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The Growth Return of Infrastructure in Latin America

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The Growth Return of Infrastructure in Latin America

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Abstract

This paper examines the effects of improvements in infrastrucutre on sectoral growth and firm-level investment, focusing on six Latin American countries. Exploiting the heterogeneity in the quality of infrastructure across countries and the intrinsic variation in the dependence of sectors on infrastructure, I find that better infrastructure raises growth and investment. Improved infrastructure could yield large economic benefits. For example, if the quality of infrastructure in Colombia increased to the sample median (Czech Republic), GDP growth would increase by about 0.1 percentage points.

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Keywords: infrastructure, growth, investment

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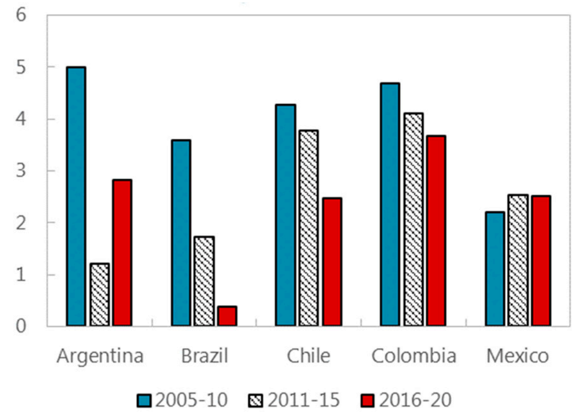
I. Introduction

Potential growth in LAC5 is on a declining trend. With the exception of Mexico, potential growth in LAC5 fell in the last decade and under current policies is projected to decline further in most countries the next five years (Figure 1). The underlying causes vary by country but IMF (2016) identifies four common reasons why potential growth is expected to be weak in the next five years: (i) shortcomings in the quality of education; (ii) low export diversity and complexity; (iii) lower commodity prices for commodity exporters; and (iv) inadequate infrastructure. The last point is the focus of this paper.

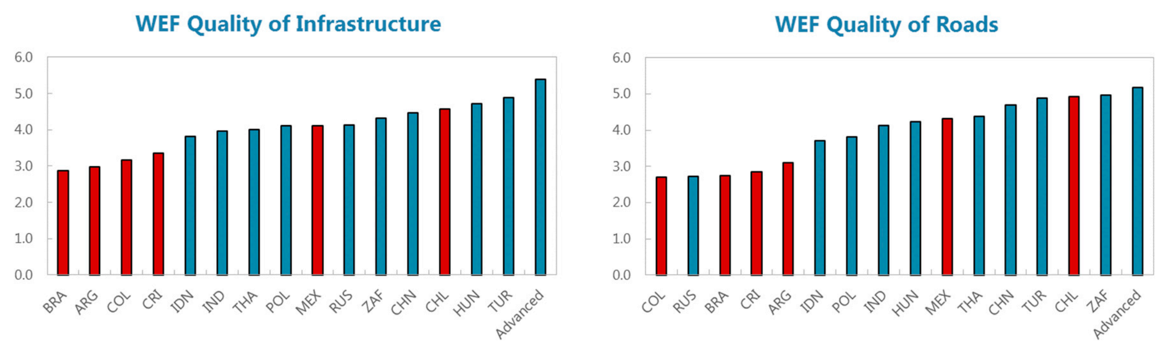
Could improvements in infrastructure lift growth in the region? This is the question I try to shed light on, given the relatively weak scores of LAC5 in the quality of infrastructure dimension of the Global Competitiveness Report (GCR) by the World Economic Forum (Figure 2). Relative to major emerging markets, the region is at the lower end of the spectrum, with the notable exception of Chile. In contrast, the region compares favorably on measures of the stock of economic infrastructure discussed in IMF (2016) such as power generation capacity.

Figure 1. Potential Growth in LAC5
(Percent)



Source: IMF WEO.

Figure 2. Quality of Infrastructure in LAC5 (2015)



Source: World Economic Forum Global Competitiveness Report.

In this paper, I assess the impact of infrastructure on growth by exploiting the variation in the dependence of sectors in the economy on infrastructure and the variation in the quality of infrastructure across countries. The central assumption in the exercise is that sectors that depend relatively more on infrastructure to produce output will grow relatively faster when infrastructure improves. This is basically the difference-in-difference approach pioneered by Rajan and Zingales (1998). I obtain sectoral value added growth for 34 sectors in 61 countries for the period 1995–2011 from the OECD input-output tables. The LA countries in the sample are Argentina, Brazil, Chile, Colombia, Costa Rica, and Mexico. A measure of dependence on infrastructure is also constructed from the OECD input-output tables. More specifically, dependence is defined as the use of transportation inputs relative to output. Data on the quality of infrastructure come from the GCR by the World Economic Forum. I also study the impact of the quantity of infrastructure, proxied by the kilometers of roads in a country.

I find evidence that improving the quality and/or quantity of infrastructure increases growth. More specifically, sectors that depend relatively more on infrastructure grow relatively faster when infrastructure improves. For example, if the quality of roads in Colombia improved to the sample median, a sector with median dependence on transportation (hotels and restaurants) would growth 0.15 percentage points faster. The sectoral results can be aggregated to calculate the impact of infrastructure improvements on GDP growth. For instance, if the quality of infrastructure in Argentina improved to the sample median, GDP growth would increase 0.13 percentage points.

I also apply the difference-in-difference identification strategy to assess the impact of infrastructure on corporate investment. Using a panel of firms from the Orbis database by Bureau van Dijk, I find evidence that firms that depend more on infrastructure invest relatively more when the quality of infrastructure improves. For example, the investment rate of a firm in the lodging and restaurant sector in Colombia would increase 0.43 percentage points if the quality of infrastructure in the country improved to the sample median.

This paper relates to the literature on the role of public investment. IMF (2016) focuses on infrastructure in LAC. They find that on average the region compares well to other emerging markets but individual countries often compare poorly with export rivals. IMF (2014) takes a global look at the infrastructure question, finding that increased public infrastructure investment raises output in the short and long term. Other relevant contributions in the field include Bom and Ligthart (2014), Romp and de Haan, 2007, Arslanalp et al. (2010), Bom and Ligthart (2010), and Gupta et al. (2011). The investment analysis adds to a voluminous literature on the determinants of corporate investment (Fazzari et al. 1988, Love and Zicchino 2006, Magud and Sosa 2015).

The rest of the paper is structured as follows. Section II outlines the empirical strategy for the analysis of value added growth and describes the data. Section III presents the results. The impact of infrastructure on firm-level investment is studied in section IV. Section V concludes.

II. Empirical Strategy and Data

A. Quality of Infrastructure: Empirical Strategy

The identification strategy in this paper relies on the idea that good infrastructure is more essential for some economic sectors to operate than others. For instance, a real estate agent managing local property would be less affected by bad infrastructure than a mining company extracting minerals in a remote location. More formally, the empirical specification is an application of the Rajan and Zingales (1998) difference-in-difference framework. The identifying assumption is that sectors that depend more on infrastructure would be more negatively affected by bad infrastructure. In other words, the effect of infrastructure is captured by the difference, across countries with different quality of infrastructure, in growth rates of sectors more or less dependent on infrastructure. The following equation is estimated for a cross-section of countries and sectors:

$$\Delta va_{sc} = \alpha * VAshare_{sc} + \beta * TranspDep_{sc} * WEF_c + \alpha_s + \alpha_c + u_{sc} \qquad (1)$$

where Δva_{sc} is average annual growth rate of real value added sector s in country c over 2006–11, $VAshare_{sc}$ is share of sector s in total value added of country c in 2005, $TransDep_{sc}$ is a measure of the dependence of sector s in country c on infrastructure, WEF_c is an indicator of the quality of infrastructure in country c (higher values mean higher quality), and α_s and α_c are sector and country fixed effects. u_{sc} is an error term. Standard errors are clustered at the country level since the variable of interest varies only at the country level.

The coefficient β captures the effect of higher quality of infrastructure on sectoral growth. It is expected to be positive and significant. The sector fixed effects control for any differences in productivity that may exist across sectors, including those deriving from global demand for output in the sector and structural sectoral characteristics, such as technology, input requirements, R&D intensity, relative prices, etc. The biggest advantage of the specification is that it allows to control for all institutional and geographical factors that affect the growth of all sectors in a country equally (e.g., differences in business cycles, policies, factor endowments, attitude towards work, climate, political developments) through the country fixed effects.

It is important to stress that the framework identifies the effects of infrastructure *through* the dependence of sectors on infrastructure but is not suitable to study other channels through which infrastructure may impact growth. For example, the construction of better infrastructure may have an aggregate demand multiplier effect on short-term growth that in the framework above would be subsumed into the fixed effects. Identification also relies on the assumption that dependence on transportation is exogenous to the quality of infrastructure. This condition may not always hold. For instance, some sectors could reduce their use of transportation inputs in response to worsening infrastructure.

B. Quantity of Infrastructure: Empirical Strategy

The specification to study the effects of the quantity of infrastructure on growth is a panel version of the equation in section II.A, with the identification strategy essentially unchanged

$$\Delta va_{sct} = \alpha * VAshare_{sc,t-1} + \beta * TranspDep_{sc} * \Delta\log(KmRoad_{c,t-1}) + \alpha_{sc} + \alpha_{ct} + u_{sct}$$

where Δva_{sct} is the log change in real value added of sector *s* in country *c* at time *t*, $VAshare_{sc,t-1}$is the lagged share of sector *s* in total value added of country *c*, $TransDep_{sc}$ is the dependence of sector *s* in country *c* on transportation inputs, $\Delta\log(KmRoad_{c,t-1})$ is the lagged log change in the length of the road network in country *c*, and α_{sc} and α_{ct} are country-sector and country-year fixed effects. β is expected to be positive and significant if increases in the quantity of infrastructure benefit relatively more sectors that depend more on infrastructure.

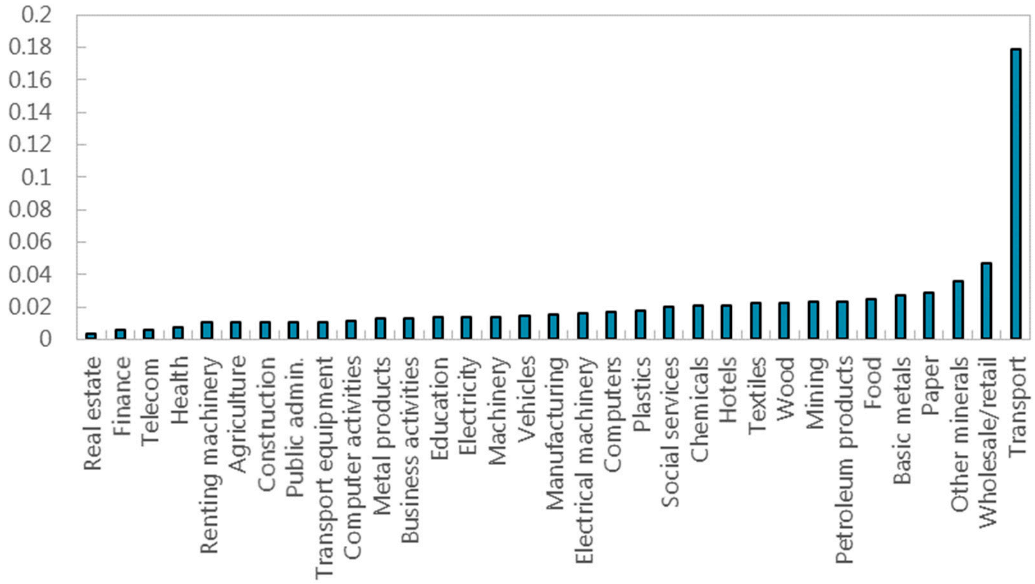
C. Measuring Sectoral Growth and Dependence on Infrastructure

The OECD input-output tables provide nominal value added data in dollars for 34 sectors in 61 countries for 1995–2011.[1] In Latin America, the tables cover Argentina, Brazil, Chile, Colombia, Costa Rica, and Mexico. I use the data from 2006 onwards since the infrastructure indicators described in section D start in 2006. The value added series are converted to local currency and deflated by the GDP deflator to obtain real value added.

The dependence of sectors on infrastructure is a complex concept that is not easy to measure. Infrastructure generally refers to structures and systems that include roads, railways, water and electricity supply, and sewers among others. There is no systematic data on what specific types of infrastructure sectors use more intensely but the input-output tables provide precise information very closely related to dependence on transportation. For each sector, the tables report the value of transportation inputs used by each sector. Scaling the value of transportation inputs by gross output gives us a measure of how intensely a sector depends on infrastructure to operate. Figure 3 plots such a measure for Colombia in 2011.

[1] Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Argentina, Brazil, Brunei Darussalam, Bulgaria, Cambodia, China, Colombia, Costa Rica, Croatia, Cyprus, Hong Kong, India, Indonesia, Lithuania, Malaysia, Malta, Philippines, Romania, Russia, Saudi Arabia, Singapore, South Africa, Chinese Taipei, Thailand, Tunisia, and Vietnam.

Figure 3. Colombia—Dependence on Infrastructure
(Units of transportation/unit output)



Source: OECD.

D. Infrastructure Data

Data on the quality of infrastructure come from the GC by the World Economic Forum. The GCR combines more than a hundred indicators that matter for productivity into a Global Competitiveness Index. For the purpose of this paper, the indicators under the infrastructure pillar are the most relevant. More specifically, the analysis focuses on the indicators of overall quality of infrastructure and the quality of roads. Indicators on the quality of railroads, ports, and air transport infrastructure are also available but are not used here since roads are likely to be the dominant mode of transportation in most countries (and the input-output tables do not break down transportation inputs by type). The indicators are survey based. They range from 1 to 7, with higher values denoting better infrastructure. It is worth stressing that answers to the survey questions are likely to combine an assessment of the quality as well as quantity of infrastructure since respondents may find a large quantity of below average infrastructure to be better than a small quantity of very good infrastructure.[2] It is well known that the within country variation in this type of survey measures may come from factors other than changes in infrastructure. For example, in times of low economic growth, survey respondents may express more negative views on infrastructure even if no material change occurred since they are likely to be unsatisfied with the general performance of the government. For this reason, the specification in section II.A does not exploit the time

[2] In fact, the wording of the questions hints at the quantity of infrastructure by using the language "extensive and efficient" to describe a score of 7: "How would you assess general infrastructure (e.g., transport, telephony, and energy) in your country? [1 = extremely underdeveloped—among the worst in the world; 7 = extensive and efficient—among the best in the world]"; In your country, how would you assess the quality of roads? [1 = extremely underdeveloped—among the worst in the world; 7 = extensive and efficient—among the best in the world]

variation in the GCR. In the regressions, WEF_c is defined as the country average of the infrastructure or road indicator over 2006–11.

I use the length of the road network as an indicator of the quantity of infrastructure. The data are from the International Road Federation and Eurostat and cover the period 2001–10, although with important gaps for non-European countries. Focusing on roads is an admittedly narrow definition of the quantity of infrastructure but roads are one of the very few dimensions of infrastructure for which there is reasonable variation at the country level on an annual basis (in contrast, the quantity of infrastructure such as ports and airports may not change often enough to make a panel specification feasible). Broader measures of the quantity of infrastructure exist, such as the infrastructure capital stock by Calderon and others (2015). Analysis based on this type of measures is beyond the scope of this paper. Table 1 shows summary statistics for all regression variables.

Table 1. Summary Statistics

Quality of infrastructure regression

Variable	Mean	StDev	N Obs
VA growth	0.024	0.067	2,051
Share in total VA	0.029	0.038	2,051
TranspDep * WEF infrastructure	0.104	0.166	2,051
TranspDep * WEF roads	0.099	0.170	2,051

Quantity of infrastructure regression

Variable	Mean	StDev	N Obs
VA growth	0.049	0.180	13,930
Share in total VA	0.029	0.035	13,930
TransDep * Δlog(KmRoads)	0.000	0.008	13,930

Source: World Economic Forum Global Competitiveness Report.

III. RESULTS

A. Baseline

The estimation results indicate that improvements in the quality of infrastructure raise sectoral growth. Table 2 presents the results from estimating equation (1) for the GCR indicators on overall quality of infrastructure and quality of roads. The results are significant both for the full sample and the subsample of emerging markets.[3]

Table 2. Effect of Quality of Infrastructure on Sectoral Growth

	Average annual value added growth, 2006-11			
	Full sample		Emerging markets	
	(1)	(2)	(3)	(4)
TransDep * WEF infrastructure	0.024**		0.026*	
TransDep * WEF roads		0.026**		0.028**
r2	0.40	0.40	0.34	0.34
N	2,051	2,051	1,235	1,235

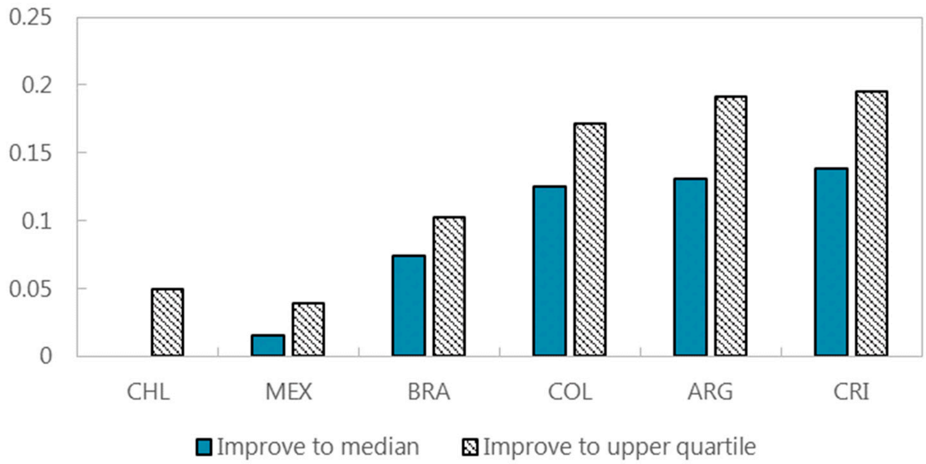
Note: All regressions include sector and country fixed effects and control for sectoral shares in total value added. Robust standard errors clustered at the country level.

The economic magnitude of the impact of the quality of infrastructure on growth is not trivial. For example, if the quality of roads in Colombia improved to the sample median (a 1.7 point improvement in the GCR score, which would put Colombia on a par with the Czech Republic), a sector with median dependence on transportation (hotels and restaurants) would growth 0.15 percentage points faster.

The magnitude of the effects for the indicator of overall quality of infrastructure are similar. Even though the regression is at the sectoral level, the sectoral effects can be aggregated using their shares in total value added to estimate the impact of improvements in infrastructure on GDP. Figure 4 illustrates the GDP impact of improving the quality of roads to the sample median and upper quartile for the Latin American countries in the sample. The effects are non-negligible, especially for Colombia, Argentina, and Costa Rica.

[3] The results for the LAC sample are not significant, probably because the variation in the GCR indicators across just four countries is very limited.

Figure 4. Impact of Quality of Roads on Growth in LAC
(Percentage points)



Source: World Economic Forum Global Competitiveness Report.

The quantity of infrastructure also has an impact on sectoral growth, although the statistical significance of the estimated effects is lower (Table 3). Quantitatively, the results for the full sample are small but the effects are much larger for the LAC subsample. For example, if the road network in Colombia grew 10 percent, a sector with median dependence on transportation would grow 1.2 percentage points faster according to the LAC regression results (just 0.05 percentage points if the full-sample estimates are used).

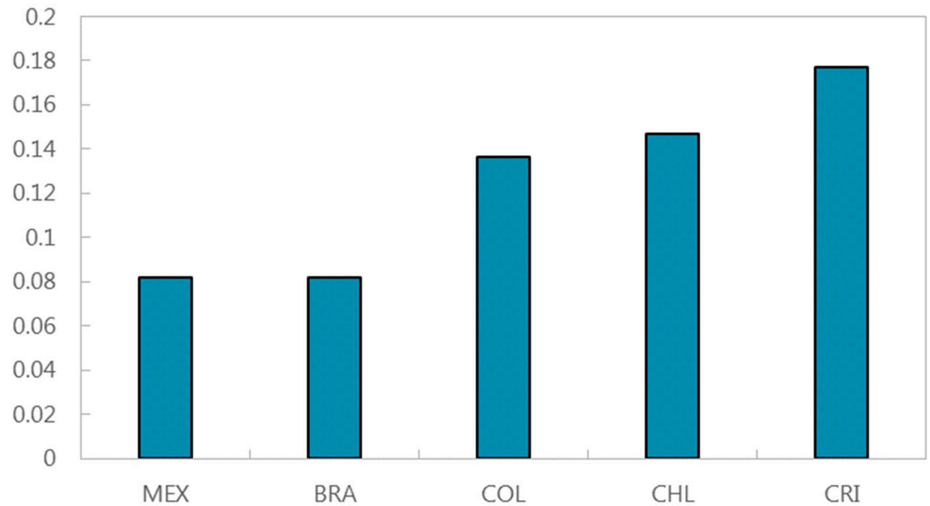
Table 3. Effect of Quantity of Infrastructure on Sectoral Growth

	Annual value added growth		
	Full sample	EMs	LAC
TransDep * Δlog(KmRoads)	0.26*	0.27*	6.31*
r2	0.44	0.44	0.43
N	13,930	6,110	1,286

Note: All regressions include sector-country and country-year fixed effects and control for lagged sectoral shares in total value added. Robust standard errors clustered at the country-sector level.

As in the case of the quality of infrastructure, it is possible to aggregate the sectoral effects of an increase in the size of the road network to estimate the effects on GDP growth. As Figure 5 shows, growth rates could increase by 0.1–0.2 percentage points in the size of road networks increased one percent (using the estimated coefficient for the LAC sample).

Figure 5. Impact of Quantity of Infrastructure on Growth in LAC
(GDP growth impact of increasing road network by 1 percent)

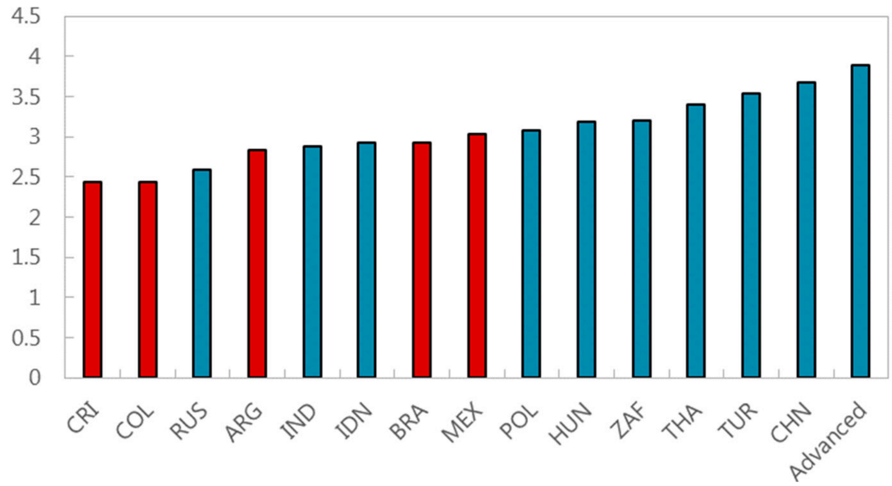


Source: World Economic Forum Global Competitiveness Report.

B. Robustness

In this section, I show the results are robust to an alternative indicator of the quality of infrastructure. The World Bank publishes a Logistics Performance Index (LPI) featuring a quality of infrastructure subcomponent. The LPI is based on a survey of global freight forwarders and express carriers. In one of the questions, respondents are asked to rate "the quality of trade and transport infrastructure" from "very low" (1) to "very high" (5). The survey is available for 2006, 2010, 2012, and 2014. Its correlation with the GCR quality of infrastructure index is high (81 percent). As Figure 6 shows, LAC countries ranked relatively poorly in terms of infrastructure in 2014 according to the LPI.

Figure 6. Quality of Infrastructure in LAC According to the LPI



Source: World Bank Logistics Performance Index.

Since the LPI is available at limited points in time, I adapt the time period in the regression to the data available. I take the average of the infrastructure indicator in 2007 and 2010 and use average annual real value added growth over 2006–10 as the dependent variable. Table 4 reports the regression results. The coefficient for the full sample is robust, although significance is lower. Results are not significant for the subsample of emerging markets

Table 4. Robustness—Effect of Quality of Infrastructure on Sectoral Growth

	Avg. annual value added growth, 2006-11	
	Full sample	Emerging markets
	(1)	(2)
TransDep * LPI infrastructure	0.032*	0.032
r2	0.35	0.33
N	1,917	1,208

Note: All regressions include sector and country fixed effects and control for lagged sectoral shares in total value added. Robust standard errors clustered at the country level.

IV. Firm-level Investment

The previous sections identified the effects of improvements in infrastructure on value added growth using sectoral data from the input-output tables. This section answers the narrower but still relevant question of whether corporate investment increases when the quality of infrastructure improves.[4]

A. Specification

The identification strategy is as in Section II, but applied to a cross-section of firms instead of sectors:

$$I_{isc} = \beta * TransDep_{sc} * WEF_c + \gamma X_{isc} + \alpha_s + \alpha_c + u_{isc} \quad (2)$$

where I_{isc} is the average net investment rate of firm *i* in sector *s* in country *c* over a 3-year window, $TransDep_{sc}$ is the dependence of sector *s* in country *c* on transportation inputs, WEF_c measures the quality of infrastructure in country *c*, X_{isc} is a vector of firm-specific controls, and α_s and α_c are sector and country fixed effects. u_{isc} is an error term. Standard errors are clustered at the country level, as the variable of interest varies only at the country level.[5]

The coefficient β captures the impact of better infrastructure on firm investment. If firms in sectors that depend relatively more on transportation invest relatively more when infrastructure improves, β will be positive and significant. The country fixed effects capture all factors that affect investment of all firms in a country equally (for example, expected GDP growth). The sector fixed effects capture all characteristics that are common to sectors across countries (for example, the capital intensity of the industry).

B. Data

Firm data are from the Orbis database by Bureau van Dijk. The database contains balance sheets, income statements, geographical information, and industrial classification for a large number of firms. Orbis covers traded and nontraded firms. I use a sample of about 600,000 firms in 18 countries for the period 2008–14 (Table 5).[6] The dataset allows me to estimate equation (x) for five overlapping cross-sections. Unfortunately, Orbis does not cover Latin America in as much detail as other regions. Brazil, Chile, and Colombia are the only Latin

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[4] I do not address the relationship between the quantity of infrastructure and investment because the overlap between the firm-level dataset and the road network data is too small.

[5] I avoid 5-year windows to maximize the size of the sample as the panel of firms is very unbalanced (for many firms it is not possible to calculate the average investment rate over 5 years). Results are robust to clustering by country-sector.

[6] After dropping the top and bottom 5 percent of the distribution of all firm-specific variables and cleaning out obviously incorrect entries (e.g., negative assets).

American countries in the sample. The coverage is very good for Colombia (more than 10,000 firms) but very limited for Brazil and Chile (under a hundred firms in both cases).

Table 5. Countries in the Firm-Level Dataset

Country	Number of firms	Country	Number of firms
Australia	316	France	249,267
Bulgaria	17,844	Hungary	73,285
Brazil	71	India	392
Chile	57	Japan	58,518
China	1,457	Korea	42,794
Colombia	11,154	Philippines	3,423
Czech Republic	41,655	Poland	22,457
Germany	25,145	Russia	86,304
Spain	219,080	Slovakia	30,610

Source: Orbis.

The net investment rate is computed as in Kalemli-Ozcan and others (2015) and is defined as the change in fixed tangible assets scaled by the stock fixed tangible assets in the previous period. In a world of complete markets, investment would depend solely on the risk-adjusted expected return of a project. In the presence of financial frictions, however, a firm's financial health could play a large role in determining its investment decisions. This is why the vector X contains a combination of proxies for the investment opportunities of the firm (return on assets defined as earnings before interest and tax over total assets) and variables that capture the firm's financial health (cash and equity, both as a share of total assets). All the variables in X are lagged one period since investment plans take time to be executed (for example, controls are set at their 2007 values if investment is calculated over 2008–10). The data on infrastructure and dependence on transportation are as in Section II. I set dependence on transportation to its 2007 values for all five cross sections. Table 6 presents summary statistics of all regression variables.

Table 6. Investment Regressions—Summary Statistics

Variable	Mean	StDev	N Obs
Investment rate	0.092	0.425	795,396
TranspDep * WEF infrastructure	0.189	0.260	795,396
TranspDep * WEF roads	0.175	0.253	795,396
ROA	0.036	0.088	732,975
Equity	0.380	0.298	728,644
Cash	0.147	0.159	727,741

Note: The reported summary statistics are based on data excluding the top and bottom 5 percent observations for firm-level variables, so as to avoid distortions from extreme outliers. The summary statistics are reported for the 2011–13 cross-section.

C. Results

The results in Table 7 provide evidence that firms that depend relatively more on transportation invest relatively more when infrastructure improves. The results are stronger for the overall quality of infrastructure indicator than for the indicator on the quality of roads. Two of the firm-level controls have the expected sign (ROA and cash) but equity sometimes displays the wrong sign, suggesting it is capturing the effects of omitted variables. The R^2s are low since no firm fixed effects can be included in a cross-sectional regression.[7]

Table 7. Effect of Quality of Infrastructure on Firm-Level Investment

	Average annual investment rate				
	2008-10	2009-11	2010-12	2011-13	2012-14
TransDep * WEF infrastructure	0.053***	0.035**	0.056***	0.056***	0.029
ROA	0.239***	0.184***	0.207***	0.249***	0.268***
Equity	-0.069**	-0.016	-0.014	-0.021	-0.018
Cash	0.206***	0.184***	0.206***	0.215***	0.231***
r2	0.02	0.03	0.03	0.03	0.03
N	518,160	563,089	605,698	603,483	377,011

	Average annual investment rate				
	2008-10	2009-11	2010-12	2011-13	2012-14
TransDep * WEF roads	0.050***	0.034**	0.054**	0.053**	0.027
ROA	0.239***	0.184***	0.207***	0.249***	0.268***
Equity	-0.069**	-0.016	-0.014	-0.021	-0.018
Cash	0.206***	0.184***	0.206***	0.215***	0.231***
r2	0.02	0.03	0.03	0.03	0.03
N	518,160	563,089	605,698	603,483	377,011

Note: All regressions include sector and country fixed effects. Robust standard errors clustered at the country level.

Similarly to Section II, the impact of infrastructure on investment is country-sector specific as the dependence on transportation term is country-sector specific too. For example, if the quality of infrastructure in Colombia improved to the sample median (an improvement of 1.7 points in the GCR score), the investment rate of a sector with median dependence on transportation (hotels and restaurants) would increase 0.18 percentage points.[8] The impact of improvements in infrastructure on aggregate corporate investment could be obtained by

[7] The smaller sample size for the 2012–14 regression may explain the lack of statistical significance.

[8] Using the regression coefficient from the 2011–13 cross section.

aggregating the firm-by-firm results (weighting them by the level of tangible fixed assets). The issue with the approach is that, unlike in the case of sectoral value added in the input-output tables, the sample of firms in Orbis may fall well short of the universe of firms in a country. In Latin America, the issue would be especially acute for Brazil and Chile, where Orbis's coverage is very low. In the case of Colombia though, the aggregation of results for 11,000 firms may be more meaningful. If the quality of infrastructure in Colombia improved to the sample median, the corporate investment rate would increase 0.43 percentage points.

The results above hold for the subsample of emerging markets (Table 8). In fact, the statistical significance of the interaction term is stronger in this subsample. However, the firm-level controls display lower significance than in the baseline and the coefficient on equity is often wrong and significant. The magnitude of the coefficients is substantially larger than in the baseline. The estimated effects of a given improvement in infrastructure are on average 37 percent larger than in the baseline.

Table 8. Effect of Quality of Infrastructure on Firm-Level Investment in Emerging Markets

	Average annual investment rate				
	2008-10	2009-11	2010-12	2011-13	2012-14
TransDep * WEF infrastructure	0.060***	0.027***	0.063***	0.077***	0.032
ROA	1.248*	0.959*	1.148**	1.377**	0.699***
Equity	-0.113**	-0.061*	-0.070**	-0.078**	-0.049***
Cash	0.370***	0.297***	0.353***	0.370***	0.358***
r2	0.03	0.02	0.03	0.02	0.02
N	171,388	180,503	211,764	218,108	142,024
	Average annual investment rate				
	2008-10	2009-11	2010-12	2011-13	2012-14
TransDep * WEF roads	0.068***	0.033***	0.080***	0.096***	0.040
ROA	1.248*	0.959*	1.148**	1.377**	0.699***
Equity	-0.113**	-0.061*	-0.070**	-0.078**	-0.050***
Cash	0.370***	0.297***	0.353***	0.370***	0.358***
r2	0.03	0.02	0.03	0.02	0.02
N	171,388	180,503	211,764	218,108	142,024

Note: All regressions include sector and country fixed effects. Robust standard errors clustered at the country level.

D. Robustness

The results are robust to using shorter and longer time windows to construct average annual investment rates. Table 9 presents regression results for two- and four-year time windows.

The coefficients are generally smaller when two-year windows are used, suggesting that the effects of improved infrastructure on investment materialize over relatively long periods of time.

Table 9. Robustness—Effect of Quality of Infrastructure on Firm-Level Investment

Panel (a): 2-year windows

	Average annual investment rate					
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
TransDep * WEF infrastructur	0.042***	0.029**	0.034**	0.044***	0.033*	0.021
ROA	0.262***	0.182***	0.221***	0.252***	0.271***	0.289***
Equity	-0.06**	-0.01	-0.001	-0.003	-0.008	-0.006
Cash	0.142***	0.104***	0.129***	0.133***	0.127***	0.156***
r2	0.01	0.02	0.02	0.02	0.02	0.02
N	596,506	653,996	702,704	729,659	753,117	443,144

	Average annual investment rate					
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
TransDep * WEF roads	0.039***	0.028***	0.034***	0.041**	0.029	0.021
ROA	0.262***	0.182***	0.221***	0.252***	0.271***	0.289***
Equity	-0.06**	-0.01	-0.001	-0.003	-0.008	-0.006
Cash	0.142***	0.104***	0.129***	0.133***	0.127***	0.156***
r2	0.01	0.02	0.02	0.02	0.02	0.02
N	596,506	653,996	702,704	729,659	753,117	443,144

Panel (b): 4-year windows

	Average annual investment rate			
	2008-11	2009-12	2010-13	2011-14
TransDep * WEF infrastructur	0.053**	0.042**	0.060**	0.034
ROA	0.209***	0.169***	0.178***	0.226***
Equity	-0.069**	-0.023	-0.024	-0.020
Cash	0.235***	0.220***	0.247***	0.252***
r2	0.03	0.04	0.04	0.04
N	464,426	505,758	524,779	315,779

	Average annual investment rate			
	2008-11	2009-12	2010-13	2011-14
TransDep * WEF roads	0.051**	0.040**	0.058**	0.034
ROA	0.209***	0.169***	0.178***	0.226***
Equity	-0.069**	-0.023	-0.024	-0.020
Cash	0.235***	0.220***	0.247***	0.252***
r2	0.03	0.04	0.04	0.04
N	464,426	505,758	524,779	315,779

Note: All regressions include sector and country fixed effects. Robust standard errors clustered at the country level.

The investment regression can also be estimated using the World Bank LPI as an alternative indicator of the quality of infrastructure. For consistency with the baseline specification, I average the LPI scores for 2010 and 2012 and use the average investment rate over 2011–13 as the dependent variable. As Table 10 shows, the finding that improvements in infrastructure have a positive impact on corporate investment is robust to using the LPI.

Table 10. Robustness—Effect of Quality of Infrastructure on Firm-Level Investment using the LPI

	Average annual investment rate
	2011-13
TransDep * LPI Infrastucture	0.088***
ROA	0.253***
Equity	-0.015
Cash	0.200***
r2	0.03
N	623,404

Note: All regressions include sector and country fixed effects. Robust standard errors clustered at the country level.

V. Conclusions

Potential growth in LAC5 decreased substantially in the last decade and it is expected to remain subdued. This paper asks whether improvements in the relatively low quality and quantity of infrastructure in the region could lift growth and investment.

Using sectoral data on value added growth and the heterogeneous dependence of sectors on good infrastructure, I find a positive association between improvements in the quality of infrastructure and growth. At the aggregate level, the gains from improved infrastructure could be large. For instance, if the quality of infrastructure in Colombia improved to the median of the countries in this study, GDP growth would increase by about 0.1 percentage points.

An analysis based on firm-level data suggests investment also increases with improvements in infrastructure. For example, if the quality of infrastructure in Colombia improved to the sample median, the aggregate corporate investment rate would increase 0.43 percentage points.

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