 km (60,894 miles) in 2012, including more than 9,360 km (5,816 miles) of high-speed rail (HSR) that moves sleek passenger trains between China's major urban centers at speeds that clock in at over 200km (124 miles)/h.[2]

Figure 1. Rapid Expansion of Beijing's Subway System Since 1969[4]



In China's current subway boom, meanwhile, not only are megacities like Beijing and Shanghai actively adding new lines and extensions (see Figure 1) but smaller Chinese cities are also racing to open their first subway lines. Thirty-eight cities have been approved by the central government in Beijing to have at least one line by the end of this decade, with more than 6,200 km (3,852 miles) of tracks laid, compared to just 1,280 km (795 miles) of heavy rail rapid transit systems in the United States.[3]

Behind this significant expansion of infrastructure, however, lie some serious concerns about how China makes its transportation infrastructure investments and whether these are sustainable. These concerns relate to funding mechanisms, decision-making processes, and policy effects, as well as the system's efficiency, equity, and financial sustainability. Follow up and sector-specific studies are needed to dig into the data on how benefits are distributed to different groups and across different areas. And these are particularly needed because of increasing concerns that China lacks reliable funding sources to pay back capital borrowing and sustain operating costs for transportation facilities.[5]

This memorandum offers a high-level snapshot and does not attempt to answer all of these questions immediately or comprehensively, in part because of the inadequacy of existing data and the long gestation period of large infrastructure

investments. Nonetheless, the way China finances its infrastructure lies at the nexus of fiscal, urbanization, and general welfare issues, and thus is worth a broad treatment.

This memorandum will not aim to answer whether China has over-invested in transport infrastructure or what the "optimal level" of infrastructure investment should be. Instead, the memo takes a birds-eye look at the mechanisms China currently uses to fund transportation investments—in particular highways, high-speed rail (HSR), and urban mass transit. It is an initial exploration into policy issues that need to be addressed as China continues to expand and improve its transportation infrastructure.

The analysis shows that China's urban infrastructure finance and transportation investments over the past several decades relied heavily on borrowing and fuzzy guarantees against future revenues at the local level. Fundamentally, China needs to get back to more "conventional" funding approaches that align with basic public finance principles, even as other countries are seeking "innovative" financing mechanisms to provide supplemental funding for transportation infrastructure.

The bottom line is this: the Chinese government should gradually reduce its reliance on borrowing and financing, but use more direct fiscal revenues (including central subsidies and earmarked local taxes and fees). And it should make related investment decisions through more participatory, transparent, and deliberate budgetary processes.

The first section of this memorandum provides an analytical framework for evaluating infrastructure finance, illustrated through comparative and international examples. The second section compares China's urban infrastructure finance system against this analytical framework. The third section addresses specific issues in key areas of transportation investments in China. The fourth section concludes with some policy recommendations about how to better address China's infrastructure financing needs over the medium term.

A Framework for Analyzing Infrastructure Finance Mechanisms

A better understanding of the specific characteristics of China's transportation investment needs to be anchored in an analytical framework for evaluating infrastructure finance mechanisms.[6] From a "user pays" or "beneficiary pays" perspective, investment in public infrastructure is more efficient and equitable when the costs of the infrastructure are closely linked to its beneficiaries. Therefore, key decisions about public infrastructure investments may be governed by five benefits-related questions: "who benefits?" "where are benefits manifest?" "when are benefits manifest?" "which payback mechanism is to be used?" and "at what price level" should infrastructure usage be charged?

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Who Benefits?

The question of "who benefits" deals with the respective roles of government and the market in the provision of public infrastructure. Some infrastructure facilities lead to private benefits that can be easily identified and separated—for example, through the metered usage of water and sewerage. In such cases, market-based mechanisms, such as direct user fees, can be applied.

Other types of infrastructure, however, tend to have spillover benefits to people beyond the direct and exclusive users. In these circumstances, by contrast, it may be appropriate for a certain level of direct provision by government (i.e., general revenues) to pay for the infrastructure. For example, providing such a facility with market mechanisms alone may lead to either higher user prices or lower supply of services than is theoretically efficient.

To illustrate with different types of transportation infrastructure, a commercial aviation system is more excludable than roadway transportation because only paid users would be allowed to embark. As a result, aviation services are more marketable and often provided through market-based tools in many countries,[7] while roadway transportation is more often subsidized with direct government revenues. Likewise, rail systems and especially passenger rail programs, including subways, are closer to being public

goods than commercial aviation, or at least passenger rail generates positive externalities and is thus typically subsidized by governments. Freight rail, again by contrast, tends to be more marketable and relies less on the public sector.

But a public good may only be considered to be as such within certain boundaries. If a highway is almost empty, then the use of one vehicle does not seriously raise the opportunity cost for another vehicle to take advantage of traffic-free roads. On a congested highway, however, adding an additional vehicle can substantively aggravate congestion and significantly increase marginal social costs. Managing the latter scenario often requires some market-based tools, such as congestion tolling.[8]

Where Are Benefits Manifest?

In the event that direct government funding is needed to support the development of infrastructure, the distribution of facility benefits over jurisdictional boundaries can affect the fiscal arrangement of public investments across various levels of government. In this case, a "correspondence principle" in public finance argues that public services are best provided in the smallest government unit and without incurring externalities.

This means that the variation in consumer demand and concentration of similar demands across small areas favor a decentralized system of funding allocation. But, at the same time, a "free rider" problem will arise when the spatial distribution of costs (or benefits) of government services is not confined to the jurisdictional boundaries of the providing government. Put more simply, if a county pays for a road, a neighboring county's residents could use those roads even though they did not pay. In such cases, control mechanisms (or subsidies) by higher-level governments are necessary to internalize the externalities.

For an illustration, just take the roadway system in the United States: The US federal government plays the central role in the country's interstate highway system, while state governments take charge of state trunk highways, and local governments are responsible for their local roads. Since state and local roads also generate benefit spillovers to neighboring states and localities that did not pay for them, transportation grants allocated from federal or state governments to lower-level governmental units are often used.

When Are Benefits Manifest?

Those who build infrastructure face a choice between pay-as-you-go financing and debt financing. Debt finance is often used for infrastructure improvements that (1) have long-term benefits, and (2) require a concentrated amount of large initial expenditure that must be paid back over time. When debt is issued, caution should be taken, however, to clearly identify future revenue streams for debt services. This is necessary to avoid perverse

incentives for overcapitalization by sub-national governments, since current local residents who benefit from improved projects do not perceive or shoulder associated future costs.

The US example is again instructive here: To improve transportation, US federal and state governments mainly rely on pay-as-you-go financing (with dedicated tax revenues) instead of borrowing. This is because system-wide investment is a continuous and ongoing process. US local governments are often more likely to issue municipal bonds to expedite local road improvements because the level of capital spending fluctuates more in smaller jurisdictions. Such bonds, however, are carefully safeguarded by specific payback mechanisms, guaranteed either by general revenues or by specific sources of fees and charges.

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Which Payback Mechanism To Be Used?

The question of a payback mechanism for infrastructure development encompasses the various public finance instruments, such as taxes, fees, and other financial arrangements, that may be used to correspond to different types of infrastructure benefits. With public roadways, for example, there are three distinctive approaches to funding, each corresponding to how roadway benefits are conceived and measured.

First is the "user fee" approach. Here, public roads are primarily enjoyed by direct transportation users, such as automobile operators, whose level of usage is correlated to their fuel consumption. For example, US federal and state governments rely heavily on fuel taxes as an indirect user fee to support transportation infrastructure.

Second is the "general revenue" approach. Here, transportation improvements also promote economic development and benefit the general public. For example, many European countries use the annual allocation of general revenues to support transportation, and, likewise, US local governments often use property taxes or other general purpose taxes to support local roads and public transit.

Finally, there is the "value capture" approach. Here, transportation improvements tend to create disproportionate benefits for property owners or developers with locational advantages. For example, a variety of value capture strategies, such as tax-increment financing, development impact fees, or joint development, may be used to supplement transportation investment.[9]

What Price Level?

A final conceptual issue in the development of infrastructure finance

mechanisms involves the important but difficult challenge of determining the proper level of infrastructure charges. This choice, wherever the price is set, sends a powerful signal that influences the behaviors of both consumers and investors.

For typical goods and services, the general rule is to set the price at its marginal cost to maximize economic efficiency. But complexities can arise for the use of infrastructure facilities because infrastructure is commonly considered to be a public good, and thus cannot be easily priced through the market.

One option is to set the fee at the breakeven point. This aims to offset the cost of construction and operation. But this price can sometimes be too high, which hinders sufficient usage of the infrastructure and the realization of its full benefits. If, by contrast, the price is set too low, it only encourages excessive facility usage. And that, in turn, can have significant negative effects on society or the environment.

To illustrate: the United States has a strong car culture and inefficient land use patterns that have yielded extensive urban sprawl. This has happened, in part, because the price of public roadway usage is very low in the country. The United States underutilizes tollways (direct user fees) relative to other countries[10] and has fuel taxes (indirect user fees) that are much lower compared to many OECD countries.

Another complexity relates to social equity. For public goods and social services, including the use of infrastructure, fees and charges are often set with affordability in mind. This aims to avoid a highly regressive scheme, through which low-income groups would face especially high fiscal burdens. The result of this is that the price for infrastructure usage is often adjusted downward for specific modes, such as public mass transit; for specific regions, such as relatively underdeveloped areas; or for specific groups, such as low-income groups or senior citizens.

China's Urban Infrastructure Finance

To support their transportation systems, some countries use dedicated revenue streams while others rely on the allocation of general revenue. In China, a mix of revenue sources—including some dedicated ones—have been used to fund a combination of urban facilities. These include surface transportation (e.g., roads, bridges, and mass transit) but also other physical infrastructure, such as water supply, sewerage, gas, environmental sanitation, flood control, and landscaping. This section briefly introduces the development of China's urban infrastructure finance in recent decades. It then looks at the Chinese-style system through the prism of the five conceptual questions discussed above.

Patterns of China's Urban Infrastructure Finance

Urban infrastructure finance in China has been marked by volatility over the last few decades. The first period between 1949 and 1978 featured deficiency in both political and financial support for urban infrastructure development. But for the next 15 years through 1994, the central government boosted its effort in promoting urban infrastructure development through laws and regulations.

During that period, the Urban Maintenance and Construction Tax (UMCT) and Public Utility Surcharges (PUS) were created as dedicated streams of revenue for infrastructure funding, along with increasing use of utility fees and charges. After China's comprehensive 1994 tax reform, local governments came to play an ever-larger role in funding urban infrastructure, using various innovative methods.

According to the *China Urban Construction Yearbook* (2000-2012), China's "Urban Maintenance and Construction Revenues" (henceforth urban infrastructure revenues) come from pay-as-you-go fiscal revenues and market financing approaches (see Table 1).[11] Pay-as-you-go fiscal revenues include central and local budgetary allocations, UMCT, PUS, utility charges, land transfer fees (LTFs), and assets exchange revenues.

China also relies on market financing approaches. These include domestic loans, foreign capital, bonds, stock financing, and self-raised funds, among others. From 1990-2005, fiscal revenue grew at an average annual rate of 12.8 percent. Meanwhile, market financing outpaced fiscal revenue growth at an average of 17.1 percent, indicating a higher reliance on borrowing over time, a trend that has likely persisted in recent years.

Among various fiscal revenues, the most visible growth in China in recent years has been in the use of LTFs, which mainly consist of the leasing of land usage rights. Since its introduction in the 1980s, the LTF has gradually become one of the most important revenue items for local governments, either for general purposes or for urban infrastructure development.

Indeed, LTFs have increased rapidly, doubling every two or three years, from 22 yuan ($3.50) per capita in 2002 to about 460 yuan ($75) per capita in 2011. But the use of revenue from LTFs was by no means smooth over time, or evenly distributed across regions, fluctuating significantly as national economic trends or policies change.

The use of LTFs has been heavily concentrated in municipalities and in China's eastern region, aggravating the disparity of fiscal spending on urban infrastructure finance across

Table 1. Per Capita Urban Infrastructure Revenue (1990-2011, in yuan)

	1990	1993	1996	1999	2002	2005	2008	2011
Fiscal Revenues	19.2	23.3	26.4	45.5	101.1	164.6	349.9	782.3
Budgetary allocation	4.9	9.1	8.1	22.2	36.3	59.5	103.7	147.6
Central budgetary allocation	1.7	2.8	0.9	8.4	5.9	4.3	5.2	9.6
Local budgetary allocation	3.1	6.2	7.2	13.8	30.4	55.2	98.5	138.0
Local earmarked taxes	13.9	13.7	17.8	22.7	28.3	42.1	57.7	104.2
Maintenance and construction	10.3	10.3	13.2	17.6	24.5	38.2	51.5	93.3
Public Utility Surcharge	3.6	3.5	4.6	5.1	3.9	3.8	6.2	10.9
Fees and user charges	0.4	0.5	0.5	0.6	14.6	21.7	42.9	71.9
Water resource fee	0.4	0.5	0.5	0.6	1.0	1.7	1.8	5.2
Infrastructure connection fee	**	**	**	**	6.7	9.9	22.9	40.4
User charges	**	**	**	**	6.9	10.1	18.2	26.3
Land transfer fee	**	**	**	**	21.9	41.2	145.6	458.6
Market Financing	5.9	10.9	22.6	53.1	119.6	190.3	**	**
Domestic loans	1.4	4.7	8.0	30.1	67.6	115.8	**	**
Nationally issued bonds	**	**	**	**	5.1	10.6	**	**
Bank loans	**	**	**	**	62.5	105.2	**	**
Other bonds	**	**	**	**	0.2	2.4	**	**
Self-raised funds	4.1	4.8	10.0	19.1	46.5	65.6	**	**
Foreign capital	0.4	1.4	4.7	4.0	4.7	6.4	**	**
Stocks	**	**	**	**	0.5	0.1	**	**
Other Sources	8.3	26.7	21.8	32.1	23.6	21.2	**	**
Total	**33.4**	**60.9**	**70.8**	**130.7**	**244.2**	**376.1**	**	**

**Missing data
Sources: Wu (2008); China's Urban Construction Yearbook (2000-2011).
All the data above have been adjusted by fixed assets index, in 2000 constant price.

provinces. In 2005, for example, the amount of LTFs used as infrastructure finance was about 245 yuan ($40) per capita in Zhejiang province near Shanghai, compared to just about 2 yuan ($0.35) in Yunnan province in China's deep south—an alarming gap of more than 100 times (see Table 2).[12]

Market financing approaches, meanwhile, can be categorized as either debt financing[13] or equity financing. During 1990-2010, the bulk of Chinese debt financing took the form of domestic loans, in particular bank loans, which were issued to Urban Development and Investment Companies (UDIC) set up by local governments to bypass restrictions and borrow directly from commercial banks.

Since 2011, however, some local governments have been formally authorized to issue municipal bonds, but the usage of bank loans is still growing under the name of "Urban Investment and Financing Platforms." Compared with debt financing, equity financing accounts for a smaller percentage of such capital in China. This category includes self-raised funds from the accumulated capital of enterprises and public institutions, or else foreign capital, such as foreign direct investment, foreign loans, or other foreign investments through public-private partnerships (PPPs).

During the period 1990-2005, self-raised funds and foreign capital both grew at lower rates than debt financing.[14]

The trend in China has been to rely increasingly on bank loans instead of private sector investments. And this is in sharp contrast to the many other countries that are actively seeking private finance in their infrastructure development.

Measuring Chinese Urban Infrastructure Finance against the Conceptual Framework

The five-part framework discussed in the last section provides a useful comparative analytical lens to examine the unique characteristics of urban infrastructure finance in China. First, regarding "who benefits?" and the role of government versus market finance mechanisms, the Chinese government has increasingly used market mechanisms, such as debt or equity financing, to fund its urban infrastructure development.

Yet the distinction between the state and market roles is blurred. On the one hand, local governments have often been reported to be forcibly acquiring land from residents and offering low compensation in what amount to land grabs. And in turn, local governments have commanded high amounts of LTF through bidding or negotiation, or have been directly engaged in real estate development with quasi-governmental entities such as UDICs to generate high market returns.

At the same time, debt financing has often taken the form of local

governments borrowing from state-owned banks, and such transactions cannot be considered to be purely market-based. Indeed, such activities may be characterized as "government-led market operations," which have been a convenient means to mobilize resources for development but have also raised concerns about the proper use of government authority and social resources.

Second, with respect to the question of "where are benefits manifest?" and the level of governmental financial support, local governments have played an increasingly important role in funding urban infrastructure in recent decades. The amount of central government budgetary allocation has been low when viewed through the lens of all urban construction revenues (see Table 1) and distributed unevenly across provinces, with much higher per capita amounts allocated to the four major national municipalities (Beijing, Chongqing, Shanghai, and Tianjin), reflecting preferential treatment for these super cities.[15]

It appears that local governments in China have relied heavily on the use of future resources as financial collateral to support urban infrastructure development in the present.

China's decentralized system may have incentivized local governments to use innovative methods, such as reliance on UDICs and LTFs, to support their urban infrastructure improvements. However, not all provinces are equipped with the same capacity to do so. In fact, since the beginning of the reform era in 1978, there has been significant variation across provinces in the use of local budgetary allocation for urban infrastructure. And in recent years, the heavy reliance on LTFs has aggravated existing fiscal gaps between China's coastal and interior provinces.

The third issue concerns "when benefits are manifest" and the use of fiscal funding as opposed to market financing. China's reliance on pay-as-you-go fiscal revenues has dropped to below 50 percent in recent years, while governments received a higher proportion of funding from debt financing or equity financing. Although LTFs are treated in China as one-time fiscal revenues, they function essentially as a special kind of debt financing because they are collected from private developers who, in exchange, usually acquire land usage rights for fifty to seventy years.

Overall, it appears that local governments in China have relied heavily on the use of future resources as financial collateral to support urban infrastructure development in the present. This raises obvious—and serious—concerns about the medium term sustainability of their current funding mechanisms.

Fourth, regarding the question of "which payback mechanism is to be used," the proportion of budgetary

allocation in China's total infrastructure revenue has been higher than that of local earmarked taxes and direct user charges. This suggests that China's urban infrastructure is primarily funded through general revenues. Notably, the increasing reliance on LTFs seems to be closely related to additional expenditures on roads, bridges, or landscaping.

Such physical improvements may enhance accessibility, create community amenities, and improve urban landscapes, all of which may be translated into higher LTFs for future land leasing. Thus the use of LTFs, if they were to be used appropriately, could be considered a Chinese-style value capture strategy widely employed by cities. But it becomes problematic because the proceeds from leasing public lands typically serve as a one-time revenue. And what is more, many cities have run out of available land to be leased.[16]

Fifth, China has also wrestled with the question of "at what price level" its urban infrastructure use should be priced, either through direct user fees or indirect taxes. Solutions are likely to vary with regard to different infrastructure types and across different regions. A consistent theme that is likely to emerge involves how to properly raise the direct cost of infrastructure usage in order to preserve natural resources, protect the environment, or prevent congestion and associated societal costs. In the transportation sector, tolls are widely used in China's highway system, but discussion of congestion charges has encountered strong public resistance in urban areas. Similarly, water shortages have become increasingly severe in many cities, yet China has been reluctant to raise water prices.[17]

In sum, China's urban infrastructure finance is characterized by "government-led market operations," such as UDIC, a high reliance on borrowing or the use of future resources such as LTFs, and the under-utilization of infrastructure charges. What is more, the processes through which urban construction decisions are made are not transparent, nor are detailed data available to link individual capital revenue sources to specific infrastructure types.

Table 2. Provincial Rank of Per Capita Urban Infrastructure Revenue (2005, in yuan)

Region	Province	Total Infrastructure Revenue		Fiscal Revenue					Market Financing			
					Per Capita					Per Capita		
		Rank	Per Capita	Per Capita	Budgetary Allocation	Two-Item Fee	Fees and User Charges	Land Transfer Fees	Per Capita	Debt Financing	Foreign Capital	Self-Raised Fund
Municipality	Shanghai	1	2766.3	598.6	270.0	280.0	48.5	178.7	1938.2	683.9	15.6	1238.8
	Tianjin	2	1779.4	514.7	354.1	93.7	66.9	16.6	1178.6	1069.2	25.3	84.1
	Chongqing	5	821.2	361.5	169.2	138.2	54.1	46.8	396.2	255.1	42.1	99.0
East	Zhejiang	3	960.7	356.7	225.9	76.1	54.7	244.7	317.1	207.0	29.5	80.6
	Jiangsu	4	906.0	289.2	150.4	85.6	53.1	155.7	429.5	338.2	2.0	89.2
	Liaoning	6	597.3	251.1	134.2	75.8	41.0	101.7	226.5	74.1	4.4	147.9
	Shandong	7	524.4	198.1	97.0	65.2	35.9	55.6	231.8	112.9	11.8	107.1
	Guangdong	8	486.5	145.6	41.5	48.6	55.4	63.5	208.1	169.9	4.7	33.6
	Hainan	13	342.3	74.0	18.6	34.9	20.5	46.5	221.0	202.2	2.6	16.2
	Fujian	15	331.3	119.8	73.0	36.8	10.0	36.2	167.1	128.6	5.6	32.9
	Hebei	16	319.3	84.8	37.5	33.9	13.4	32.8	187.5	80.1	6.5	100.9
Central	Jilin	12	354.8	80.0	19.8	40.6	19.6	16.1	236.1	179.9	1.8	54.4
	Hubei	17	302.6	65.9	29.8	25.1	11.0	3.1	194.9	99.5	10.5	84.9
	Heilongjiang	18	302.3	104.9	28.7	63.4	12.8	20.9	131.5	65.5	5.2	60.7
	Hunan	21	230.5	48.8	14.1	23.9	10.8	25.7	138.0	94.3	8.2	35.5
	Jiangxi	23	200.0	72.4	54.1	12.3	5.9	22.4	83.6	33.0	10.8	38.1
	Anhui	24	181.2	50.2	15.6	22.1	12.5	33.4	88.6	64.4	4.0	20.2
	Shanxi	26	161.4	74.6	19.2	39.5	15.9	34.8	44.4	30.1	2.0	12.2
	Henan	27	121.7	45.2	10.5	23.5	11.1	14.2	59.3	34.2	0.7	24.4
West	Ningxia	9	419.1	224.0	149.2	56.8	18.0	13.3	175.7	84.7	2.0	88.9
	Neimenggu	10	391.4	118.3	74.6	38.8	5.0	18.5	241.6	142.2	22.8	76.6
	Sichuan	11	371.5	122.2	93.6	17.2	11.4	4.9	225.4	140.4	1.4	83.6
	Shanxi	14	333.1	86.0	38.1	16.2	31.7	17.0	216.8	188.8	8.5	19.6
	Xinjian	19	288.6	102.3	51.9	35.5	15.0	10.7	160.5	81.9	7.5	71.1
	Guangxi	20	284.1	84.6	54.7	19.6	10.2	24.4	153.6	102.7	3.5	47.5
	Gansu	22	205.0	51.1	25.5	21.4	4.3	5.3	145.6	128.1	2.1	15.4
	Qinghai	25	175.7	44.3	19.0	14.0	11.4	4.9	110.9	99.6	0.0	11.2
	Yunnan	28	86.5	45.4	20.2	24.4	0.9	2.3	32.4	25.6	0.2	6.0
	Guizhou	29	81.4	35.7	8.4	19.4	8.0	6.9	33.3	31.2	0.0	2.2

Source: China's Urban Construction Yearbook (2006).
All the data above have been adjusted by fixed assets index, in 2000 constant price.

Improving Fiscal Sustainability for Transporation Investment

Among fixed-asset investments (FAI) related to "urban construction," surface transportation facilities, including "roads and bridges" and "public transportation" (urban transit), are the largest and also fastest-growing categories. They account for nearly two-thirds of a total of $281 billion in national urban FAI in recent decades.[18]

According to China's National Bureau of Statistics, the annual transportation investment (including roads, rail, and public transit) has grown from about $58 billion in 2003 to about $438 billion in 2011. The national data have less detailed information about funding sources, but it is clear that the overall pattern is to rely heavily on financing, just as is the case with the urban

Table 3. Heavy Reliance on Financing for Transportation Investments (2003-2011)

	Road		Rail		Public Transport		Aggregate	
	Fiscal Revenue	Market Financing	Fiscal Revenue	Market Financing	Fiscal Revenue	Market Financing	Fiscal Revenue	Market Financing
2003	9.5%	90.5%	32.6%	67.4%	2.5%	97.5%	12.4%	87.6%
2004	9.9%	90.1%	38.9%	61.1%	2.4%	97.6%	13.7%	86.3%
2005	10.1%	89.9%	34.6%	65.4%	5.7%	94.3%	14.3%	85.7%
2006	10.8%	89.2%	30.2%	69.8%	3.6%	96.4%	14.4%	85.6%
2007	13.3%	86.7%	22.4%	77.6%	5.9%	94.1%	14.8%	85.2%
2008	14.9%	85.1%	18.0%	82.0%	7.2%	92.8%	15.1%	84.9%
2009	17.6%	82.4%	14.5%	85.5%	6.4%	93.6%	15.2%	84.8%
2010	15.9%	84.1%	14.2%	85.8%	6.2%	93.8%	14.4%	85.6%
2011	17.0%	83.0%	11.5%	88.5%	8.4%	91.6%	14.6%	85.4%

Source: China's National Bureau of Statistics http://data.stats.gov.cn/workspace/index?m=hgnd.
All sources other than fiscal revenues are considered as broadly-defined marking financing.

The "urban construction" data, however, do not include transportation developments outside of urban centers, including the national highway system, which has been estimated at around $35 billion each year in recent decades, and the HSR network, which is estimated to have reached around $400 billion by 2011.[19]

construction data. As Table 3 shows, in 2011, fiscal revenues accounted for only 17 percent of total road investment, only 11.5 percent of total rail investment, and only 8.4 percent of total public transit investment.

More data and further analysis are still needed to understand the detailed mechanisms through which China has invested in its recent transportation

boom and the effects of such investments. But the stakes are high, not least because how China invests in its staggeringly large—and continuing—infrastructure boom lies at the heart of its fiscal policies and future growth prospects. Given this scope and scale, as well as its implications for China and the world, it is worth weighing the major policy issues and offering recommendations, even on the basis of partial data.

Generally speaking, in all three major areas of surface transportation—highways, HSR, and urban mass transit—China should consider: (1) further regulating quasi-governmental operations at the local level, (2) reducing the reliance on debt finance, and (3) raising infrastructure charges.

China's highway development in recent decades has relied heavily on tolling, which, in turn, has generated heated controversies among the public.

Highways: To Toll or Not To Toll?

China's highway development in recent decades has relied heavily on tolling, which, in turn, has generated heated controversies among the public. A widely cited news report claimed that in 2006 there were about 100,000 km (62,317 miles) of toll roads in China.[20] Yet the actual mileage is likely to be much higher, possibly more than 250,000 kilometers (155,342 miles) as of 2010.[21] According to official reports, 95 percent of expressways, 61 percent of Class One highways, and 42 percent of Class Two highways in China rely on tolling. (By comparison, the United States contains only 6 percent of freeways and less than 0.1 percent of total highways that are tolled.)[22]

Due to its extensive use of tolls, China's direct user costs on highways are reportedly higher than the international average, which is commonly cited as one reason behind China's especially high logistics costs.[23] Expensive toll charges in China may be attributed, in part, to high administrative costs or the misuse of toll proceeds for other purposes. Fundamentally, however, it is China's basic approach to highway development strategy that pushes the country to rely so heavily on borrowing, with about $400 billion in accumulated highway debts in 2011 to be paid back through tolls.

In response to public opprobrium over high tolls, the central government decided in 2012 to waive toll charges for personal vehicles on national holidays. But subsequent announcements about extending tolling periods for more years provoked a public outcry. To address the issue of expensive tolling, the Chinese government should consider gradually reducing its reliance on borrowing-and-tolling and instead improve tollway pricing through a combination of technical and procedural considerations.

First, China should directly allocate more fiscal resources to support highway development. That is because tolling alone cannot provide sufficient revenues. The United States and many other countries, during earlier periods in their history, relied on toll roads extensively. But after the development of modern taxation systems, most countries turned to taxation as the main way to support roadway investment. Tolling could be financially viable in supporting certain highway segments, for example as a way to pay back the initial construction cost. And it could be a policy tool to manage transportation demand.

Photo: © Steve Harris / World Bank

Yet because of the "public good" nature of highway transportation, relying solely on direct user fees will not likely generate sufficient revenue to support the construction and maintenance of the entire highway system. This can already be seen in China through the fact that highway segments constructed earlier have ample traffic demand and thus higher returns on investment while newly developed segments, especially in rural or remote areas, are not generally able to collect sufficient tolls to pay back their initial cost and cover future maintenance needs.

This problem cannot be fully addressed by additional borrowing, PPPs, or extending tolling periods. China's national and provincial governments need to undertake more fiscal responsibilities to bridge the gaps. This means gradually de-tolling current toll roads and reducing new construction's reliance on tolls. Proper revenue sources may instead come via general budget allocations (the European approach) or dedicated fuel taxes (the US approach).

A second recommendation for China's highway development concerns how to determine the level of toll pricing. This is not just a technical issue but also has financial, managerial, and legal implications.

Technically, setting toll fees at an appropriate level can be used to regulate traffic behavior and improve the efficiency of facility usage. But waiving toll charges on national holidays, as the Chinese government has done, may be counterproductive as it may simply aggravate roadway congestion during high-demand periods. Financially, meanwhile, it is unclear how toll agencies in China determine their toll rates. The public often expresses the view that toll proceeds should only be collected to offset facility costs. Such costs should include not just initial construction costs but also operation and maintenance costs along

the lifecycle of a facility. The breakeven point should be determined system-wide for the simple reason that it makes sense to have cross subsidies between different highway segments.

Managerially, international experiences of "public utility management" often combine technical analysis with political procedures (such as public hearings and representational voting) in setting toll prices.[24] Informing the public and empowering them to participate in relevant decision-making processes would significantly improve policy implementation and reduce the potential for conflict.

Photo: © Yang Aijun / World Bank

Legally, existing toll projects may involve PPPs or other contractual relationships, and thus should be managed through proper legal processes. The recent decisions to waive toll charges and then later extend tolling periods were made through ad hoc administrative announcements, triggering criticism from the legal community in China.

High-Speed Rail: Would Private Finance Help?

The rapid expansion of China's HSR network is an impressive engineering feat that has yielded unprecedented personal mobility across the country's vast regions. Yet the economic and fiscal returns on this massive HSR investment remain unclear.

One reason that HSR is not widely developed in other countries is its high upfront construction and operation costs. In general, studies about the cost-benefit or cost-effectiveness of high-speed transit in developed countries do not yield substantive evidence to support undertaking such a massive investment.[25]

In addition, the economic returns of high-speed transit tend to be highly distributional—in other words, economic benefit gains in certain regions often come at the expense of other regions, thus further complicating policy decisions.

Compared to many other countries, China's government is better equipped to mobilize societal resources for such a large-scale undertaking. Still, the economic and financial effects of HSR investment in China need to be urgently studied to address policy concerns and inform future decision-making.

At this point, anecdotal evidence suggests that HSR has significantly improved the experience of personal travel in China, especially across the populous cities along the eastern coast. It is possible that in China, with its

sheer size, high population density, and compact development patterns, HSR may generate better economic returns than in other advanced but more sparsely populated countries.

That said, detailed data have not been released about how the $400 billion has been spent on HSR, thus complicating the ability to assess the effects of HSR investment across regions, over time, and in comparison to the economic returns from alternative investment options. For example, more economic and social benefits may accrue from a similar amount of investment in education, the environment, and social welfare, or perhaps even in other types of transportation improvements, such as regular passenger rail or freight.

It is possible that in China, with its sheer size, high population density, and compact development patterns, HSR may generate better economic returns than in other advanced but more sparsely populated countries.

In addition, special attention should be paid to the redistributive effects related to HSR, which may generate benefits surrounding the nodes but incur costs along the lines due to nuisance effects, such as noise pollution or the need for businesses to relocate.

Improved understanding of the economic effects of HSR would help not just to determine whether and how to invest in the system in the future, but also the proper ways to fund the system so that it remains sustainable. It is commonly known that rapid transit in most places cannot generate sufficient operating profits to offset the initial capital cost, thus HSR needs heavy direct governmental subsidies.

China has relied on borrowing for much of its HSR construction, mostly through national government loans and bonds issued by the Ministry of Railways (MoR), typically backed by an implicit guarantee from the government.[26] Facing increasing debt pressure and following a significant corruption scandal, the MoR was dismantled in 2013 into two parts, the State Railway Administration and the China Railway Corporation (CRC).

CRC was created in part to attract private finance through new mechanisms to issue bonds[27] or to form PPPs. But China needs to exercise due caution and avoid unrealistic expectations for additional private finance. Borrowing, of course, needs to be paid back, and private investments (including PPPs) must generate tangible returns. By and large, PPPs are a tool of financing, not a source of funding. They could expedite HSR project development in China, but cannot fundamentally change the fact that the construction of HSR requires huge fiscal subsidies.

To further expand financing tools will only push off the fiscal responsibilities that should be shouldered by the government, in any case. Worse, it may create false public perceptions that HSR is self-funding, thus leading to a

decision to over-spend without realizing true future costs. This means that the bulk of capital costs should be covered with direct governmental revenues, and most appropriately at the national level, for the simple reason that HSR has significant network effects and can yield broad national benefits.

On the operating side, it is not yet clear what percentage of the initial cost of HSR investment can be recovered through passenger fares. Although some of the most popular HSR routes have shown some potential to break even, HSR as a whole is likely to require substantial financial subsidies for some years. The burden of these subsidies should fall to the provincial or lower levels of local government that enjoy visible economic benefits from HSR.

Photo: © Wu Zhiyi / World Bank

These subsidies could either come from general revenue allocations or be generated through value capture strategies, such as joint development or development impact fees, applied in areas that are close to major HSR nodes. As noted above, PPPs cannot be relied on as a source of revenue, since public sector contracts will still have to be paid back in the future by the government through whatever general fiscal revenues are available (so-called "availability payments").[28]

Urban Mass Transit: Demarcation of Central and Local Roles

Until the last decade, investments in urban transit had been growing at a lower rate in China than that for roads and bridges. Urban mass transit accounted for just 8 percent of total urban infrastructure investment in 1990, a share that decreased by almost half in 1995 before returning to 8 percent in 2000.

In comparison, the corresponding share of roads and bridges grew from 26 percent to 45 percent during the same period. After 2000, more attention has been paid to the development of urban transit, which now accounts for about 15 percent of total urban infrastructure investment, but this investment has been highly concentrated on the four major municipalities of Beijing, Chongqing, Shanghai, and Tianjin, as well as several eastern provinces, leaving the rest of the country less touched.[29]

In recent years, the central government in Beijing has repeatedly called for a "vigorous expansion" (*dali fazhan*) of urban transit, which includes either regular transit with buses and streetcars or newly approved construction or expansion of metropolitan subways. A

critical issue is how the fiscal burden should then be divided among different levels of government, since transit services typically require substantial governmental funds to supplement fare proceeds.

An improved urban transit system in China could reduce reliance on personal vehicles, helping to relieve urban congestion, reduce environmental pollution, and enhance urban mobility, especially for those in lower-income groups. Reducing environmental pollution will have especially positive effects across jurisdictional boundaries. Enhancing mobility for low-income groups would have significant redistributive effects. Yet these responsibilities cannot be put onto local governments alone. They should be borne by the central government.[30]

One way to better handle cost-sharing between central and local governments would be the creation of a formula-based matching grant to help local governments cover the capital costs of urban transit.

One way to better handle cost-sharing between central and local governments would be the creation of a formula-based matching grant to help local governments cover the capital costs of urban transit, such as initial construction of transit corridors or the purchase of buses. Such a grant would be especially important for new construction or expansion of metro subways, which should not be dependent on local borrowing because subway operations usually do not generate future profits for debt payments. A carefully designed matching grant for capital expenditures would not create the incentive to overspend, so long as local governments are held accountable for pledging their share of fiscal contributions.

For expansive urban transit programs, such as subways, even the operation cost would be a substantial financial obligation that requires careful management. Local governments planning for new subway lines should set aside certain amounts of local fiscal revenues to supplement possible annual operating deficits. The central government, meanwhile, should review such financial plans before approving new construction projects.

Another potential source of urban infrastructure funding could come from property taxes, which are being developed in China but are much more widely used in other countries as the mainstay of local revenue to fund public services, including local roads and public transit.

Property taxes have been piloted in several Chinese cities since 2011, including Shanghai and Chongqing, and are likely to be widely adopted in the near future. It would be advisable to tie some proportion of future property taxes to infrastructure improvements and allow city residents to participate in relevant decision-making through

an open process. Unlike LTFs, property taxes are not one-off revenues but can be sustained over many years and tied directly to home ownership.

Since the improvement of urban transit tends to raise property values, Chinese cities may also apply a wide range of value capture strategies, such as joint development around transit stations, to generate supplemental revenues to support urban transit. This again will require consent and collaboration among the government, residents, and developers.

Conclusion

In recent years, countries like the United States have struggled with insufficient funding to meet transportation infrastructure demands. By contrast, the Chinese government has been able to achieve substantial progress in upgrading and expanding its transportation system. Questions have been raised, however, about the long-term sustainability of current investment mechanisms.

This policy memorandum has offered a five-question conceptual framework to analyze some of the key decisions about infrastructure finance. Its premise is that the investment system would be more efficient and equitable if the costs of infrastructure are closely linked to its beneficiaries. Chinese urban infrastructure finance can be characterized as a "government-led market operation," in which local governments have taken the lead in experimenting with different financing and revenue approaches. Yet such a system is unlikely to be sustainable because of the lack of central government support, heavy reliance on debt financing, and a shortage of dedicated regular fiscal sources.

Photo: © Yang Aijun / World Bank

Beijing faces several distinct challenges in sustaining its investment boom in highways, HSR, and urban transit. For the highway system, temporary toll waivers during holidays are not an efficient way to reduce public resistance to high tolls, nor would extending toll periods be an effective approach to the payback of construction debts or to sustaining future operations and maintenance. China should gradually reduce its reliance on borrowing-and-tolling and improve decision-making about toll rates, in part by adopting better procedures and technical analysis.

For HSR, in addition to assessing the possible relationship between enormous investment and economic returns, potential redistributive effects and associated equity concerns also need to be better understood. The use of private finance will not provide sufficient funding to pay back HSR construction debts and sustain HSR operations. Instead, joint fiscal efforts at the national and provincial levels are required.

For urban transit, such as subways, central or provincial governments could allocate a formula-based matching grant to help city governments cover

capital costs, and use dedicated local revenue sources, such as a property tax, to subsidize ongoing operations and maintenance. Ultimately, cost- sharing arrangements between the central and local governments need to be further clarified and aligned.

Because of the public-good nature of transportation facilities ("who benefits?"), it is unrealistic to expect that highways, HSR, and urban transit will pay for themselves without substantial fiscal support. These facilities have significant regional or even national effects ("where are benefits manifest?"), thus the central government needs to play a role in assisting local governments. While transportation facilities have long-term benefits ("when are benefits manifest?"), most transportation facilities will not generate sufficient operating profits for debt services. That means the government should consider using more pay-as-you-go fiscal revenues and rely less upon financial tools, including borrowing, LTF, or PPP, that mainly push off funding responsibility to a future time.

Additional allocation of direct government funding, such as formula-based central capital grants and dedicated local revenue sources, may make China's transportation investment more sustainable ("which payback mechanism is to be used?"). Moreover, it is advisable to develop a more open and transparent decision-making process, in which such important investments, including funding mechanisms and pricing ("at what price level?"), can be made through cooperative decisions that are informed, deliberate, and have the benefit of public consent.

Questions will inevitably arise about where additional fiscal revenue may come from to reduce the reliance on market financing. Tax increases are not a popular proposition in any country. And this will especially be the case if a new property tax is used to pay for such public goods. Inevitably, Chinese citizens and homeowners will demand that their taxes be used in a way that yields immediate benefits to them.

The transportation sector is but one manifestation of the overall problem of fiscal imbalances in China. The prevailing system delegated too much responsibility to localities that, when pressured, turned to "innovative" and often unregulated financial tools to make up for shortages of direct funding. Reforming China's overall revenue system is beyond the scope of this memorandum, but more sustainable financing of China's transportation sector will be essential to create a more balanced system.

Endnotes

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[8] "Public good" is not a fixed definition and is dependent on certain conditions. A "pure public good" shall be both non-excludable and non-exhaustive. A congested highway is exhaustive and thus becomes a "toll good" or "club good."

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[13] Based on anecdotal observations and interviews, we suspect that much of the payback mechanisms for these financing activities are not included in the urban infrastructure fiscal revenues, and thus the concern of possible double counting is low.

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