

A ZAMBIAN ROAD TO NOWHERE?

The History of Big (Road) Infrastructure and the
2011-2022 Zambian Road-Building Boom

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Contents

1.	Introduction.....	4
2.	Case Studies: The Historical and Contemporary Background.....	6
3.	Economic Growth and Income.....	8
4.	Urbanization and Agglomeration Externalities.....	11
5.	Property Rights and Institutions.....	13
6.	Trade.....	19
7.	Firms.....	21
8.	Distributional Impacts.....	22
9.	Conclusion.....	23

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"We're on a road to nowhere..."

...come on inside / takin' that ride to nowhere
we'll take that ride / I'm feelin' okay this mornin'
and you know / we're on a road to paradise
here we go, here we go."

1. Introduction

A road to nowhere or a road to (economic) paradise? What long-run economic impact will the boom in road construction between 2011 and 2022 have in Zambia?

Academics, donor organizations, and policymakers have long discussed the reasons for lagging economic growth in sub-Saharan Africa (SSA) and their appropriate policy responses. The debate has turned full circle in the past 70 years. In the 1950s, it focused on the shortage of infrastructure capital, for which the policy response was more (donor-funded) investment. In the 1970s, it was basic needs and a (donor-funded) effort to promote wider human development. In the 1980s, it was policy failures and a (donor-prompted) effort to liberalize economies. In the 1990s, it was institutional failures and a (donor-promoted) effort to support the good governance agenda (Wethal 2019). In 2022, we are back where we started, and debates about economic development in SSA actively stress the importance of infrastructure.

This is because Africa research has revealed the high costs of transport. In 2007, average transport costs (per ton-kilometer) ranged from \$0.02 in Pakistan and \$0.0354 in Brazil to \$0.055 in the United States and \$0.06 in China. However, in SSA, costs tended to be much higher, including \$0.06 on the Durban–Lusaka route, \$0.08 on the Lomé–Ouagadougou route, \$0.10 on the Mombasa–Kampala route, and \$0.12 on the Douala–N'Djaména route (Teravaninthorn and Raballand 2009, 14). Comparing recent price data on goods at their port or source location to prices at their destination shows that the effect of distance on the cost of transporting goods in Ethiopia and

Nigeria is estimated to be 3.5 times and 5.3 times higher, respectively, than in the United States (Atkin and Donaldson 2015). Evidence points to striking price differentials over geographic distance. In the years between 2002 and 2008, the price of oil in SSA increased from \$25 to \$97 if it is sold more than 500 kilometers (310 miles) from a major city (Storeygard 2016).

Differences in transport costs significantly affect African exporters—especially because many SSA countries are small suppliers of agricultural products, the prices of which are fixed on world markets. Differences in transport costs in this situation will be borne by the African exporters. In economic sectors where production involves importing machinery and components for assembly and reexport (such as textiles and electronics), even relatively small transport costs can have a substantial impact on final costs. The very sectors characteristic of successful, export-led growth stories in Asia are those most hindered by transport costs (Woods 2004).

The high cost of transport has also been linked to the poor quality of African infrastructure. The coverage of paved roads in SSA is the lowest of any global region. In 2010, SSA only had 31 kilometers (19 miles) of paved road per 100 square kilometers (0.4 square miles) of land, compared to 134 in other low-income countries (Graff 2019). In rural areas, more than two-thirds of the population live further than two kilometers (1.2 miles) away from any all-season road (Teravaninthorn and Raballand 2009). (Section 6 of this paper discusses additional causes of high transport costs, such as inefficient border crossings and anti-competitive regulation of the trucking industry.)

Research on the economics of geography has found a deeper determinant of high transport costs in Africa. This agenda has explained economic development failures in SSA as being linked to the geography of distance: Being a landlocked country—or having a large share of the population living more than 100 kilometers (62 miles) from the coast—has a negative impact on economic growth (Bloom and Sachs 1998; Gallup and Sachs 1999). In SSA, for instance, 25 percent of the population lives in landlocked countries, and only 19 percent live near a coast, compared to 38 percent—or 67 percent if including ocean-navigable rivers—in the United States (Gallup and Sachs 1999). Controlling for distance, income levels, and language, non-European landlocked countries trade 40 percent less with the rest of the world, while landlocked African countries trade 60 percent less (Coulibaly and Fontagné 2005). Half of the world's trade takes place among countries located within a 3,000-kilometer (1860-mile) radius of each other, but in 1990 SSA countries were an average of 7,800 kilometers (4850 miles) from their trading partners (Gallup and Sachs 1999).

Africa has also readily embraced the road-infrastructure agenda. The New Partnership for Africa's Development (NEPAD) was established under the African Union (AU) in 2001. NEPAD has promoted the Program for Infrastructure Development in Africa (PIDA), established in 2012 to promote a set of goals for achievement by 2040, as one of its flagship initiatives. One of PIDA's priority areas is the Missing Links on the Trans-African Highway project, which proposes increasing the connectivity of Africa through ten routes, including Lagos to Mombasa, N'Djamena to Djibouti, and Cairo to Cape Town, among others. The vision has been a focal point for donor engagement; for example, the African Development Bank (AfDB) supported the construction or rehabilitation of over 10,000 kilometers (6,200 miles) of roads between 2015 and 2020 (African Union 2022, 32). In 2021, an AU evaluation on the union's Agenda 2063 progress indicated mixed success on Goal 10, "world-class infrastructure crisscrosses Africa." The continent had done well on implementing the Single African Air Transport Market (reaching 80 percent of expected values by 2021), adding megawatts to national grids (193 percent of expected values), and increasing mobile-phone access (91 percent of expected values). However, completion of parts of the Missing

Links on the Trans-African Highway project increased from 8.12 percent in 2013 to only 19.38 percent in 2021, falling short of its target by a significant margin—though some countries did make significant progress. Ethiopia completed 100 percent of its road links to Sudan, Kenya, Somalia, and Djibouti; Senegal finalized 60 percent of its projects, including its segment of the Dakar–Abidjan coastal corridor, which will stretch across Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia, and Côte d'Ivoire (African Union 2022, 31–32).

For Zambia, one of 16 landlocked countries in Africa, road building over the past decade promises to make it "land-linked" instead. In 2011, President Michael Sata of the Patriotic Front came to power, and his incoming government committed itself to a more expansionary fiscal policy, in part driven by spending on infrastructure. Roads constituted 42 percent of all expenditures on non-financial assets between 2011 and 2017. In addition, the 2012 Zambia 8000 Accelerated National Roads Construction Program (ANRCP) promised to rehabilitate or upgrade 8,000 kilometers (4970 miles) of roads to meet international standards for bituminous surfaces (Zajontz 2022). The aim was to turn Zambia into a "highly road-linked" country by 2017 (Ngulube 2021, 6). The country's seventh National Development Plan, released in 2017, promised that "investment in improved transport systems and infrastructure will drive wider economic benefits, including supporting growth and creation of jobs, raising the productive capacity of the economy, driving efficiency and boosting international competitiveness" (Zajontz 2022). This paper examines the economic impact of road building between 2011 and 2022. In 2022 Zambia entered into an IMF agreement. In return for a large loan and IMF criticism that Zambia had over-borrowed and over-invested in (road) infrastructure Zambia agreed to reign in public spending and reduce fiscal deficits. It appeared likely that the 2011–2022 road building boom would come to an end.

Fiscal space for these projects was enabled by a decade of conservative fiscal management, particularly under Minister of Finance Ng'andu Magande (2003–08). This was complemented by the International Monetary Fund's (IMF) and World Bank's Multilateral Debt Relief Initiative, which launched in 2005 to benefit Highly Indebted Poor

Countries (HIPC). Under this initiative, Zambia saw its international debt stock reduced from \$7.1 billion in 2004 to around \$600 million in 2006. The debt reduction—as well as Zambia’s regaining of middle-income status in 2010 and sustained economic growth stemming from high copper prices—raised its sovereign credit ratings to a B+ in 2011 (Cheelo, Hinfelaar, and Ndulo 2020, 116). More success in mobilizing domestic resources also meant donor support as a share of revenues declined from 40 percent in the 1990s to 2 percent in the 2000s; meanwhile, annual inflation dropped from 30 percent in 2000 to 7.2 percent in 2011 (Hinfelaar and Sichone 2019). Rising copper prices and a reform of copper taxation saw mining revenue increase from 2.8 percent of gross domestic product (GDP) in 2008 to 6 percent in 2012, enabling Zambia to borrow Eurobonds on private capital markets (Cheelo and Hinfelaar 2020, 6). The increase in road spending was financed roughly equally from government and external sources, with the latter coming mainly from China.

Using historical and contemporary studies of road construction, this paper seeks to draw economic lessons for contemporary Zambia. The conclusions present a paradox. The historical and contemporary literature is one of economic optimism: Roads consistently boost economic growth, urbanization, trade, and firm-level dynamics and benefit from (and often in turn promote) good institutions. However, the historical record on distribution is more nuanced. Although roads have distributional impacts that increase economic inequality, these impacts are often offset by the simultaneous positive effects of economic growth, industrialization, and employment creation. For Zambia specifically, the economic impact of 2011-2022 road construction is more likely to be negative. The following eight sections justify this paradox.

Section 2 introduces the case studies used in this paper and the 2011 road-building program in Zambia. Sections 3–8 explore historical and contemporary lessons from road building in Zambia, including for economic growth, urbanization and agglomeration externalities, property rights and institutions, trade, firms, and distribution. Section 9 concludes.

2. Case Studies: The Historical and Contemporary Background

To determine what economic impact the 2011-2022 boom in road construction will have in Zambia, this paper turns to historical and contemporary studies of road construction. These case studies broadly follow a global history of road building, from the network of Roman roads that spanned much of Europe, the Middle East, and North Africa in the first few hundred years CE all the way to China’s massive investment in roads after the death of Mao Zedong in 1976. In subsequent sections of this paper, we use these case studies to ask economic questions. Did historical and contemporary road construction boost economic growth, increase urbanization, improve institutions, promote trade, and benefit firms? What impact did they have on income distribution?

There is a body of economic theory that focuses on the direct impact of transport infrastructure, using four methods to gauge whether there is a shortage. These are: engineering assessments of infrastructure needs, economic measures of rates of return, political measures based on voting outcomes, and econometric estimates of impacts on productivity.

The engineering assessment relies on studies on the condition of existing roads and need for rehabilitating them or constructing new ones. The most convincing evidence of a shortage is urban highway congestion. Such studies are useful in deciding whether to invest in road building, but less so in estimating the likely economic impact of that investment. They do not consider wider economic questions such as whether the benefits outweigh the construction costs (Gramlich 1994).

The economic approach to infrastructure investment involves estimating all the benefits and costs of a road project to determine whether a project will generate a positive rate of return (promote economic growth) and how that return compares to other potential uses of the investment resources (Gramlich 1994). In Zambia, road construction after 2011 was

often done without detailed feasibility studies. Even the studies that were done tended to be conducted in a political environment that encourages promoters of infrastructure projects to underestimate costs and overestimate benefits in order to gain approval and funding (Flyvbjerg 2009).

A third, indirect method is to look at political debates. If public investment really is as profitable as claimed, would private investors not be clamoring to have the public sector impose taxes or float bonds to build roads, highways, and sewers that can generate these high net benefits (Gramlich 1994)? The promise of the 2011 road-building project was an electoral boon to its advocates. The Patriotic Front government under President Sata won office with a campaign structured around promoting economic growth and employment through infrastructure building. However, in the Zambian context, political pressure to build might not have emanated from likely economic benefits, as discussed in Section 5. Politicians, constructors, and financiers may promote road building because of (likely corrupt) private gains or opportunities to utilize road construction to support political patronage.

Another approach is to use econometric analysis to measure the past impact of road infrastructure on economic growth (Gramlich 1994). One methodological problem with the other approaches is the long potential lag between road construction and the full economic response to the new infrastructure. This paper incorporates an econometric method, focusing on before-and-after conditions of completed road projects. For example, Roman road construction after 312 BCE has influenced patterns of European urbanization through to the present day. However, there is a significant methodological problem at the heart of before-and-after studies that has bedeviled economic analysis of road infrastructure. There is abundant evidence that economic growth, industrialization, and/or growth of international trade (in post-1980 China, for example) also occurred at the same time as road expansion, making it difficult to establish a causal relationship between them. Did roads drive economic growth, or did economic growth create a demand for roads and the government tax revenue to fund their construction? This paper draws from the vast number of historical studies, the new datasets they created, and the impressive array of econometric-statistical methods they used to deal with the problem of causality.

The ancient Roman road network expanded simultaneously with the military conquests of the Roman armies. The main reason for constructing roads was to rapidly deploy troops around the growing empire. The earliest Roman road was the Via Appia, constructed in 312 BCE from Rome eastward to Capua (close to Naples) and later extended to Brindisi on the Adriatic coast. The Via Appia was first built to supply Roman troops during the Second Samnite War, contributing to the defeat of the Samnites in 304 BCE (De Benedictis, Licio, and Pinna 2018, 10; Dalgaard et al. 2018). The road network expanded with the empire; Julius Caesar's invasion of Gaul was as much about infrastructure engineering as it was military tactics (Goldsworthy 2006). Painstaking modern scholarship has opened up Roman roads to detailed econometric study. Scholars have compiled data on more than 7,000 segments of the Roman road network across 36 (modern) countries, classifying them according to their importance (De Benedictis, Licio, and Pinna 2018, 6). This has enabled the creation of an original measure of Roman roads used to track the extension of the network from Italy (Licio 2021). At the peak of the Roman Empire, 113 provinces were connected by 372 main roads—connecting every (modern) country between Scotland and Iraq, including west of the Rhine, south of the Danube, and north of the Sahara. At the peak of the Roman Empire, when Emperor Trajan died in 117 CE, it is estimated that the empire hosted around 80,000 kilometers (50,000 miles) of paved road (Dalgaard et al. 2018).

In the United States, the Federal-Aid Highway Act of 1944 created plans for a national system of Interstate highways, stipulating that these should strive to connect metropolitan areas, serve national defense, and link to international borders with Mexico and Canada. States were asked to submit proposals for their portion of the interstate system, and in 1947 the federal roads commissioner approved final proposals for 37,324 miles of highways. The 1956 Interstate Highways Act expanded the network to 41,000 miles of highways and committed the government to pay 90 percent of construction costs. These plans represent most of the system that exists today, though some of it was not completed until the 1980s (Baum-Snow 2007). The system has since been added to at the margin. For example, in 1998 President Bill Clinton signed into law the Transportation Equity Act, which included \$167 billion for highway construction (Chandra and Thompson 2000).

The first modern highways in Spain were built in the late 1960s and 1970s, but by the early 1980s, Spain still only had roughly 2,000 kilometers (1,200 miles) of highways. Over the next three decades, Spain expanded its highway network through various national road-construction plans partially funded by the European Union, and by 2015 the Spanish highway system comprised more than 14,000 kilometers (8,700 miles) of roads, making it the fifth-longest network in the world after the United States, China, Russia, and Canada (Garcia-López, Holl, and Viladecans-Marsal 2015, 54–56). The European Union has promoted highways much more widely in recent decades. The goal of the Trans-European Road Network (TERN) project, launched in 1993, has been to improve the continent's internal road infrastructure; and between 2007 and 2013, 53 percent of EU structural funds were allocated to road construction (Garcia-López 2018, 7). Overall, the European network increased from 44,000 kilometers (27,000 miles) to 68,000 kilometers (42,000 miles) of highways between 1990 and 2010. A new transportation policy, approved in 2014 with a budget of €24 billion (about \$32 billion at the time), aimed to expand the network to 90,000 kilometers (56,000 miles) of highways and high-quality roads by 2020 (Garcia-López 2018, 1).

China's intercity road network in the early 1990s was mostly two-lane, unpaved roads. Most goods were moved by rail or river, while less than 5 percent of freight ton-miles traveled by road (Baum-Snow 2020). In 1992, the Chinese State Council approved the National Trunk Highway Development Program. With an estimated cost of \$120 billion over fifteen years, this project aimed to connect all provincial capitals and cities with a population above 500,000 to a single road network by 2007 and to link up the national system to the emerging Asian Highway Network. The State Council approved a more ambitious sequel in 2004, hoping to connect all cities with a population of more than 200,000 by 2020 (Faber 2014). By 2011, the highway network reached 85,000 kilometers (53,000 miles), then the second-longest in the world (Xu and Nakajima 2013).

India launched its National Highway Development Project in 2001. This included the Golden Quadrilateral (GQ), which connected the major economic centers of Delhi, Mumbai, Chennai, and Kolkata with four-lane highways. Its "construction, mostly upgrades of existing highways to higher

quality, began in 2001 and was completed by 2012 with a total network length of 5,846 km at a cost of USD 5.4 billion" (Alder 2016). A second phase of the program was approved in December 2003 to improve a further 6,647 kilometers (4,130 miles) of highways (Ghani, Goswami, and Kerr 2014).

Other countries have recently upgraded their highways as well. Brazil's road network, largely constructed during the 1960s and 1970s, accounts for about 60 percent of all goods transported within the country. The network was upgraded between 2007 and 2010 through the Programa de Aceleração do Crescimento (Bottasso et al. 2021). In Ethiopia, the Road Sector Development Program expanded the road network from 26,550 kilometers (16,500 miles) in 1997 to 53,997 kilometers (33,550 miles) in 2011, increasing the share of roads in good and serviceable conditions from 22 percent to 57 percent. Its estimated total cost was about \$7.08 billion, which was financed by various donors (Shiferaw et al. 2015).

3. Economic Growth and Income

Macroeconomic studies have found a consistently positive correlation between road construction and economic growth. However, there is limited evidence that the 2011-2022 road-building program in Zambia has had a positive impact on economic growth. This is likely because roads in Zambia are being built to improve national connectivity rather than targeting economic returns, in addition to the lack of a well-planned strategy for maintaining roads once they are constructed.

The endowment of motorways in the European Union relative to the population in any given region has had a positive and significant correlation with economic growth that has spilled over into neighboring regions. This temporary growth boon provided by roads contrasts with other, more enduring factors—such as research and development (R&D), migration, and education—that have a more sustained positive impact on economic growth (Crescenzi and Rodríguez-Pose 2008). In Brazil, there is evidence of positive spillovers from local road-network extensions into nearby states (Bottasso et al. 2021). In India, the GQ project, which connected India's four main urban centers, raised incomes by between 2.4 and 3.5

percent by 2009 (Alder 2016). Road construction also had a positive impact on economic growth across 24 Chinese provinces between 1985 and 1998. More rapid road construction in the coastal provinces helps explain their better economic performance and the resulting rise in intraregional inequality (Démurger 2001). Another study on China, using provincial data from a later period (1990–2013), found roads had a more mixed impact on economic growth, even being inversely related at times. Two decades of massive investment in transport (during which highway networks grew from near zero in 1988 to 53,000 miles by 2011) may have led to diminishing returns and a crowding-out effect on non-infrastructure investment (Shi, Guo, and Sun 2017).

The limited existing literature on Zambia suggests that road building has had a positive impact on economic growth. Case in point is the \$841.51 million Nacala Road Corridor project, a 1,165-kilometer (724-mile) road-rehabilitation project to improve the Trans-Africa Highway system between Lusaka in Zambia through Malawi to the Port of Nacala in Mozambique. The Zambian portion of the road—a 592-kilometer (368-mile) stretch—was originally constructed between 1967 and 1972 and was in a very poor condition by the 2000s. The project aimed to reduce travel time and vehicle operation costs on rehabilitated sections by 30 percent each, with funding coming from the AfDB, European Union, European Investment Bank, and Agence Française de Développement (Ngulube 2021, 4–6). A detailed study showed that after the Nacala Road Corridor upgrade was completed, grid cells closest to the upgraded highway experienced a faster growth in nighttime light intensity than before, indicating more electricity and economic development. Grids within 10 kilometers (7 miles) of the road showed an increase in light intensity of around 28 percent, reflecting an estimated 21 percent increase in GDP (Ngulube 2021, 100).

There is some, even more limited work examining which economic sectors are most impacted by road investment. In both China (Xu and Nakajima 2013) and Brazil (Bottasso et al. 2021), highways benefited heavy industry but not light industry, as heavier goods tend to be more road-intensive. In the United States as well, an increase in highways within a city pushed that city to specialize in the export of heavy goods. The data indicates that this specialization takes about 10 or 20 years to complete (Duranton,

Morrow, and Turner 2014). In Zambia, after the Nacala Road Corridor was upgraded, firms in the tradeable experienced a larger increase in gross profit and sales and a decrease in fuel and labor costs compared to firms in the non-tradeable sector (Ngulube 2021, 80). This was in accordance with the Zambian government's long-standing efforts to promote exports and diversify the economy away from copper production.

There are also few studies that attempt to quantify whether roads' positive impact on economic growth is outweighed by the cost of construction (the opportunity cost). One study found that intra-city highways in the United States generated about \$125 billion per year of short-distance new trade but only cost approximately \$12 million per year to maintain (Duranton, Morrow, and Turner 2014). In India, the GQ project raised incomes by more than three times the cost of construction (Alder 2016). However, there is good reason to believe that the metrics by which road construction is judged in developing countries are pushing donors and local governments into building uneconomic roads. In Africa, an oft-cited measure is Road Access Index (RAI), which looks at the share of the population that lives more than 2 kilometers (1.2 miles) from a paved road; in 2010, this was one billion people worldwide, or 31 percent of the total rural population. The RAI is frequently used to shape policy interventions. One such (non-African) example was the Prime Ministers Village Road Program in India, launched in 2000 with the goal of providing year-round access to all residences. By 2015, "over 400,000 km of roads had been constructed, benefiting 185,000 villages – 107,000 of which previously lacking an all-weather road – at a cost of more than \$37 billion" (Asher and Novosad 2016, 13–14).

Although 17 percent of the population of SSA was not living within 5 kilometers (3 miles) of a road in 2008, focusing on the RAI as a driver of road construction was unlikely to have much impact on economic growth or poverty reduction in this context. All-weather roads allow transport by trucks, which cost (per ton-kilometer) one-tenth as much to move goods as transport by bicycle and one-eighth as much as transport by motorbike. In SSA, road access is not a major consideration for small farmers because, in most cases, infrastructure is sufficient for motorcycles. The limited size and productivity of farms means that even access to good roads would not enable farmers

to utilize trucks. In SSA, the average cultivated farm needs to transport about 100–200 kilograms (220–440 pounds) of farm produce per week; a bicycle or motorbike is enough to do this (unless loads are consolidated). A bicycle can carry 60 kilograms (130 pounds) per trip, while a truck needs to haul around 5–7 tons per trip to cover costs, making trucks 10–15 times more expensive per ton-kilometer (Raballand, Macchi, and Petracco 2010, 39). A gravel or bitumen road that trucks can use year-round would be an overinvestment in many cases. Farmers would benefit more from load consolidation and agglomeration at the local level, wherein roads for trucks are only needed to connect hubs that consolidate many farms' output (Raballand, Macchi, and Petracco 2010, 59–71). Road building should therefore account for economic-agricultural potential rather than respond to deficiencies in the RAI.

The data is lacking for Zambia, but national household surveys from Cameroon, Uganda, and Burkina Faso do show a distinct negative correlation between household income from sales of agricultural products and distance from markets or large cities. There is no significance within 2 kilometers (1.2 miles)—the cutoff for the RAI. What matters for increased income is farm-level productivity such as overall crop yield, crop type, and share of output sent to market (Raballand, Macchi, and Petracco 2010, 29–30). One World Bank study examined the impact of providing a subsidy to a minibus service for six months to serve five villages in Malawi (neighboring Zambia) that were 17 kilometers (11 miles) from a market town. Prior to the subsidized bus service, there was no passenger road transport from the five villages to the market town. Travel was done by walking or by bicycle and consequently people made only infrequent trips outside the villages. The bus proved popular enough with 60 percent of the 406 households who received subsidized tickets, but usage declined sharply as prices increased because local marketed agricultural output was not enough to pay the break-even charge for the bus service (Raballand et al. 2011). The cost of extending all-weather roads to within 2km of farmers outweigh the benefits in most cases, as people would continue to walk or use bicycles to get around (Raballand, Macchi, and Petracco 2010, 11). Basing policies on the RAI metric used by donors and the Zambian government would severely reduce the economic return from road construction in Zambia, where major roads cover vast distances despite the relatively small size of the towns, cities, and villages they connect (see Figure 1).

The emphasis in the recent infrastructure renaissance has been on constructing new or extended roads to fill an “infrastructure gap,” particularly as determined by the RAI. This is significant since maintenance investment typically has higher rates of return but new construction more often gets donor or federal funding (Gramlich 1994). With generous funding, recipient countries or sub-national regions have an incentive to maximize infrastructure construction for which they are not paying much—but also to neglect maintenance of existing and newly created infrastructure. For example, the US federal government allowed states to choose the location of interstate highways, then paid 90 percent of the construction costs. Unsurprisingly, the incentive to build using the budget of another layer of government led to dramatic cost inflation. By 1968, total highway spending was double the initial estimate at \$56.5 billion, reaching \$90 billion (and rising) by 1972 (Swift 2011, 285). The corollary was the relative neglect of long-term maintenance. By 2010, the United States was struggling to maintain the existing interstate system—which accounted for a quarter of the nearly 3 trillion miles Americans drove each year despite constituting only 1 percent of the nation's road mileage (Swift 2011, 318). One federal study by the National Surface Transportation Policy and Revenue Study Commission estimated that it would cost \$225 billion per year for 50 years to maintain road transport, an increase of 250 percent from current spending (NSTPRSC 2007).

The US experience was writ large in Africa's post-colonial history. The 1960s and 1970s saw massive investment in infrastructure, largely financed by various international donors. Infrastructure financing comprised 60 percent of total aid to SSA in 1973; in Zaire, US and European financiers committed to more than \$2 billion for infrastructure between 1970 and 1980 (Mold 2012). The same cycle played out as in the United States: an incentive to maximize construction and a neglect of longer-term maintenance. By the mid-1990s, about one-third of the roads in SSA built during the 1970s were no longer in use (Wethal 2019). Much of Zambia's road system was constructed during the decade following independence in 1964, but only 20 percent remained in good condition by 1990 (Ngulube 2020, 6). The post-2011 cycle of road construction in Zambia risks repeating this history.

FIGURE 1: THE ROAD NETWORK IN ZAMBIA



Source: Ezilon Maps, <https://www.ezilon.com/maps/africa/zambia-road-maps.html>

4. Urbanization and Agglomeration Externalities

Economic theory posits that road construction can either boost or undermine urbanization. Historical case studies show that road construction tends to have a positive impact on cities. Yet although cities typically boost economic growth and reduce poverty, this is no longer the case in Africa since 1970. In Zambia, the post-2011 road-building program is at risk of accelerating dysfunctional urbanization.

The foundational work of economist Alfred Marshall (1920) emphasized three different agglomeration externalities. First, he argued that firms will locate near suppliers or customers to save on transport costs. Second, he argued that a cluster of firms will attract workers with relevant skills and create a

labor pool for existing and potential firms. Finally, he pioneered the theory of knowledge spillovers, in which firms can learn from each other and increase innovation by being in close proximity (Ellison, Glaeser, and Kerr 2010). There is good empirical evidence that these benefits come with urbanization. Productivity does increase when firms and skilled workers are in close contact, which enables them to collaborate, compete, share ideas, and learn from each other (knowledge spillovers) (Bertaud 2014). Wages tend to increase with urban population density (Combes, Duranton, and Gobillon 2010). Firms clustered in cities can access a wider market of inputs, buyers, and workers (agglomeration externalities). Firms supplying a large urban market can grow larger and produce at lower cost (economies of scale) (Turok 2016). Urban density also facilitates the delivery of public services. Among households in large cities, 80 percent are connected to the electricity grid, whereas only 20 percent of households in rural areas have access to electricity. Depending on the size of the city, young city dwellers receive, on average, between 2.5 and

4 more years of education than young rural residents (OECD 2022, 12).

In the past, urbanization has worked to promote economic development and alleviate poverty on a vast scale (Romer 2015). Although poverty can persist in cities, cities do not make people poor; rather, they attract poor people with the prospect of improving their situation in life (Glaeser 2011, 70). Worldwide, there is a clear link between the level of urbanization and GDP per capita. Over time, income per capita and the urban population share increase together, countries that historically became more developed also became more urbanized, and countries that have experienced an acceleration of economic growth, such as China after 1980, also experienced an acceleration in the rate of urbanization (Pritchett 2014). There is a substantial body of empirical evidence to explain this causal link between urbanization and economic growth (Glaeser 2011). A review of 180 studies of urbanization shows that density is associated higher wages, patent activity, consumption variety, and preservation of green spaces, as well as lower car use, vehicle mileage, energy consumption, crime, and costs of local public services. Density, however, is also associated with higher rents, construction costs, pollution, skill-wage gaps, and mortality risk, as well as lower average transport speed and self-reported wellbeing (Ahlfeldt and Pietrostefani 2018, 4).

Transport investment has an ambiguous impact on agglomeration externalities and urbanization. Better transport may facilitate firms and households relocating to urban areas to take advantage of agglomeration externalities (urban migration) or, alternatively, reduce the need to cluster in particular locations (de-urbanization) to benefit from agglomeration externalities. However, the empirical case studies are clear: better roads cause urban growth overall.

This long-term impact of road construction can be easily seen in historical case studies. As Duranton, Morrow, and Turner (2014) noted, the industrial structure may take decades to evolve in response to the construction of new roads. Some empirical analyses on roads look at centuries of economic evolution. For example, one study investigated whether there are significant differences in economic development (proxied by nighttime light intensity) between former Roman and non-Roman parts of

contemporary Germany. The results indicate that “economic development is significantly higher in the historically Roman parts of Germany,” where cities are, on average, larger—and that this is “particularly true for cities founded by the Romans and/or connected by Roman roads” (Wahl 2016, 6). This result generally holds across Europe; there was more economic activity in 2010 in places with greater density of ancient Roman roads (Dalgaard et al. 2018). The effect of this road network on city development is significant—if slightly declining—over most of the years between 1200 and 2000 CE (Wahl 2016, 36). The economic significance of Roman roads is dramatically smaller in the Middle East and North Africa, where wheeled transport disappeared between fourth and sixth centuries. “Consequently, following the fall of the western part of the Roman Empire, the roads fell into disrepair, and ultimately went out of use in North Africa and the Middle East. In contrast, Roman roads continued to be maintained and in use in Europe” (Dalgaard et al. 2018). Econometric analysis shows that the network of Roman roads has had a significant influence on the pattern of contemporary roads (García-López, Holl, and Viladecans-Marsal 2015, 57; De Benedictis, Licio, and Pinna 2018, 32). This persistence in road presence is associated with contemporary economic development (Wahl 2016, 6).

A study of 579 European cities between 1990 and 2012, using satellite imagery to measure urban sprawl, found that a 10 percent increase in kilometers of highway “causes a 0.4% growth in the residential land area [and] a 1.7% growth in the number of residential lots... over 20 years” (García-López 2018, 1). Another study combined satellite data on nighttime lights for 287 cities across 15 countries in SSA with a dataset about the length and surface material of roads. It found that transport costs had a significant influence on the economic output of cities between 1992 and 2008 (Storeygard 2016).

If roads boost urbanization, does it mean road development will also boost GDP growth and public services in Zambia? The answer is no. The link between urbanization and economic development is not automatic. Across much of Africa after 1970, urbanization has failed to boost per capita incomes (Gollin, Jedwab, and Vollrath 2016). Urbanization across the continent is occurring among people at a much lower relative income level than other continents historically experienced. Africa, which is

only about 40 percent urbanized, has an average GDP per capita of around \$1,000—but Asia’s GDP per capita was around \$3,617 when it reached the same level of urbanization in 1994 (Henderson and Kriticos 2017). In addition, governments in SSA often lack the tax revenue to provide necessary public goods and services. This has meant that the urbanization of people has not been accompanied by increased housing, infrastructure, and business investment, leaving many residents crowded into informal slums (Lall, Henderson, and Venables 2017, 38). Without planned transport and infrastructure connections, neighborhoods remain scattered, reducing workers’ access to jobs and preventing firms from reaping agglomeration benefits or achieving economies of scale.

African cities have become cities of consumption rather than production, with a large share of their workforce employed in non-tradeable services such as retail rather than manufacturing (Gollin, Jedwab, and Vollrath 2016). The service sector is much larger in Africa than expected given the level of GDP per capita (Badiane, Ulimwengu, and Badibanga 2012, 468). The economic impact of structural change has also altered dramatically over the past century. Between 1960 and 1975, African workers who left agriculture often moved to employment in manufacturing, where productivity was higher, meaning structural change boosted aggregate productivity. After 1975, workers were moving out of agriculture and manufacturing into market services such as retail trade and distribution; for instance, in Zambia between 1990 and 2010, “market services almost doubled from 6.8 per cent to 13.2 per cent of the labor force,” but the marginal productivity of these new service-sector workers was low (De Vries, Timmer, and de Vries 2013). Gabon, Libya, Algeria, Angola, and Nigeria also experienced rapid rates of urbanization with little industrialization. In Zambia, agricultural jobs actually increased their share of total employment by 5 percentage points between 1990 and 2005 (McMillan, Rodrik, and Verduzco-Gallo 2014).

5. Property Rights and Institutions

This section shows that while good institutions and property rights are likely to boost infrastructure

and road investment, there may be another, more insidious dynamic at work. Road building may also undermine property rights and stimulate corruption, as it is sometimes driven by political dynamics rather than by efforts to boost economic growth or reduce poverty. There is good evidence that the post-2011 road-building program in Zambia was associated with a worsening of domestic institutions.

5.1 Good Institutions Promote Good Road Building

Historical and contemporary examples of road construction show that it is promoted by good institutions, which economic historian Douglas North, who pioneered the modern study of institutions, described as “formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and their enforcement characteristics. Together they define the incentive structure of societies and specifically economies” (1994, 360).

Institutional innovation in the seventeenth-century United Kingdom led to a boom in road building. Acts of Parliament established turnpike trusts, private organizations that financed road improvements, naming a body of trustees (generally local property owners) and giving them the authority to levy tolls and issue mortgage debt secured upon this income. Prior to the trusts, local governments could not access external funding such as tolls or bonds, instead financing road construction through property taxes and by claiming up to six days of labor per year from their residents (Bogart 2005). The advent of debt-based bond financing allowed turnpike trusts to finance substantial initial investments at low interest rates without needing to accumulate sufficient revenue. Local landowners were still happy to participate in the trusts—nonprofit organizations whose revenue could only be used for road improvements or to fund operating expenses—because they earned indirect returns through greater agricultural market access and higher land values (Bogart 2004).

Turnpike trusts solved two market failures. First, they generated revenue to pay for the construction and use of roads. Second, they resolved a coordination externality by replacing a multitude of local governments with an interlocking network of trustees, centralizing decisionmaking authority over an entire road or a network of roads (Bogart 2004).

For instance, the 8-mile road that connected the northern textile manufacturing cities of Leeds and Wakefield was vital for local trade. The two town governments were reluctant to invest without the financial cooperation of the other until a turnpike trust was established in 1758 to improve it. By connecting Wakefield to Leeds, the new turnpike also increased access (network externalities) to all other cities connected to Leeds (Bogart 2004).

Turnpike trusts were established from the seventeenth through the early nineteenth centuries. During the peak years in the 1750s and 1760s, over 300 trusts were established to construct or improve 10,000 miles of road. By the 1830s, the turnpike trusts had built 20,000 miles of roads, or 17 percent of the then existing road network. These trusts accounted for the majority of both the four-fold increase in total real road spending between 1730 and 1800 and the second increase in road expenditure during the 1810s and 1820s (Bogart 2004). In addition, these road improvements reduced freight costs by an average of 20 percent over the eighteenth century (Bogart 2005).

5.2 Road Building May Undermine Institutions

However, the example of Roman and US roads shows that road construction may also undermine good institutions, especially property rights.

Roman roads famously did not respect existing property rights. They were constructed for military purposes—whether to send forces to a conquering front or to repress revolts in newly established territories—so were as straight as possible, not adapting to existing patterns of land ownership. Expansion of the Roman road network often entailed forcibly acquiring property from others through colonial conquest (De Benedictis, Licio, and Pinna 2018, 9).

The US case shows how road building promoted countervailing forces that eventually both helped protect property rights and tackle the corruption that was unleashed by road construction. The US Federal-aid Highway Act of 1956, with an initial budget of \$25 billion to construct 41,000 miles of highways (by 1972), took two years to negotiate (1954–56) among the president, Congress, and automobile, trucking, and highway interests (Lewis 1997, 98). The vocal railway interests of the 1920s had long declined and

by the 1950s railways were a degraded version of their former selves, with passengers often trundling along at 10mph looking out through grimy windows at cars whizzing past them (Lewis, 1997:217). The conflict centered on truckers' objection to paying higher diesel taxes and fiscal conservatives' objection to using debt and bonds to pay for the roads. Truckers eventually decided that the increase in the federal tax on gas and diesel from \$0.02 to \$0.03 was small compared to their prospective gains (Lewis 1997, 121). Politicians relented when they realized the opportunities federal construction would open up for local development and political patronage in their home states (Lewis 1997, 262).

Prior to 1956, the impact of road building on property rights had not been subject to much debate. Each mile of federal highway required 24 acres of land, and those living in the path of scheduled roads were not consulted; the federal government used its right of eminent domain to acquire property when necessary (Lewis 1997, 153). However, as discussed in Section 8 below, highways between cities generated more road congestion within cities, leading planners to push highways into urban areas as well. For instance, Robert Moses, who was appointed head of the New York City Parks Department and head of the Triborough Bridge Authority in 1934, spent two decades overseeing the construction of 627 miles of expressways in New York—much of which went through Black neighborhoods, which were both poorer and politically marginalized (Lewis 1997, 193). Yet there was little opposition to highway construction until middle-class residents concerned about aesthetics and preservation began complaining in the mid-1960s—for example, against the planned Vieux Carré expressway in New Orleans, a 40-foot high, 108-foot-wide Interstate that would have run through the historic French Quarter (Lewis 1997, 189). Over time, mounting protests, including by the poor, compelled the government to better protect private property rights. The Federal-Aid Highway Act of 1962 added a requirement to cooperate with local communities, and the 1968 version gave people more options to voice their opposition, including through public hearings and socioeconomic impact assessments (Swift 2011, 288).

By the early 1960s, US states had awarded an estimated 60,000 construction contracts and hosted thousands of meetings related to land acquisition,

rights of way, and standards inspections. There was endless opportunity for corruption: Government officials could divulge the planned route in advance to friends, who would then purchase the land and sell it to the government at an inflated price (Lewis 1997, 163). In New Mexico, for example, land in the right of way was being sold for 30 times its appraised value; it was widely expected that contractors would make donations to the local political machine as the price of doing business in a state. This corruption prompted a response from the media. In July 1960, *Readers Digest* published a piece entitled, “Our Great Big Highway Bungle,” and in 1962 *Parade* magazine wrote about “The Great Highway Robbery.” These accusations were picked up and repeated by NBC News, prompting institution building in the form of new federal safeguards. In July 1962, the Federal Bureau of Investigation (FBI) created the Office of Audit and Investigations and the Office of Right of Way and Location to help ensure that land was obtained at a reasonable price (Swift 2011, 221–22).

5.3 The Politics of Road Building

The politics of road construction can be generalized across the contemporary developed and developing world. One study of the United States between 1978 and 1988 found that greater political instability at the state level is associated with more spending on public infrastructure (Crain and Oakley 1995). In Spain between 1987 and 1996, regional parties supporting the central government attracted more infrastructure projects to their regions (Castells and Solé-Ollé 2005). In France between 1985 and 1992, tight electoral races were associated with more spending on roads and railways (Cadot, Röller, and Stephan 2006). Across France, Germany, Italy, and Spain, political factors have been found to influence the regional distribution of infrastructure investment, even though these countries would see the most economic growth by concentrating such investment on less-developed regions (Kemmerling and Stephan 2008).

The results are similar across developing countries. One study estimated the impact of politics in African road construction by using the degree to which the existing road system differs from an “optimal trade network” as a proxy. The author used satellite data on nighttime light intensity to construct an economic topography of Africa, combining it with a network model to simulate trade flows through more than

70,000 links across the continent. The analysis then modeled this “optimal” transport system given the underlying economic fundamentals for every African country, finding that optimal reallocation of national road systems would improve overall welfare by 1.15 percent. Some nations, such as South Africa or Tunisia, have a well-patterned road network and would only see a 0.5 percent and 0.2 percent increase in welfare gains, respectively. Other countries, such as Somalia, Chad, and South Sudan, would gain significantly (4.8 percent, 4.3 percent, and 6.7 percent, respectively) from a reallocation of their existing road networks (Graff 2019, 20).

The rationale for poorly allocated road building is political. Another study, looking at 38,427 subnational regions across 126 countries, showed that being the home region of a nation’s political leader increases GDP by around 1 percent on average. Regional favoritism increases in scale the longer said leader is in office but vanishes after a regime change (Hodeler and Raschky 2014). In Africa, the home regions of 117 national leaders have significantly more infrastructure than is nationally efficient (Graff 2019). For instance, in Kenya between 1963 and 2011, districts where the majority of people had the same ethnicity as the president received twice as much expenditure on roads—translating to almost five times the length of paved roads built—relative to their share of the overall population (Burgess et al. 2015).

Can outside umpires help mitigate this political bias? One study directly tests this question by utilizing lending data from two sources. The first is over 5,600 loans totaling more than \$300 billion from the World Bank to African countries between 1996 and 2014. Each loan is assigned a geographical coordinate to indicate where it was spent. The second is a similar dataset of Chinese loans. The data here is less reliable and had to be culled from local and intermediate media outlets owing to the absence of official and comprehensive Chinese data. This data covered 1,500 loans totaling around \$73 billion between 2000 and 2011. The loans were assigned in turn to more than 10,000 grid cells across Africa, of which more than 21 percent received assistance from at least one source (Graff 2019). The study found that having “neutral” donors did not solve the problem of domestic political bias: Areas identified as having too many roads to be “optimal” received even more funding from both the World Bank and China (Graff 2019).

Yet there is evidence that some factors do reduce politics' negative impact on infrastructure allocation. Higher aid inflows are associated with more regional favoritism, but only in countries with comparatively weak political institutions and lower educational attainment (Hodler and Raschky 2014). In periods of autocracy in Kenya, regions that shared the ethnicity of the president received three times the average expenditure in roads and over five times the length of paved roads—but during democratic periods, both these biases disappear (Burgess et al. 2015). In democratic political systems, legislative debates are frequently shown on national television, and discussion forums allow for civil society feedback, suggesting that free media and civic engagement can more easily expose misguided or corrupt public investment.

In an attempt to reduce political interference in infrastructure projects, Zambia created the National Road Fund Agency (NRFA) under the Ministry of Finance in 1994 and the Road Development Agency (RDA) under the Ministry of Public Works in 2002. The NRFA funds capital works, road upgrades, and maintenance. It prepares budgets that it then allocates to the RDA, which undertakes the planning, execution, operation, and management of road and bridge construction. Yet, looking at a database of contracts between 2008 and 2011, one study determined that political interference did not in fact decline after the semi-autonomous NRFA and RDA were set up (Raballand et al. 2013). In 2009, the Zambian auditor general found major weaknesses in finance management, budgetary control, procurement efficacy, and quality control. In particular, there was a lack of transparency in procurement. The RDA tender committee ignored recommendations by the bid-evaluation committee and engineering estimates by the procurement committee. There is also evidence that road construction was corrupt before the 2011 road-building boom, with workers using a lower quality of materials than specified in order to skim revenue. The independent authority of the RDA was weak, and members of parliament retained significant influence over the choice of roads to be constructed. Between 2008 and 2011, 40 percent of the total value of government-funded road projects was for unplanned projects; for instance, in the run-up to the September 2011 national election, the government of Zambia agreed to a \$170-million program to rehabilitate urban roads, bypassing normal selection procedures to add it to the RDA work plan. There

was pressure to build quickly to make the ruling Movement for Multi-Party Democracy (MMD) look good, and the project was executed without proper and detailed engineering design. The 34-kilometer (21-mile) road across the Zambezi flood plain was scheduled to cost \$260 million, making it one of the most expensive roads per kilometer in the world (Raballand et al. 2013).

5.4 Zambia after 2011: Road Building and Institutions

The road-building program in Zambia after 2011 demonstrates both how infrastructure investment can undermine institutions (Section 5.2), particularly given the role of Chinese financing and construction, and how the process is intensely political (Section 5.3).

The empirical studies discussed above indicate that road building, especially if financed by foreign aid, is linked to worsening institutions—but that democracy and a free press in Zambia could mitigate these adverse impacts.

Zambia's increase in road expenditure was heavily financed by China. For example, the Lusaka 400 Program to construct 400 kilometers (249 miles) of urban roads relied on a \$348-million loan from the Export-Import Bank of China (Raballand et al. 2013). China extended \$9.7 billion in loans to Zambia between 2000 and 2018, at which point it accounted for 30 percent of Zambia's external debt. These loans were not concessionary: They had higher interest rates than the World Bank (2 percent compared to 1.7 percent), a smaller grant element (23 percent compared to 35 percent) and shorter repayment periods (10–15 years compared to 20–50 years) (Zajontz 2022).

Some analyses have argued that Chinese engagement in road building caused a weakening of institutions in Zambia. In this narrative the link is causal, from Chinese lending to Zambian governance. Central to this narrative is that China does not attach conditions on good governance to its lending. By contrast, traditional donors have shown a striking concern with governance. One study identified 615 donor projects in Zambia related to civil service reform between 1981 and 2018, documented a persistent emphasis on reducing staff, restructuring organizations, decentralization, managing targets and incentives, publishing annual

confidential reports, and conducting performance appraisals. This contributed to IMF and World Bank-backed staff and expenditure cuts to the Public Sector Reform Program in the 1990s and to the Public Service Capacity Building Program in the early 2000s (Williams and Yecaló-Tecle 2019). The absence of such governance conditions attached to Chinese lending created an opportunity for institutional decay in Zambia since greater aid inflows are linked to worsening institutions. The appointment of Alexander Chikwanda as Minister of Finance in 2011, for example, corresponded to an emphasis on budgetary expansion rather than prudence. Measures of “good budget practice”—such as final expenses matching original plans, budget classification, and public access to fiscal information—all worsened after 2011 (Hinfelaar and Sichone 2019).

Chinese contractors lobbied Zambian government officials for contracts, promising loans that would finance road construction. For example, the 175-kilometer (109-mile) Mansa–Luwingu road was built by the China Henan Corporation under a \$207-million contract (including a \$180 million concessional loan from China Development Bank), even though the RDA had not prioritized this route (Zajontz 2022). The Zambia-China loan negotiations were conducted behind closed doors and lacked transparency. In many cases, there were no feasibility studies, with contracts awarded to Chinese contractors without tendering (Raballand et al. 2013). Illustrating the suboptimal allocation of investment, a new, Chinese-built bridge across the Zambezi Valley opened in 2014. Although it is four lanes, built of steel, illuminated by twenty solar-powered streetlights, and designed for heavy loads, it connects only to pot-holed dirt roads on each side. The bridge was inaugurated by the Vice President under the full glare of media publicity (Scott 2019, 149). This process:

caused a systematic bypassing of transparency norms and competition standards which are legally codified in Zambian public procurement law and has reinforced “not so public” procurement processes, characterized by informal, highly personalized negotiations between Zambian political elites and Chinese enterprises about terms and conditions of road projects. (Zajontz 2022)

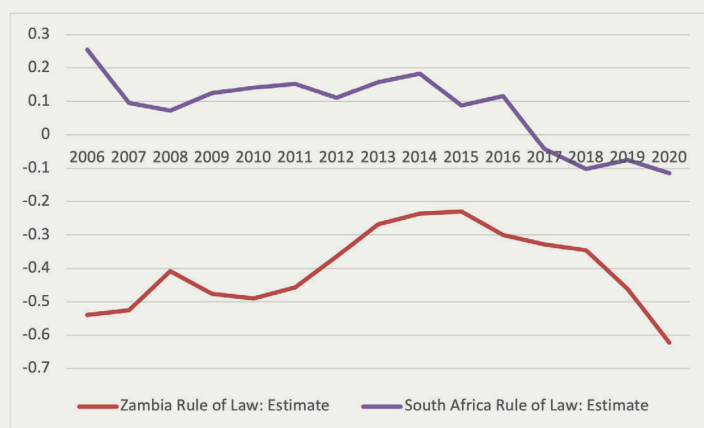
While Chinese engagement may have contributed to the worsening of institutions in Zambia, it is not the ultimate cause. The decision to build roads after 2011 was driven by domestic Zambian politics, not Chinese lobbying. Incoming President Michael Sata had a career-long obsession with infrastructure building (Ntomba 2021, 6) and, upon taking office, he became the “chief whip-wielder” driving road construction (Scott 2019, 150). The incoming Patriotic Front government in 2011 had a well-developed manifesto that included new social policies, setting up cash transfers, increasing tax credits, raising the minimum wage, and investing in infrastructure (Hinfelaar and Sichone 2019). Chinese lending merely helped create an environment that made institutional decay more likely. While the decision to build roads was a domestic Zambian decision, the choice of which roads to build was influenced by China.

Zambian domestic intrigue during the road building era, 2011–2022, further contributed to the worsening of institutions. The death of President Sata in 2014 saw a new outbreak of factionalism wherein rival politicians were “prevented from talking on the radio by thugs, chased, harassed, threatened, and attacked” (Scott 2019, 246). Under new President Edgar Lungu, technocratic rule at the Ministry of Finance further declined in favor of demonstrated loyalty to the President. For instance, budgetary arrears totaled less than 2 percent of total government expenditure in 2014 but increased rapidly to more than 10 percent in 2016 (Hinfelaar and Sichone 2019, 9). The professionalism of the Zambia Revenue Authority (ZRA), a semi-autonomous unit under the Ministry of Finance, was undermined by politically motivated, non-qualified appointments—such as that of Kingsley Chanda, who was appointed commissioner general of the ZRA in 2016 despite having been fired for corruption in 2011 (Cheelo and Hinfelaar 2020). Meanwhile, the “competent” governor of the Bank of Zambia, Denny Kalyalya, was sacked in 2020 for political reasons. Ministries were added and removed in 2011, 2015, and 2016, with each new government appointing its own political allies to head regulatory bodies (Cheelo and Hinfelaar 2021).

Data from several World Bank indices supports the proposition that (already poor) institutional quality in Zambia declined after 2011, offering potential support for blaming both Chinese loans and domestic Zambian politics.

The Rule of Law Index rates a country's institutions from +2.5 (best) to -2.5 (worst), reflecting "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (World Bank 2022). As seen in Figure 2, which also shows South Africa's ratings for comparison, the rule of law was poor but improving in Zambia between 2006 and 2015, then declined dramatically from 2015 to 2020.

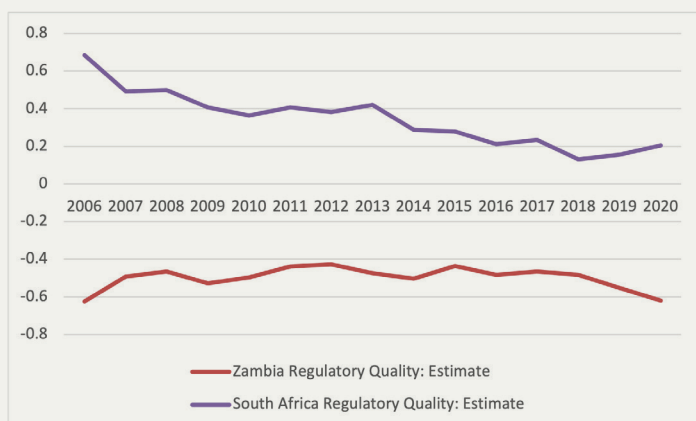
FIGURE 2: RULE OF LAW INDEX FOR ZAMBIA AND SOUTH AFRICA



Source: World Bank (2022)

The Regulatory Quality Index uses the same scale to rate "perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development" (World Bank 2022). Figure 3 (again including South Africa for comparison) shows that regulatory quality was poor but slowly improving in Zambia between 2006 and 2012, then declined slowly from 2012 to 2020.

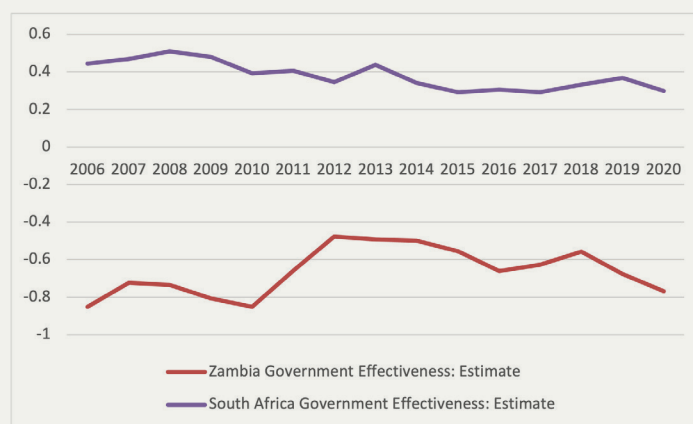
FIGURE 3: REGULATORY QUALITY INDEX FOR ZAMBIA AND SOUTH AFRICA



Source: World Bank (2022)

Finally, the Government Effectiveness Index measures "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (World Bank 2022). Figure 4 (South Africa included for comparison) shows that government effectiveness in Zambia was poor overall but improved sharply between 2010 and 2012, then declined steadily from 2012 to 2020.

FIGURE 4: GOVERNMENT EFFECTIVENESS INDEX FOR ZAMBIA AND SOUTH AFRICA



Source: World Bank (2022)

As noted in Section 5.3, road building in Zambia was politicized before 2011—but this was in an environment of poor but improving institutions (as shown by Figures 2–4). In the early 2000s, the Zambian Ministry of Finance had acquired the reputation of being a "pocket of effectiveness" where officials typically had master's degrees, successfully represented Zambia at technical forums such as the Common Market for Eastern and Southern Africa (COMESA) and the Southern African Development Community (SADC), and liaised with the IMF and AfDB. The 2002–08 period, despite intense political competition, had a technocratic cabinet under President Levy Mwanawasa, who appointed many political outsiders, including Minister of Finance Ng'andu Magande (Hinfelaar and Sichone 2019). From 1994 onward, tax revenue was collected by the Zambia Revenue Authority, which was headed by an independent commissioner appointed by the president (Cheelo and Hinfelaar 2020). The road-building program (as well as the associated political victory of Michael Sata and Chinese engagement) contributed to undermining a decade-long improvement in institutions that could

have helped lay the foundations for long-term, sustainable economic growth in Zambia.

6. Trade

Although roads usually boost international trade, this has not been in the case with road construction in Zambia since 2011. Compared to other countries in SSA, in 2011 Zambia already had roads in good enough condition that its efficient and low-cost trucking industry could easily access ports in South Africa. Road construction in Zambia after 2011 was unlikely to have a significant impact on international trade.

Construction of roads (or turnpike trusts, as they were then known) made an important contribution to international trade in eighteenth-century England. Greater road expenditure had a direct impact on the capacity of road transport by lowering travel times, freight charges, and passenger fares (Bogart 2005). It had indirect effects by encouraging a growth in travel and interregional trade that incentivized firms to adopt new technologies and methods of organization, as well as increase their scale since wider roads allowed for replacing packhorses with wagons that could carry larger loads. Turnpike trusts also promoted industrialization by connecting factories with ports and with rural sources of food and raw materials (Bogart 2004).

Similarly, although the highway system China started constructing in the late 1990s had a negative impact on some smaller cities (see Section 8), this was outweighed by the opportunities roads offered to engage in international trade. Better highway connections to ports boosted the GDP and population of all Chinese cities regardless of their initial size or location (Baum-Snow et al. 2020). During this 1998–2001 road-building boom, China received \$165 billion of direct investment flows, the biggest cause of which was increased market and supplier access, as determined by a study of 519 manufacturing industries across 29 Chinese provinces. Roads were crucial to attracting foreign investors seeking to use China as a low-cost export platform (Amiti and Javorcik 2008).

There are significant market failures in road investment: network externalities. The construction of any road improves the accessibility of all other

roads. When Kenya built a road from the capital, Nairobi, to its coastal port at Mombasa, this also benefited Kenya's landlocked neighbor Uganda. If each country makes investment decisions separately, these spillovers may not be taken into account. National infrastructure may leave local trade stranded from wider market connections unless neighboring countries each extend their road infrastructure up to international borders. These market failures are often dealt with by regional approaches to road building; for example, the Association of Southeast Asian Nations (ASEAN) and Greater Mekong Subregion have headed initiatives that focused on road connectivity within Southeast Asia and emphasized cross-border links (World Bank 2019, 47). Another example is the 2018 upgrade to the Khorgos–Almaty road, which:

connects Khorgos, the primary road border crossing point between Kazakhstan and China, with Almaty, one of the major economic centers of Central Asia. The project upgraded the 305 kilometers of road between Khorgos and Almaty from a two-lane to a four-lane highway. This section completed the improvement of the corridor between Urumqi (China) and Yaysan (Kazakhstan) on the border with Russia. (World Bank 2019, 51)

Chinese involvement in road and other transport financing and construction is specifically designed to overcome this market failure. In particular, the Belt and Road Initiative (BRI) plans infrastructure investments on a region- and continent-wide basis. Current BRI transport projects across the 70 “corridor economies” in which it is involved cost an estimated \$144–304 billion. If fully implemented, these projects are forecast to increase trade by 2.8–9.7 percent for corridor economies and 1.7–6.2 percent globally (World Bank 2019, 4–5). The AU Missing Links on the Trans-African Highway program similarly seeks to solve the market failure of network externalities by planning and then seeking to finance road infrastructure at a regional level. The African Union projects that completion of its wider infrastructure agenda (and trade facilitation) “will see intra-African trade growing from less than 12% in 2013 to approaching 50% by 2045. Africa's share of global trade shall rise from 2% to 12%” (African Union 2015, 5). Fortunately, Zambia is fully cognizant of network externalities and has planned its road program at a regional level. For instance, the new

Nacala Road Corridor, which was financed by a consortium of donors, runs from Lusaka in Zambia through Malawi to the port of Nacala in northern Mozambique (Ngulube 2021, 4).

However, there is good evidence that transport costs in SSA—which can contribute to up to 17 percent of import costs, or three times the average for developed countries—hinder international trade. For example, the effect of distance on the cost of transporting goods is 2.5 times higher in Ethiopia and 4 times higher in Nigeria than in the United States even though African truckers earn much lower wages than equivalent American workers (Atkin and Donaldson 2015). In Ethiopia between 1998 and 2009, reductions in import tariffs had a bigger impact on input prices for firms in regions with better market access, which were also then more likely to use newly imported intermediate goods in production (Fiorini, Sanfilippo, and Sundaram 2021).

Estimating the likely impact of a road building program (such as in Zambia) also requires quantifying the extent to which high transport costs are due to poor quality roads versus other factors (Raballand, Kunaka, and Giersing 2008). These could include frequent checkpoints or long waiting times for loading and unloading. For instance, it takes an average of 116 days to “move an export container from the factory in Bangui, Central African Republic, to the nearest port and fulfil all the customs, administration, and port requirements to load the cargo onto a ship” (Donaldson, Jinhage, and Verhoogen 2017). In 2016, Rwanda amended a policy that had required all imported products to be inspected before shipment, also instituting a new single-window system at the border. As a result, Rwanda jumped more than 40 positions in the World Bank’s Ease of Doing Business Index that year (Donaldson, Jinhage, and Verhoogen 2017). The comparative impact of road transport and other trade-facilitation measures can be clearly seen in studies of the BRI. In Uzbekistan, a landlocked country, “average income gains from infrastructure improvements are estimated at less than 1 percent. But when complementary measures reduce border times, income gains rise to 9 percent” (World Bank 2019, 6). By complementing infrastructure construction with measures to reduce border delays and to ease trade restrictions BRI countries could boost real incomes by 2-4 times (World Bank, 2019).

So how can we determine the impact on trade of the massive road-building and -upgrading program Zambia launched in 2011? The evidence from the Nacala Road Corridor shows that it did lead to a reduction in transport costs and to a consequent increase in the number of exporting firms in the tradeable sector (Ngulube 2021, 80). Yet, overall, the program’s effect on trade appears to have been relatively small.

Zambia is a landlocked country whose main economic center, Ndola, is 1,400 kilometers (870 miles) from the nearest port. The railway system was historically used to export copper. The decline in global copper prices after the mid-1970s and output (from 712,000 tons in 1976 to 255,000 tons in 1998) reduced revenue for railways and consequently maintenance investment which led to their diminished speed, security, and reliability (Raballand and Whitworth 2012, 3). Post-apartheid trade expansion with South Africa and regional rehabilitation of roads allowed highways to compete with railways. When copper output rebounded, to 852,000 tons in 2010, rail transport did not recover, and trucking carried the expanding export industry, accounting for about 70 percent of Zambia’s overall trade (Raballand, Kunaka, and Giersing 2008).

Prior to the 2011 road program, Zambia was already well-served with several road (and rail) connections between domestic economic centers and regional ports such as Dar es Salaam, Beira, and Durban. Substantial improvements were made to Zambian roads in the mid-to-late 1990s, meaning they were generally good condition as of the mid-2000s. Zambian trucking already had low transport costs, with road tariffs of only \$0.037–\$0.056 per ton-kilometer (Raballand, Kunaka, and Giersing 2008, 15). And when fuel costs were higher, Zambian firms could offset expenses by importing cheap, second-hand trucks—which South Africa, by contrast, prohibited in order to protect its domestic assembly industry (Raballand, Kunaka, and Giersing 2008, 17).

A more significant problem for trade in southern Africa has long been the lack of progress in COMESA and SADC efforts to promote regional free trade. Although eight states in COMESA/SADC had agreed in 2005 to harmonize rules and liberalize market access for transport, this remained more an aspiration than reality, and permits issued for trucks at borders continued to be based on bilateral

agreements that aimed to restrict the transport of goods through third countries. Permits varied across the region—so, for example, load limits could be permitted in one country but lead to fines in another. However, these problems were of limited consequence for Zambia. Nearly 45 percent of its trade in 2005 was directly with South Africa, with another 15 percent via South African ports, and the trucking route between Zambia and South Africa has been one of the most efficient and lowest cost corridors in Africa since the early 2000s. (Raballand, Kunaka, and Giersing 2008). Because the port of Durban operates fairly efficiently—with significantly shorter “dwell times” than other ports in SSA, which often face long delays in loading and unloading cargo—Zambian trade benefits even more from the country’s good road connections with South Africa (Raballand et al. 2012, 55).

7. Firms

Empirical evidence shows a strong causal link between road construction and improvements in company-level outcomes such as inventory management, output, and new firm entry. There is some evidence that the 2011-2022 road building program in Zambia had a positive impact on firms—but this effect has likely been limited because roads had not been a significant constraint on firms’ functioning prior to 2011.

Road improvements may benefit firms through cheaper and more reliable freight services, as well as reduced assembly and delivery costs. Cheaper and better roads provide incentives for firms to reorganize and reduce their inventories, sometimes to just-in-time levels, even as they grant access to large regional and global markets. Firms can increase output by consolidating production and distribution sites, taking advantage of economies of scale—further enabling them to use new technologies that require large levels of production to cover fixed costs. Roads also increase imports, benefiting firms through access to a greater range of intermediate inputs.

In India, the Golden Quadrilateral (GQ) project sought to improve the quality and width of 5,846 kilometers (3,633 miles) of existing highways connecting Delhi, Mumbai, Kolkata, and Chennai. The new highways offered average driving speeds

of 75 kilometers (47 miles) per hour, compared to an average of less than 40 kilometers (25 miles) per hour on existing roads (Alder 2016). One study, conducted in 2005 when the project was roughly two-thirds complete, showed that firms along the GQ had already reduced inventory holdings by the equivalent of six days’ worth of production. The effects were most pronounced for modern industries such as pharmaceuticals, food processing, and electronics. Firms in cities that gained better highway access were also more likely to have found new suppliers for their most important production inputs (Datta 2011). Another study, comparing data on firms within 10 kilometers (6 miles) of the GQ network and firms 10–50 kilometers (6–31 miles) away, determined that the GQ upgrades “stimulated significant growth in organized manufacturing (formal sector) in the districts along the highway network” (Ghani, Goswami, and Kerr 2014).

Firms in Sri Lanka similarly benefited from the rehabilitation of two roads—one linking the capital, Colombo, with the north and north-east and one linking the central city of Kandy with the northern city of Jaffna—that directly or indirectly serve most of northern Sri Lanka. Prior to the highway improvement, begun in 1987, firms located closer to the highway produced 15 percent less output than firms located further away; by 2000, firms near the highway had a 15 percent higher average output than the others. Meanwhile, average employment in textile firms close to the highway increased by 275 percent (Gunasekera, Andseron, and Lakshmanan 2008).

In China, road infrastructure investments reduced input inventory by about 4 percent cumulatively from 1998 to 2007 (Li and Li 2013). Similarly, Ethiopia’s 1997–2001 road-building project correlated with an increase in new firm entry and new firm size, as well as a reduction in travel time (Shiferaw et al. 2015).

In Zambia, what limited evidence exists shows that firms also benefited from the 2011-2022 road-building program. The development of the Zambian portion of the Nacala Road Corridor led to increased overall fuel costs for firms within 400 kilometers (250 miles) of the road, indicating increased frequency and length of trips. Firms also experienced a fall in inventory costs, suggesting they were increasing production capacity and had more access to cheaper, imported inputs (Ngulube

2021, 85). The impact of road building was not likely to be transformative at the firm level. A 2010 survey of Zambian businesses found that the top five problems faced by large firms were access to electricity (30 percent), macroeconomic instability (13 percent), cost of finance (13 percent), access to finance (10 percent), and high tax rates (8 percent). More than 90 percent of large businesses in Zambia did not include transportation issues as an obstacle to doing business (Clarke et al. 2010, 26).

8. Distributional Impacts

Although road building is frequently claimed to be uniformly good for poor people and poor regions by integrating them into the national or international economy, in reality it has significant distributional impacts that should be taken into consideration. Historically, labor migration has been one effect: People move to areas where road building has boosted economic opportunity. While such migration can occur more easily within a single sovereign entity such as the United States or China, it has been more difficult to accomplish in multi-sovereignty regions such as the European Union and Africa. While the European Union has a well-developed and massive system of fiscal redistribution to compensate declining areas, there is nothing equivalent in Africa.

Europe has long understood that building roads is good for economic development in both richer and poorer regions. The 30 priority projects within the Trans-European Transport Network (TEN-T) were selected because they were deemed good for growth and distribution (Crescenzi and Rodríguez-Pose 2008). In China, the National Reform and Development Commission has prioritized road building within projects to “Develop the West,” for example, or “Revitalize the Northeast.” Although such labels promise pro-poor regional economic growth, empirical studies show that, in reality, road construction has had complex distributional impacts (Baum-Snow et al. 2020).

In the United States (as elsewhere), highways have had a directly destructive impact on low-income neighborhoods. When better roads led to increased car ownership, congestion worsened in urban areas,

prompting officials to shift from building bypasses to routing highways into cities, many of which (such as Chicago, Boston, and Philadelphia) had densely packed neighborhoods. Robert Moses aspired to “punch three huge expressways 160 feet wide through Manhattan, one... burying Washington Square” (Swift 2011, 209). Although this plan was not enacted, the construction of the US highway system did destroy tens of thousands of homes, especially in slums, where highway developers could find more affordable land (Swift 2011, 126). Highways also had a negative impact on competing businesses such as railways, which had initially welcomed better roads, imagining they would help people get to and from stations. By the 1920s and 1930s the road-rail relationship turned acrimonious. Use of the railway system peaked in 1915 when it carried 1 million people, then declined steadily under competition from cars, to 786,000 in 1929 (Lewis 1997, 22). In Zambia, the Nacala Road Corridor upgrade similarly led incumbent firms to experience a decline in total assets due to more competition (Ngulube 2021, 9).

Highways also had an indirect redistributive impact by influencing patterns of urbanization. Between 1969 and 1993, the construction of new Interstate highways raised the earnings from manufacturing, retail, and services in the US counties through which they passed. In adjacent counties, however, total earnings fell by 1–3 percent and earnings in retail fell by 8–11 percent. The net economic effect was close to zero and dominated by the redistribution of economic activity (Chandra and Thompson 2000). Similarly, new roads in the European Union have helped concentrate human capital and R&D investment in already favored locations, widening regional economic gaps (Crescenzi and Rodríguez-Pose 2008). The same effect has been observed in Russia, where road investment between 1985 and 2004 led to significant gains (in terms of productivity) in the central region around Moscow but had few benefits for the backward far-eastern region (Brown et al. 2008). In China, improved access to domestic markets from new highway construction reduced population, GDP, and private-sector wages in peripheral areas even as it increased the same variables in major cities (Baum-Snow et al. 2020). A more disaggregated study in Ethiopia, Vietnam, and Zambia showed that road construction has had a varied impact on incomes within villages. It found a positive correlation between the utilization

of new roads (by distance traveled) and existing household wealth, except for Vietnam (where all income groups owned motorbikes). This meant that roads did little to alleviate poverty (Bryceson, Bradbury, and Bradbury 2008).

This domestic distributional effect disappears when new highways connect a city to an international port. In China, port-connected highways boosted GDP and population growth in both major and peripheral cities (Baum-Snow et al. 2020). In Brazil, road construction increased economic output even in states whose economic centers are located far from a port (Bottasso et al. 2021). However, this just means the distributional impact is felt globally, causing low-income workers in developed countries to lose wage income and employment (Wood and Ridao-Cano 1999).

Another striking distributional impact of roads has been the rise of the suburb at the expense of the city. By 1980, 18 of the 25 largest US cities were experiencing population decline, even as the US suburb population grew by 60 percent over the previous two decades (Lewis 1997, 71). In 1950, about half of all metropolitan-area jobs in the United States were in central cities, compared to about 30 percent by 1990, and empirical analysis shows that “highways can explain about one-third of the change in aggregate central city population relative to metropolitan area population as a whole” (Baum-Snow 2007). In Spain, each new highway contributed to an estimated 8–9 percent decline in central-city population and 20 percent increase in suburban population between 1960 and 2011 (Garcia-López, Holl, and Viladecans-Marsal 2015). And in China, each additional radial highway displaced at least 4.2 percent of a city’s population to suburban regions (Baum-Snow et al. 2012).

In many US cities, “neighborhoods tended to be homogeneous, but municipalities were heterogeneous, often in a crazy-quilt pattern with Ukrainian blocks adjacent to Irish areas, Jewish neighborhoods next to black ones, and servants living near the upper-class homes they served”—but “suburbanization meant both greater separation of workplace and residence and greater segregation by race and class” (Putnam 2000, 208–209).

Highways in the United States contributed to white flight. Those left behind in cities

tended to be poorer and marginalized and suffer the consequences of a declining tax base that undermined public-service provision. Suburbanization also undermined community life because “each additional ten minutes in daily commuting time cuts involvement in community affairs by 10 percent,” such as fewer public meetings attended (Putnam 2000, 213).

If road construction leads to the migration of firms and jobs out of a city, one mechanism to manage the politics of distribution is to encourage the migration of workers. In the nineteenth century, America coastal areas (New York) were wealthier than inland areas (Tennessee). In the twentieth century American automobile manufacturing declined (Detroit) and new technology cities boomed (Seattle or Houston). In China economic reforms from the late-1970s generated rapid economic growth centered in the coastal regions. The US and China has historically coped by migration. People follow wealth. In China, around 100 million people moved from inland regions to rapidly growing coastal cities in the 1980s and 1990s. A change in employment laws allowed firms located in special economic zones (SEZs) to hire labor through contracts, which enabled flexibility in hiring and firing, bonus payments, and wages, as well as the ability to recruit migrant workers located in rural areas (Sklair 1999). In the booming city of Shenzhen, for example, the proportion of temporary migrants in the city population surged from 1 percent in 1979 to 72 percent in 1994 (Liang 1999). In the United States, which has a highly mobile labor force, every decade a quarter of the population changes its state of residence (World Bank 2009, 46). This means region-specific shocks are absorbed by migration and do not affect national employment or labor force participation as they do in the European Union—in which bureaucratic constraints and linguistic and cultural differences hinder migration despite policies allowing freedom of movement and right of residence across member countries. In comparison to the United States and China, there is less intra-EU migration in response to economic incentives such as wage differentials (Decressin and Fatás 1995; Puhani 2001).

The 54 countries of Africa face much greater challenges. Despite the AU aspiration of visa-free travel, the continent is not politically prepared to accommodate tens of millions of people crossing borders looking for employment. For example,

South Africa has been constructing a lethal electrified fence along its border with Mozambique and Zimbabwe since the mid-1980s (Marshall 2018). In addition, the African Union is not adequately addressing the fact that poor people tend not to have the ability to migrate to richer areas. Between 2021 and 2017, the European Union budgeted around \$400 billion for the social and economic development of backward regions (Krausova and Walsh 2021). By comparison, the AU budget in 2021 was around \$620 million, partly because member states have not been amenable to increasing the union's funding. Only 17 countries across Africa are implementing the recommended 0.2 percent levy on imports to generate finance for the organization. Between 2016 and 2020, the levy had raised just over \$7 million, and contributing countries were \$25 million in arrears (African Union 2020). Instead of practical redistribution, the AU is relying on a moral exhortation and call for: "Changed attitudes and mind-sets, to rekindle and strengthen Pan-African values of self-reliance, solidarity, hard work and collective prosperity."

Zambia has no strategy to deal with the redistribution impact of the 2011 road-building effort, save arguing that connecting poor regions and isolated villages to the road network will draw them into the national and international economy. How will Zambian politicians react when Zambian firms and skilled labor use the opportunities presented by the Nacala Road Corridor (and AU efforts to allow freedom of travel and trade within Africa) to relocate to the Mozambican port of Beira? Such promises of integration ignore the reality of transport-induced impacts on income inequality. In cities, regions, and countries being squeezed by a vicious cycle of agglomeration externalities working in reverse, politicians will not care about a nebulous appeal to "collective prosperity." There is no collective prosperity: There are always winners and losers, wealth and poverty. Zambia needs more than the AU dream to deal with the real distributional consequences of transport infrastructure.

9. Conclusion

As historical and contemporary studies of road construction show, roads have positive impacts on economic growth. However, this effect is likely to be muted in Zambia.

- The 2011-2022 road-building program targeted access for all regions rather than focusing on corridors with the most potential to boost the economy. There is also no discernible strategy to maintain roads after construction, meaning any economic boost may be short-lived.
- Although roads increase urbanization, which historically has boosted economic growth by encouraging industrialization and reducing poverty, they could continue the dysfunctional urbanization that Zambia has been experiencing since the 1970s and 1980s by stimulating more overcrowding in slums.
- While good institutions may promote big infrastructure construction (such as roads), the relationship between roads and institutions is complex. It was domestic politics that created the ultimate motivation to build roads in Zambia after 2011. In addition, the entry of China into road finance and construction appears to have undermined institutions and governance in Zambia, with negative consequences for the country's potential to sustain long-term, inclusive economic growth.
- The Zambian road-building program is unlikely to have the expected impact on international trade. Even before 2011, transport costs were some of the lowest in the continent, and roads were already good enough to facilitate trade via South Africa, where Zambia had relatively easy access to the cheap and efficient international port of Durban.
- Roads influence firm logistics by reducing the time and cost of getting goods to market and increasing reliable access to inputs, customers, and international markets. Yet, aside from the relatively efficient trucking industry, logistics in Zambia are very poor, so improved highways will have only a modest positive impact on firms—not a transformative one.
- Misperceptions about transport infrastructure dominates political promises—whether in the European Union, China, the African Union, or Zambia—that better roads will reduce inequality by integrating poor regions or isolated farmers into the national and/or international economy. Road infrastructure will likely intensify regional inequalities in Zambia by promoting agglomeration externalities

in some locations at the expense of others. While some countries (such as the United States and China) have coped with the political costs of such inequality by encouraging internal migration, this mechanism is not practical in Africa. Any such migration that might occur would likely provoke a political reaction in countries and regions that feel they are losing out. For example, if Zambia partly funds road networks linking its economic centers to regional ports, its firms and skilled labor might migrate out of Zambia, prompting a political backlash.

In 2022, Zambia entered into an agreement with the IMF to receive a \$1.3 billion loan in exchange for implementing various policy reforms. In explaining its underlying rationale for the loan—Zambia’s default on its international debt obligations—the IMF called Zambia out for “years of economic mismanagement, especially an overly ambitious public investment drive that did not yield any significant boost to growth or revenues” (IMF 2022, 5). Exemplifying this mismanagement, the post-2011 road-building program was more like a road to (economic) nowhere than a road to (economic) paradise.

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