Policy Research Working Paper 9970

Smoke and Mirrors

Infrastructure State-Owned Enterprises and Fiscal Risks

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WORLD BANK GROUP
Infrastructure Chief Economist Office
March 2022

Policy Research Working Paper 9970

Abstract

Infrastructure is critical to economic development. When infrastructure companies are owned and operated by the government, however, they create significant sources of fiscal risk. These fiscal risks can be sizable, but they are often preventable with proper planning, risk assessment, and strict rules and procedures for corporate and fiscal governance. This paper examines fiscal risk stemming from state-owned enterprises (SOEs) in the infrastructure sector in a sample of 135 firms in 19 countries from an original database of SOE financials for 2009–18. The paper develops a typology of fiscal risks and their determinants, builds new measures of fiscal injections to SOEs, and documents them using the novel database. The results show that governments support SOEs through a remarkably wide range of fiscal instruments. The fiscal cost of supporting infrastructure SOEs is usually below 1 percent of gross domestic product. Support is more prevalent and frequent than previously thought. The findings show that fiscal risk stems not only from "tail risk," but also from the everyday operation of infrastructure SOEs. The paper calculates the Altman Z" score (a measure of default risk) and shows that it can be used to forecast the need for fiscal injections in SOEs.

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Smoke and Mirrors: Infrastructure State-Owned Enterprises and Fiscal Risks[1]

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JEL: H2, H54, H81, L9
Keywords: Fiscal risk, state-owned enterprises, infrastructure, subsidies, contingent liabilities

[1] This paper was peer reviewed by Sudarshan Gooptu, Senior Director, Millennium Challenge Corporation, and Maria Vagliasindi, Lead Economist, World Bank. It was prepared as a background paper for the Infrastructure Vice-Presidency Flagship *Fiscal Costs and Risks from Infrastructure in an Era of High Debt Vulnerabilities* and presented at the corresponding authors' workshop, held July 13, 2021, benefiting from feedback provided by the workshop participants. The authors thank Vivien Foster and Teresa Ter-Minassian in particular for their helpful comments and suggestions.

1 Introduction

Fiscal risks stemming from the operation of state-owned enterprises (SOEs) are large and significant. Infrastructure SOEs are a double-edged sword for governments. On the one hand, they are large and important for the economy, increasing the temptation for intervention, as they are attractive political tools to perform quasi-fiscal operations (QFOs). Capping electricity tariffs or road tolls, for instance, can deliver electoral gains, through its large impact on manufacturing, trade, and household budgets. In addition, governments can charge railways, roads, electricity, and water and sanitation SOEs with undertaking "costly investments to expand their coverage in remote rural areas, without any compensation for the initial costs or the operational losses of these services" (Ter-Minassian 2019, 53). Furthermore, because infrastructure SOEs have large capital projects, in which there can be delays and cost overruns, it is normal for them to request fiscal transfers. It is also normal for them to have periods in which they operate with losses. It is precisely these qualities that make them ideal to also conceal/hide operational underperformance and large QFOs that benefit government politically.

On the other hand, given the importance of infrastructure companies and their political relevance, governments have their hands tied when it comes to providing financial support for these SOEs. Governments tend to be too invested and have a hard time refusing the provision of operational and capital subsidies, bailouts, or subsidized credit for essential projects or to cover the losses generated by QFOs.

The problem turns into a series of smoke and mirrors in which QFOs generate quasi-fiscal deficits that SOEs often obfuscate until they come back to haunt the Treasury. SOEs receive fiscal transfers in a variety of ways, including budgetary fiscal transfers, subsidies for operational and capital needs through deferred tax liabilities, and nontransparent loans from other SOEs or state-owned banks. Many of these fiscal transfers are often not budgeted and arise out of SOEs' need to recapitalize their operations after they suffer a shock or perform QFOs for a few years (by, for example, subsidizing the price of their service, providing employment by overstaffing their firms or paying high salaries, or even financing other SOEs). These fiscal transfers can be large and volatile from one year to the other. Using infrastructure SOEs for QFOs often comes back to haunt the Treasury when officials must make urgently needed large, unbudgeted fiscal transfers.

The empirical literature analyzing fiscal risks devotes much attention to the costs of fiscal crisis and public-private partnership (PPP) commitments, especially as a consequence of the Latin American and Asian financial crises of the 1990s (Honohan and Klingebiel 2000; Polackova Brixi and Schick 2002). There is substantial evidence on the fiscal cost of financial crises and bank bailouts as well (Roubini and Setser 2004; Laeven and Valencia 2013). Less work has been done on the fiscal costs associated with the underperformance of and/or shocks to SOEs (Huenteler et al. 2020; and Melecky 2021). In an overview by the International Monetary Fund (IMF), Bova et al. (2019) compiled data on the gross fiscal costs of shocks to SOEs that exceed 0.2 percent of GDP. They identify 29 episodes in which SOEs were the source of contingent liabilities for the government, 17 of which involved infrastructure SOEs broadly defined (15 in the four sectors we study). They find an average gross fiscal cost of 3.2 percent of GDP for SOEs (3.0 percent for the sectors we study), with a maximum gross cost of 15 percent of GDP. Most of these costs were incurred during the global financial crisis of 2008–10 (see table A.1 in the appendix).

The empirical work on fiscal risk has focused on contingent liability risk, usually under extreme events. But fiscal risk—defined as "the possibility of deviations in fiscal variables from what was expected at the time of the budget or other forecast" (Cebotari aet al. 2009, 4)—is not a once in a lifetime event for an SOE. As we demonstrate with systematic cross-country data, fiscal risk is more often manifested as a series of small to medium-size deviations from budgeted figures, shortfalls in performance in SOEs, and liquidity crises that may require small fiscal injections (0.1–0.3 percent of GDP) on a regular basis. When we examine fiscal injections that increase capitalization and/or substitute liabilities (that is, net fiscal transfers) as a percentage of assets, we see that bailouts are frequent and occur more often than assumed by the literature. This finding suggests that better ex ante monitoring of SOE financials can prevent both major catastrophes and some of the smaller instances of cash flow risk, which can compound into major events (Musacchio et al. 2015; Ter-Minassian 2018).

Following the categorization of fiscal risk of Polackova Brixi and Mody (2002), we explore a variety of implicit contingent liabilities that stem from the operation of infrastructure SOEs and from their accumulation of liabilities. We examine the fiscal risk and its key sources in the power, roads, railways, and airlines and airports sectors. We use a sample of 135 firms in 19 countries that come from an original, hand-collected database of SOE subsidies and financials for 2009–18. This sample covers fewer countries and a shorter period than the Bova et al. sample.

Using this database (which we refer to as the World Bank's Infrastructure SOEs Database), we examine the fiscal risk that stems from the operation of infrastructure SOEs. We provide an overview of the financial performance of these SOEs, their shortfalls in performance, and the factors that constrain them from being profitable. We then build new measures of fiscal injections to SOEs that include not only the flow of subsidies from the government but also changes in the stock of government equity (recapitalizations); changes in the loans SOEs receive from the government, from financial and nonfinancial SOEs; and changes in deferred tax liabilities (when they are used to support an SOE), all net of asset increases. We examine these fiscal injections net of asset increases in order to ensure that we capture only fiscal transfers that increase government involvement in the financing of the operation of the SOE, not transfers to fund investments.[2]

Using these new measures of fiscal injections, we show that the fiscal costs of supporting infrastructure SOEs across countries is usually below 1 percent of GDP[3] but that support—and the performance of SOEs—is volatile and needed more often than Bova et al. (2019) acknowledge. We identify 44 country-year events of fiscal injections to infrastructure SOEs that are above 0.2 percent of GDP (see table A.2 in the appendix for a comprehensive list). We document a slow dripping of support in the average country during the average year that, over a handful of years, turns into points of GDP. This evidence indicates that fiscal risk is not only about "tail risk" but also about the risks associated with the daily operation of infrastructure SOEs.

We also show the variation in fiscal costs by sector and the variety of instruments used to support infrastructure SOEs in different countries. Average annual fiscal costs range from 0.04 percent of GDP for airlines and airports to 0.12 percent for railways and 0.24 percent for power and roads. There is also wide heterogeneity in how governments support SOEs.

We use conventional tools from the corporate finance literature on defaults to assess the effectiveness of forward-looking measures of fiscal risk to predict the need of fiscal injections in SOEs and provide a simple tool that can help prevent fiscal disasters stemming from the operation of SOEs. We rely on the Altman Z-score, a traditional measure of default risk, as applied to firms that are not publicly traded, a measure known as the Z" score. We calculate the Altman Z" score using the Infrastructure SOE Database and show that it can be used to forecast the need for fiscal injections in SOEs. Our estimates reinforce the idea that ex ante monitoring of SOE financials can significantly reduce the need for fiscal injections and thus reduce overall fiscal risk in a country.

The paper is organized as following. Section 2 defines a typology of fiscal risks. Section 3 describes the data. Section 4 defines the fiscal injection variables and presents the descriptive analysis of fiscal injections. Section 5 presents the methodology and findings on predicting fiscal risks. Section 6 summarizes the paper's main conclusions.

[2] Using gross figures to analyze fiscal risk may overestimate the actual fiscal cost of a bailout (from a recapitalization and/or substitution of liabilities, for example) and confuse bailouts/fiscal risk with transfers to provide productive assets to an SOE, a common practice around the world. Therefore, in contrast to existing approaches to measure fiscal risk, we examine fiscal injections net of changes in assets. See the definitions in section 4.

[3] Our measures of fiscal injection capture the explicit fiscal costs of SOEs. They differ from the measure of quasi-fiscal deficit used by Huenteler et al. (2020), who measure the implicit or potential fiscal cost as "the difference between the cash collected by the existing utility and the revenues that would be collected without bill collection losses by a utility applying cost-recovery tariffs . . . and achieving commercial and operational efficiency."

2 Typology of Fiscal Risks

Following the typology of Polackova Brixi and Mody (2002), we classify fiscal risks into direct liabilities and contingent liabilities, which can be divided into explicit and implicit liabilities. Direct liabilities are predictable obligations. Explicit liabilities are "specific government obligations defined by law and contract"; implicit liabilities "represent a moral obligation or expected burden for the government. . . based on public expectations and political pressures" (p. 22). Therefore, following Ter-Minassian (2019), we think of direct liabilities as fiscal costs that should be budgeted for and focus on contingent liabilities as the key source of fiscal risk. Contingent liabilities are obligations triggered by a discrete but uncertain event. Implicit contingent liabilities "also emerge from so-called quasi-fiscal activities—that is, activities of a fiscal nature that the government pursues outside its budgetary framework" (Polackova Brixi and Mody, 2002; p. 22). Implicit liabilities emerge not only from the fact that some SOEs are too big to fail but also from the fact that infrastructure SOEs are usually too important and politically sensitive to fail.

In table 1, we organize the fiscal costs and risks emanating from the operation of infrastructure SOEs, dividing them into direct and contingent liabilities and explicit and implicit liabilities. Beyond the more obvious liabilities included, we add QFOs. When QFOs are properly accounted and budgeted for, they are explicit, direct liabilities. When they are not properly accounted for or budgeted for, they end up creating a loss for an SOE. Government officials are then morally or politically pressured to cover those losses, making them implicit contingent liabilities. We refer to the kinds of shortfalls that the government usually covers with fiscal transfers as *cash flow risk*, as they arise from small shortfalls in the cash flows of SOEs that are hard to predict. If, for example, a power company charges tariffs controlled by the government at a level that does not allow it to recover costs, it will incur a loss that the government usually covers. The exact amounts will vary based on the level of demand and the cost of inputs.

Table 1 Fiscal risks emanating from infrastructure SOEs

Type of liability	*Direct (fiscal costs)*	*Contingent*
Explicit	• Expenditures legally binding in the long term, such as SOE pensions when they are part of the civil service pension system • Compensation for quasi-fiscal operations (QFOs) when they are properly accounted for ex ante (or ex post)	• Explicit guarantees for SOE debt and public-private partnership (PPP) investments in which SOEs are one of the partners • State insurance schemes for infrastructure SOE assets
Implicit	• Future recurring costs of investment projects • Future public pensions that are not a direct part of the civil service pension system	**Cash flow risks:** • Unexpected losses of SOEs generated by QFOs not compensated by the Treasury ex ante • Losses from QFOs beyond what is budgeted for (unexpected losses)

		• Unexpected (small) cost overruns or shortfalls in capital expenditures of SOEs not budgeted for • Environmental disaster costs, such as emergency infrastructure repair costs • Unexpected (small) losses of SOEs caused by nonenvironmental exogenous shocks. **Bailout risks** • Unexpected SOE recapitalization and liability cleanup • Avoidance of default of large, nonexplicitly guaranteed SOE debts

Source: Adapted from table 1.1 in Polackova Brixi and Mody (2002).

We zoom in on two of the main manifestations of implicit contingent liabilities—cash flow risk and bailout risk—because, according to Polackova Brixi and Mody, "public finance institutions, including systems for government budget management, debt management, accounting, financial control, and public scrutiny, often remain blind to government contingent liabilities." Therefore, even when governments report "a balanced budget and low public debt" one cannot be ensured that "it will enjoy fiscal stability in the near future," as many of the cash flow and bailout risks hide "outside the budgetary system" (Polackova Brixi and Mody 2002). In section 4, we propose ways to document and account for such risks.

The fact that some of these risks are hidden in the financial accounts of infrastructure SOEs is not an accident, as "contingent liabilities often grow from fiscal opportunism, when policymakers seek to hide the real fiscal cost of their decisions" (Polackova Brixi and Schick 2002). We are particularly concerned with the cases in which governments charge SOEs with QFOs that are not compensated for ex ante—QFOs that show up unexpectedly as contingent liabilities. Acknowledging them and doing something to minimize them is "first of all a question of political will" (Polackova Brixi and Schick 2002).

2.1 Cash Flow Risk

Cash flow risk is the risk stemming from the volatility of SOE net income, which requires fiscal transfers to cover occasional and modest losses associated with demand and operational risk, QFOs, or shortfalls in cash flows to cover capital expenditures. Cash flow needs can be volatile. They are often covered by operational subsidies. They can also be covered by other means, such as deferring tax liabilities and providing loans from other SOEs or state-owned banks.

Cash flow risk is often a consequence of weak fiscal governance regulating the capacity governments have to use SOEs for QFOs and the capacity SOEs have to make ad hoc requests of funds from the government. According to Ter-Minassian (2019), QFOs can turn into fiscal risk when "SOEs are directed by their governments to pursue public policy objectives and are not given the resources to do so." The main QFOs imposed on SOEs include pricing policies (capping tariffs for public services), labor market policies (overstaffing or hiring or avoiding layoffs during downturns), investment policies (undertaking investments to develop a region or sector that is a priority for the government), and procurement policies that favor specific domestic firms.

This type of fiscal risk is problematic because it can create vicious circles in which a government charges an SOE to undertake QFOs, such as subsidizing inputs to a group of firms or directly to households, generating losses for the SOE and leading it to request fiscal transfers to cover the losses. SOEs may not request the funds to cover the losses from such QFOs immediately, instead writing off the losses until they run out of equity and then asking for larger, unpredictable recapitalizations and/or bailouts.

SOEs also cover the deficits generated by QFOs by reducing maintenance and/or capital expenditures. Poorly maintained infrastructure generates unexpected cash flow risk because of the need to cover urgent repairs. Continuous reductions in capital expenditures and maintenance expenses can also lead to a continuous depletion of equity reserves (retained earnings) and eventually lead to larger financial pressures, including bailout risk. Thus, to a large extent, QFOs generate risks because they generate uncertainty about when fiscal transfers will be needed to cover the costs of such operations.

Another problem is that the ad hoc nature of the fiscal relation between the SOE and the government creates moral hazard, incentivizing SOEs to request funds in unexpected moments in the middle of the budget cycle and in amounts that may or may not correspond to the size and value of the QFOs they perform (or have performed in the past) for the government (Musacchio and Pineda Ayerbe 2019; Baum et al. 2020). QFOs often ask SOEs for very specific subsidies that create burdens that can be calculated ex ante and compensated for by the Treasury in each budget cycle (either ex ante or ex post); they can thus be classified as direct explicit liabilities. More often, however, as SOEs defer maintenance and capital expenditures to cover QFOs, what could initially have been a predictable fiscal transfer (to compensate for the QFO) turns into a larger, unexpected, harder to quantify fiscal risk down the road.

Contingent liabilities of infrastructure SOEs can arise because of poor planning and risk assessment, corruption, and fraud. Historically, on average a third of infrastructure projects have cost overruns; for energy projects the average is two-thirds, according to Monteiro, Rial, and Tandberg (2020). These cost overruns and the fiscal risk that emanates from these projects are dealt with ex post.

Contingent liabilities of SOEs are also a consequence of the types of shocks infrastructure SOEs are exposed to, on both the demand and the supply sides of their operations. Among these other sources of risk are the demand risk generated by exogenous and unexpected reductions in the demand for the products or services the SOE sells (Herrera Dappe et al. 2022); shocks to the prices of inputs, such as commodity price fluctuations; and financial, exchange rate, and climate risks. Some of the climate risk can be insured against, through explicit insurance policies for physical infrastructure or national disaster funds (De Janvry, Del Valle, and Sadoulet 2016). Because of increased variability in weather patterns and the severity of extreme events, however, some insurance mechanisms may be insufficient to cover unexpected costs, especially in countries with no disaster relief endowments. For this reason, a major source of implicit contingent liabilities associated with climate change will be the increase in frequency of large, severe weather shocks that can impair infrastructure assets.

2.2 Bailout Risk

Bailout risk refers to the implicit contingent liability risk associated with having to disburse large fiscal transfers to recapitalize an SOE or help it avoid default or bankruptcy after it faces large, mostly unexpected shocks for which the SOE has insufficient capital buffers. Bailout risk also arises when cash flow shortfalls happen in a way that erodes the equity of the firm with uneven, continuous write-off of losses, eventually generating the need for a major recapitalization.

Bailout risk also includes the contingent risk that governments face because SOEs may accumulate large liabilities for which the government is an implicit guarantor and that can turn into a responsibility of the government when large shocks occur. SOE debt is usually not added to the total debt of a country, especially if the SOE has been partially privatized or operates under corporate rather than under some form of administrative law. Even if SOE debt is explicitly not guaranteed by the government, however, if an SOE is too big or important to fail—the case of most infrastructure SOEs—governments cannot avoid having to bail them out in the event of a negative shock or threatened financial default (Lewis and Mody 1998; Wagner, Musacchio, and Jara-Bertin 2016). As budgets are computed on a cash basis, they rarely contain an estimate of the net present value of those contingent liabilities or the government's risk exposure to such liabilities.

3 Data

The World Bank Infrastructure SOEs Database was compiled as part of a broader research project to analyze the fiscal costs and risks of infrastructure. The data come from financial statements from SOE websites, government websites that include SOE financial statements, annual reports, and other sources, such as the EMIS Intelligence database and stock exchange websites. The database covers all SOEs operating infrastructure assets in the power (generation, transmission, and distribution) and transportation (roads, railroads, and airlines and airports) sectors for 19 countries between 2000 and 2018. The countries were selected based on data availability and to maximize sectoral coverage. They include the following:

- East Asia and Pacific: Indonesia, Solomon Islands
- Europe and Central Asia: Albania, Bulgaria, Croatia, Georgia, Kosovo, Romania, Ukraine
- Latin America and Caribbean: Argentina, Brazil, Peru, Uruguay
- South Asia: Bhutan
- Sub-Saharan Africa: Burundi, Ethiopia, Ghana, Kenya, South Africa.

The database classifies an enterprise as an SOE if the state directly or indirectly owns more than 50 percent of its shares or the state is the ultimate controlling entity, through majority ownership of common stock or any other mechanisms of control. This definition is in line with the European Union's definition of public undertakings in Commission Directive 2006/111/EC.

The database provides panel data on financials of SOEs in the power and transport sectors at the SOE/year level that are consistent over time and comparable across SOEs no matter where they operate. To ensure consistency and reliability, researchers collected the data using a standardized accounting data template that was populated using the information on financial statements. To ensure that quantities like earnings before interest, taxes, depreciation, and amortization (EBITDA) or operational subsidies in the database are comparable across SOEs and years, they identified each item as defined by the template using the notes to the financial statements rather than relying on the way such items are presented in the SOEs' main financial tables. Data reliability was further ensured through quality assurance checks by alternate analysts and accounting experts.

The database provides a standardized representation of the income statement, balance sheet, and cash flow statement of each SOE. It also contains supplementary items, including currency risk, debt/loan analysis, maturity profiles of assets and liabilities, and SOE ownership structure.

We used financial data on 135 SOEs in 19 countries for the 2009–18 period. Some of the regressions are based on fewer SOEs (92–118), because of data availability issues regarding subsidies, retained earnings, and other financial information. Table 2 presents the country and sectoral distribution of the SOEs in the sample.

Table 2 SOEs in the sample by country and sector

Country	*Power*	*Airlines and airports*	*Roads*	*Railways*	*Total*
Albania	3	0	0	1	4
Argentina	2	2	0	3	7
Bhutan	2	1	0	0	3
Brazil	8	1	0	0	9
Bulgaria	4	3	0	2	9
Burundi	1	0	0	0	1

Croatia	1	8	3	3	15
Ethiopia	2	1	0	1	4
Georgia	1	0	0	1	2
Ghana	3	1	0	0	4
Indonesia	1	3	1	1	6
Kenya	4	1	0	1	6
Kosovo	2	0	0	2	4
Peru	15	1	0	0	16
Romania	4	2	1	3	10
Solomon Islands	1	1	0	0	2
South Africa	1	3	1	2	7
Ukraine	16	4	0	1	21
Uruguay	1	0	1	3	5
Total	72	32	7	24	135

Source: World Bank Infrastructure SOE Database.

4 Fiscal Injections to SOEs

4.1 A Typology of Fiscal Injections to SOEs

We created the following measures of fiscal injections to support infrastructure SOEs:

- **Operational subsidies:** Operational subsidies are the fiscal transfers governments send to SOEs to cover shortfalls for the year and, often, to compensate the SOE for specific QFOs. They also include extraordinary transfers to cover unexpected losses, shortfalls in capital investments, etc. These subsidies can account for a large share of assets, especially when they cover equity shortfalls (that is, are used to recapitalize an SOE). In some countries, they are made regularly, especially when governments compensate SOEs ex ante for specific QFOs and mandates.
- **Government injections of equity:** Governments can bail out and recapitalize SOEs by injecting equity. These equity injections increase the equity owned by the government (in SOEs that have other shareholders). We track them using a variable called Proceeds from Equity Injection from Government, which adds up the additions to equity from government either directly (by a domestic government entity, such as a ministry or a government agency) or indirectly (by a domestic government entity through its shareholding in another company, such as another SOE, or any other enterprise with government participation).
- **Credit from the government:** This variable is created by adding up long-term debt or loans from the government or other government-affiliated creditors except SOEs and state-owned banks. Credit usually has a direct impact on the budget and on the support governments report for their SOEs.

- **Loans and credit from SOEs:** Loans and credit from SOEs occur when a state-owned bank or SOE extends credit or rolls over existing loans to an underperforming SOE. This form of credit may or may not have an impact on the government budget directly the year the transaction happens, depending on whether the bank or lending SOE has cash reserves or sufficient capital buffers to take on the loan on its balance sheet. Such loans usually have significant fiscal costs, as they may reduce dividends or taxes for the government when the credit is extended. These inter–SOE transfers have two advantages for governments, which make them appealing for SOE managers and government officials. First, such support can be kept off budget for the government and may not manifest itself as fiscal risk unless either the SOE does not pay the loan or the lending party has less profitability because of the transaction and, therefore, pays less in dividends and taxes to the government. Second, these transactions may hide the underperforming results of an SOE for a few years, until one of the parties ultimately has to face the losses. If politicians have short discounting horizons, they may therefore support these kinds of transactions, hoping things will pick up in the future or that they can defer the pain of an SOE bailout.
- **Deferred tax liabilities:** A common way to support SOEs and obviate the need for parliamentary approval for emergency funds to cover their operational losses (or the need for urgent capital injections) is to allow underperforming firms to accumulate deferred tax liabilities. By deferring the tax bill of an SOE, governments can provide an immediate fiscal transfer to it in the form of a loan that can be collected a few years down the line. Deferred tax liabilities are similar to credit among SOEs, except that the impact on the budget is immediate, as there is a loss of government tax revenue. Ultimately, the government ends up paying for the shortfall of funds by the SOE, although it can recover some of the amounts down the road, when the SOE has capacity to pay.
- **Fiscal injections variables:** We combine the subsidies and equity injections with changes in deferred tax liabilities and loans from government and other SOEs to create a variety of measures of fiscal injections that can be calculated at the SOE level and aggregated by sector and country, if necessary. To avoid counting as fiscal injections transfers that are intended to finance capital investments and/or the purchase of productive assets, we create a measure that tracks injections net of changes in the SOE's nonfinancial assets. We add up operational subsidies, equity injections from the government, and nonnegative changes in deferred tax liabilities, government loans, and loans from SOEs and subtract nonnegative changes in assets during the year to determine the fiscal events that truly represent cash flow and/or bailout risk—that is, positive fiscal transfers net of assets—in order to ensure we do not capture transfers of assets from the government to an SOE as a bailout.

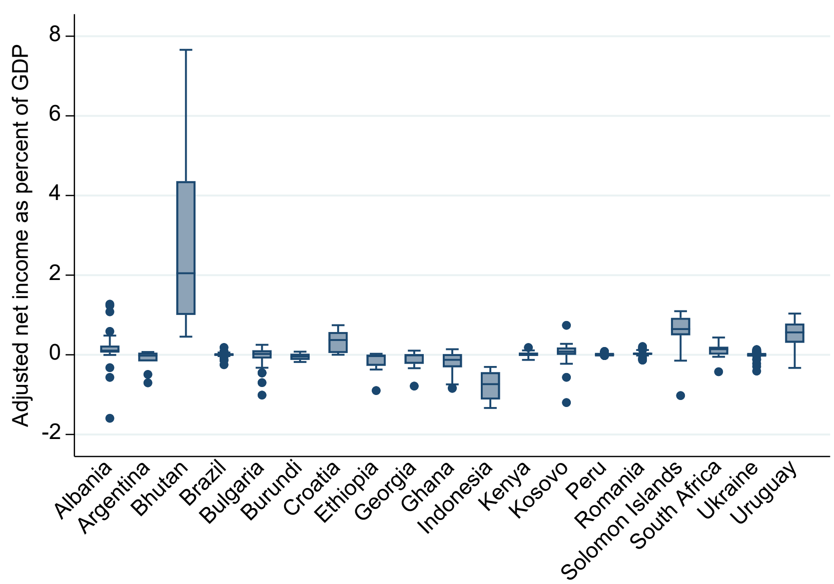
There are other ways in which SOEs can account for financial support from the government. For instance, there could also be support in the form of increases in trade payables owed to another SOE. We err on the side of caution and prefer to underestimate our fiscal injections ratios by leaving out trade payables from our calculations.

4.2 Descriptive Analysis of Fiscal Injections

The main reason why SOEs generate fiscal risk is because their financial performance is both weak and unpredictable. Figure 1 shows the distribution of adjusted net income to GDP in the power and railway sectors. Adjusted net income subtracts operational subsidies from profit (loss) for the year.[4] The volatility in net income can be explained by demand-side risk (for example, less electricity consumption in a recession); rain patterns in countries that have a large share of hydroelectric capacity; QFOs that cap tariffs; and other factors. In some countries, the net income of a power SOE can be 1–2 percent of GDP in one year and minus 1–2 percent of GDP the next. In Indonesia, for example, net income is usually negative, because of QFOs that cap electricity tariffs. Some of the losses are then compensated with subsidies. In railways, there is also risk associated with demand-side risk, but losses are also associated with QFOs related to employee costs (in Argentina or South Africa, for example) and/or caps on tariffs.

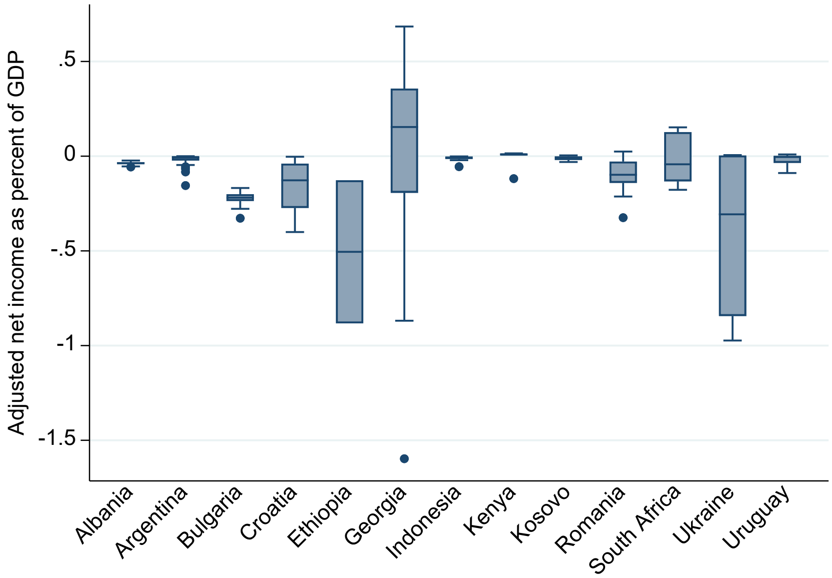
Figure 1 Adjusted net SOE income as a share of GDP in the power and railway sectors, by country

a. Power companies



[4] Operational subsidies include all subsidies an SOE receives for operational expenses, including both extraordinary and recurrent subsidies to cover overall losses or QFOs, as disclosed by the SOE, including those reported as revenues.

b. Railways

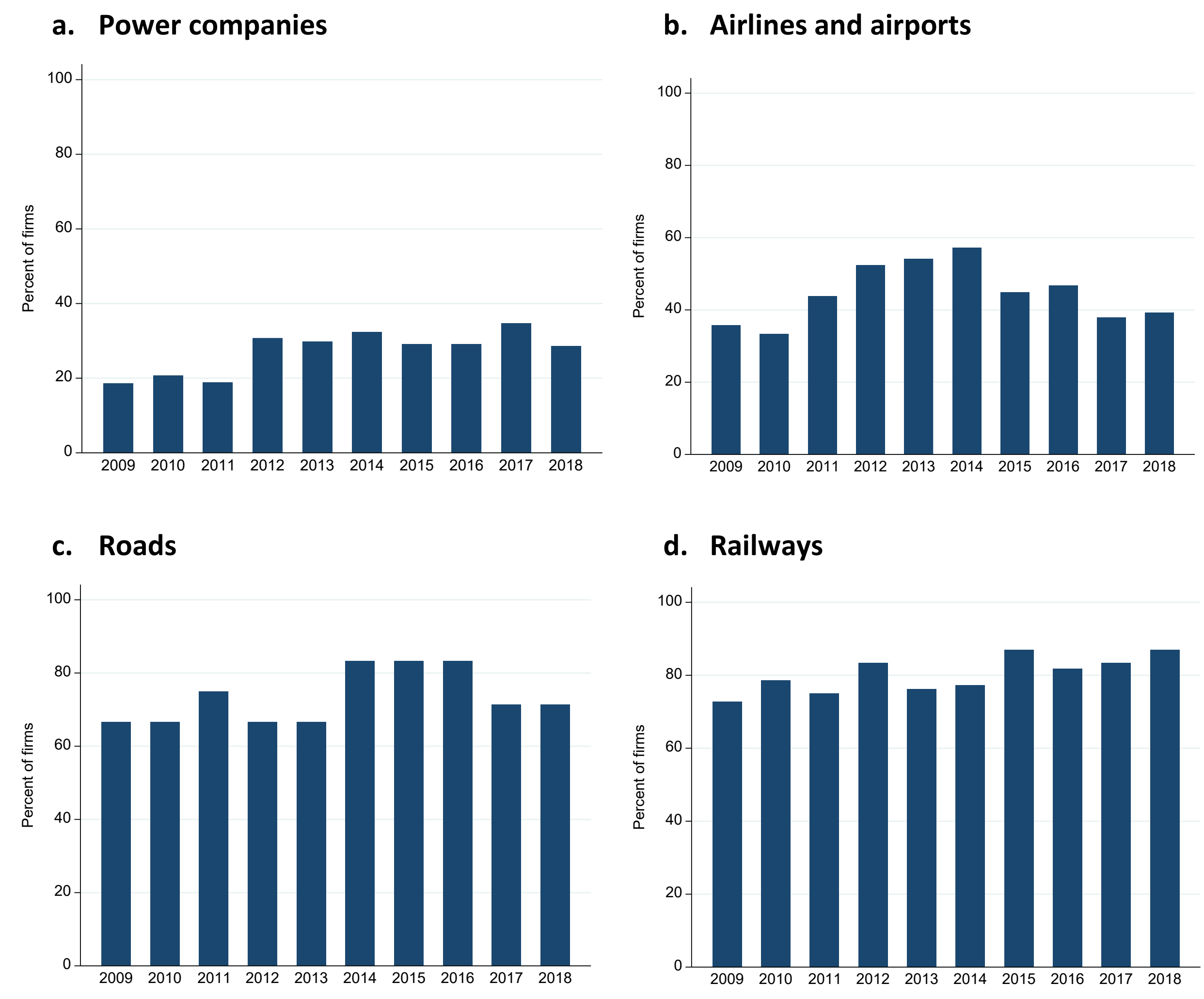


Source: World Bank Infrastructure SOE Database.
Note: Data are for 2009–18. Boxes show interquartile variation (25–75 percent) of subsidies to assets. Dark lines across the boxes show the median per year. Whiskers show the maximum and minimum of this variable per year, capped at 1.5 times the interquartile range. Dots represent outliers.

Figure 2 shows the percent of SOEs that lose money every year, net of fiscal transfers. In the power sector, a third of firms incur losses every year. In the airlines and airports sector, about 35–55 percent of firms incur losses each year, with losses lower after 2014 than before it. In the railways and roads sectors, more than 60 percent of firms failed to turn profits before subsidies every year, and the proportions remained more or less constant over the sample period. Firms in both sectors tend to be funded directly by the government to carry out construction and maintenance works.

The power sector has fewer losses than other sectors in the database. This difference may be related to the fact that most of the countries in the sample adopted sectoral reforms that improved competition and regulation, vertical disintegration, and cost recovery (Foster et al. 2017).

Figure 2 Percent of SOEs generating losses before receiving subsidies, by sector, 2009–18

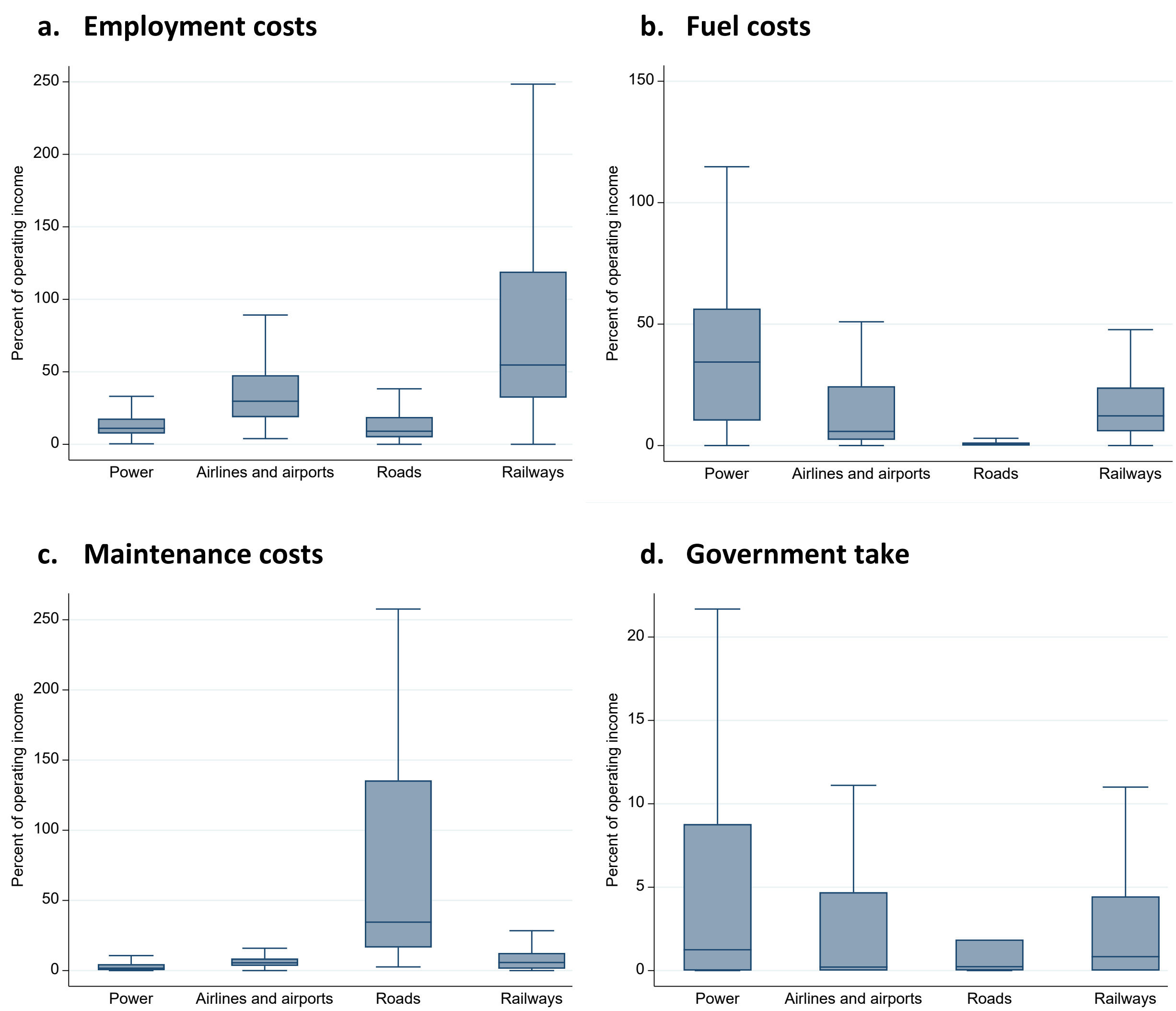


Source: World Bank Infrastructure SOE Database.
Note: Losses were calculated using adjusted net income, which subtracts operational subsidies from total profit (loss) for the year.

Part of the fiscal risk we examine stems from the fact that infrastructure SOEs have very little slack to deal with shocks. They use most of their revenues to cover payroll or maintenance expenses, leaving little net income for retained earnings—a key capital buffer for writing off the losses from large shocks. Figure 3 displays the variation across sectors of key expense items as a percent of operating income. Employment costs are extremely large in the railway and the airlines and airports sectors. Employment costs at railways average 145 percent of revenues (the median across sectors is 55 percent). Any demand shock that reduces revenues can therefore end up generating losses. Without fiscal transfers, on average, over 80 percent of company-year observations in railways have net losses. Some of those losses seem predictable. In Croatia and

Bulgaria, for example, total subsidies are high and similar every year. In other countries, such as Argentina, losses are more volatile and extremely high as a percent of GDP.

Figure 3 Main expense items of infrastructure SOEs, by sector



Source: World Bank Infrastructure SOE Database.
Note: Data are for 2009–18. Boxes show interquartile variation (25–75 percent) of subsidies to assets. Dark lines across the boxes show the median per year. Whiskers show the maximum and minimum of this variable per year, capped at 1.5 times the interquartile range. Dots represent outliers. Government take is defined as corporate taxes paid plus dividends paid to the government.

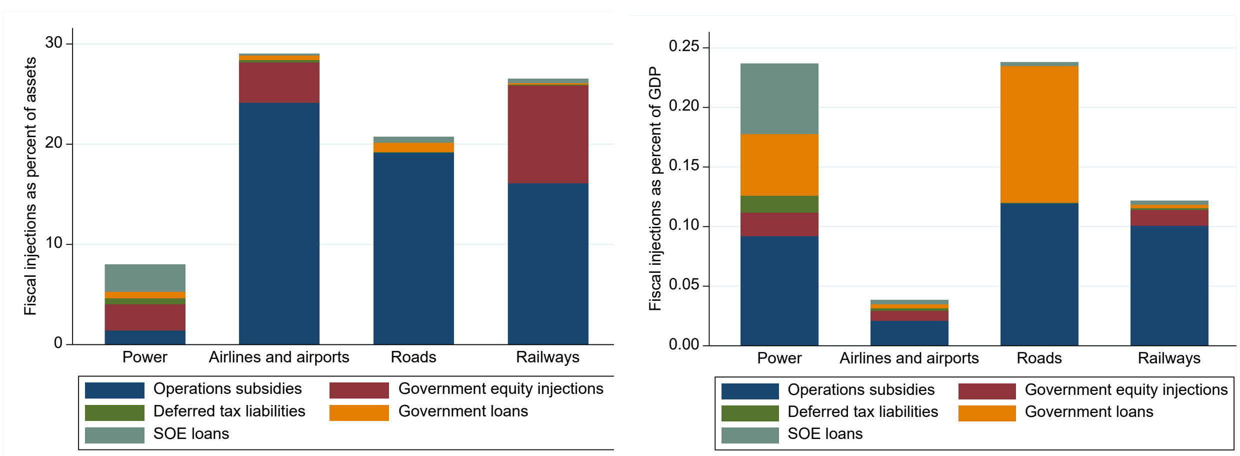
The main expense of SOEs in the roads sector is maintenance, with a mean of 132 percent of operating expenses and a median of 35 percent. Maintenance costs are not only the most important component of expenses, they are also highly volatile (the interquartile range is close to 120 percent of revenues), largely because most of the road SOEs in our sample do not have revenues to cover their expenses and depend fully on government transfers to pay for maintenance and road construction. Maintenance of roads can have predictable components that can be budgeted for, but emergency maintenance expenses can also be large and unpredictable. These increases are often caused by weather shocks or sudden deterioration of infrastructure that requires immediate attention (Heggie 1995).

For power companies, fuel inputs are the main source of volatility in operating profits and, therefore, the main source of fiscal risk. For most years, fuel cost averaged about half of revenues in the power sector and about 20 percent in the airlines sector. In these sectors, sudden increases in the price of oil can destabilize profitability and create a need for further fiscal transfers. Airlines not only have relatively high fuel expense ratios, they also have large employment expenses, which can also increase the volatility of profits.

To get an idea of the fiscal support SOEs receive in each sector and the different instruments used by governments, we focus on fiscal injections. Panel a of figure 4 shows that on average, the airport and airline SOEs in our sample received the largest annual fiscal transfers as a percentage of assets (29 percent), followed by railways (27 percent), roads (21 percent), and power (8 percent) SOEs. These transfers are so large relative to assets that they look more like frequent bailouts than small cash flow increases.

Figure 4 Average fiscal injections, by sector

a. As share of total assets **b. As share of GDP**



Source: Authors, based with data from the World Bank Infrastructure SOE Database. *Note*: Data are for 2009–18. Figure was constructed by adding operational subsidies, government equity injections, deferred tax liabilities, government loans, and SOE loans and subtracting changes in assets from the previous year to determine whether there was a fiscal injection. Government loans and SOE loans capture long-term debt or loans. Deferred tax liabilities, government loans, and SOE loans show increases since the previous year.

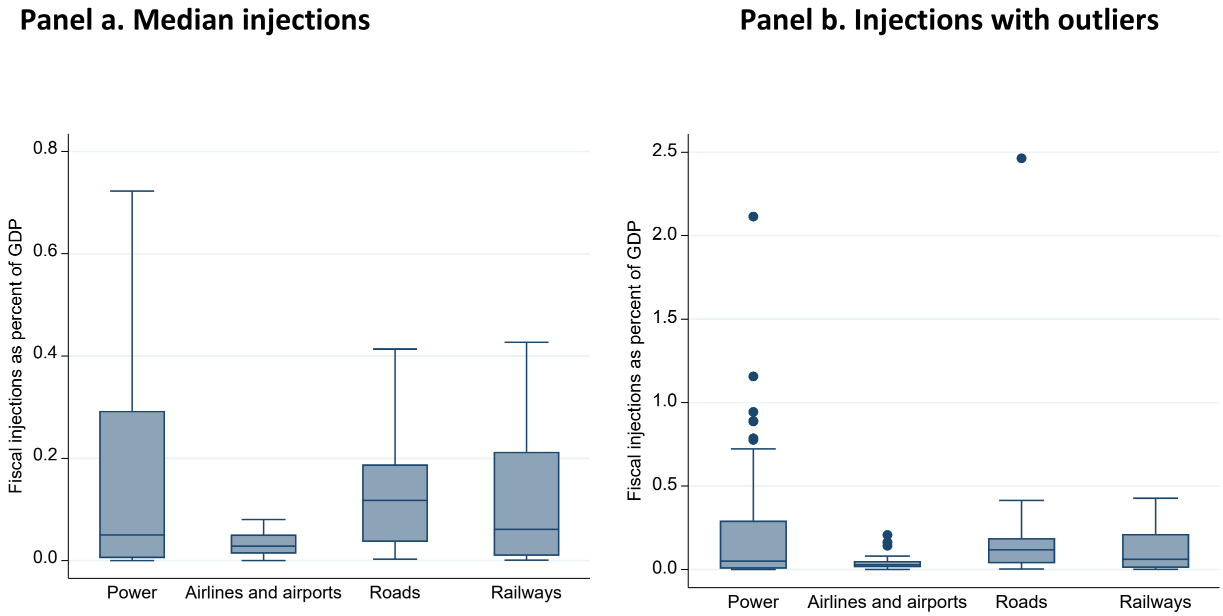
In the power sector, governments use a combination of equity injections, SOE loans, and government loans and subsidies. In the airlines and airports sector, the share of subsidies and equity injections is larger, in part because these SOES are more often fully-owned SOEs , thus having more access to equity injections**.** Roads are more dependent on the government budget. The main form of fiscal injection they receive is operational subsidies, which usually transfers to fund their yearly operations (mostly construction and maintenance of roads). Railways also rely heavily on operational subsidies, which account for a large share of equity injections.

Panel b of figure 4 shows that fiscal injections are important not only from the SOE perspective but also from the point of view of the government. Where there was more than one SOE in a country in a sector, we added the fiscal transfers to all of them in a year to get the fiscal transfer at the sector level. On average, the governments in our sample made annual fiscal injections of 0.24 points of GDP for power and roads, 0.12 for airlines and airports, and 0.04 percent for railways. These figures reinforce the idea that rather than look for country risk in sporadic episodes of large shocks, one should think of fiscal risk emanating from SOEs as a slow drip that over a few years represents as great a fiscal cost as a natural disaster or financial crisis. Panel b of figure 4 also reveals that on average, the largest fiscal injections are operational subsisides and government loans.

Figure 5 reveals the variation in the need for fiscal injections—that is, fiscal risk—in infrastructure SOEs. Panel a shows that the median size of all fiscal injections was less than 0.2 percent of GDP, with significant variation around it. Panel b presents the outliers. Appendix table A.2 presents all 44 country-year events in our sample in which total fiscal injections to infrastructure SOEs exceeded 0.2 percent of GDP. These events represent shocks of the kind documented by Bova et al. (2019). In addition, four events caused total fiscal injections that exceeded 1 percent of GDP.

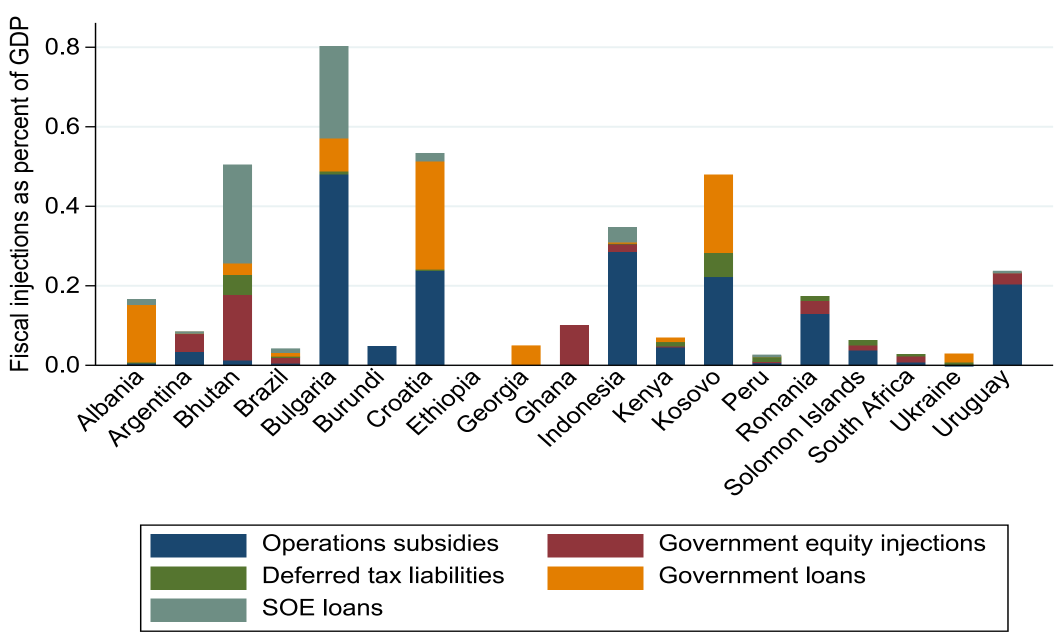
Across infrastructure sectors, fiscal support to SOEs is significant relative to GDP. Figure 6 displays the annual average fiscal injections by country. During the period 2009–18, Bulgaria supported its SOEs in airports, railways, and power with annual fiscal injections of 0.8 percent of GDP on average. Average annual fiscal injections to infrastructure SOEs in Bhutan, Croatia, and Kosovo amounted to about 0.5 percent of GDP.

Figure 5 Fiscal injections to SOEs as percent of GDP, by sector



Source: Authors, based on data from the World Bank Infrastructure SOE Database.
Note: Data are for 2009–18. Boxes show interquartile variation (25–75 percent) of fiscal injections to GDP. Blue lines across the boxes depict the median per year. Whiskers show the maximum and minimum of this variable per year, capped at 1.5 times the interquartile range. Panel a excludes outliers. Panel b depicts outliers as dots. Distributions are over positive fiscal injection events.

Figure 6 Average fiscal injections to SOEs as percent of GDP, by country and type of support

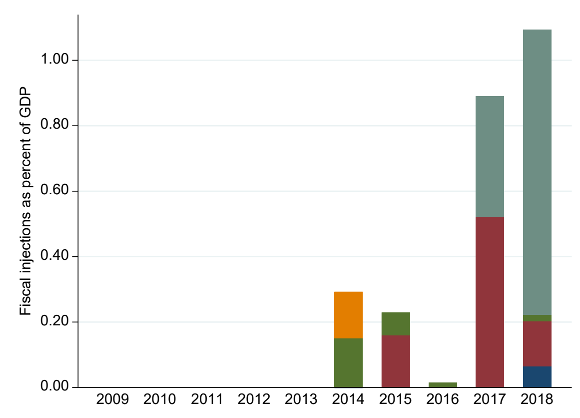


Source: Authors, based on data from the World Bank Infrastructure SOE Database.
Note: Data are for 2009–18.

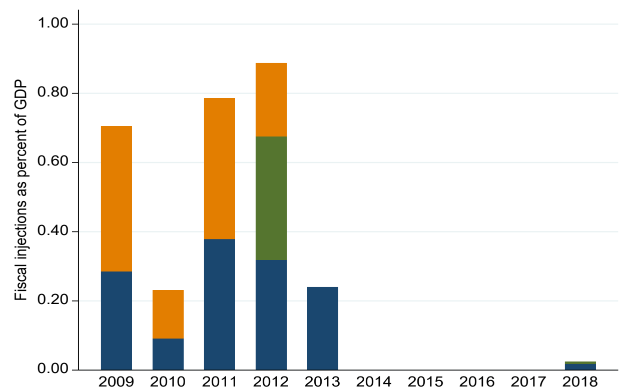
There is heterogeneity in the type of fiscal injections used across countries. In Bulgaria, Indonesia, Romania, and Uruguay, operational subsidies are the main instrument of support. In Albania, government support is channeled mainly through government loans. Croatia and Kosovo use both operational subsidies and government loans. Loans from SOEs are important in Bhutan and Bulgaria; equity injections are important in Argentina, Bhutan, and Ghana. On average, deferred tax liabilities are small relative to GDP, although some countries, such as Bhutan, Kosovo, and Peru, used them in some years (figure 7).

Figure 7 Fiscal injections to SOEs as percent to GDP in Bhutan, Kosovo, and Peru, by type of support 2008–18

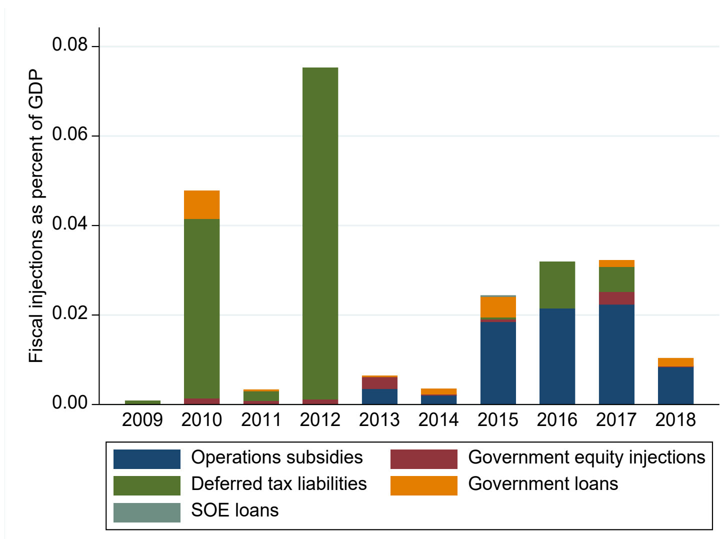
a. Bhutan



b. Kosovo



c. Peru



Source: Authors, based on data from the World Bank Infrastructure SOE Database.

5 Predicting Fiscal Risks from Infrastructure SOEs

5.1 Methodology

This section examines some of the determinants of insolvency events. These events are not proper bankruptcies and may not be defaults; they are events in which governments have to send large fiscal injections to specific SOEs. They can be fiscal injections to cover unexpected losses or fiscal injections that operate as a bailout.

In order to understand what determines SOE bailout events, we turn to the literature on business failures (Altman 2000, 2018). Studies conducted over the last 50 years have tried to figure out what financial indicators can predict insolvency. The initial methodology was based on samples of firms that were insolvent or bankrupt and similar firms that were not facing distress. From that quasi-matching exercise, Edward Altman reduced the number of relevant variables to explain failure to five financial ratios (all normalized by assets or liabilities to be able to compare firms of different sizes): working capital over assets, retained earnings to total assets, earnings before taxes and interest (EBIT) over assets, the market value of equity to book value of liabilities, and sales over total assets.

Studies using similar methodologies and samples of private (not publicly traded) firms reduced the number of ratios to four, given that there is no market valuations for such firms. The market value of equity is no longer needed to calculate what has been termed the Altman Z" Score. This index of financial vulnerability is calculated as follows:

$$Z" = 3.25 + 6.56 * \frac{Current\ assets - current\ liabilities}{Total\ assets} + 3.26\ \frac{Retained\ earnings}{Total\ assets} + 6.72\ \frac{EBIT}{Total\ assets} + 1.05\ \frac{Book\ value\ of\ equity}{Total\ liabilities},$$

where Z" is a numeric score that has usually been estimated in the range of 0–8.8 (Altman 2018), where 0 is equated with bankruptcy. Higher Altman Z" scores are usually correlated with higher credit ratings, even though credit rating agencies use a variety of qualitative scores beyond financials to categorize a company's risk of default.

The logic of using each of these financial ratios is as follows:

1. *(Current assets – current liabilities)/total assets*: This ratio is good measure of the working capital or liquidity available on a firm's balance sheet in a specific year. Working capital is defined as current assets minus current liabilities. If current assets cover current liabilities, this term will be positive and will provide additional buffering from shocks that may lead an SOE to suffer losses. At poorly run SOEs, this term can be negative.

2. *Retained earnings/total assets*: This ratio measures one of the most liquid buffers a company has: the amount of "reinvested earnings and/or losses of a firm over its entire life" (Altman 2000). Altman notes that these accounts are subject to decreases if outsized dividends are paid. They can also decrease if governments take outsized dividends or when an SOE suffers losses or has modest profits. The higher this ratio, the less the SOE will have to request financial support from the government.
3. *EBIT/total assets*: This ratio is a proxy for the operational efficiency of the firm's assets, "independent of any tax or leverage factors" (Altman 2013). As this factor ultimately determines whether or not firms face losses and, thus, erode their equity, in Altman's studies it usually has the highest correlation with insolvency. To avoid distorting EBIT for the SOEs in our sample with operating subsidies, we use EBIT before subsidies.
4. *Book value of equity/total liabilities*: This measure indirectly captures the leverage of the firm and how much the capital base can sustain the level of liabilities of the firm. It is a key measure for SOEs, which are usually undercapitalized. Governments often let SOEs erode their capital base before they provide fiscal injections to recapitalize them or extend loans to finance and/or substitute problematic liabilities.

We treat the SOEs in our database as private firms (as most of them have no market value) and follow the methodology of the Z" score to estimate our own index of vulnerability. Table 3 shows the descriptive statistics of the Z" score for SOEs and of the main variables we use to study fiscal risk. It shows that the median SOE has a Z" score of 5.27, which is just above the median value of private firms with a credit rating of BB– (see table 5); this rating indicates speculative grade but not high risk. The 75th percentile of our sample has an average Z" score that is just below the median for AAA–rated firms.

Table 3 Summary statistics for the Z" score for SOEs, its components, and fiscal injection variables

Variable	*Mean*	*Standard deviation*	*Minimum*	*Median*	*Maximum*
Z'' SOE score	7.11	16.92	–49.35	5.27	417.38
(Current assets as a percent of current liabilities)/assets	0.01	0.330	–3.91	0.03	0.88
Retained earnings/assets	–0.09	0.643	–7.37	0.02	0.97
Adjusted EBIT/assets	–0.04	0.260	–1.98	0.02	0.90
Book value of equity/liabilities	4.12	15.26	–0.84	1.20	393.78
Subsidies + government equity injections + δ government loans + δ state-owned bank loans + Δ DTL	5.3	25.50	0	0	303.02
Subsidies	4.07	19.53	0	0	194.32
Government equity injections	1.22	13.59	0	0	303.02
Subsidies + government equity injections	5.43	26.27	0	0	303.02
Δ Government loans + Δ SOE loans	0.68	9.72	0	0	259.04
government equity injections + δ government loans + δ SOE loans	3.21	20.02	0	0	303.02

Government equity injections + δ government loans + Δ SOE loans + Δ DTL	1.77	16.96	0	0	303.02

Source: Authors, based on data from the World Bank Infrastructure SOE Database.
Note: SOE scores were calculated using the Altman Z" parameters as follows: Z" = 3.25 + 6.56 * (current assets – current liabilities)/total assets + 3.26 * retained earnings/total assets + 6.72 * EBIT/assets + 1.05 * book value of equity/total liabilities

What is unique about the SOE data is that the estimated Z" scores have very fat tails: Many SOEs have extremely high Z" scores, and many have with extremely low scores. Table 4 compares the distribution of the Z" score for private firms from Altman (2018, table 6) with the distribution of the Z" score for SOEs in our sample. It shows that private firms have more of a bell-curve shape and our data follow a *U*-shape, with very thick tails on both ends.

Table 4 Distribution of infrastructure SOEs along the Altman Z" score range

			Infrastructure SOE sample	
Rating	*Average Z" across samples*	*Altman's estimates (percent of 4,147 private firms)*	*Number of SOEs*	*Percent of 121 SOEs*
AAA/AA+	8.15	1.2	30	24.8
AA/AA-	7.78	2.2	5	4.1
A+	7.61	2.3	3	2.5
A	7.04	4.8	3	2.5
A-	6.54	4.9	4	3.3
BBB+	6.17	5.8	4	3.3
BBB	6.00	9.1	3	2.5
BBB-	5.90	7.1	2	1.7
BB+	5.72	5.5	4	3.3
BB	5.55	7.6	4	3.3
BB-	5.16	11.4	4	3.3
B+	4.79	10.6	3	2.5
B	4.16	11.2	9	7.4
B-	3.72	6.2	3	2.5
CCC+	3.01	1.7	9	7.4
CCC	2.42	0.7	7	5.8
CCC-	1.70	0.5	3	2.5
CC/D	0.30	7.2	21	17.3

Source: Authors' calculations based on Altman (2018, table 6).

Note: SOE scores were calculated by the authors using the Altman Z" parameters as follows: Z"= 3.25 + 6.56 * (current assets – current liabilities)/total assets + 3.26 * retained earnings/total assets + 6.72 * EBIT/assets + 1.05 * book value of equity/total liabilities, using a sample of 1,101 firm-year observations from the World Bank Infrastructure SOEs Database.

In our data, the median levels for the current assets minus liabilities and retained earnings ratios (both over assets) are near zero (0.031 and 0.016, respectively), and almost 40 percent of the observations have negative ratios (see table 3). SOEs thus operate with very low capital reserves or reinvestment, usually not enough current assets to cover current liabilities. Similar ratios in private firms would make them highly vulnerable and would probably put them near default.

Tables 3 and 4 show that there is enough heterogeneity within our sample to use the Z" score as a forward-looking measure of vulnerability, because the sample has firms that never require fiscal injections from the government (the control group) and firms that require fiscal injections rather regularly. We therefore use our measures of fiscal injections as dependent variables and check whether the lagged Z" score can help predict such injections. Our baseline regression uses the estimated Z" score as follows:

$$Fiscal\ injection_{itry} = \alpha + \beta Z"_{SOEit-1} + \pi_r + \pi_r * Year_t + \pi_y + \epsilon_{it}$$

where $Fiscal\ injection_{itry}$ is a dependent variable that measures one or a combination of fiscal injection variables for firm *i* in year *t* for industry *r* in country *y*. We include a constant and the $Z"_{SOE}$ score lagged one period to see how much it works as a forward-looking measure of fiscal or financial vulnerability. We also include industry fixed effects (π_r), industry times year fixed effects, and country fixed effects (π_y), depending on the specification. As there are a few extreme values for the Z" score, we winsorize the Z" score variable at the 1 percent level.

We try a variety of combinations of fiscal injections as dependent variables and include the four financial ratios from which we created the $Z"_{SOE}$ score. We then replace $Z"_{SOEit-1}$ with the four financial ratios that we initially used to create it. In theory, this regression should uncover the relative importance of each of the four financial ratios to explain the need for each specific type of fiscal injection.

5.2 Findings on Fiscal Risk

Table 6 displays the regression results in which we look at how effective the lagged Z" SOE score ($Z"_{SOEit-1}$) is as a forward-looking predictor of fiscal risk. The coefficient is negative and highly significant across specifications. The findings in this table imply that improvements in the $Z"_{SOEit-1}$ score would significantly reduce the need for fiscal injections and vice versa. For instance, a company that had a mean $Z"_{SOEit-1}$ score (7.11) and a deterioration of one standard deviation the previous year (a decrease of 16.92 in the Z" score, putting it at –9.81) would need an increase of 189 percent in total fiscal injections (9.5 percentage points of assets versus. the mean value of 5.0 [specification 1]). The effect on the fiscal injection variables is different for each column. In specification 6, for instance, the effect of the same decline in the Z" score is extremely large if the fiscal injections variable is only the change in government equity plus the change in government and SOE loans (over assets). In this case, a decrease in the Z" score of one standard deviation from the mean leads to an increase in fiscal injections of 150 percent. The effects are also large when the fiscal injections variable is subsidies (179 percent increase in fiscal injections), government equity injections (218 percent increase), and changes in government and SOE loans (108 percent). These results are consistent with the Z-score literature that uses this indicator as a forward-looking indicator of default.

The findings in table 5 imply that governments may want to track SOE Z” scores as a way to prevent or foresee the need for fiscal injections. It is not clear from these specifications, however, which of the financial ratios best explains the need for each type of fiscal injection. Therefore, we add all four financial ratios to our specifications.

In table 6, we substitute the $Z"_{SOEit-1}$ score as the variable of interest with the four financial ratios that create the score in the first place (lagged as well). These regressions are run in order to understand which ratio is driving each of the fiscal injections more.

Table 5 Regressions results on lagged Altman's Z" SOE score as a predictor of fiscal injections

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Difference from change in total assets (as % of total assets), country and industry x year fixed effects						
Item	*Subsidies + government equity injections + Δ government loans + Δ state-owned bank loans + Δ DTL*	*Subsidies*	*Government equity injections*	*Subsidies + government equity injections*	*Δ Government loans + Δ state-owned bank loans*	*Government equity injections + Δ government loans + Δ state-owned bank loans*	*Government equity injections + Δ government loans + Δ state-owned bank loans + Δ DTL*
Z′′score (t – 1)	–0.562***	–0.372***	–0.053***	–0.561***	–0.017***	–0.226***	–0.052***
	(0.107)	(0.053)	(0.012)	(0.080)	(0.006)	(0.048)	(0.016)
Observations	608	843	795	788	734	691	608
Number of SOEs	92	118	114	112	110	106	92
R-squared	0.236	0.285	0.229	0.291	0.142	0.317	0.144
Adjusted R-squared	0.160	0.232	0.168	0.234	0.0682	0.255	0.0584
F-statistic	3.104	5.395	3.773	5.148	1.925	5.064	1.685
Log likelihood	–2,671	–3,317	–1,919	–3,392	–1,238	–2,587	–1,524
Mean of dependent variable	5.035	3.519	0.412	4.793	0.266	2.545	0.756
Standard deviation of dependent variable	22.40	14.66	3.083	21.27	1.411	12.38	3.209

Note: The dependent variables are variations of the fiscal injections variable that measure the change in fiscal injections, when they are nonnegative, minus the change in assets, all relative to assets in period t. The regressions have random effects and no clustering, in order to let the financials of the firms rather than variation that affects firms define the fiscal events. Regressions include industry times year fixed effects and country fixed effects to try to capture variation that affects all firms in an industry/country the same way. Robust standard errors in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6 Regressions results on lagged Altman's Z" score components as predictors of fiscal injections

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Difference from Δ total assets (as percent of total assets), country and industry x year fixed effects						
Item	*Subsidies + government equity injections + Δ government loans + Δ state-owned bank loans + Δ deferred tax liabilities (DTL)*	*Subsidies*	*Government equity injections*	*Subsidies + government equity injections*	*Δ Government loans + Δ state-owned bank loans*	*Government equity injections + Δ government loans + Δ state-owned bank loans*	*Government equity injections + Δ government loans + Δ state-owned bank loans + Δ DTL*
(Current assets – current liabilities)/assets (lag)	2.070	5.444***	0.219	6.799***	–0.655**	0.622	–1.377**
	(3.579)	(1.687)	(0.511)	(2.551)	(0.260)	(2.030)	(0.644)
Retained. earnings/assets (lag)	4.118**	5.861***	–0.001	7.775***	–0.299**	–2.648**	–0.880***
	(1.838)	(0.880)	(0.258)	(1.317)	(0.134)	(1.042)	(0.331)
Adjusted EBIT/assets (lag)	–63.759***	–46.843***	–3.780***	–67.170***	0.187	–11.095***	–0.108
	(3.867)	(1.662)	(0.502)	(2.559)	(0.249)	(1.999)	(0.696)
Book value of equity/liabilities (lag)	0.070	–0.036	–0.023	–0.057	–0.008	–0.104*	–0.019
	(0.119)	(0.050)	(0.015)	(0.076)	(0.008)	(0.061)	(0.021)
Observations	608	843	795	788	734	691	608
Number of SOEs	92	118	114	112	110	106	92
R-squared	0.474	0.638	0.280	0.626	0.161	0.358	0.169
Adjusted *R*-squared	0.418	0.609	0.220	0.594	0.0851	0.296	0.0815
F-statistic	8.516	22.53	4.665	19.90	2.117	5.747	1.928
Log likelihood	–2,558	–3,031	–1,892	–3,140	–1,229	–2,566	–1,515
Mean of dependent variable	5.035	3.519	0.412	4.793	0.266	2.545	0.756
Standard deviation of dependent variable	22.40	14.66	3.083	21.27	1.411	12.38	3.209

Note: EBIT = earnings before taxes and interest. The dependent variables are variations of the fiscal injections variable that measure the change in the fiscal injections, when they are nonnegative, minus the change in assets, all relative to assets in period *t*. The regressions have random effects and no clustering. Industry times year fixed effects and country fixed effects are included to try to capture variation that affects all firms in an industry/country the same way. Robust standard errors in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The variable that drives fiscal injections the most is *Adjusted EBIT to assets*. Its coefficient is negative, large, and significant across all specifications except specifications 5 and 7. Using the coefficient in specification 1 reveals that a deterioration in adjusted performance significantly increases the need for subsidies (relative to assets). If, for instance, the average firm, with an adjusted EBIT to assets ratio of –0.038 were to suddenly show losses of –0.05 (an increase of 1.2 percentage points of assets), it would need to receive additional fiscal injections of 0.77 percent of assets, an increase of 15 percent relative to the mean fiscal injection to assets.

Both current assets minus current liabilities and retained earnings (both as a percentage of assets) have positive coefficients when the fiscal injections variable includes operating subsidies. That is, firms that receive subsidies probably have high coverage of their current liabilities with current assets and high retained earnings to assets.

When operating subsidies are not included in the dependent variable in specifications 5, 6, and 7 in table 6, we observe negative and significant coefficients for ratios of current assets minus current liabilities to assets and retained earnings to assets. That is, firms with low current ratios and low retained earnings to assets tend to need fiscal injections in the form of loans from the government or other SOEs, as equity injections from the government, or as deferred tax liabilities.

Table 6 shows that the three indicators that governments need to track regularly are the top three financial ratios. Adjusted EBIT seems to drive the need for operational subsidies directly, but the difference between current assets and liabilities (as a percent of assets) and the ratio of retained earnings to assets are also important predictors of the need for loans, equity injections, and deferred tax liabilities. Simplifying tracking in one simple Z" SOE score seems to be more effective and may make it easier to draw comparisons and create thresholds and/or dashboards that simplify monitoring.

As a way to check that our results are not driven by the selection of controls, in the appendix we replicate tables 5 and 6 without any fixed effects (tables A.3 and A.4). The coefficients barely change. We also ran all regression only for the post–2009 period; the results were very similar. We also excluded the roads sector, because of its reliance on fiscal transfers to operate, to ensure that it was not biasing the results; the main significant coefficients did not change much. We therefore believe that the results in tables 5 and 6 are extremely robust and confirm that the key financial ratios can be used as forward-looking measures of fiscal risk.

6 Conclusions

Infrastructure SOEs are like smoke and mirrors, providing endless possibilities to conceal fiscal problems. SOEs can lend to each other to hide losses, increase their deferred tax liabilities and/or get credit from the government, take losses and deplete their equity, and issue debt that generates dangerous contingent liabilities. If they know that governments will bail out their operations at the first sign of trouble, they can be laxer about cost overruns, request fiscal support or bailouts in unexpected moments, and become dependent on frequent fiscal transfers to cover operational inefficiencies or pay for QFOs. These losses and requests for fiscal transfers are a form of hidden deficits (Kharas and Mishra 2001) that can be sizable relative to GDP and can make or break the savings a government tries to make in the budget.

This paper makes three contributions to the study of fiscal risk and hidden deficits. First, it documents the size of these hidden deficits, which are substantial (averaging 0.04 percent of GDP per year in the airlines and airports sector, 0.12 percent in the railways sector, and 0.24 percent in the power and roads sectors). These fiscal injections are also large relative to the size of the SOEs they support. Our evidence highlights that fiscal risk is not only about big bang events (about tail risk). Fiscal risk stemming from SOEs is more of a slow drip that accumulates rapidly and can eventually turn into a big bang event.

Second, the paper shows that the fiscal risk of SOEs is systemic. The slow dripping from different SOEs can add up to significant fiscal risk. We document this drip for some infrastructure sectors, but there are also other SOEs in the countries we study that are not accounted for in our calculations. If other sectors also generate hidden deficits like those we document for the infrastructure sectors we study, the fiscal risk of the SOE sector as a whole is large all the time. Our findings of extremely large fiscal injections of over 0.2 percent of GDP (see figure 5) include more instances than Bova et al. (2019) find—and we studied only four sectors, a smaller set of countries, and shorter period of time than they did.

Third, the paper provides straightforward policy recommendations. According to our findings, governments can use forward-looking indicators to monitor SOE performance and prevent the need for fiscal injections. In particular, we show how the Z" SOE score may provide some forewarning for governments that can help them avoid having to inject precious fiscal resources to rescue underperforming SOEs.

Recommendations for reducing fiscal risk have focused on improving the way in which governments account for contingent liabilities and hidden deficits. For instance, Kharas and Mishra (2001) propose setting aside every year an amount "equal to its long-run average hidden deficit, so that the country can meet future contingent claims." Lewis and Mody (1998) also recommend setting aside reserves for unexpected costs, in order to obviate the need to make frequent funding requests from Congress. They argue that part of the problem is the cash budget accounting system used by most governments and recommend keeping a good account of assets and liabilities, including contingent liabilities, to be able to calculate "the expected loss exposure of each of its contingent liabilities independently" but taking into account the "aggregate loss distribution of the government's portfolio of risks, using value-at-risk" methodologies. These reserves can be part of a sovereign disaster or contingent liability fund, which may be in foreign currency and in liquid and easy-to-convert assets. Depending on the size of those contingent liabilities, the government can also maintain a contingent liability fund, ideally with limited liability, so that there is a limit to government support (Cohen 2002).

Because governments rarely hold any form of reserves or provisions to cover probable losses that stem from these liabilities, the literature recommends using standard risk management methodologies to calculate appropriate provisions in the annual budgets and develop reserves or sovereign funds with uncorrelated risk (Lewis and Mody 1998; Currie and Velandia 2000). Our insights extend this view of fiscal risk management for governments by providing basic insights on how governments can create dashboards to track the fiscal risk of SOEs using the Z” SOE score to prevent problems. Our measures of fiscal risk can be used to improve the value at risk for the SOE portfolios of governments as well. It can thus help governments estimate the provisions they need to deal with SOE risk and reduce the unexpected need for fiscal injections (and of provisions) by improving ex ante monitoring.

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Appendix

Table A.1 Infrastructure SOE bailout events according to Bova et al. (2019)

Item	*Number of SOE bailouts since 1990*	*Percent of total SOE bailouts*	*Average gross payout (percent of GDP)*
Airline	1	3	1.8
Construction	1	3	9.0
Power	9	31	2.7
Railways	5	17	3.6
Water	1	3	1.1
Oil and gas	4	14	4.2
Non-infrastructure	8	28	2.6
All SOE cases	29	100	3.2
All infrastructure SOE cases except oil and gas	17	59	2.8
Infrastructure sectors analyzed in this paper (airline, power, and railway sectors)	15	52	3.0

Source: Coded by sector by the authors using the dataset from Bova et al. (2019).

Table A.2 Annual fiscal injections to SOEs of at least 0.2 percentage of GDP

Country	*Year*	*Subsecctor*	*Total fiscal injections in sector as percent of GDP*	*Total fiscal injections as percent of GDP*
Uruguay	2012	Roads	0.14	0.20
		Railways	0.06	
Romania	2013	Railways	0.21	0.21
Indonesia	2018	Roads	0.18	0.23
		Railways	0.05	
Bhutan	2015	Power	0.23	0.23
Kosovo	2010	Power	0.23	0.23
Uruguay	2015	Roads	0.19	0.24
		Railways	0.05	
Kosovo	2013	Power	0.23	0.24
		Railways	0.01	
Argentina	2016	Power	0.18	0.25
		Airlines and airports	0.01	
		Railways	0.05	
Uruguay	2017	Roads	0.19	0.24
		Railways	0.05	
Romania	2015	Power	0.00	0.27

		Roads	0.08	
		Railways	0.18	
Albania	2016	Power	0.26	0.27
		Railways	0.01	
Bulgaria	2012	Power	0.00	0.27
		Airlines and airports	0.05	
		Railways	0.22	
Uruguay	2010	Roads	0.28	0.28
Bulgaria	2009	Airlines and airports	0.05	0.28
		Railways	0.23	
Bhutan	2014	Power	0.29	0.29
Romania	2014	Power	0.00	0.30
		Roads	0.04	
		Railways	0.27	
Romania	2016	Power	0.08	0.32
		Roads	0.09	
		Railways	0.15	
Croatia	2015	Airlines and airports	0.03	0.32
		Railways	0.29	
Uruguay	2013	Roads	0.29	0.32
		Railways	0.04	
Indonesia	2010	Power	0.34	0.34
		Airlines and airports	0.00	
Croatia	2014	Airlines and airports	0.03	0.35
		Railways	0.32	
Indonesia	2012	Power	0.35	0.36
		Roads	0.01	
Bulgaria	2011	Airlines and airports	0.04	0.36
		Railways	0.32	
Croatia	2018	Airlines and airports	0.02	0.38
		Railways	0.36	
Uruguay	2009	Roads	0.41	0.41
Croatia	2011	Airlines and airports	0.14	0.42
		Railways	0.28	
Croatia	2016	Airlines and airports	0.02	0.45
		Railways	0.43	
Bulgaria	2010	Airlines and airports	0.04	0.47
		Railways	0.43	
Bulgaria	2015	Power	0.25	0.51
		Airlines and airports	0.04	
		Railways	0.22	
Indonesia	2013	Power	0.66	0.70
		Roads	0.04	
Kosovo	2009	Power	0.71	0.71
Albania	2014	Power	0.72	0.73
		Railways	0.01	
Bulgaria	2013	Power	0.49	0.76
		Airlines and airports	0.06	
		Railways	0.21	
Bulgaria	2014	Power	0.53	0.77
		Airlines and airports	0.04	

		Railways	0.20	
Indonesia	2014	Power	0.78	0.78
		Roads	<0.01	
Kosovo	2011	Power	0.79	0.79
Bulgaria	2017	Power	0.46	0.84
		Airlines and airports	0.05	
		Railways	0.32	
Kosovo	2012	Power	0.89	0.89
Bhutan	2017	Power	0.89	0.89
Indonesia	2016	Power	0.94	0.95
		Railways	<0.01	
Bhutan	2018	Power	0.89	1.09
		Airlines and airports	0.21	
Bulgaria	2018	Power	1.16	1.45
		Airlines and airports	0.00	
		Railways	0.29	
Bulgaria	2016	Power	2.11	2.32
		Airlines and airports	0.03	
		Railways	0.17	
Croatia	2017	Power	<0.01	2.91
		Airlines and airports	0.02	
		Roads	2.46	
		Railways	0.42	

Source: Author, based on data from the World Bank Infrastructure SOE Database and World Development Indicators.

Table A.3 Regression results on Altman Z" SOE score as a predictor of fiscal injections (no controls)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	Difference from Δ total assets (as percent of total assets), no controls						
Item	*Subsidies + government equity injection + Δ government loans + Δ state-owned bank loans + Δ DTL*	*Subsidies*	*Government equity injection*	*Subsidies + government equity injection*	*Δ Government loans + Δ state-owned bank loans*	*Government equity injection + Δ government loans + Δ state-owned bank loans*	*Government equity injection + Δ government loans + Δ state-owned bank loans + Δ DTL*
Z″ score	–0.473***	–0.256***	–0.039***	–0.393***	–0.019***	–0.175***	–0.057***
	(0.105)	(0.056)	(0.012)	(0.084)	(0.006)	(0.051)	(0.015)
Observations	608	843	795	788	734	691	608
Number of SOEs	92	118	114	112	110	106	92
R-squared	0.0324	0.0243	0.0127	0.0273	0.0156	0.0170	0.0230
Adjusted *R*-squared	0.0308	0.0231	0.0114	0.0260	0.0143	0.0155	0.0214
F-statistic	20.28	20.95	10.17	22.03	11.60	11.88	14.26
Log likelihood	–2743	–3449	–2018	–3516	–1288	–2713	–1564
Mean of dependent variable	5.035	3.519	0.412	4.793	0.266	2.545	0.756
Standard deviation of dependent variable	22.40	14.66	3.083	21.27	1.411	12.38	3.209

Note: The dependent variables are variations of the fiscal injections variable that measure the change in the fiscal injections, when they are nonnegative, minus the change in assets, all relative to assets in period *t*. The regressions have random effects, no additional controls, and no clustering, in order to let the financials of the firms, and not variation that affects firm, define the fiscal events. The coefficients are not very different from the specifications in which we include year x industry fixed effects or year effects alone. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4 Regression results on lagged components of the Altman Z" score as a predictor of fiscal injections (no controls)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Difference from Δ total assets (as percent of total assets), no controls						
Item	*Subsidies + government equity injection + Δ government loans + Δ state-owned bank loans + Δ deferred tax liability (DTL)*	*Subsidies*	*Government equity injection*	*Subsidies + government equity injection*	*Δ Government loans + Δ state-owned bank loans*	*Government equity injection + Δ government loans + Δ state-owned bank loans*	*Government equity injection + Δ government loans + Δ state-owned bank loans + Δ DTL*
(Current assets – current liabilities)/assets (*t* –1)	6.649**	5.678***	0.335	8.069***	–0.474**	1.287	–0.621
	(3.163)	(1.558)	(0.485)	(2.342)	(0.237)	(1.977)	(0.576)
Retained earnings/assets (*t* –1)	3.061*	6.029***	–0.024	7.265***	–0.265**	–1.727*	–1.066***
	(1.629)	(0.823)	(0.250)	(1.226)	(0.124)	(1.031)	(0.297)
Adjusted EBITDA/assets (*t* –1)	–66.129***	–48.721***	–4.646***	–69.676***	–0.058	–17.642***	–0.870
	(3.295)	(1.447)	(0.446)	(2.206)	(0.216)	(1.828)	(0.600)
Book value of equity/liabilities (*t* –1)	0.035	0.023	–0.006	0.014	–0.011	–0.019	–0.025
	(0.107)	(0.046)	(0.014)	(0.069)	(0.007)	(0.060)	(0.019)
Constant	3.357***	1.887***	0.252**	2.585***	0.304***	1.765***	0.737***
	(0.782)	(0.369)	(0.116)	(0.561)	(0.059)	(0.497)	(0.142)
Observations	608	843	795	788	734	691	608
Number of SOEs	92	118	114	112	110	106	92
R-squared	0.416	0.592	0.134	0.578	0.0287	0.148	0.0557
Adjusted *R*-squared	0.412	0.590	0.129	0.576	0.0234	0.143	0.0494
F-statistic	107.2	304.0	30.53	268.2	5.389	29.77	8.888
Log likelihood	–2,589	–3,081	–1,966	–3,187	–1,283	–2,663	–1,554
Mean of dependent variable	5.035	3.519	0.412	4.793	0.266	2.545	0.756

Standard deviation of dependent variable	22.40	14.66	3.083	21.27	1.411	12.38	3.209

Note: Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.