Productivity growth and infrastructure related sectors: the case of Argentina*

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Main findings

1. *Are productivity shocks in infrastructure related sectors quantitatively important for aggregate productivity performance in Argentina?* Yes, productivity improvements in infrastructure related sectors have a significant impact on aggregate productivity in the argentine case adding up 44% to the growth rate in the case of convergence to the best regional (LAC) performer in each sector (low scenario) or almost 300% in the case of convergence to the best world performers (high scenario). Table 5.1 below summarizes our results. Direct effects explain 30% of this improvement while the rest occur trough impacts on other sectors.
2. *Which infrastructure sectors seem to drive productivity shocks across sectors?* Our findings suggest that utilities (where energy infrastructure is the main subsector) and construction have shown more important effects than transport (which also includes telecommunications and storage) in the argentine case (while construction and transport are more relevant than utilities in the case of LAC). The higher the size of the shocks in infrastructure productivity (defined as resembling the performance of high productivity performers across the world) makes transport productivity improvements more relevant and close to utilities productivity improvements, while construction productivity becomes even more significant.

Table 5.1. Catch-up Impact Simulations on Economywide Labor Productivity (in annual % growth rates for period 1971-2014)

	Own Effect	Indirect Effect		**Total Impact**	Average Economywide Productivity Annual Growth Rate (%) 1971 - 2014	Ratio Impact / Avg. growth rate
		Labor Productivity	*Capital Productivity*			
LAC Global Panel Model	**0.16%**	**0.20%**	**0.11%**	**0.49%**	**0.6%**	**85%**
Utilities	0.00%	0.01%	-	0.01%		
Construction	0.07%	0.20%	0.11%	0.38%		
Transport S&C	0.09%	-	-	0.10%		
Argentina Low	**0.05%**	**0.08%**	**0.04%**	**0.17%**	**0.4%**	**44%**
Utilities	0.01%	0.07%	-	0.08%		
Construction	0.02%	0.00%	0.04%	0.07%		
Transport S&C	0.01%	0.00%	0.00%	0.02%		
Argentina High	**0.41%**	**0.32%**	**0.40%**	**1.13%**	**0.4%**	**294%**
Utilities	0.03%	0.26%	-	0.29%		
Construction	0.21%	0.03%	0.39%	0.63%		
Transport S&C	0.17%	0.03%	0.01%	0.21%		

Note: catch-up is defined as the necessary increase in labour productivity's annual growth rate to reach that of a benchmark case
Argentina's Low benchmarks are LAC's sectoral best performers for infrastructure sectors (Brasil for Utilities, Peru for Construction, Chile for Transport S&C)
Argentina's High benchmarks are sectoral best performers for infrastructure sectors (Korea for Utilities, China for Construction and Transport S&C)
LAC's benchmark is OECD
For capital productivities and stocks, estimates corresponding to Utilities are available since 1980 so average annual growth rates are calculated for 1981-2014
For capital productivity estimates, the catch-up necessary jumps considered correspond to those used for labor productivity catch-ups

3. *On which sectors do infrastructure productivity shocks have a greater impact? Are they high/dynamic or low/sluggish sectors of the argentine economy?* The results show effects on both sides, with agriculture and manufacturing on the one hand and domestic trade and financial services being on the other. Thus, it is not true, from our results, that infrastructure productivity shocks have a high impact on intersectoral productivity heterogeneity. It does not seem that productivity shocks in infrastructure reduce the productivity gap across sectors at 2-digit classification (it may be different inside sectors) but it does not increase it either.
4. *Does infrastructure has an impact on growth but not on employment, as it impacts on sectors with very low employment shares?* This is not the case in our results. The four sectors on which infrastructure productivity shocks have a long run impact represent about 48% of total employment in Argentina in 2014. The two dynamic sectors, Agriculture and Manufacturing, had in 2014 6% and 12% share respectively, while the other two, Domestic Trade and Financial Services had 21% and 9% respectively. Among the infrastructure related sectors Utilities had an employment share of les that 1%, while Transport had a 6% share and Construction an 8%.

5. *Performance Gaps for Argentina.* Argentina has experienced a period of stagnation in its relative global rank in what is related to infrastructure according to the WEF's GCI evaluation, although recent years have shown an improving trend on the matter. A study of the infrastructure pillar's building blocks enables us to conclude that our country outperforms LAC pairs involving communications coverage, but underperforms them in quality perception indicators, especially in relation to electricity supply quality, which has shown a declining status throughout the previous editions of WEF's CGI.
6. *Investment efforts.* Argentina has displayed a deficit-prone performance in terms of economic infrastructure investment in comparison with LAC countries, of a magnitude of about 2% of GDP per year in the last years. This is shown in both investments undertaken by the public (above 1% of GDP) and private sectors, where the percentage gap with LAC average for the private sector has been notably greater. Finally, the investment deficit in infrastructure was skewed towards Transport and Utilities sectors correspondingly (relative to LAC), where the underinvestment was more pronounced at a sectoral level.
7. *Recent developments in spending*. In **Annex B** we explore differences between Infralatam data and official fiscal statistics in Argentina, so as to use the latter to measure infrastructure investment efforts by the public sector to find out a visible adjustment in energy infrastructure. Thus towards 2019 Argentina went substantially below the 1% of GDP effort in public investment

infrastructure towards 0.5% of GDP, with energy sector investing droping below water, and transport somehow showing a modest adjustment. This is partly due to the efforts in roads given by the plans of a new and revamping highway system.

8. *Gaps estimates and investment needs.* Estimates of physical and monetary magnitudes of the horizontal gap that Argentina displays against high-income countries would imply an investment equivalent up to 130% of GDP. Instead, and more realistically, closing the gap with upper middle-income countries, such as Turkey (which has been identified as the main performer in a peer group where Argentina belongs) would require a more modest effort equivalent to 18% of GDP.
9. *"Revealed" infrastructure investment strategy.* Regarding the sectoral distribution of the investment requirements for closing gaps, it is mainly concentrated in investments in the energy sector (expansion of the power generation capacity) and in the transport sector (densification of the road network, railway and expansion of port capacity). Precisely, these results are consistent with the previous diagnosis of deterioration in the quality of provision and underinvestment, especially public, in economic infrastructure by our country. And it is also consistent with the efforts revealed in recent infrastructure policy and PPP programs. Nevertheless, the adjustment in energy infrastructure effort in the last two years somehow departs from the desired direction. In other words, the recent capital spending (procyclical) adjustment in capital spending observed in Argentina has been more biased in favor of transport sector projects as opposed to energy infrastructure projects.
10. *Complementary policies.* Our analysis has warned about the idea that only infrastructure investment is fine for a growth strategy. To avoid second-best problems (both at an institutional and policy levels) we strongly advocate for a "regulatory compact" that maximizes the effect of for infrastructure productivity improvements. In particular, we favor competition and deregulation (in input and output markets related to energy and transport infrastructure) as well as sound fiscal policies as crucial companion ingredients. Nevertheless we have to be fair enough to acknowledge that this position comes more from a reasonable policy approach than from econometric results. Despite a battery of controls being used in our regressions we have not obtained strong effects from institutional or regulatory variables, except one –not minor- case. This is trade intensity which in our regressions plays a significant positive effect in the productivity performance of both Manufacturing and Domestic Trade.

Productivity growth and infrastructure related sectors: the case of Argentina

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1. Introduction

This paper is part of a research agenda to address the role of infrastructure in fostering growth in the LAC region that is inserted in important books and documents of the IADB produced in recent years.[1] Against an interest to explore the scope of existing methodologies to potentially address the link between growth and infrastructure (presented in Izquierdo et al, 2018) we seek to implement an approach that, based on available but not fully exploited data platforms for growth analysis, can tie down more concrete strategies for sustainable growth that are consistent with infrastructure development strategies. Given the somehow too aggregate level of analysis that available approaches usually provide on the link between infrastructure and growth, we respond to a demand for an analysis that could be more informative in terms of *"which infrastructure"* and for *"which sectors"* , so that it could be part of a growth strategy. This acknowledges that the role of infrastructure in fostering growth is country and sector specific, and needs to be complemented with fiscal, institutional and other supporting policies. Thus, beyond a needed methodological analysis, country case studies based on this background should in the end provide useful elements for a country strategy in practice.

The summary result of the previous starting point was presented at the 59th Meeting of the Board of Governors of the Inter-American Development Bank in Mendoza, Argentina on March 25th, 2018. It considered available platforms for growth analysis considering their relevance and usefulness for a growth strategy based on infrastructure, namely *"growth diagnostics"* (Hausmann *et al,* 2005); *"going for growth"* (OECD, 2013); *"development gaps"* (Borensztein *et al*, 2014); *"priorities for reaching higher per-capita incomes or PPI"* (Izquierdo *et al*, 2016) and *"growth accounting"*, which includes *"KLEMS accounting"* (Hoffman *et al*, 2017a, 2017b) as a promising avenue but involves significant data challenges given that infrastructure capital is not (unlike Mas, 2009) measured. However, perhaps the main contribution was a preliminary exploration for disaggregating the effect of infrastructure on growth across different sectors. The resulting evaluation suggested a line of analysis that makes use of the *GGDC Database* (Trimmer *et al*, 2015) to study sectoral productivity evolution across time for a given economy with the intention to detect if productivity shocks in infrastructure-related sectors (Energy, Gas and Water; Transport, Storage and Communications or the Construction sector) could be shown as having an impact in others sectors of the economy. The analysis further briefly elaborated on the roles for public and private sectors and the complementary institutions and policies that increase the likelihood of success of infrastructure

[1] Among others, for example, team work coordinated in Izquierdo et al (2016), Cavallo and Serebrisky (2016), Izquierdo, Pessino and Vulletin (2018) and Cavallo and Powell (2018, 2019).

investment in jumpstarting growth, stressing the role of regulatory institutions, competition policy, budget institutions and cost and demand management issues.

The methodology adopted in this report is based on a background paper (Ahumada and Navajas, 2019) that exploits the above mentioned such global data set on labor productivity to explore and quantify effects of improvement of productivity growth on infrastructure-related sectors (such as energy, transport and construction) on the rest of the economy and on the growth of aggregate productivity. Preliminary results of this exercise were first discussed in the recent IADB Macro Report (Cavallo and Powell, 2019, Chapter 7). The proposed methodology implements two types of different models, one for a global panel of 10 sectors and 25 economies during 43 years (1971-2014) and another one specific for a given economy across the 10 sector. The IABD (2019) Macro Report takes results from the global panel model while this pilot study uses the second, country-specific, model for the case of Argentina. Using an automatic selection procedure for specifying equations, labor productivity growth for the 10 sectors depends on labor productivity and capital labor proxies in infrastructure related sectors as well as on a set of control variables. This allows to estimate which infrastructure sector (energy, transport, construction) impacts on which sector and give rise to direct (own) and indirect effects (through labor productivity improvements in other sectors) that lead to an aggregate effect. By assuming an improvement or convergence of infrastructure-related sectors productivity to a given norm (for instance best regional or world country performers in each infrastructure sector) we can estimate the impact of such convergence on aggregate labor productivity growth, which in our sample highly correlated with TFP growth and income per capita growth. Beyond this aggregate effect, an easy decomposition of *which infrastructure sector* is responsible for the improvements and through which sector of the economy gives this modeling strategy a wider view of the channels whereby infrastructure has influenced productivity growth. In particular knowing *which economic sectors* benefit most from productivity improvements in infrastructure related sectors can be easily related to the (high, low) productivity status of sectors and see how either advanced, dynamic or backward, sluggish sectors benefit from productivity shocks in infrastructure. All this estimation and simulation effort, along with the dataset used, is reported in the first part (sections 3 to 5) of this report.

The previous results lead to a logical dialogue or contrast with what have been the revealed preferences of infrastructure plans and investments in Argentina in recent times, as they might have been biased towards certain infrastructure sectors (eg energy or transport) which may correspond with (or respond to) the conventional observed infrastructure “gaps”, but they may not necessarily coincide with the

productivity effects that arise from the previous econometric estimation.[2] Thus, in section 6 we perform review the diagnosis of infrastructure plans in Argentina and perform a conventional gap measurement of infrastructure needs, along with the investment efforts denoted in executed plans.

The report ends with some qualification related to complementary policies and the regulatory compact required for a successful infrastructure-base growth strategy in the case of Argentina. Annexes A, B and C complement with part of the substantial effort in data analysis made in several dimensions useful for the project, namely a comparison of GGDC and KLEMS datasets, budgetary data on investment in Argentina and a recent revision made in the PWT dataset on capital stock.

2. Data and measurement: GGDC/PWT dataset and control variables

In the case of Argentina our existing data source (i.e., the GGDC data on labor productivity) covers up to 2011. Thus one immediate task of the project was to extend the data set on added value and employment by sector to 2014, in order also to conform the country data with a larger, global dataset. This is done using national accounts official statistics to extrapolate the GGDC data with the variations in the data contained in national accounts. At the same time we will make an effort to include a number of control variables (controls) that can be added to the analysis.

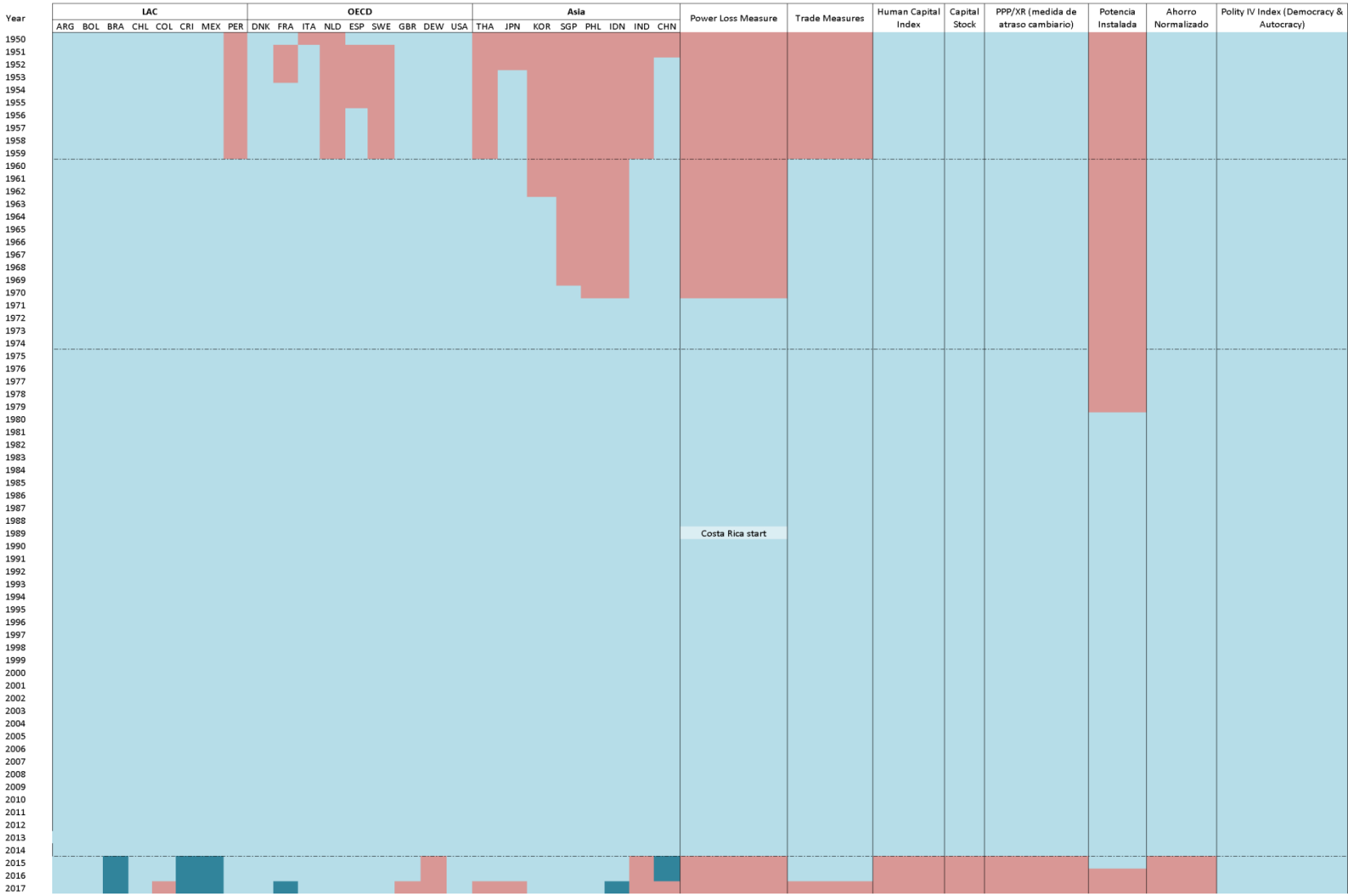
Data for Argentina is taken from a larger, global dataset that we built. This is a panel database on labor productivity at the sectoral level (one-digit level of the International Standard Industrial Classification, ISIC) expressed both in levels and as a gap (ie relative to the average for the economy) and a set of control variables (5 measures of capital stock per worker; and other 12 controls), for a sample of 25 countries (8 from LAC, 9 OECD (non LAN, non Asia) and 8 from Asia) and 44 years (1971-2014). **Table 2.1** summarizes the glossary of our dataset definition, while **Figure 2.1** shows the coverage in terms of countries, time span for labor productivity measures and for control variables. Light blue in Figure 2.1 indicates available data across countries and controls. Light red indicates years, countries or variables where data is not available. Following a detailed work, that included extend ing (splicing) by related (national accounts) measures, the GGDC productivity measurement to 2014, we ended up with a sample from 1971 to 2014 for the above mentioned 25 countries.

[2] This is in line with Izquierdo et al (2016) when they state that "results also indicate that the identification of priorities by looking at the impact that sectors have on increasing the likelihood of advancing to a better income per capita group may or may not coincide with the size of sector gaps typically used for the determination of priorities, as larger gaps do not necessarily capture the relevance of sectoral restrictions and their interactions".

Table 1 Database Glossary

Variable	*Description*	*Unit*	Source
y_agr	Labour Productivity - Agriculture Sector	*Thousands of constant 2005 PPP US dollars per worker*	GGDC
y_min	Labour Productivity - Mining Sector		GGDC
y_man	Labour Productivity - Manufacturing Sector		GGDC
y_utl	Labour Productivity - Utilities Sector		GGDC
y_con	Labour Productivity - Construction Sector		GGDC
y_trh	Labour Productivity - Trade, Restaurants & Hotels Sector		GGDC
y_tsc	Labour Productivity - Transport, Storage & Communication Sector		GGDC
y_fire	Labour Productivity - Finance, Insurance & Real Estate Sector		GGDC
y_gvs	Labour Productivity - Government Services Sector		GGDC
y_csp	Labour Productivity - Community, Social & Personal Services Sector		GGDC
y_Eco	Labour Productivity - Economywide		GGDC
gap_agr	Labour Productivity Internal Gap - Agriculture	*Sectorial Productivity relative to Economywide Productivity*	GGDC
gap_min	Labour Productivity Internal Gap- Mining Sector		GGDC
gap_man	Labour Productivity Internal Gap- Manufacturing Sector		GGDC
gap_utl	Labour Productivity Internal Gap - Utilities Sector		GGDC
gap_con	Labour Productivity Internal Gap - Construction Sector		GGDC
gap_trh	Labour Productivity Internal Gap - Trade, Restaurants & Hotels Sector		GGDC
gap_tsc	Labour Productivity Internal Gap - Transport, Storage & Communication Sector		GGDC
gap_fire	Labour Productivity Internal Gap - Finance, Insurance & Real Estate Sector		GGDC
gap_gvs	Labour Productivity Internal Gap - Government Services Sector		GGDC
gap_csp	Labour Productivity Internal Gap - Community, Social & Personal Services Sector		GGDC
rk	Capital Stock per Worker, at constant national prices - Total Stock	*Thousands of constant 2005 PPP US dollars per worker (using total workers in economy)*	PWT + GGDC
rks	Capital Stock per Worker, at constant national prices - Structures		PWT + GGDC
rkm	Capital Stock per Worker, at constant national prices - Machinery		PWT + GGDC
rkt	Capital Stock per Worker, at constant national prices - Transport Equipment		PWT + GGDC
rko	Capital Stock per Worker, at constant national prices - Other		PWT + GGDC
hc	Human capital index, based on years of schooling and returns to education	*Index*	PWT
pl_gdpo	Price level of Output-side real GDP (PPP/XR), price level of USA GDPo in 2011=1	*Index*	PWT
trade_gdp	Exports + Imports as fraction of GDP	*% of gdp*	World Bank
trade_share	X+M as share of the sample's total X+M	*% of sample total trade (X+M)*	World Bank
power_loss	Electric power transmission and distribution losses	*% of output*	International Energy Agency
power_installed	Total Installed Power Capacity per capita	*Million kW per capita*	US Energy Information Administration (Beta)
savings_rate	Savings calculated as 1-(C(%)+G(%))	*% of gdp*	PWT
polity_index	Revised Combined Polity Score = Democ - Autoc, -10 being strongly autocratic, 10 strongly democratic	*Index*	Polity IV
polity_democ	0 = no democracy ; 10 = full democracy, adjusted	*Index*	Polity IV
polity_autoc	1 = no autocracy ; 10 = full autocracy, adjusted	*Index*	Polity IV
polity_transition	1 if transition regime installed	*Dummy*	Polity IV
polity_foreign_interrupt	1 if foreign interruption installed	*Dummy*	Polity IV
group	0 = OECD member ; 1 = Asia ; 2 = LAC	*Dummy*	Polity IV
k_con	Structures Capital Stock per worker in Construction sector	*Thousands of constant 2005 PPP US dollars per worker*	PWT + GGDC
k_tsc	Transport Equipment Capital Stock per worker in Transport, S&C sector		PWT + GGDC
k_utl	Total Installed Power Capacity per worker in Utilities sector	*Thousand kW per worker*	PWT + GGDC

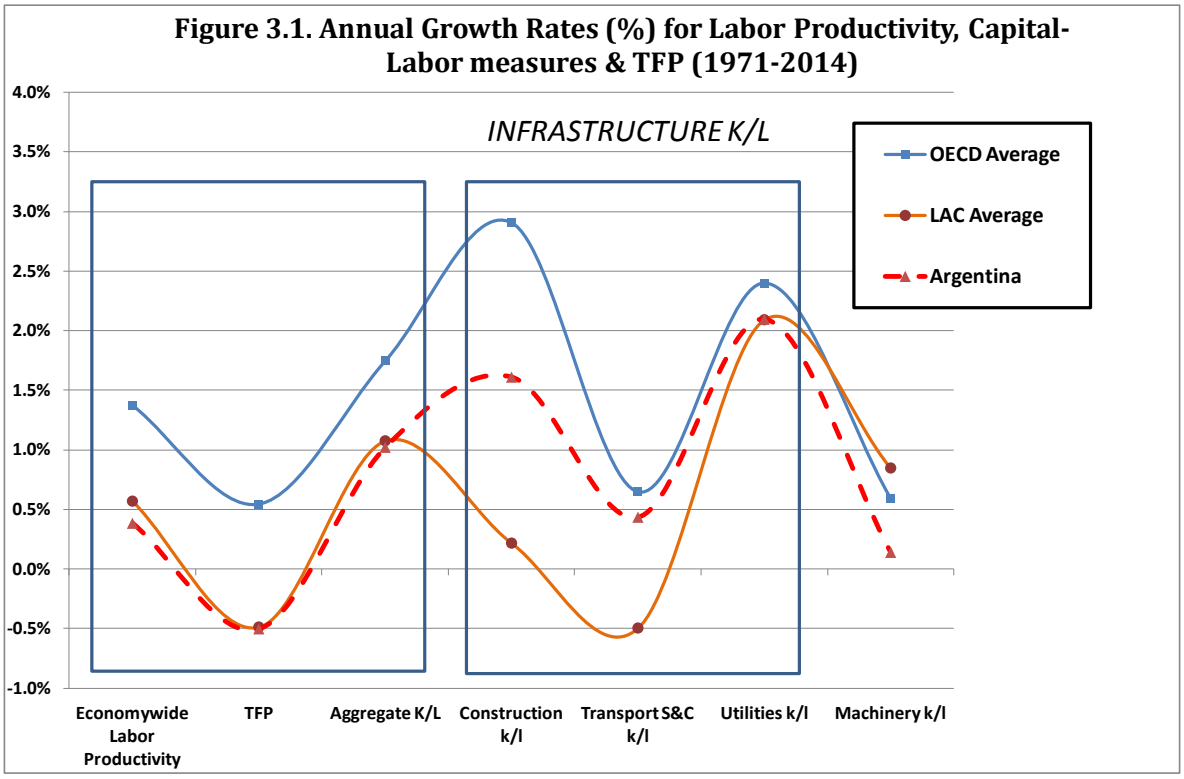
Figure 1 Dataset Coverage



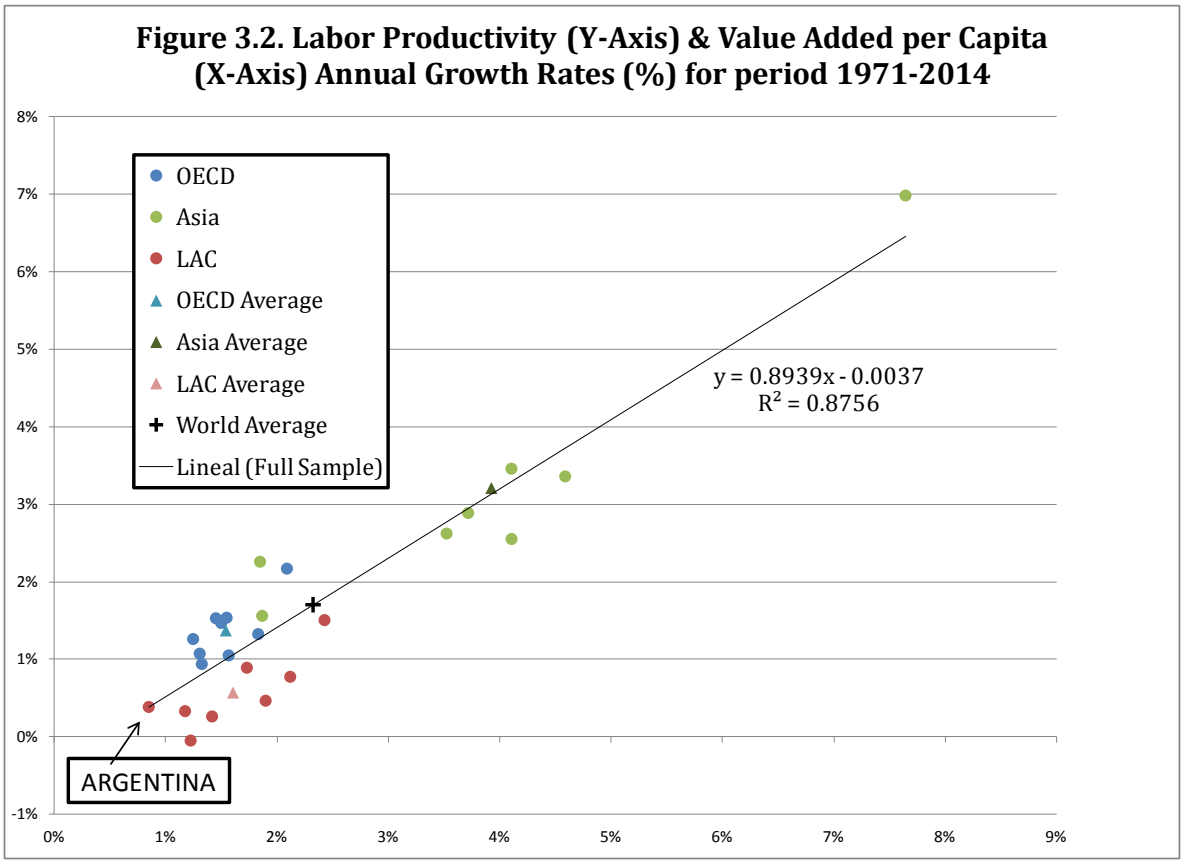
3. Productivity performance and sectoral gaps

Argentina has shown a very poor aggregate labor productivity performance in our sample 1971-2014 which highly correlates with a very poor performance in both income per capita and total factor productivity. **Figure 3.1** illustrates a first-hand basic growth grammar diagnostics, using GGDC and PWT datasets. Argentina´s labor productivity grew at 0.4% per year in our sample, just below LAC's performance with a similar (negative) TFP and aggregate Capital-Labor growth rates. Decomposing Capital-Labor growth performance in infrastructure-related sectors and Machinery, it turns out that Argentina´s performance in infrastructure-related sectors has been better than the LAC (unweighted) average in the case of (Construction and Transport) infrastructure and worse in the case of Machinery[3]. Cross-plotting labor productivity and income per-capita growth rates show Argentina at the bottom of the line in our 25 countries sample for 1971-2014 (see **Figure 3.2**). This is also similar in the cross-plot of labor productivity and TFP growth.

Figure 3.1. Annual Growth Rates (%) for Labor Productivity, Capital-Labor measures & TFP (1971-2014)



[3] This possibly relates to an anemic private capital investment decision related to contractual private-public governance, as infrastructure capital in our sample has been obviously sustained by public investment.



Productivity levels and performance shows a marked heterogeneity across sectors both in Argentina and elsewhere. Thus the analysis of productivity gaps should consider the relative position and evolution across time of productivity across sectors. **Figure 3.3** shows that expressed in growth rates for the sample period, the evolution across sectors has been quite different in Argentina with only four sectors (Agriculture, Manufacturing, Transport and Utilities) showing positive rates of growth. Except for Utilities, these sectors show a relative favorable position against LAC and World averages in 2014. At the same time, sectors such as Government, Community and Financial Services show a relative low productivity status in the international comparison in 2014 (See **Figure 3.4**).

Figure 3. 3. Annual sectoral labor productivity growth rates: Best performers, Argentina, World and LAC (%) 1971-2014

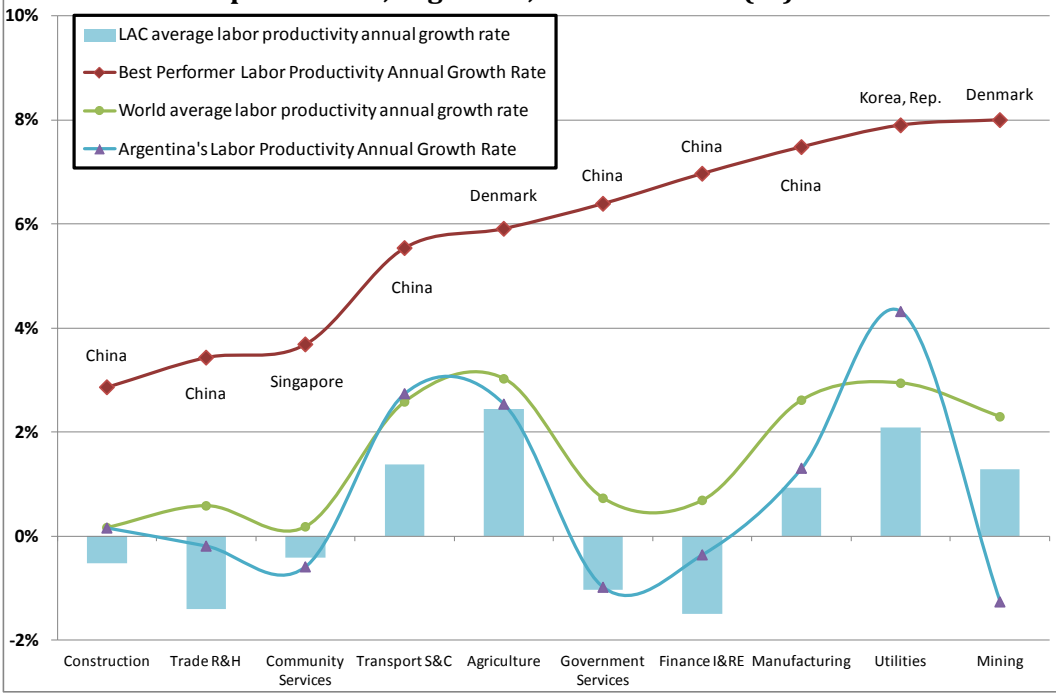
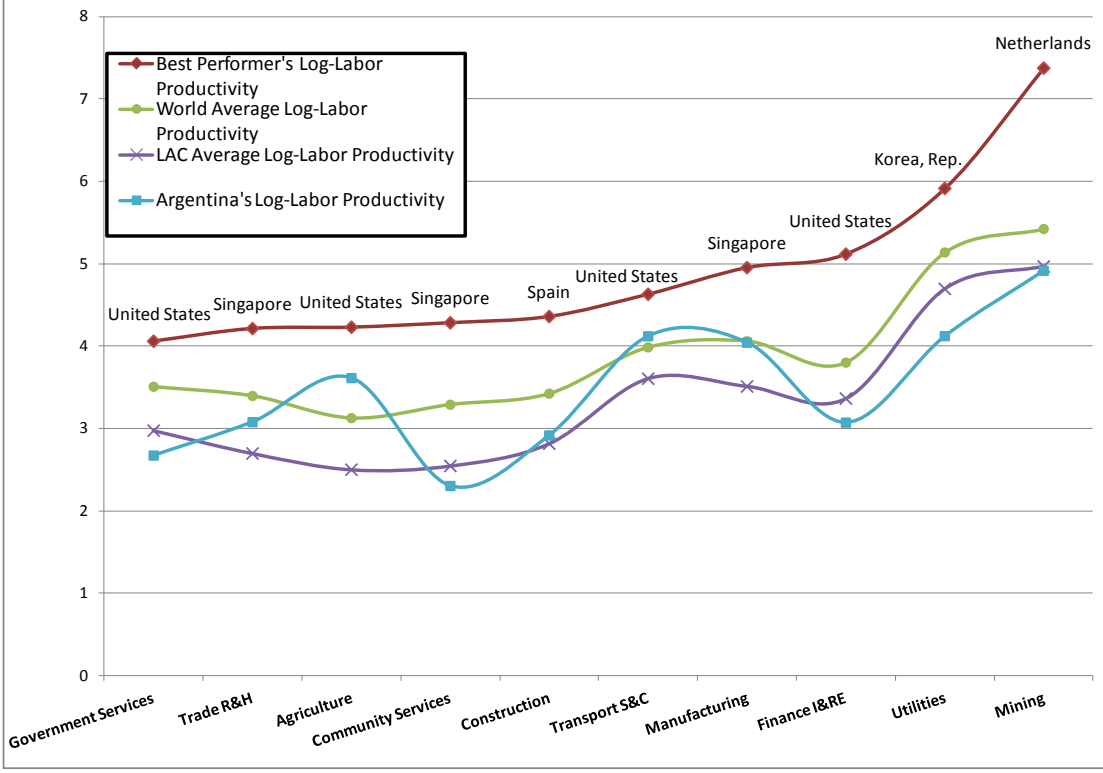
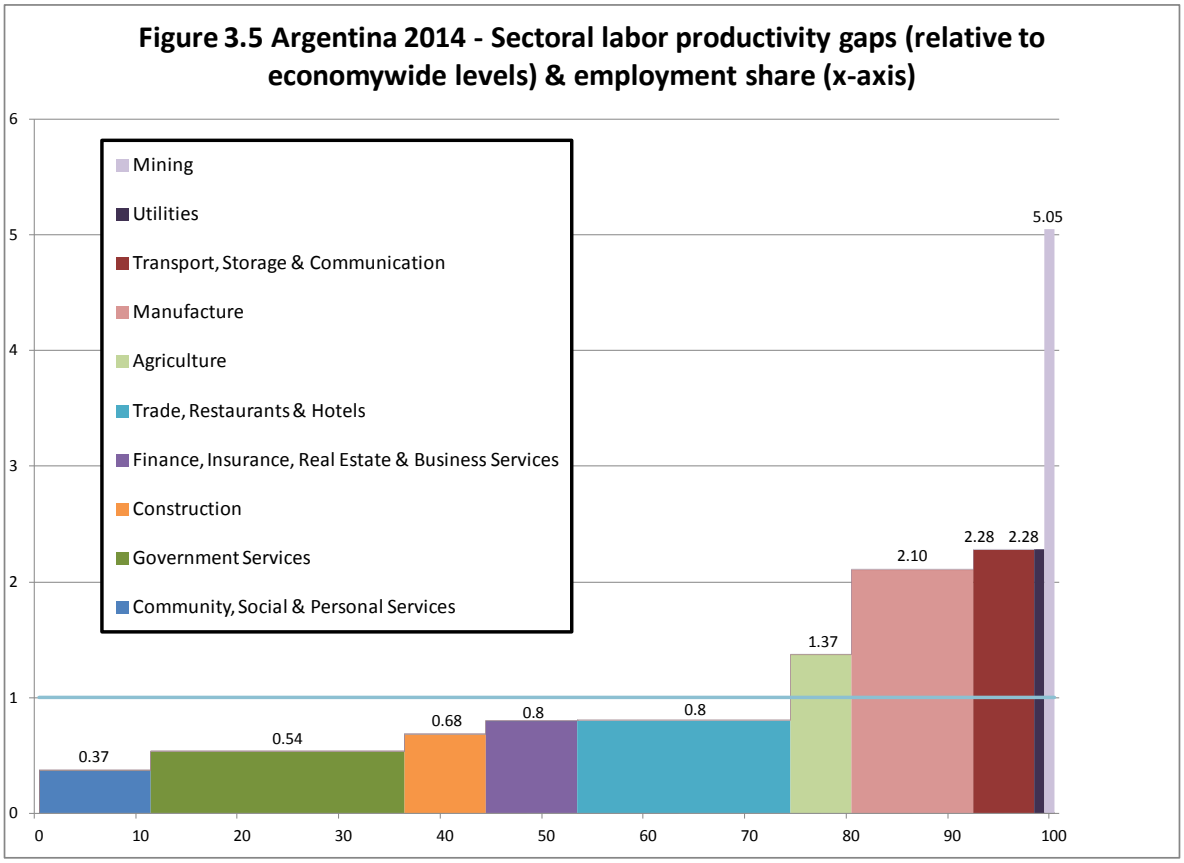


Figure 3.4. Labor productivities levels (in logs) for best sectoral performer, Argentina, World average & LAC average in 2014



A static (2014) classification of sectors according to productivity gaps (relative to average economy wide) shows 5 sectors as (relatively) high productivity sectors covering only 25% of the employment in 2014, and other five sectors as relatively low and covering 75% of employment. Two infrastructure related sectors (Utilities and Transport) are among the first group, the other being tradable sectors such as Agriculture, Mining and Manufacturing. The remaining infrastructure related sector (Construction) share with all the services sector (including the financial services sector) the low productivity group (see **Figure 3.5**).[4]



Seen from a dynamic perspective the evolution of productivity gaps (relative to the economy-wide) across sectors shows that Manufacturing and Mining have been above average productivity levels all along our sample period, while Agriculture, Transport and Utlities moved from below to above the productivity average. The evolution of

[4] As part of the data and measurement of this project we performed a comparative analysis of labor productivity measurement in GGDC and LA KLEMS datasets (FIEL, 2018). We discover that GGDC and KLEMS datasets differs substantially in their respective series of labor productivity, due to a serious decoupling that occurs in the vicinity of the recession of 2008-09 and is coincident with official data interventionism. The results were shown in a previous preliminary report and are too detailed to be included in this main report. They became outdated as our findings led to a revision of the LA KLEMS dataset for Argentina, being a byproduct contribution of this project.

productivity gaps across time shows that both Utilities and Transport sectors have moved from low to high productivity in the 80s and 90s, while Construction remained stagnant in the low productivity group. The agriculture sector made a transition from low to high productivity across our sample, in between the 70s and 90s, while the manufacturing sector increased its positive productivity gap. Meanwhile none of the service sectors showed some trend towards improved productivity; rather the opposite is seen for most of them. This suggest that channels were productivity shocks in infrastructure related sectors have affected productivity in other sectors relates Utilities/Transport with Agriculture/Manufacturing. Our econometric analysis below tends to validate this view.

Figure 3.6
Argentina: Evolution of labour productivity gaps by sector (to economy-wide) 1971-2014

4. Econometric estimates of infrastructure productivity shocks on sectoral productivity

Modeling approach

In this section we use the pilot-country-case estimation framework suggested in Ahumada and Navajas (2019) global panel data model, in order to model the effects of productivity improvements in infrastructure related sectors on other sectors of the economy. The modeling strategy is based on time-series equation for each "s" sector so as to obtain country specific elasticities of the effect of productivity growth in sector "j" on sectors "s". Given country and time or even development stage specificities of infrastructure have an impact on growth (*e g* Estache and Garsous,

2012) these elasticities need not be on the same j-s relation neither be of a similar magnitude from the global panel model. Ahumada and Navajas (2019) perform a sensitivity analysis for using global panel estimates (say LAC estimates) to be used for Argentina, and find that aggregate effects are not quite different but the composition of sectoral influence may be different. From an econometric modeling perspective the approach described in equations (1) to (3) below, is similar to the global panel model's but using time series equations for the "s" sectors.

Initially we started with unrestricted models of labor productivity (output per worker in logs, y) for a given sector "s"(agricultural, manufacturing, etc.) using, in each case, as explanatory variables the labor productivity of the three "j" infrastructure sectors ($y_{utl}, y_{con}, y_{tsc}$) along our proxies for the capital per worker of the same infrastructure sectors ($k_{utl}, k_{con}, k_{tsc}$) so as to distinguish productivity from stock of capital effects. We also included, in the unrestricted model as control variables, (x) two different measures of trade openness (exports plus imports of each country as fraction of the GDP and also as a fraction of the sample's total exports plus imports) along with a human capital index, a political index and the total and machinery capital stock per worker. For the same unrestricted models, we included impulse dummies for outliers (for a specific year observation).

To handle such large information set, an automatic algorithm (*Autometrics* , see Doornik, 2009 and Hendry and Doornik, 2014) helped us to select the relevant variables. It uses a tree search to discard paths rejected as reductions of the initial unrestricted model based on ordered squared t-statistics, given a p-value provided by the researcher.[5]

Given the time behavior of the data we take into account the possibility of unit roots and evaluate cointegration according to the following approach. The unrestricted models of labor productivity are formulated for their log differences and the explanatory variables expressed in log levels and log differences (as suggested by Bardsen, see Banerjee 1993).

Therefore, the starting unrestricted models have the following form for a given economy "s" sector,

[5] We used 1% target (probability) values. *Autometric*s evaluates diagnostic tests for time series-model. The reported models passes all of them except heteroskedasticity in some cases, for which consistent standard errors were included .

$$\Delta y_{s,t} = \alpha_s + \delta_s\, y_{s,t-1} + \beta_{s,utl}\; y_{utl,t-1} + \beta_{s,con}\; y_{con,t-1} + \beta_{s,tsc}\; y_{tsc,t-1}$$
$$+\; \varphi_{s,utl}\; \Delta y_{utl,t} +\; \varphi_{s,con}\; \Delta y_{con,t} \;+\; \varphi_{s,tsc}\, \Delta y_{tsc,t}$$
$$+\; \theta_{s,utl}\; k_{utl,t-1} + \theta_{s,con}\; k_{con,t-1} + \theta_{s,tsc}\; k_{tsc,t-1}$$
$$+ \lambda_{s,utl}\; \Delta k_{utl,t} +\; \lambda_{s,con}\; \Delta k_{con,t} \;+ \lambda_{s,tsc}\, \Delta k_{tsc,t}$$
$$+ x_{t-1}{}'\, \phi_s + \Delta x_t{}'\, \tau_s + \varepsilon_{s,t} \qquad t = 1, \dots, T \qquad (1)$$

where "t" indicates each year for sector "s". In the first row we have the long run effects of labor productivities given by (as δ_s is expected to be significantly negative under cointegration) by the negative value of $\beta_{s,utl}/\delta_s$, $\beta_{s,con}/\delta_s$, $\beta_{s,tsc}/\delta_s$, that is the long run infrastructure sector elasticity, respectively.[6] The next row indicates the impact effects of changes in infrastructure productivities. Similarly, the third and four rows includes parameters for the long run and short run effects of capital per worker of the infrastructure and the last row for the control variables in the vector x' respectively. All variables are in logs (except the political index).

From the log functional form in Equation (1) we can also obtain the effects of infrastructure sector capital productivities, as well. In this case the estimates should not reject the hypothesis that $\beta_{s,j=} - \theta_{s,j}$ for *j = utl, tsc, con* because when they hold the corresponding effects becomes $\beta_{s,j}\; y_{j,t-1} - \theta_{s,j}\; k_{j,t-1} = \beta_{s,j}\,(ln$ (Y/L) - ln (K/L) = $\beta_{s,j}\,(ln$ (Y/K). Therefore the estimates of $\beta_{s,j}$ is the elasticity with respect to capital productivity of the *j* infrastructure sector.

It is important to note that Equation (1), nesting levels and differences, allows us to have variables which enter the model either into the long run or short run, or both. The advantage of estimating this type of model is that it can be easily reparametrized as an error correction (EC) model which includes growth rates and deviations from the log run relationship. For example, when there is only a long run effect of a *j* infrastructure sector say, construction on a given *s* sector productivity, the restricted

Equation (1) would have the next EC representation,[7]

$$\Delta y_{s,t} = \alpha_{si} - \delta_s\, [y_{s,t-1} - \beta^*_{s,con}\, y_{con,t-1}] +\; \varphi_{s,con}\; \Delta y_{con,it} + \varepsilon_{st} \qquad (2)$$

[6] The long run elasticities are derived from $\Delta y_{jt} = \Delta x'_t = 0$.

[7] For simplicity we show this for one sector, construction, but it can be generalized for a multivariate case.

where $\beta^{*}_{s,con} = {\beta_{s,con}}/{\delta_s}$

If the variables were first order integrated, we can test whether or not this long run relationship is a cointegration vector evaluating the significance of the t-statistic of the lagged explained variable (of the estimated coefficient of δ_s). Although the distribution of this statistic is non-standard when there is no cointegration, the critical values derived from the response function in the Monte Carlo study of Ericsson and MacKinnon (2000) can be used to test cointegration.[8]

Since our main interest is to evaluate for the long run effects of infrastructure productivity during the automatic selection we kept fixed (an option of *Autometrics*) the log levels of productivity, apart from the constant term and only dropping the non-significant ones after estimation. We also initially assumed: i) there is no effects among the different economic sectors and ii) the explanatory variables are all exogenous. To evaluate these assumptions for the selected models we performed the following post estimation checks.

With respect to i), we test long run sectors interdependence from augmenting the selected model from equation (1) for a given sector by the other sectors lagged levels and testing their significance.[9] The augmented equation could be considered as one of a VEC (Vector Error Correction) for the different sectors' productivities while the productivities and capital for the related infrastructure sectors as external variables of this system. Regarding iii), we re-estimate the models by instrumental variables in cases when infrastructure (log differences) variables enter contemporaneously into the selected models. Our main identification assumption is that capital per worker of the infrastructure sectors are exogenous and therefore can be used as valid instruments, as detailed in the different cases. For long run effects of different sector productivities on infrastructure related sectors productivity we check if they are significant in the inverted (one of the VEC) reduced form equations, when modeling the different sectors. If it were significant we have not structural effects but those of the reduced form.[10]

[8] A useful approximation of the critical values of the *t-statistics* from the response function, which could be seen as a multivariate unit roots, is given by the rule "3-2-3", that is the critical value is *-3 -0.2 K-0.3 (d-1)* where *K* is the number of variables in the long run relationship and *d* is the number of deterministic components such as constant, step dummies and trends.

[9] For the models with variables entering into the long run we did not find significant effects at 1% except for manufacturing. Some short effects were found in some cases; however they imply only small changes in the long-run elasticities.

[10] No long run effects (of different sectors productivity) on infrastructure related sectors productivity were found.

We can note (see Hendry, 2008) in the case of variables with unit roots representation we can have different sources of no exogeneity. To see it in the simple case of the conditional model of equation (2) which assumes cointegration of the labor productivity of the sector with that of the infrastructure, the marginal model for construction could be,

$$\Delta y_{con,t} = \rho[\, y_{s,t-1} - \beta^*_{s,con}\, y_{con,t-1}] + \ \omega_{con}\ \Delta y_{s,t-1} + \varepsilon_{con,t} \qquad (3)$$

While ω_{con} is associated with Granger- Causality from the "*s*" sector on construction, it is neither necessary nor sufficient to be zero for a valid conditional model to obtain consistent estimates of the parameters in (2).[11] For weak exogeneity, $\rho = 0$ is needed, that is the EC term does not enter the marginal model. Given that we started with a conditional model then, $\rho = 0$ requires that the effect of $y_{s,t-1}$ should be not significant in (3). Therefore, no level of the sector "*s*" enters into each equation of infrastructure sector which has effects on sector "*s*". This evaluation is often called LR exogeneity. However, the contemporaneous effect of $\Delta y_{con,t}$ can be associated, apart from the long run effect, to $E[\varepsilon_{con,t}.\, \varepsilon_{s,t}\,] \neq 0$. Thus, we use IVE to have consistent estimates from a single equation like (2).

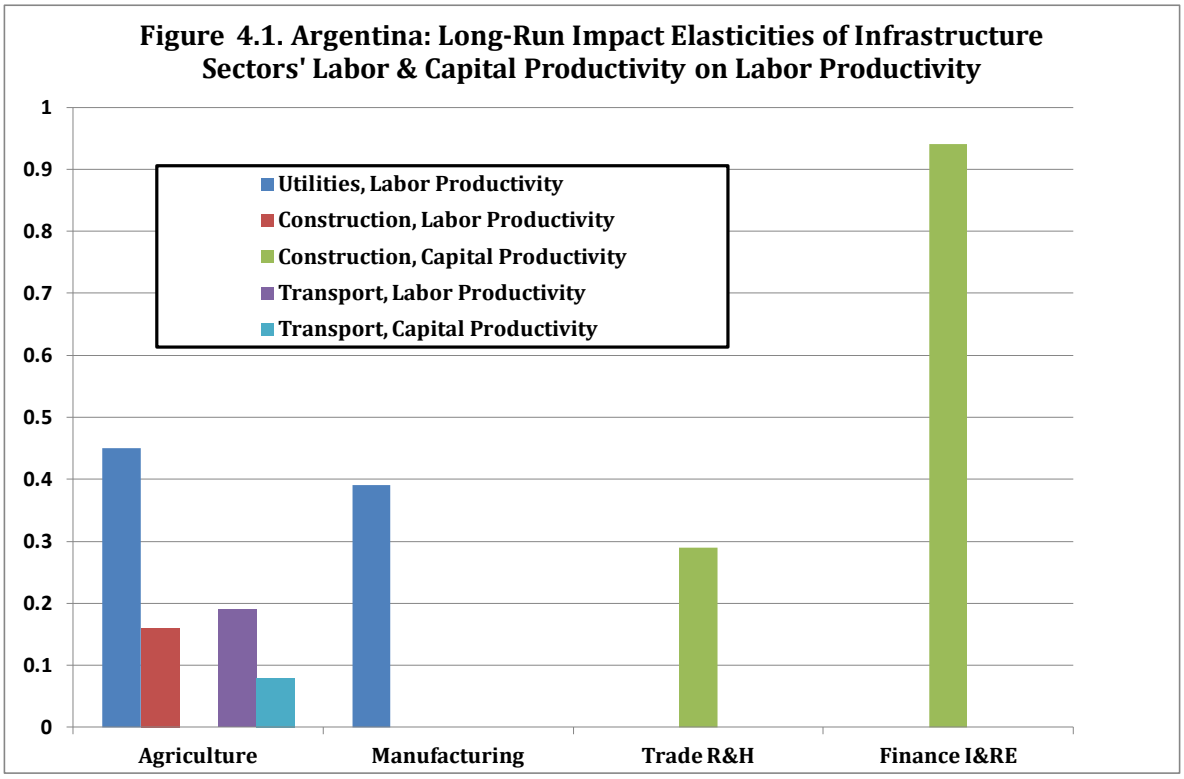
Results

Annex A contains all the output of our estimation procedure for all sectors. Table 4.1 and Figure 4.1 summarize our findings in terms of the long-run elasticities or impacts of infrastructure sector "j" on sector "s". There are eight effects identified and measured in our estimation. Labor productivity improvements in utilities have a long term impact on agriculture and manufacturing labor productivity; while improvements in the labor productivity in the transport sector add to the effects on on agriculture. The construction sector displays impacts through both labor and capital productivity adding to the effects on the agriculture sector but in addition on sectors such as domestic trade and financial services. While utilities and transport have effects on relatively advanced or dynamic sectors –in terms of the gaps terminology of section 3- construction has an impact on other sectors that are laggards in terms of productivity. Other sectors receive short term impacts, as reported in Annex A, but they will not be taken as part of the long term impacts simulated in the next section

[11] When the model has one lag in levels, there is no effect from $\Delta y_{s,it-1}$.

Table 4.1. Infrastructure related sector long-run elasticities of sectoral labor productivity

	Labor Productivity	Impacts on sector "j"	Capital Productivity	Impacts on sector "j"
Utilities	0.45 , 0.39	agr , man		
Construction	0.16	agr , trh	0.29 , 0.94	trh , fire
Transport	0.19	agr	0.08	agr



5. Simulating the impact of infrastructure related productivity growth improvements

Productivity improvements in infrastructure related sectors "j" affects aggregate productivity performance through direct (own) and indirect effects. Expression (4) decomposes all the effects needed to compute or simulate effects.

$$\Delta\log\left(\frac{y}{l}\right) = \sum_j \alpha_j \Delta\log\left(\frac{y}{l}\right)_j + \sum_i \alpha_i \left(\eta_{\frac{y}{l_i}\frac{y}{l_j}} \Delta\log\left(\frac{y}{l}\right)_j + \eta_{\frac{y}{l_i}\frac{y}{k_j}} \Delta\log\left(\frac{y}{k}\right)_j + \eta_{\frac{y}{l_i}\frac{k}{l_j}} \Delta\log\left(\frac{k}{l}\right)_j \right) \quad (4)$$

where i=*1,…7* are other sectors, j=*utl, tsc, con* are infrastructure related sectors and α are labor share ratios. Expression (4) decomposes the final effect on aggregate productivity growth in a "direct or own" effect (the first term on the RHS) and an "indirect" effect that depends on the infrastructure-related sector (j) elasticity (defined for labor productivity y/l, capital productivity y/k and capital-labor k/l) of the sectoral (i) labor productivity, and the rate of growth (or, for simulation purposes, the convergence to a benchmark of the rates of growth) of y/l, y/k and k/l in the infrastructure related sector j.[12] Employment shares α_i and α_j also drive the magnitude of effects.

Expression (4) is easy to compute given the set of relevant elasticities taken from Table 4.1, the labor shares and the assumed annual rates of growth of productivities in the infrastructure related sectors. In our simulation for Argentina we assume two scenarios: in the first one (Low) we assume that productivity in infrastructure related sectors converge to the annual rate displayed by the world average in our 1971-2014 sample. In the second scenario (High) we assume that productivity in infrastructure related sectors converge to the annual rate of the world best performer in each sector (see Figure 3.3 in section 3 for illustration of countries). **Figures 5.1 to 5.3** and **Table 5.1** illustrate the results of the simulations. In all cases we include both "low" and "High" scenarios (that only differ in the rate of growth of productivities in "j" sectors) and, only for comparison of magnitudes purposes, the results for LAC (i.e. using LAC elasticities) estimated in the global panel model in Ahumada and Navajas (2019).

[12] Capital-labor effects are not considered since they do bnot arise in the estimations reported in Annex A.

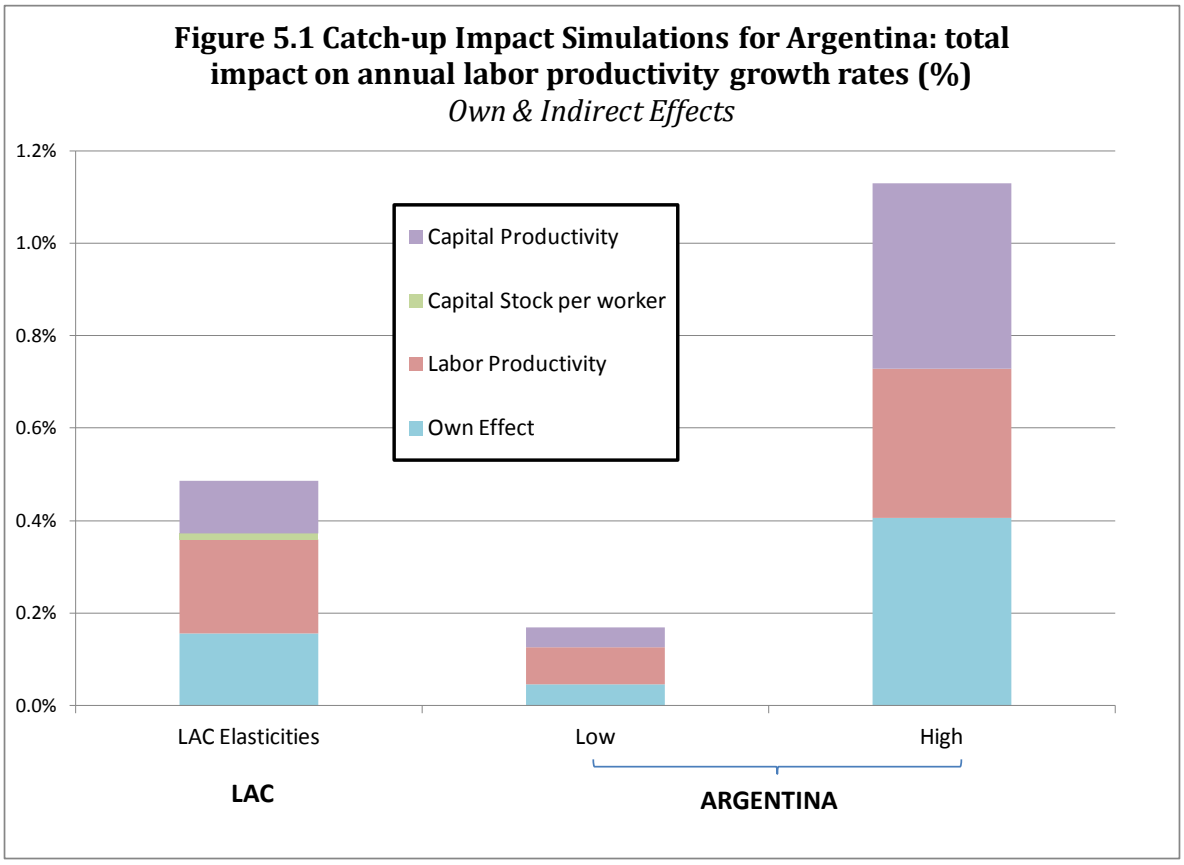


Figure 5.1 shows that convergence to world average annual rates of productivity growth in infrastructure related sectors would increase the performance of aggregate labor productivity by 44% in Argentina (i.e., adding a 0.17% annual rate); see also **Table 5.1**. Indirect effects dominate own effects and are mostly explained by labor productivity improvements. The high scenario is of course very dynamic, as the convergence is to the best performer annual rates of productivity. Argentina would improve its annual aggregate productivity performance by almost 3 times, growing at an annual rate of 1.53%. The relative importance of own and indirect effects is similar, although capital productivity effects are more important in this high scenario.

Figure 5.2 measures the decomposition of effects according the infrastructure sector from which it comes, so responding to the *which sector?* issue (i.e. causes growth spillovers). In the low or base case scenario for Argentina about half of effects come from the utilities sector with construction explaining most of the rest (see also Table 5.1). The high scenario changes the shares in favor of construction, with utilities and transport explaining a third of the effect in equal parts. The LAC average case (base on a global panel model) is mostly (80%) explained by construction and the rest by transport.

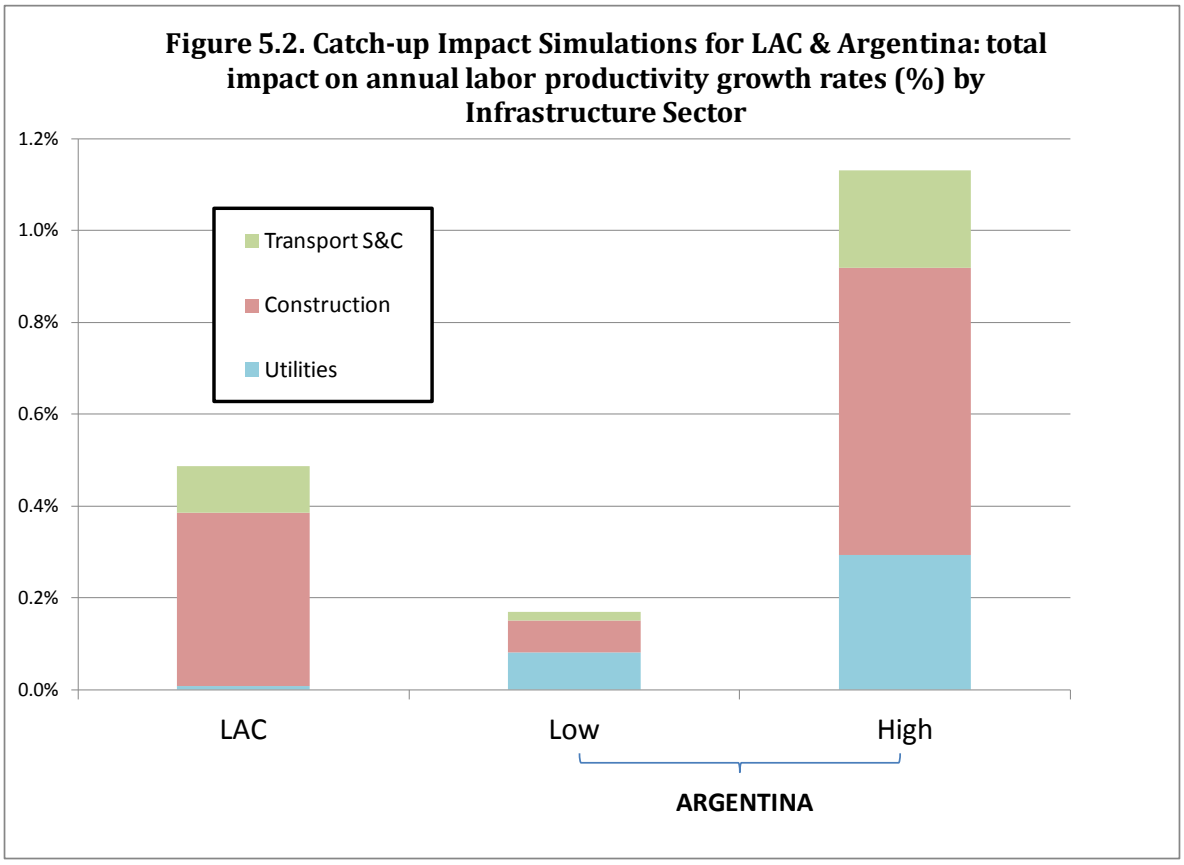
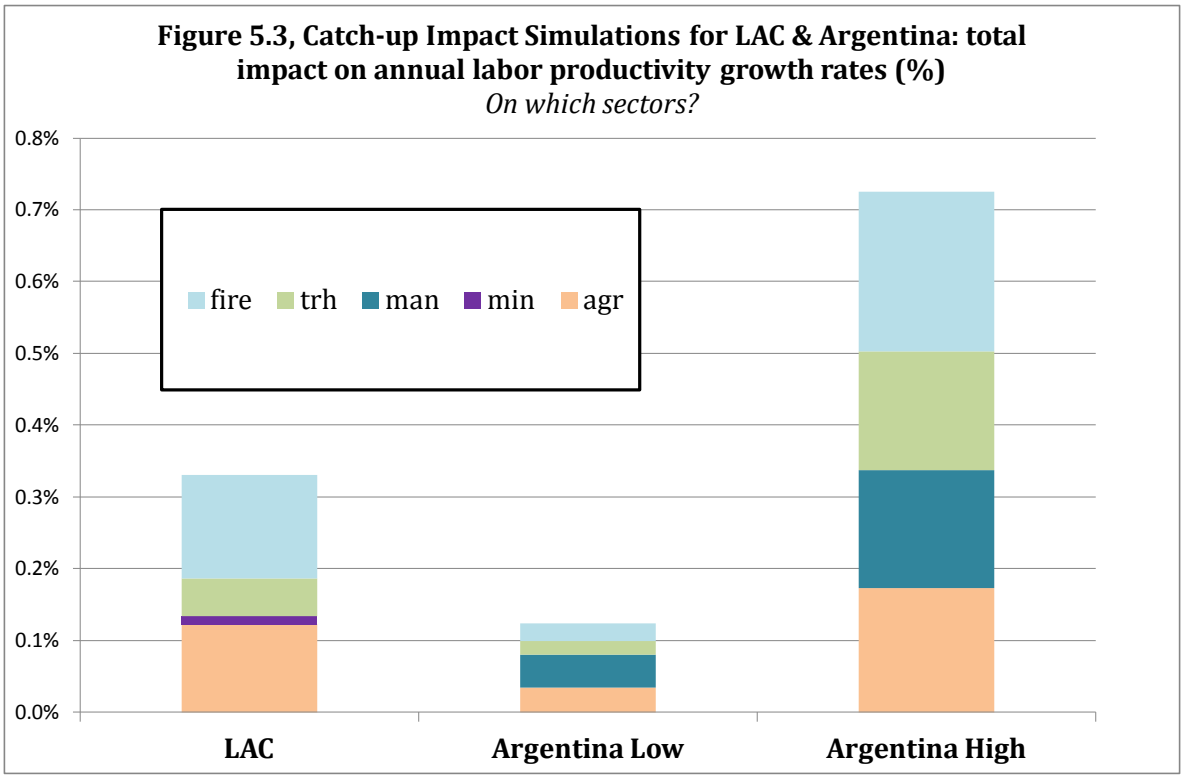


Figure 5.3 decomposes the results according to the sectors that receive the impact of infrastructure productivity growth, so responding to the *on which sector?* issue. For this reason Figure 5.3 only includes indirect effects of infrastructure sector productivity on aggregate productivity through the impact on other sectors (see expression (4)). Agriculture –which is also relevant in the LAC simulation in Ahumada and Navajas (2019)- is one of the sectors through which infrastructure productivity has an impact on productivity growth, while manufacturing is also relevant in the case of Argentina. But also as displayed in the LAC simulation, Domestic Trade and Financial Services are channels were infrastructure productivity improvements have an impact on growth. Domestic Trade is more significant in the Argentine case.



To sum up:

11. *Are productivity shocks in infrastructure related sectors quantitatively important for aggregate productivity performance in Argentina?* Yes, productivity improvements in infrastructure related sectors have a significant impact on aggregate productivity in the argentine case adding up 44% to the growth rate in the case of convergence to the best regional (LAC) performer in each sector or almost 300% in the case of convergence to the best world performers. Table 5.1 summarizes our results. Direct effects explain 30% of this improvement while the rest occur trough impacts on other sectors.
12. *Which infrastructure sectors seem to drive productivity shocks across sectors?* Our findings suggest that utilities (where energy infrastructure is the main subsector) and construction have shown more important effects than transport (which also includes telecommunications and storage) in the argentine case (while construction and transport are more relevant than utilities in the case of LAC). The higher the size of the shocks in infrastructure productivity (defined as resembling the performance of high productivity performers across the world) makes transport productivity improvements more relevant and close to utilities productivity improvements, while construction productivity becomes even more significant.

Table 5.1. Catch-up Impact Simulations on Economywide Labor Productivity (in annual % growth rates for period 1971-2014)

	Own Effect	Indirect Effect		**Total Impact**	Average Economywide Productivity Annual Growth Rate (%) 1971 - 2014	Ratio Impact / Avg. growth rate
		Labor Productivity	*Capital Productivity*			
LAC Global Panel Model	**0.16%**	**0.20%**	**0.11%**	**0.49%**	**0.6%**	**85%**
Utilities	0.00%	0.01%	-	0.01%		
Construction	0.07%	0.20%	0.11%	0.38%		
Transport S&C	0.09%	-	-	0.10%		
Argentina Low	**0.05%**	**0.08%**	**0.04%**	**0.17%**	**0.4%**	**44%**
Utilities	0.01%	0.07%	-	0.08%		
Construction	0.02%	0.00%	0.04%	0.07%		
Transport S&C	0.01%	0.00%	0.00%	0.02%		
Argentina High	**0.41%**	**0.32%**	**0.40%**	**1.13%**	**0.4%**	**294%**
Utilities	0.03%	0.26%	-	0.29%		
Construction	0.21%	0.03%	0.39%	0.63%		
Transport S&C	0.17%	0.03%	0.01%	0.21%		

Note: catch-up is defined as the necessary increase in labour productivity's annual growth rate to reach that of a benchmark case
Argentina's Low benchmarks are LAC's sectoral best performers for infrastructure sectors (Brasil for Utilities, Peru for Construction, Chile for Transport S&C)
Argentina's High benchmarks are sectoral best performers for infrastructure sectors (Korea for Utilities, China for Construction and Transport S&C)
LAC's benchmark is OECD
For capital productivities and stocks, estimates corresponding to Utilities are available since 1980 so average annual growth rates are calculated for 1981-2014
For capital productivity estimates, the catch-up necessary jumps considered correspond to those used for labor productivity catch-ups

13. *On which sectors do infrastructure productivity shocks have a greater impact? Are they high/dynamic or low/sluggish sectors of the argentine economy?* The results show effects on both sides, with agriculture and manufacturing on the one hand and domestic trade and financial services being on the other. Thus, it is not true, from our results, that infrastructure productivity shocks have a high impact on intersectoral productivity heterogeneity. It does not seem that productivity shocks in infrastructure reduce the productivity gap across sectors at 2-digit classification (it may be different inside sectors) but it does not increase it either.
14. *Does infrastructure has an impact on growth but not on employment, as it impacts on sectors with very low employment shares?* This is not the case in our results. The four sectors on which infrastructure productivity shocks have a long run impact represent about 48% of total employment in Argentina in 2014. The two dynamic sectors, Agriculture and Manufacturing, had in 2014 6% and 12% share respectively, while the other two, Domestic Trade and Financial Services had 21% and 9% respectively. Among the infrastructure related sectors Utilities had an employment share of les that 1%, while Transport had a 6% share and Construction an 8%.

Another different issue coming from these results is whether they are consistent with a gaps approach that suggests that efforts should be directed at those sectors that display a larger investment or performance gap. The next section touches this issue

while addressing the evidence on infrastructure plans as displayed or revealed in the country evidence.

6. Diagnosis of infrastructure plans, investment needs from observed gaps and "revealed" priorities from recent investment allocations

Preview of infrastructure gaps and investment requirements: where do we stand?

In this section we summarize an effort to address the recent evolution of investment on infrastructure in Argentina according to several available information sources –including own estimates and measurements-. We proceed to estimate the investment required for the closing of horizontal gaps at a sectoral level with the goal of achieving density and coverage of provision standards respective to regions and country groups (e.g.: income groups). We start with a revision on the recent evolution of Argentina's position in the infrastructure pillar world ranking included in the Global Competitiveness Index (ICG) elaborated by the World Economic Forum (WEF). Our main conclusions are:

1. Argentina has experienced a period of stagnation in its relative global rank in what is related to infrastructure according to the WEF's GCI evaluation, although recent years have shown an improving trend on the matter. A study of the infrastructure pillar's building blocks enables us to conclude that our country outperforms LAC pairs involving communications coverage, but underperforms them in quality perception indicators, especially in relation to electricity supply quality, which has shown a declining status throughout the previous editions of WEF's CGI.
2. Argentina has displayed a deficit-prone performance in terms of economic infrastructure investment in comparison with LAC countries, of a magnitude of about 2% of GDP per year in the last years. This is shown in both investments undertaken by the public (above 1% of GDP) and private sectors, where the percentage gap with LAC average for the private sector has been notably greater. Finally, the investment deficit in infrastructure was skewed towards Transport and Utilities sectors correspondingly (relative to LAC), where the underinvestment was more pronounced at a sectoral level.
3. In **Annex B** we explore differences between Infralatam data and official fiscal statistics in Argentina, so as to use the latter to measure infrastructure investment efforts by the public sector to find out a visible adjustment in energy infrastructure. Thus towards 2019 Argentina went substantially below the 1% of GDP effort in public investment infrastructure towards 0.5% of GDP, with energy sector investing droping below water, and transport somehow

showing a modest adjustment. This is partly due to the efforts in roads given by the plans of a new and revamping highway system.

4. Estimates of physical and monetary magnitudes of the horizontal gap that Argentina displays against high-income countries would imply an investment equivalent up to 130% of GDP. Instead, and more realistically, closing the gap with upper middle-income countries, such as Turkey (which has been identified as the main performer in a peer group where Argentina belongs) would require a more modest effort equivalent to 18% of GDP.
5. Regarding the sectoral distribution of the investment requirements for closing gaps, it is mainly concentrated in investments in the energy sector (expansion of the power generation capacity) and in the transport sector (densification of the road network, railway and expansion of port capacity). Precisely, these results are consistent with the previous diagnosis of deterioration in the quality of provision and underinvestment, especially public, in economic infrastructure by our country. And is also consistent with the efforts revealed in recent infrastructure policy and PPP programs, although the adjustment in energy infrastructure effort in the last two years clearly departs from the desired direction.

Diagnosis of infrastructure plans

There are several documents that have addressed some diagnosis of the infrastructure plans and investment requirements in Argentina. FIEL (2009) for example presents a diagnosis of the emergence of effective sectoral bottlenecks (energy) and potentials (roads, transport, ports), from a bias towards investment in social infrastructure and the deterioration of the regulatory environment in previous years. Other diagnostics at the time, CAC (2008) among others, stressed the need for a comprehensive investment plan with high road, rail, hydraulic and electrical components. Some of the more sector-specific diagnoses, e.g. Barbero and Serebrisky (2007), observed the need for investments in infrastructure to solve transport logistics problems: congestion in the hub of agricultural products (Rosario), container handling at AMBA and low participation of transport by rail. However, the approach given by the governmental authorities of the area in the 2000s, embedded in MPFIPyS (2004), showed fundamental differences with the diagnosis made from the private sector and multilateral organizations in the sense of not responding to a clear diagnosis based on performance but rather being a document based on the idea that isolated infrastructure helps to close the territorial gaps regardless of comparative regional advantages in sectoral productivity. Given this situation, FIEL (2009) concludes that the retraction of private investment, product of the deterioration of the regulatory environment, followed by a slow and insufficient public response in

investments for economic infrastructure led to the appearance of sectoral bottlenecks as in the case of the provision of energy and potential problems in roads, transportation and ports. In this context, the comparative indicators of the perception of the quality of infrastructure in Argentina show a deterioration relative to the rest of the other countries in the region and a greater departure from the average of the OECD countries.

In the case of FIEL (2009), the specific sectoral analysis, e.g. the case of agro-industry is addressed. The diagnosis shows that the shared activity is exposed to deficits in transport infrastructure, which are shared with other activities, such as poor maintenance of rural roads, defective access to bulk ports and deficit in the provision of freight services. In terms of energy and water infrastructure, the sector faces specific problems such as low rural electrification for processing at source, the lack of access to potable water for processing at source and the lack of access to electricity for agro-export processing also at source. In this scenario FIEL (2009) proposes guidelines for investment in infrastructure for the sector, starting from prioritizing access to transport corridors, improving tertiary roads, and strengthening value chains, with actions aimed at solving bottlenecks, lower costs and increase competitiveness. In terms of rail transport, promoting projects aimed at accommodating private investment to achieve greater volumes of cargo, favoring the shift of the productive frontier and improving productivity, while in relation to river transport, advance investments in the waterway and the provision of barges. Finally, in the matter of energy, it was proposed to advance rural electrification.

The same diagnosis was given in Navajas (2010), moving forward in the quantification of the effort required for investments in sanitation, energy, roads and railways. According to those estimates, moving forward only in priority projects for those four sectors would require an investment floor of USD 77 billion, equivalent to 18% of GDP in 2010, which should be scheduled for the next six years. The magnitude of the investment can be put into perspective according to FIEL (2013) where the investment costs in public national and provincial infrastructure, public companies and trust funds are measured, as well as the private sector. According to this study, between 2008 and 2012, investment in infrastructure directed to the energy and fuels and transportation sector reached 3.3% of the average annual GDP, in a context where there was a recovery in investment in potable water, sewerage and hydraulic works.

According to CIPPEC (2015), the diagnosis of the infrastructure investment requirements starts from a scenario in which there has been a noticeable deterioration in the performance of energy, transport, water and sanitation, and telecommunications. Among the axes to advance in an infrastructure investment

program are: the expansion of the national electric transport network, the promotion of electricity generation works and the exploitation of unconventional resources, the advancement of specific road works, the promotion of investments in freight railways and metropolitan trains and advance in the adoption of the 4G system in telecommunications. This required an investment effort in infrastructure close to 5% of the annual GDP to reach a growth rate of GDP per capita of 3% between 2016 and 2030.

In 2015 the Argentine Chamber of Construction -CAC (2015)- developed a plan for the development of infrastructure during the decade 2016-2025. The plan proposes an investment program with goals for social infrastructure (housing, education, health, etc.) that aim to reduce deficits or achieve 100% coverage of households by 2025, with the exception of the sector's water and sanitation where the goals are more modest. As regards the infrastructure for the productive sectors, objectives are proposed in terms of energy (electric, atomic and gas and oil), transportation (roads, railways, ports and airports) and technology. In terms of investment in infrastructure at the level of sectors of activity are indicated agriculture, mining and tourism. The CAC program is based on a long-term annual growth target of 5%, and for this the investment requirements involve raising the investment ratio to GDP to 25.2%, of which 15.1% should correspond to investment in construction. Investment in infrastructure should reach 8.44% of GDP, with 6.24% of GDP being the investment in infrastructure for production referred to above. The sources of financing included the proposal of public-private participation programs.

Regarding the impact of the program, the initial mention refers to the growth of employment in the construction sector that is supposed to double by 2025, in the same way as would the consumption of steel and cement. Associated with each specific project presented by the program, the objectives, the general characteristics of the project, the execution deadlines and the expected improvements are described. Regarding investments directed to specific sectors, for agriculture reference is made to the need to invest in fixed storage capacity and irrigation infrastructure, outlining a national plan in this area. With regard to the mining sector, investment needs are related to railway lines, port facilities and electricity generation, as well as improvements in accesses and accommodation sites. As for the investments associated to the tourism sector, they refer more to private projects for the construction of hotels or tourist complexes, rather than productive infrastructure works. Finally, the report mentions investments in industrial constructions associated with specific private productive projects.

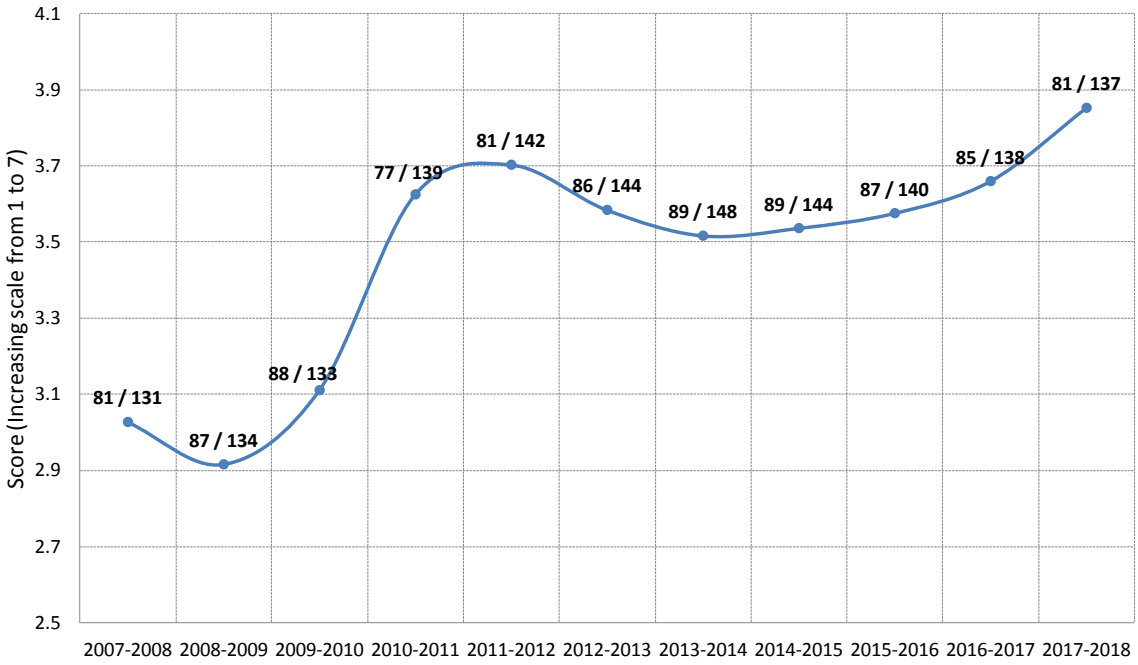
One of the most recent works that seeks to identify obstacles to the development of sectoral competitiveness from a territorial perspective is ECLAC (2017). The document presents an analysis of the growth restrictions faced by eighteen productive complexes distributed in five regions of our country, starting with the complex of biofuels, fruit, meat-bovine complex, textile and clothing, automotive, software, winemaking complex , mining, fishing and sheep. The growth restrictions identified vary according to the regions of the country and activities, and cover dimensions beyond the chapter on infrastructure requirements. Regarding the limitations, the work concludes that more differences are observed between complexes than between regions, so that firms and productive processes of high standards can be found even in more backward regions. The study does not identify in a first qualitative analysis the allocation of basic infrastructure and transport as the main constraints to growth, neither at a national level nor in regions. Notwithstanding the above, the provision of basic infrastructure and transportation shows a greater lag in the NEA and NOA region. Likewise, the results are variable depending on the productive complex analyzed in each region.

Quality, coverage and infrastructure gap in Argentina

The WEF constructs the ICG on a regular basis with the objective of measuring the relative ranking of the different economies based on different pillars that impact on productivity, and thus on long-run growth. In this context, the second pillar introduced in WEF's ICG corresponds to infrastructure. The domain synthesizes qualitative indicators –perceptions on the quality of infrastructure- and quantitative –service coverage- in an index scaled from 1 to 7 reflecting a growing perception of quality and coverage. **Figure 6.1** exhibits Argentina's position in the global country ranking and its score achieved in the last eleven measurements made by the WEF. As shown, Argentina experienced rank stagnation for the period, maintaining rank 81 between editions 2017 – 2018 and 2007 – 2008. Interestingly, changes in the number of countries composing the sample in different editions did not help a better rank positioning. It is worthwhile to note an incipient recovery in the position of the last edition with respect to the previous ones. This way, it is possible to conclude that Argentina has experienced a significant stagnation in the perception of infrastructure quality and coverage, with a recent indicative change towards a better positioning of our country in the world ranking.

Figure 6.1. Argentina: Global Competitiveness Index - Infrastructure Pillar

Recent evolution and positioning in the ranking of countries

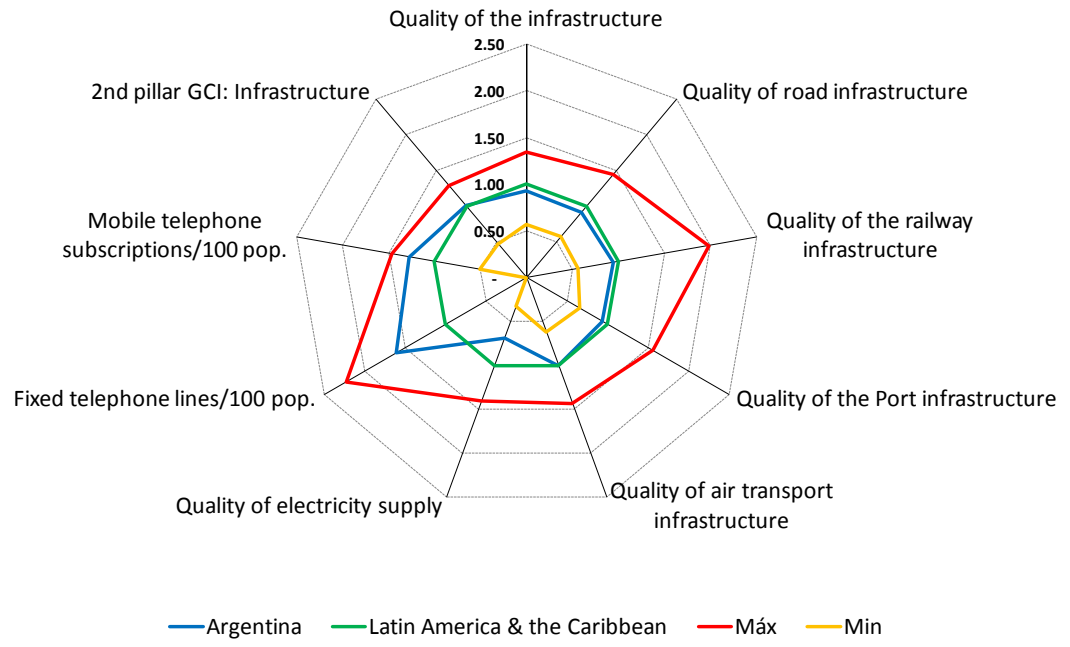


Source: Qwn based on The Global Competitiveness Report 2017–2018 Database. https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018

On inspection of the indicators considered for the infrastructure pillar's elaboration, those involving quality perception are combined with coverage ones, as already mentioned. **Figure 6.2** as follows presents Argentina's relative position in the infrastructure pillar, and that corresponding to each indicator conforming it[13], relative to Latin America and the Caribbean (LAC) countries. As shown, for the pillar as a whole, Argentina reaches a score equivalent to LAC's average. With respect to quality perception indicators, excepting air navigation domain, our country exhibits a score below LAC's average, with a greater distance to average involved in the quality of electricity supply. In addition, both indicators related to communications coverage position Argentina better than LAC's average, whilst in no case whatsoever does Argentina's score correspond to the maximum achieved by one of the included countries. Finally, it is worthwhile to note that a similar analysis on the building blocks of the pillar for the 2007 – 2008 GCI edition enables us to conclude that during the period a sharp decline has prevailed in relation to the electricity supply quality indicator, while that related to communications has improved.

[13] With the exception of airline seat availability per weekly km, indicator for which Argentina doubles LAC's endowment

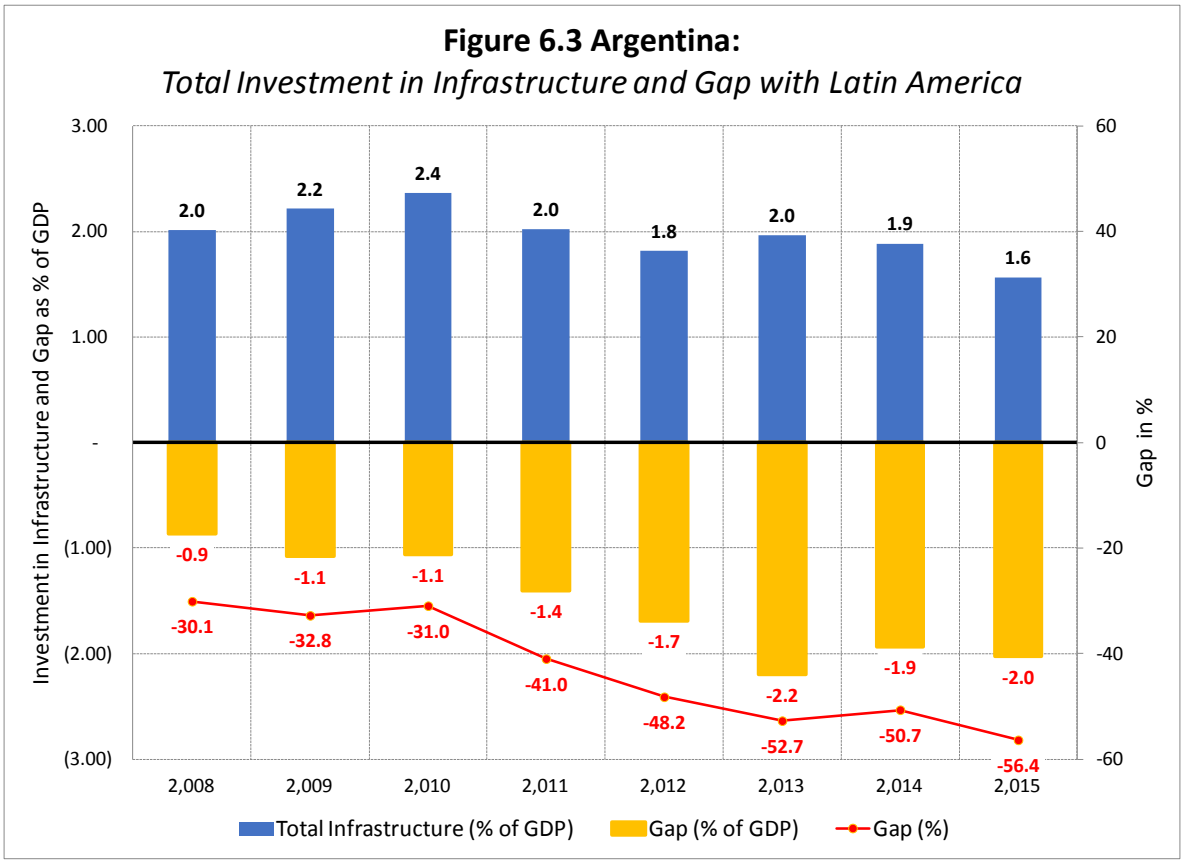
Figure 6.2. Global Competitiveness Index - Infrastructure Pillar
By Component - Normalized to the average ALC
2017 - 2018 Edition



Source: Qwn based on The Global Competitiveness Report 2017–2018 Database. https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018

Argentina's infrastructure quality perception decline and stagnation in the world competitiveness ranking have as its related counterpart a poor performance in terms of infrastructure investment. **Figure 6.3** exhibits information on the evolution of public and private investment on economic infrastructure for our country in comparison to LAC countries in the 2008 – 2015 period[14]. As observed, infrastructure investment averaged 2% of GDP for the period, but displaying deterioration towards the last years of the sample. Compared to LAC, Argentina has had an average infrastructure investment deficit of 1.5% of GDP between 2008 and 2015, with a growing gap in the last years that topped a 2% of GDP. It can thus be concluded that for the last years of the sample (2013 – 2015), Argentina has made investments in economic infrastructure in terms of GDP that were lower by more than 50% to those made on average by the LAC countries.

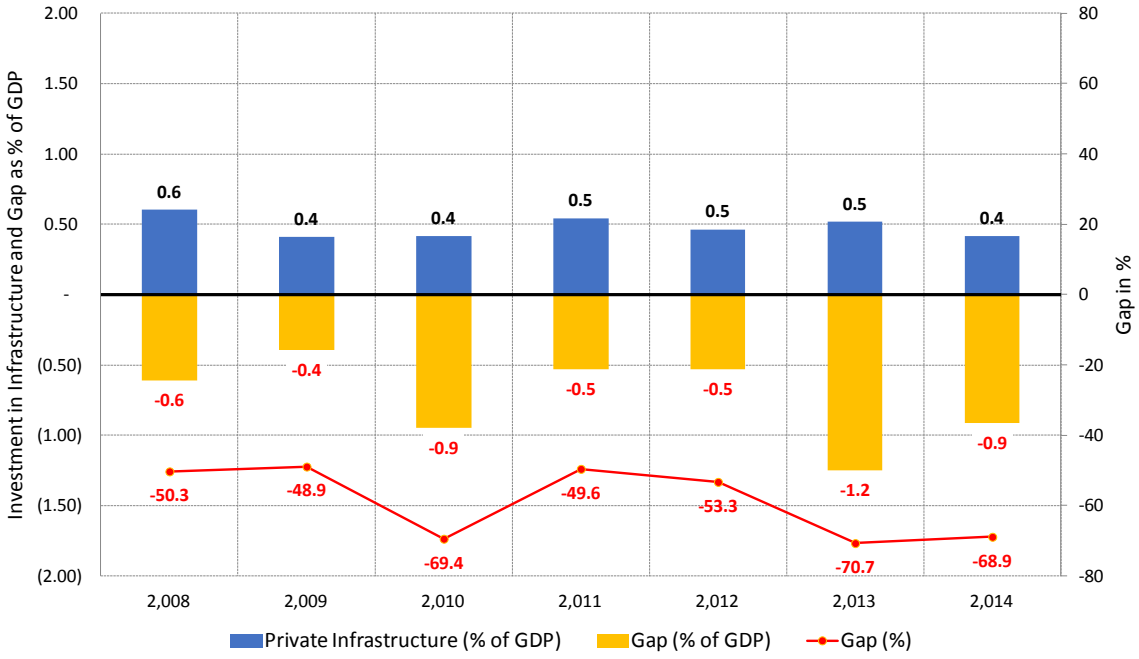
[14] Shown pictures are self-made based on the information revealed by the Project Infralatam (http://infralatam.info/).



Source: Qwn based on InfraLatam Database. http://www.infralatam.info/

This investment deficit in concept of economic infrastructure has been evidenced in public sector investments, but in a greater scale in the capital expenses made by the private sector. **Figure 6.4** depicts economic infrastructure related investments made by the private sector relative to GDP. This ratio has remained stable between 2008 – 2014, close to 0.5%, representing an investment deficit relative to LAC of 0.7% of GDP on average, with a difference that came to represent a gap of 70% in years like 2010, 2013 and 2014.

Figure 6.4. Argentina:
Private Investment in Infrastructure and Gap with Latin America

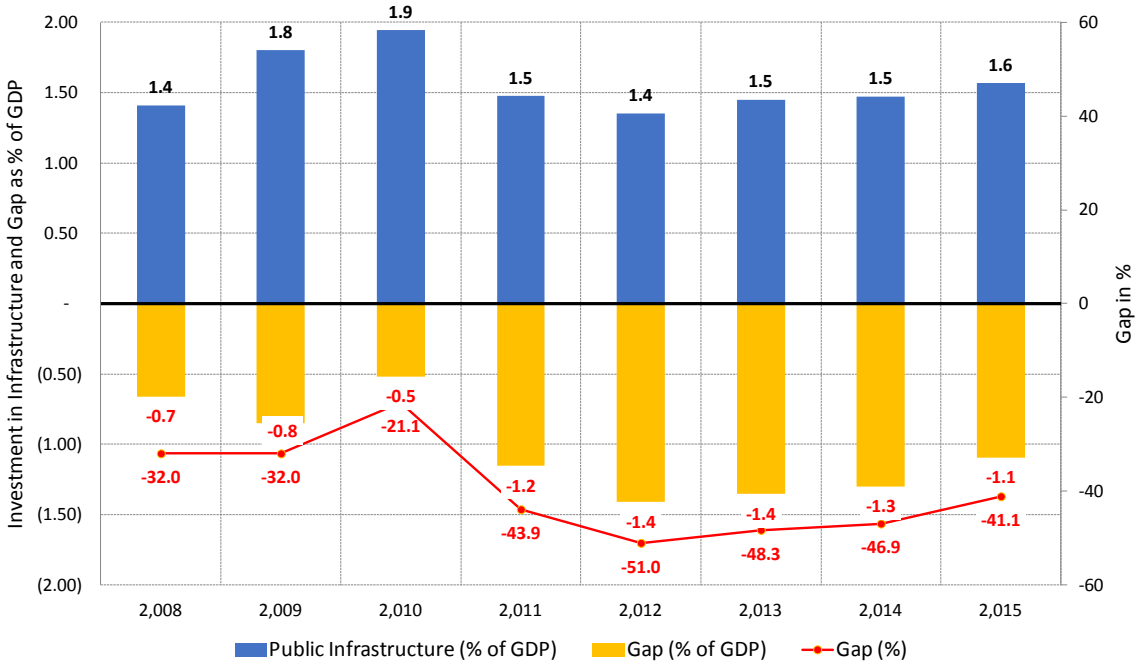


Source: Qwn based on InfraLatam Database. http://www.infralatam.info/

Public investment, on the other hand, explains the greater part of total investment on economic infrastructure, averaging 1.5% of GDP for period 2008 – 2015. In comparison to LAC's average, the obtained investment deficit was about 1% of GDP for the period and implied an average gap in the order of 40%, reaching a peak of 51% in 2012.

Figure 6.5.Argentina:

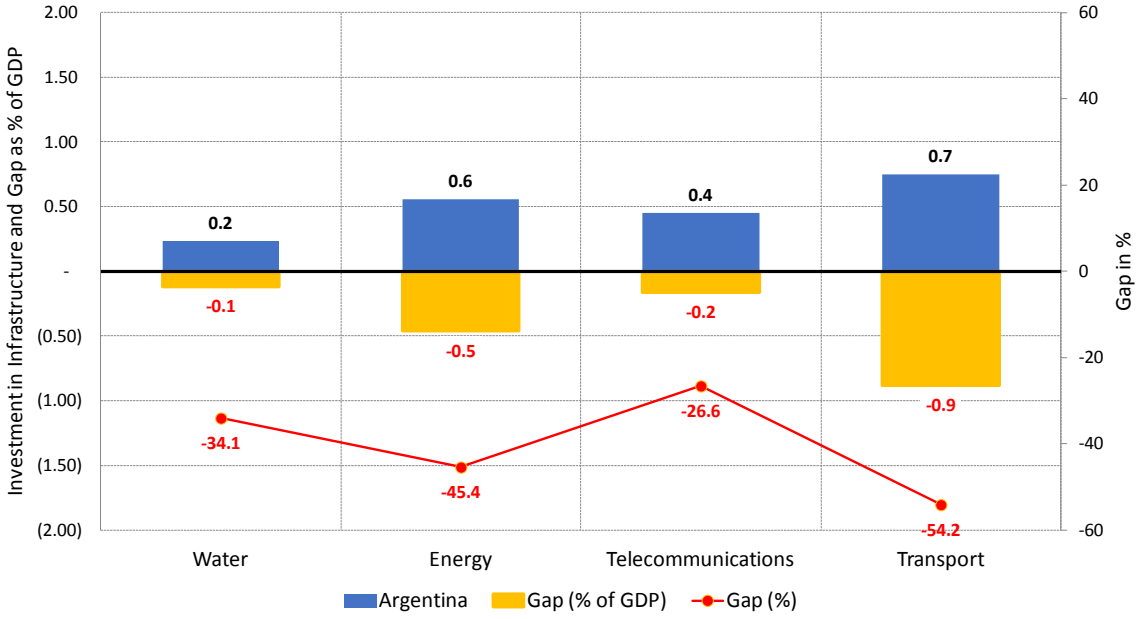
Public Investment in Infrastructure and Gap with Latin America



Source: Qwn based on InfraLatam Database. http://www.infralatam.info/

In terms of the sectors that have displayed the greater gap relative to LAC in 2008 – 2015 average terms, Transport & Utilities represented the highest investment deficits. This is exhibited in **Figure 6.6**, where the investment deficit in Transport relative to LAC's average reached an annual 0.9% of GDP, implying an equivalent investment gap of 56% in relation to LAC's average, with a pronounced decline in the period of analysis. Involving the Utilities sector, the average annual investment deficit resulted in 0.5% of GDP, a 45% below LAC's average, exhibiting a deterioration pattern similar to Transport's with a mild reversal in 2015. The investment gap for Water was more of a moderate nature (34% of LAC's average), whilst for the Telecommunications sector Argentina undertook investments some 26.6% below LAC's average for the 2008 – 2015 period.

Figure 6.6 Argentina:
Total Investment in Infrastructure 2008 - 2015
Average by Sectors and Gap with Latin America



Source: Qwn based on InfraLatam Database. http://www.infralatam.info/

Recent public investment on infrastructure in Argentina

An overview of different data sources spanning diverse periods for the recent years shows that Argentina consistently undertakes underinvestment across infrastructure sectors. Since 2017, estimates reveal public investment on economic infrastructure fell below 1% of GDP and continued downhill to the present where the active budget for 2019 displays the lowest public investment estimate of the decade. A sectoral analysis also sheds light on the fact that budget cuts related to capital expenses on infrastructure had their highest toll in relation to Transport and Utilities, crucial sectors where Argentina presents the most dramatic horizontal gap relative to many comparison groups. In **Annex B.1 to B.5** we present a detailed account on the different sources of information that yield investment estimates and on the budget items involved by sector and by program.

An approximation of investment needs in economic infrastructure.

In this section of the paper, is presented a preliminary approximation to the magnitude required of investment in infrastructure of Argentina to close the horizontal gap with respect to regions or groups of selected countries. The methodology used here starts from observing different indicators related to coverage

of infrastructure services. **Table 6.1** below shows these indicators for Argentina, LAC countries, regions and groups of countries according to their level of income, as well as the reference of the OECD and the case of Turkey. In the case of Argentina, its proximity group is the region and the group of high-income countries. **Table 6.1** shows that Argentina has a deficit of investment in electricity generation in comparison with the regions, except for South Asia and Sub-Saharan Africa, while in the comparison with high-income countries our country is better positioned to the average, but it lags behind the position of Turkey. In relation to neighboring countries such as Chile and Uruguay, Argentina shows a lower endowment in generation capacity, but it surpasses Brazil, Colombia, Mexico and Peru. The greatest distance generation capacity is in relation to North America and the group of OECD member countries.

Table 6.1 also shows that in terms of density of road infrastructure, Argentina is lagging behind any comparison groups: regional, by level of income, neighboring countries, members of OECD or Turkey. Except in relation to LAC, the density of the railway infrastructure yields a similar diagnosis, while in terms of port capacity measured by the flow of containers a similar diagnosis is reached. Comparisons of the indicators associated with the communications sector are varied, although Argentina's coverage measures yield better results than its closest comparison groups: LAC and high-income countries, including Turkey among the upper middle-income countries. In terms of Water and Sanitation, Argentina generally shows a better indicator of access to safe sources of water, surpassing all comparison groups and reached the average for OECD members, while in terms of sanitation there is a lag with respect to LAC, high-income countries and with respect to Turkey.

The quantification of the magnitude of resources needed to close the sectoral infrastructure gaps was carried out in two stages. First, the coverage or density differential, as appropriate for each indicator, was measured between the target associated with the group of reference countries and Argentina. The resulting spreads were expressed in absolute terms, that is: in KW of generation capacity, in km of roads and railways, in port capacity measured in TEUs and in number of subscriptions and population with access to infrastructure services considered in the analysis. For this purpose were used the parameters of population, area, GDP for Argentina, so that for each indicator the horizontal gap (deficit) was quantified according to the country or group of benchmark. In a second stage, the valuation of the deficits at 2018 prices was carried out, using the unit costs of infrastructure presented by Sánchez et al (2017) and Ruiz Nuñez and Wei (2015) updated to 2018 according to the evolution of American wholesale inflation.

Table 6.1

Infrastructure Stock
Argentina and selected countries
By Infraestructure Sector

	Electric Generating Capacity (kW/ per capita)	Paved Roads (km/Km^2)	Rail Lines (km/km^2)	Container Port Throughput (TEUs / GDP)	Fixed Telephone Subscriptions/ hab	Mobile cellular subscriptions/ hab	Fixed Broadband Subscriptions/ hab	Safe Water Access (% of population)	Safe Sanitation Access (% of population)
East Asia & Pacific	1.01	0.80	0.011	0.000032	0.18	1.00	0.115	90.5	78.3
Europe & Central Asia	1.82	1.81	0.041	0.000009	0.31	1.19	0.277	97.4	96.2
Latin America & Caribbean	0.95	1.00	0.010	0.000028	0.20	1.15	0.140	95.2	86.4
Argentina	***0.87***	***0.08***	***0.010***	***0.000004***	***0.22***	***1.40***	***0.178***	***99.6***	***94.8***
Brazil	0.72	0.19	0.004	0.000004	0.20	1.13	0.137	97.5	86.1
Chile	1.36	0.10	0.007	0.000015	0.18	1.27	0.169	100.0	99.9
Colombia	0.34	0.18	0.001	0.000009	0.14	1.27	0.129	96.5	84.4
Mexico	0.56	0.19	0.014	0.000005	0.16	0.89	0.133	98.3	89.2
Peru	0.46	0.11	0.002	0.000012	0.10	1.21	0.072	89.9	76.8
Uruguay	1.39	0.44	0.017	0.000018	0.33	1.47	0.275	99.2	95.7
Middle East & North Africa	1.38	0.98	0.013	0.000082	0.17	1.15	0.098	93.6	91.3
North America	3.27	0.29	0.014	0.000003	0.37	1.02	0.355	99.3	99.5
South Asia	0.42	0.54	0.018	0.000025	0.03	1.08	0.029	89.0	
Sub-Saharan Africa	0.12	0.19	0.004	0.000021	0.02	0.80	0.013	63.5	34.5

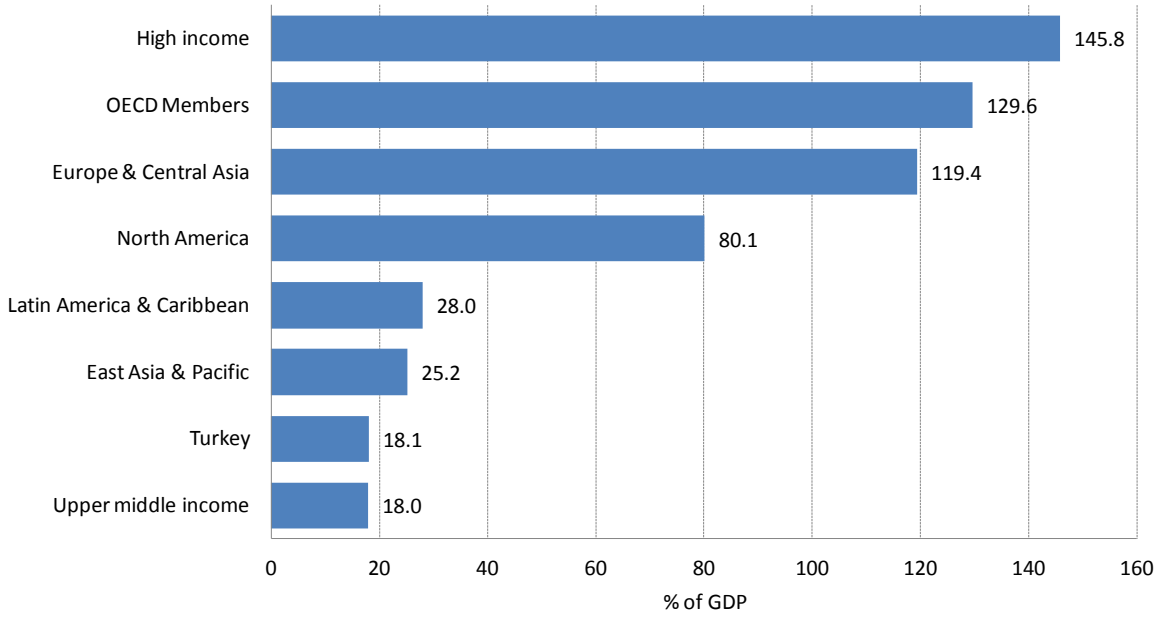
Argentina and selected countries by income level
By Infraestructure Sector

	Electric Generating Capacity (kW/ per capita)	Paved Roads (km/Km^2)	Rail Lines (km/km^2)	Container Port Throughput (TEUs / GDP)	Fixed Telephone Subscriptions/ hab	Mobile cellular subscriptions/ hab	Fixed Broadband Subscriptions/ hab	Safe Water Access (% of population)	Safe Sanitation Access (% of population)
High income	2.25	2.09	0.045	0.000025	0.34	1.25	0.278	99.0	97.4
Argentina	***0.87***	***0.08***	***0.010***	***0.000004***	***0.22***	***1.40***	***0.178***	***99.6***	***94.8***
Chile	1.36	0.10	0.007	0.000015	0.18	1.27	0.169	100.0	99.9
Uruguay	1.39	0.44	0.017	0.000018	0.33	1.47	0.275	99.2	95.7
Upper middle income	0.74	0.53	0.014	0.000021	0.16	1.10	0.115	94.1	85.7
Brazil	0.72	0.19	0.004	0.000004	0.20	1.13	0.137	97.5	86.1
Colombia	0.34	0.18	0.001	0.000009	0.14	1.27	0.129	96.5	84.4
Mexico	0.56	0.19	0.014	0.000005	0.16	0.89	0.133	98.3	89.2
Peru	0.46	0.11	0.002	0.000012	0.10	1.21	0.072	89.9	76.8
Turkey	0.97	0.49	0.013	0.000008	0.14	0.96	0.148	98.9	96.4
Lower middle income	0.30	0.28	0.010	0.000051	0.05	0.97	0.034	78.9	58.0
Low income	0.07	0.14	0.004	0.000028	0.01	0.65	0.006	61.3	32.5
OECD Members	2.36	1.33	0.046	0.000009	0.33	1.22	0.322	99.5	98.3

Source: Qwn based on EIA-DoE US; WDI – World Bank and UNCTAD.

The investment amounts required were expressed in terms of the GDP of 2018 and in **Figure 6.8** below are presented for each of the benchmarks selected for the closure of the sectorial infrastructure gap.

Figure 6.8 Argentina:
Investment Needs in Infrastructure in % of GDP (year 2018)
To close the horizontal gap with groups of selected countries



Source: Own results.

As can be seen in the previous figure, the effort to be made by Argentina to close the horizontal gap with high-income countries would imply an investment equivalent to 145.8% of GDP, or in the case of comparison with OECD member countries, the effort would reach up to 130% of GDP. At the other extreme, closing the gap with upper middle-income countries, as with Turkey for taking a case, would require a more modest effort equivalent to 18% of GDP.

Regarding the distribution by infrastructure sector of the investment requirements for closing the gaps, that will depend on the selected benchmark, although in all cases it is mainly concentrated in investments in the energy sector (expansion of the power generation capacity) and in the transport sector (densification of the road network, railway and expansion of port capacity). Precisely, these results are consistent with the previous diagnosis of deterioration in the quality of provision and underinvestment, especially public, in economic infrastructure by our country.

Table 6.2

Infrastructure investment needs to close the horizontal gap
By Infraestructure Sector
As % of GDP

	Energy	Transport	Comunications	Safe Water Access & Sanitation	Total needs
East Asia & Pacific	3.87	21.31	-	-	25.18
Europe & Central Asia	26.60	91.86	0.88	0.02	119.36
Latin America & Caribbean	2.21	25.78	-	-	27.99
North America	67.06	11.48	1.52	0.06	80.12
High income	38.63	106.07	1.07	0.03	145.80
Upper middle income	-	17.95	-	-	17.95
Turkey	2.95	15.11	-	0.02	18.08
OECD Members	41.62	86.76	1.21	0.04	129.64

Source: Own estimates.

Furthermore, in the previous **Table 6.2** it can be observed that in relation to all selected benchmarks, investments in the transport sector dominate the energy sector, with the exception of the case of North America, for which more than 83% of the investment effort required for closing the gap corresponds to the energy sector. Finally, in the previous figure it is observed that in communications the investment effort is lower and in relation to some of the selected benchmarks, Argentina has a greater coverage of services, while in relation to access to safe sources of water and sanitation, Argentina is at the frontier of coverage.

7. Complementary policies and the regulatory compact[15]

One of the main lessons of the development literature that emerge around the growth diagnostic and policy/priority problems is that complementarities are essential to a reasonable growth strategy. To put it differently, a one-bullet strategy will not deliver an effective policy for growth. One should start by saying that any policy proposal or strategy requires "support or context" conditions for success and a strategy based on channels as envisaged in this paper is not an exemption. It is <u>not</u> a win-win strategy under any or all institutional, policy or instrumental circumstances. That infrastructure needs a better interfase with several critical key areas is well known in the literature.[16]

[15] This section elaborates on Izquierdo et al (2018) from the perspective of the argentine case.

[16] See for example Helm and Mayer (2016). They identify three critical issues needed to improve infrastructure policy in order to avoid repeating a cycle of bad provision and management. One is acknowledging the system nature of infrastructure. The second is to critically improve accounting, particularly the balance sheet and the savings and investment process. The third is to improve

Given this background there are four areas relevant for an effective impact of infrastructure on growth.

First of all, complementarities should be addressed to avoid the so-called institutional second best problem (Rodrik, 2008) whereby certain institutional distortions preclude that reforms in certain sectors will be effectively welfare improving. This in turn requires a careful assessment of existing institutional restrictions. These are related to political economy restrictions that in Argentina, in the infrastructure-growth dimension, operate through several channels and need to be carefully factored in ex-ante (not ex-post) in the strategy. Argentina is particularly vulnerable to institutional second best because it does face several institutional constraints that are associated with its political equilibrium in a decentralized (federal) setting that leads to rent-seeking political culture (Gervasoni, 2010) and a political allocation of infrastructure projects. This later problem is more severe in social infrastructure projects (such as housing or water for households) than in productive infrastructure, although it has had an impact in both transport (roads) and also energy infrastructure. Besides this political allocation process there is the problem of severe corruption that Argentina has had to face in the interfase between the construction sector and infrastructure projects. Thus Argentina needs a substantial effort to bring transparency and economic rationality to the selection of infrastructure projects. Recent developments in PPP legislation have tried to move the practice towards international standards but continuous reform process is much needed.

Second, there are conventional (i.e. market related distortions) second-best problems or bottlenecks that may impede that a good supply of physical infrastructure is translated into better infrastructure services.[17] These problems range from (output or input) market power in direct or ancillary services that operate the infrastructure and may create price distortions, to fiscal related distortions, to even market disequilibrium due to policy interventions. Among this list of distortions those that limit the market size of infrastructure services are perhaps the most important to

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governance and regulation. Complementarities as understood by the literature addressing priorities for growth or growth diagnostics have an ample view of many other interacting factors affecting a given policy strategy, as for example the interaction between infrastructure and capital market distortions or regulatory institutions at large. As stated by these authors, infrastructure has another characteristic akin to broader complementarities that requires a systems analysis to allocate resources, beyond the piece meal evaluation of Cost Benefit Analysis.

[17] One approach to sectoral policy recently adopted by Argentina, the so called "mesas sectoriales", represents a good practice to gather interested parties in a given, sectoral value-chain (from energy to manufacturing and service subsectors) to identify bottlenecks and perform troubleshooting. In all these instances infrastructure shows up and therefore the practice allows an identification of infrastructure projects with direct sectoral impact

consider. There is one thing worse than not having proper infrastructure which is having it underutilized because of market distortions in the exchanges supported by infrastructure. Given this, competition policy is a complementary policy area for infrastructure insofar as it helps shaping and controlling an appropriate industrial organization of markets for services provided by infrastructure. While regulatory design and policy manage the critical problems of ex post opportunism and time inconsistency that afflict infrastructure, competition policy in related markets should move in a consistent and coordinated manner to avoid that investments projects in infrastructure be granted contractual provisions that exclude or hinder competition. All sectors of infrastructure should be subject to competitive surveillance and be exposed to deregulation in the interest of enlarging the size of markets for goods and services. Recent efforts in Argentina in air transport should be extended to other areas. Industrial organization issues in the construction industry, related to the adoption of digital technologies such as BIM, need also be addressed (see FIEL, 2019). This deregulation approach also includes trade policy. Even if there is scant evidence on the influence of trade openness to productivity in general or at a sectoral level, our econometric results suggest channels present in manufacturing (as expected) and also in domestic trade.

Third, sound fiscal policies are fundamental to the successful implementation of an infrastructure based growth strategy. Budget institutions are critical to govern the balance sheet of infrastructure investment and the medium term savings-investment coordination. The fact that government does not have a balance sheet equivalent to that of a private sector company; second, that there is an inbuilt bias in favor of consumption over investment which constraints the supply of funds towards projects; and third, that a system analysis is not properly included in the cost benefit analysis in standard government approaches. The effects of the current expenditure bias has been recently documented by an analysis performed in Ardanaz and Izquierdo (2017) which shows a deleterious rebalancing between current and capital expenditures during recessions. Our measurement of public investment performance in the 2017-19 cyclical downturn in Argentina adds another dimension to the Ardanaz-Izquierdo asymmetric effect. As we disaggregate among components of capital expenditure we are able to observe which infrastructure projects suffer most during recessions. As it turns out the evidence suggest that energy infrastructure suffered more than transport infrastructure. This may be consistent with the inertia of infrastructure projects as well as with political allocation bias, apart from the fact stated in section 6 that gaps are more prominent in infrastructure transport. Nevertheless our analysis in section 4 and 5 shows that this does not quite correspond with the best configuration for obtaining productivity growth effects, as energy infrastructure (contained in

Utilities in our data base) has larger elasticities (on aggregate productivity) than transport.

Fiscal accounting is also critical in the case of infrastructure and growth because there are ways in which an unaccounted depletion of capital (through under maintenance of infrastructure, privatization of assets to sustain public consumption or depletion of natural resources such as energy and mining reserves) may create severe problems for growth. These problems call the attention to the creation of an infrastructure balance sheet in the public sector, even under a partially decentralized infrastructure provision under PPP --i.e. regardless who owns them- that may provide both sustainability and system analysis.

Finally, there are two "sound microeconomic" dimensions in the addition of infrastructure capital that are cross-cutting in a growth strategy. One is that the final costs of infrastructure services be as low as possible, which not only means competition for the investment but absence of subsidies to the supply that end up raising the costs by cost-plus mechanisms. Cost overruns in infrastructure provision should be a focus of attention as recent evidence suggest (Serebrisky *et al*, 2017), but also overall cost of infrastructure services should be guided by a cost minimization doctrine (see for example Helm, 2017). The other dimension is that there should be very good demand management of infrastructure use, where the use of prices and taxes be correctly designed to avoid inefficient use of infrastructure. Argentina's performance on both fronts, costs and demand management of infrastructure service provision, badly needs improvement.

8. Concluding remarks

Several reports and papers on infrastructure and growth have produced empirical results that account for the importance of aggregate or different types of infrastructure investment on aggregate growth (eg Calderon and Serven, 2004, 2014; Egert *et al*, 2009; and Estache and Garsous, 2012) or on aggregate output (Calderon *et al*, 2015). There is no complete agreement on *which infrastructure* sector matters most for growth, with results that may depend on the methodology employed. However, there is no available empirical results on the sectoral impact of infrastructure (*which sectors*). Besides, the precise contribution of infrastructure to growth might not only be sector specific or even country specific but may also be conditional on the development stage. Thus, we follow Izquierdo *et al* (2018) and explore sectoral productivity growth and the performance of infrastructure related-sectors in terms of their contribution to productivity growth.

We have focused our study on a methodology (Ahumada and Navajas, 2019) that turns into an econometric exploration of the effects that productivity shocks in infrastructure related sectors have on other sectors. We exploit a data base that allow us to find that infrastructure productivity improvements trigger aggregate labor productivity growth through direct and, manly indirect effects across other sectors. A convergence of labor productivity growth in infrastructure related sectors to the rates shown by the best regional performers (which we call a low scenario case) would had been equivalent to a 44% increase in the annual growth rate of aggregate labor productivity in Argentina. Most of this (70%) comes from indirect effects of infrastructure productivity on other sectors. The improvement is substantially higher (almost 300%) if the convergence were to the best world performers (the high scenario case). Our results allow us to perceive *which infrastructure sectors on which sectors* have a higher impact. In the low or scenario Utilities (energy infrastructure mainly) explains half of the (indirect) effects, while Construction explain most of the rest and Transport (mainly transport infrastructure) has a minor effect.

Regarding the sectoral distribution of the investment requirements for closing gaps, it is mainly concentrated in investments in the transport sector (densification of the road network, railway and expansion of port capacity) and in the energy sector (expansion of the power generation capacity). Precisely, these results are consistent with the previous diagnosis of deterioration in the quality of provision and underinvestment, especially public, in economic infrastructure by our country. And it is also consistent with the efforts revealed in recent infrastructure policy and PPP programs. Nevertheless, the adjustment in energy infrastructure effort in the last two years somehow departs from the desired direction. In other words, the recent capital spending (procyclical) adjustment in capital spending observed in Argentina has been more biased in favor of transport sector projects as opposed to energy infrastructure projects. Beyond the Ardanaz and Izquierdo (2017) result of procyclical bias adjustment against capital spending, our results suggest that there may be another bias inside capital spending that is not entirely consistent with a productivity shocks analysis. This apparent dissonance between investment efforts and the potential productivity impacts found in our results should be subject to further analysis as it may depend on the lumpy and temporal allocation of projects and the fact that transport's investment in Argentina is mainly in roads which maps into the Construction sector and therefore could in principle feed back into productivity effects (although we have not found econometric support for this hypothesis).

Agriculture, Manufacturing, Domestic Trade and Financial Services are the four sectors whose labor productivity performance benefit from improvement in the productivity of infrastructure related sectors. In the low scenario, the first two sectors (which are tradable and with relatively high productivity gap in relation to the

economy-wide) benefits from productivity improvements in Utilities and Transport and receive two-thirds of (indirect effects) improvement s in productivity, but in the high scenario their share is below 50%. Thus our results do not support a view that infrastructure productivity shocks increase the productivity gap or the heterogeneity across sectors. Domestic Trade and Financial Services, both non-tradable and low productivity sectors in Argentina and according our results benefit from improvements in capital productivity in Construction. Neither our results suggest that productivity impact sectors with low labor demand as these four sectors explain 48% of employment in 2014.

Our results that even modest infrastructure productivity improvements can make a visible difference in growth performance should be balanced by the fact that they do not to make a case for fast growth in Argentina because the status quo is one of very low productivity (see Figure 3.2) with a meager annual growth rate of 0.4% in labor productivity across our sample. Thus a 44% jump still leaves Argentina in a low rate box and only convergence to high (Asian) productivity growth in infrastructure productivity could make a big difference. Nevertheless, this view is inaccurate and too skeptical of our results. First, our assumed convergence of productivity growth in infrastructure sectors is really modest or achievable as it has best performers in LAC countries. Second, the relative improvement in growth rates strongly suggests that the impact is truly significant. Last, but not least, historical performance in Argentina suggests that sectoral productivity shocks (like the ones originated in infrastructure related sectors) have not been properly transmitted or generated spillovers due to severe governance problems.

Thus our analysis of complementary policies has warned about the idea that only infrastructure investment is fine for a growth strategy. In fact, being a productivity-shocks argument rather than an investment-shock one, our analysis captures both hardware (capital) and software (productivity) elements interacting in raising performance. To avoid second-best problems (both at an institutional and policy levels) we strongly advocate for a "regulatory compact" that maximizes the effect of for infrastructure productivity improvements. In particular, we favor competition and deregulation (in input and output markets related to energy and transport infrastructure) as well as sound fiscal policies as crucial companion ingredients. Nevertheless we have to fair enough to acknowledge that this position comes more from a reasonable policy approach than from econometric results. We cannot make a strong case from general statements without the support of sound estimates and despite a battery of controls being used in our regressions we have not obtained strong effects from institutional or regulatory variables, except one –not minor- case. This is trade intensity which in our regressions plays a significant positive effect in the productivity performance of both Manufacturing and Domestic Trade.

The results for Argentina obtained in this paper gave us the satisfaction to have used a somewhat novel approach to explore the link between infrastructure and sectoral growth at a more disaggregated level than other previous studies and makes us confident to extend the study to others LAC economies. Nevertheless we acknowledge that the limitations or problems in our results come from two avenues that we believe deserve more efforts in several directions. First, we need in future work to overcome the still too-aggregated nature of our sectors, a thing that will depend on efforts of measurement that lead to consistent databases. Second, even with this aggregation we would benefit from the development of the KLEMS methodology for LAC, which would allow us to implement a model that studies TFP shocks within a consistent growth accounting framework which by construction still preserving the methodological homogeneity we have demanded in our study.

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Annex A

Econometric Estimates

In this **Annex A** we report the econometric output of the modeling strategy outlined in section 4. For each sector we report the OLS results followed by the IVE estimation procedure and the long run equation that relates sector "s" labor productivity with sector "j" labor productivity, capital-labor effects or capital productivity effects.

Notation in all Tables is straightforward. D stands for first difference, L stands for log, y_s_ARG_1 stands for labor productivity in sector "s" (s=agr (agriculture), min (mining), man (manufacturing), utl (utilities), con (construction), tsc (Transport), trh (Domestic Trade), fire (Financial Services), gvs (Government Services), csp (Social Services). ARG stands for Argentina while _1 stands for t-1. Capital-Labor in sector "s" is denoted by "k", thus capuital productivity (which is not measured as an independent variable, but rather emerges from a simplifying specification in our model) is represented by Ly_s – Lk_s, that is the difference between (the logs of) labor productivity and capital-labor. Impulse dummies are represented by I:year. Other control variables are show explicitly, for example Ltrade_share_ARG is the log of the trade share of Argentina as defines in the Data set (see Table 1.1 in the main text).

Agriculture (agr)

Table A.1: Agriculture Sector (OLS) - Argentina

Modelling DLy_agr by OLS	Coefficient	t-value	t-prob
Constant	0.335	1.94	0.060
Ly_agr_ARG_1	-0.797	-6.79	0.000
Ly_con_ARG_1	0.126	2.60	0.014
Ly_utl_ARG_1	0.356	6.45	0.000
Ly_tsc_ARG_1	0.155	2.91	0.006
Ly_tsc_ARG-Lk_tsc_1	0.0607	2.70	0.011
DLy_tsc_ARG	0.300	3.59	0.001
I:2009	-0.162	-3.48	0.001

sigma	0.044
R^2	0.684
Adj. R^2	0.619
sample	1973-2014

Table A.2: Agriculture Sector (IVE) - Argentina			
Modelling DLy_agr by IVE	Coefficient	t-value	t-prob
Constant	0.330	1.85	0.073
Ly_agr_ARG_1	-0.800	-6.63	0.000
Ly_con_ARG_1	0.127	2.53	0.016
Ly_utl_ARG_1	0.357	6.38	0.000
Ly_tsc_ARG_1	0.157	2.80	0.008
Ly_tsc_ARG-Lk_tsc_1	0.0601	2.59	0.014
DLy_tsc_ARG	0.308	2.71	0.011
I:2009	-0.162	-3.48	0.001

sigma	0.044
no. of endogenous variables	2
no. of instruments	9
no. of observations	42
no. of parameters	8
Specification test: Chi^2(1)	1.4570 [0.2274]
Testing beta = 0: Chi^2(7)	67.977 [0.0000]**

Additional instruments: DLk_tsc, DLk_tsc_1
Note: Sample spans 1973-2014

Comments:
IVE similar OLS, tsc exogenous SR and no LR effects of agr level on each infrastructure sectors LR from OLS
Ly_agr = constants + 0.19 Ly_tsc + 0.45 Ly_utl + 0.16 Ly_con + 0.08 (Ly-Lk)_tsc
SR effects negative effect from DLy_man-1 but similar LR elasticities

Manufacturing (man)

Table 3: Manufacturing Sector (OLS) - Argentina			
Modelling DLy_man by OLS	Coefficient	t-value	t-prob
Constant	0.632	5.40	0.000
Ly_man_ARG_1	-0.229	-5.71	0.000
Ly_utl_ARG_1	0.0898	5.91	0.000
DLy_tsc_ARG	0.218	5.13	0.000
Ltrade_share_ARG_1	0.152	6.59	0.000
DLtrade_share_ARG	0.197	8.22	0.000
I:1975	0.0929	3.18	0.003
I:1979	0.171	6.28	0.000

sigma	0.026
R^2	0.822
Adj. R^2	0.785
sample	1973-2014

Table A.4: Manufacturing Sector (IVE) - Argentina			
Modelling DLy_man by IVE	Coefficient	t-value	t-prob
Constant	0.633	5.40	0.000
Ly_man_ARG_1	-0.229	-5.71	0.000
Ly_utl_ARG_1	0.0901	5.91	0.000
DLy_tsc_ARG	0.202	3.83	0.001
Ltrade_share_ARG_1	0.153	6.59	0.000
DLtrade_share_ARG	0.196	8.19	0.000
I:1975	0.0921	3.14	0.004
I:1979	0.172	6.28	0.000

sigma	0.026
no. of endogenous variables	2
no. of instruments*	9
Specification test: Chi^2(1)	2.4825 [0.1151]
Testing beta = 0: Chi^2(7)	144.33 [0.0000]**
sample	1973-2014

** Additional instruments: DLk_tsc, DLk_tsc_1*

Comments:

IVE similar OLS, tsc exogenous SR and no LR effects of man level on utl

LR from OLS:

Ly_man = constants + 0.39 Ly_utl + 0.66 Ltrade_share

SR and LR effects effects from DLy_trh but similar LR elasticities (0.4)

Trade, Restaurants and Hotels (trh)

Table A.5: Trade, Restaurants & Hotels Sector (OLS) - Argentina			
Modelling DLy_trh by OLS	Coefficient	t-value	t-prob
Constant	1.80	4.48	0.000
Ly_trh_ARG_1	-0.417	-4.81	0.000
Ly_con_ARG-Lk_con_1	0.122	2.79	0.001
Ltrade_share_ARG_1	0.156	4.57	0.000
DLy_con_ARG-Lk_con	0.245	4.60	0.000
Dltrh_ARG_1*	0.138	1.31	0.198
I:1979+80	0.125	3.36	0.002

** se incluye por autocorrelación*

sigma	0.045
R^2	0.664
Adj. R^2	0.606
sample	1973-2014

Table A.6: Trade, Restaurants & Hotels Sector (IVE) - Argentina			
Modelling DLy_trh by IVE	Coefficient	t-value	t-prob
Constant	1.790	4.47	0.000
Ly_trh_ARG_1	-0.417	-4.79	0.000
Ly_con_ARG-Lk_con_1	0.122	2.67	0.011
Ltrade_share_ARG_1	0.156	4.56	0.000
DLy_con_ARG-Lk_con	0.243	2.58	0.014
Dltrh_ARG_1*	0.138	1.27	0.212
I:1979+80	0.125	3.33	0.002

sigma	0.045
no. of endogenous variables	2
no. of instruments*	9
Specification test: Chi^2(2)	0.35631 [0.8368]
Testing beta = 0: Chi^2(8)	36.925 [0.0000]**
sample	1973-2014

** Additional instruments: DLk_con, DLk_con_1, I:2002*

Comments:
IVE similar OLS
LR from OLS:
Ly_trh = constants + 0.29 (Ly-Lk)_con+ 0.37 Ltrade_share

Finance, Insurance and Real Estate (fire)

Table A.7: Finance, Insurance & Real Estate Sector (OLS) - Argentina			
Modelling DLy_fire by OLS	Coefficient	t-SE	t-prob
Constant	1.53	4.11	0.000
Ly_fire_ARG_1 *	-0.264	-3.35	0.002
Ly_con_ARG-Lk_con_1	0.200	4.03	0.000
I:1975	-0.371	-4.74	0.000
I:1977-78+-	0.359	6.43	0.000

sigma	0.074
R^2	0.737
Adj. R^2	0.709
sample	1973-2014

** For the Error Correction term the t-statistic si-4.25*

Table A.8: Finance, Insurance & Real Estate Sector (IVE) - Argentina			
Modelling DLy_fire by IVE	Coefficient	t-value	t-prob
Constant	1.57	4.36	0.000
Ly_fire_ARG_1	-0.248	-3.23	0.003
Ly_con_ARG-Lk_con_1	0.229	4.53	0.000
DLy_con_ARG	0.244	2.68	0.011
I:1975	-0.427	-5.68	0.000
I:1977	0.362	5.05	0.000
I:1978	-0.357	-4.62	0.000

sigma	0.067
no. of endogenous variables	2
no. of instruments	13
no. of observations	42
no. of parameters	7
Specification test: Chi^2(6)	7.7222 [0.2592]
Testing beta = 0: Chi^2(6)	136.74 [0.0000]**

Additional instruments: DLy_con_ARG_1,DLk_con, Ly_con_ARG_1, I:1985, I:1989, I:1990, I:2002
Note: Sample spans 1973-2014

Comments:
IVE similar OLS
LR from OLS
Ly_trh = constants + 0.94 (Ly-Lk)_con
(Using IVE 0.92)
SR effects effect from DLy_trh LR elasticities (1.3)

Mining (min)

Table A.9: Mining Sector (OLS) - Argentina			
Modelling DLy_min by OLS	Coefficient	t-JHCSE	t-prob
Constant	0.0211	1.51	0.140
DLy_tsc_ARG	0.626	4.00	0.000
DLy_con_ARG_2	0.303	3.11	0.004
dumm2001-2104	-0.146	-4.58	0.000

sigma	0.082
R^2	0.582
Adj. R^2	0.548
sample	1974-2014

Comments:

Model only in (log) differences. No different estimates from IVE.

Break in the rate of growth after 2001

Government services (gvs)

Table A.10: Government Services Sector (OLS) - Argentina			
Modelling DLy_gvs by OLS	Coefficient	t-JHCSE	t-prob
Constant	-0.00193	-0.43	0.669
DLy_con_ARG_1	0.0832	2.57	0.015
I:1977	-0.0808	-2.89	0.007
I:1980	0.0968	3.47	0.001
I:1982	-0.207	-7.39	0.000
I:2002	-0.123	-4.28	0.000

sigma	0.027
R^2	0.755
Adj. R^2	0.721
sample	1973-2014

Comments:
Model only in (log) differences
SR effect of CPS on GVN

Community, social and personal services (csp)

Table A.11: Community, Social & Personal Services Sector (OLS) - Argentina			
Modelling DLy_csp by OLS	Coefficient	t-value	t-prob
Constant	-0.006	-1.15	0.259
DLy_con_ARG_1	0.142	3.46	0.014
I: 1980	0.101	2.91	0.006
I:1982	-0.199	-5.72	0.000
I:2003	0.131	3.59	0.001

sigma	0.034
R^2	0.639
Adj. R^2	0.600
sample	1973-2014

Comments:

Model only in (log) differences
Large short run effect of GVS

Annex B.
Infrastructure investment and recent budgetary data in Argentina

The present section carries forward an inspection of patterns and magnitudes of economic infrastructure investment undertaken by the Argentine public sector. A qualitative and quantitative comparison is made on the diverse available measurements from different information sources across the last couple of years, including own estimates elaborated for the present document, and thus proceeds to verify what do budget details reveal about public investment: its magnitude relative to the economy and its composition across the selected infrastructure sectors.

Coherent with the conclusions drawn from previous section, which exhibit a sharp underinvestment in Utilities and Transport sectors relative to several regions and income groups, as well as neighbor countries, it is of our interest to study where specifically is public investment on infrastructure skewed towards and focused into, with the aim of providing evidence that surfaces an incipient need to redirect this investment towards the sectors that need a closing of the existing horizontal gap.

Table B.1 details, in percentage points of GDP, the public budget items corresponding to economic infrastructure sectors based on two sources of information: Infralatam, from which data spans up until 2015, and *Ministerio de Hacienda*, where data is drawn from consolidate budgets up until 2017 and from the *Informe Mensual de Ingresos y Gastos* (IMIG) up until 2018.

Table B.1

Argentina

Public investment in Economic infrastructure by economic sector[1]

As a percentage (%) of GDP[2]

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
National Public Sector[3]	**TOTAL**	**(..)**	**1.41**	**1.80**	**1.95**	**1.48**	**1.35**	**1.45**	**1.47**	**1.57**	**(..)**	**(..)**	**(..)**
	Utilities	(..)	0.53	0.56	0.57	0.41	0.40	0.42	0.51	0.67	(..)	(..)	(..)
	Transport	(..)	0.75	0.93	0.90	0.75	0.62	0.68	0.62	0.58	(..)	(..)	(..)
	Communications	(..)	0.01	0.05	0.19	0.11	0.11	0.12	0.09	0.08	(..)	(..)	(..)
	Water & Sanitation	(..)	0.13	0.27	0.28	0.21	0.23	0.24	0.25	0.24	(..)	(..)	(..)
National Public Sector[4]	**TOTAL**	**1.12**	**1.30**	**1.29**	**1.41**	**1.37**	**1.37**	**1.57**	**1.88**	**1.39**	**1.01**	**0.94**	**(..)**
	Utilities	0.26	0.41	0.30	0.39	0.32	0.41	0.43	0.93	0.56	0.26	0.21	(..)
	Transport	0.74	0.75	0.79	0.77	0.75	0.62	0.71	0.62	0.53	0.55	0.56	(..)
	Communications	0.00	0.01	0.04	0.10	0.12	0.13	0.19	0.09	0.10	0.01	0.01	(..)
	Water & Sanitation	0.11	0.14	0.17	0.15	0.18	0.22	0.24	0.24	0.20	0.18	0.15	(..)
Non-Financial National Public Sector[5]	**TOTAL**	**(..)**	**(..)**	**(..)**	**(..)**	**(..)**	**(..)**	**(..)**	**(..)**	**(..)**	**1.07**	**0.96**	**0.77**
	Utilities	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	0.38	0.24	0.21
	Transport	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	0.50	0.54	0.43
	Communications	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)
	Water & Sanitation	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	(..)	0.18	0.18	0.12

Note:

(..) No Data

[1] *Investment is measured by Capital Expenses*

[2] *GDP data for 2018 based on FMF - FIEL estimates to date (08/02/2018). Previous to 2018, INDEC estimates for GDP are used.*

[3] *Source: INFRALATAM - CEPAL. In accrual basis, based on Ministerio de Producción. Subnational investments only account for those financed by capital transfers from the Central National Government. No data is available on investments made by provinces & municipalities using their own funds.*

[4] *Source: Oficina Nacional de Presupuesto del Ministerio de Hacienda. It computes real direct investment and capital transfers to provinces and state-owned enterprises in accrual basis.*

[5] *Source: Informe Mensual de Ingresos & Gastos del SPNF, Ministerio de Hacienda. It computes in cash basis real direct investment and capital transfers to provinces made by the Non-Financial National Public Sector.*

During the period 2008 – 2015 covered by Infralatam, data-available years match those corresponding to the data from *Oficina Nacional de Presupuesto*, which enables direct comparison. In particular, 2012 is the year in which the estimates most closely resemble, in terms of magnitude and sectoral composition.

In general, Infralatam estimates exceed our own measurements based on information from *Ministerio de Hacienda* (excepting 2012 – 2014 period) with variable dispersion. These inconsistencies can be partly explained by the fact that Infralatam estimates are based on investment measured on an accrual basis, whilst data from *Oficina Nacional de Presupuesto* are calculated on a cash basis system, causing that possible budget under-executions may be opening a gap between both accounting method. As a last possible source for data deviations, estimates from Ministerio de Hacienda may include updates and revisions which may not have been captured by the Infralatam project in constructing their estimates.

It must be duly noted that during 2014, year in which estimates from *Ministerio de Hacienda* exceed with the biggest difference those from Infralatam, most of the gap is explained by an abnormally large capital transfer from the Central National Government under the Utilities item. Discounting this specific capital transfer, we find that the match between both sources of information is as close as to the 2012 one in terms of scale and composition. In general, years with the highest inconsistencies between both sources do not show systematic patterns in terms of which particular sector should be attributed for the gap.

Having exposed the main discrepancies, we must state that in average both sources are consistent on the magnitude and skewed patterns of investment in between sectors. Excepting some particular cases, the most heavily invested sector is Transport, followed by Utilities, and finally by Water and Communications, respectively. Taking into account the conclusion that indicates a higher effort on these first two sectors, it is possible that more capital expenses in concept of infrastructure are required in order to close the gap relative to LAC, in presence of the magnitudes exposed by the previous section.

Estimates are consistent in showing that since 2017 public investment in economic infrastructure breaks the 1% of GDP floor to locate itself in levels operating in opposite direction from the recommendations stemming from our previous analysis. To make things worse, the two sectors where investment has its sharpest decline are Utilities and Transport, where investment efforts should be majorly focused.

Table B.2 exhibits the detail of estimates corresponding to *the Informe Mensual de Ingresos y Gastos* from *Ministerio de Hacienda*. It is evident that the deterioration in matter of investment in economic infrastructure throughout these last years is mostly explained by a downfall in the capital expenses from behalf of the Non-Financial National Government, given that on average transfers to provinces do not fall in the same order of magnitude. In particular, Utilities sector stands out as the most punished sector in this sense, falling in 2018 to nearly half its investment value relative to two years before (2018) in terms of GDP. This sharp decline is entirely explained by the level of capital expenditure undertaken by the Non-Financial National Government, given that transfers to provinces in fact increase for the corresponding time window.

Table B.2

Argentina

Capital Expenses incurred by the National Non-Financial Public Sector[1]

By economic sector

As a percentage (%) of GDP[2]

	2016	2017	2018
Energía	**0.38**	**0.24**	**0.21**
Nación	0.35	0.19	0.14
Transferencias a provincias	0.03	0.04	0.07
Transporte	**0.50**	**0.54**	**0.43**
Nación	0.43	0.44	0.38
Transferencias a provincias	0.08	0.10	0.05
Agua potable & alcantarillado	**0.18**	**0.18**	**0.12**
Nación	0.14	0.14	0.09
Transferencias a provincias	0.05	0.04	0.04
Total	**1.07**	**0.96**	**0.77**
Nación	0.92	0.77	0.61
Transferencias a provincias	0.15	0.19	0.16

[1] Source: Informe Mensual de Ingresos & Gastos del SPNF, Ministerio de Hacienda. It computes in cash basis real direct investment and capital transfers to provinces made by the Non-Financial National Public Sector.

[2] GDP data for 2018 based on FMF - FIEL estimates to date (08/02/2018). Previous to 2018, INDEC estimates for GDP are used.

Also due a notice, investment on Transport more than doubles the amount for the case of Utilities. Although investment needs answer to structurally different matters across sectors, this evidence leaves it clear that if Argentina suffers from underinvestment in Transport infrastructure, the case seems even worse for the Utilities sector.

A synthesis of expended budget items for 2018 is detailed in **Table B.3**. The importance of State-owned Trust Funds and Non-Financial State-owned Enterprises does indeed stand out. Although they are mainly financed with capital transfers from the Central National Government, they do contribute with their own resources to the capital expenses of the aggregate Non Financial Public Sector.

Table B.3

Argentina: Capital Expenses[1] as % of GDP[2] - 2018						
	Central National Government[3]	+	State-owned Trust Funds[4]	+	Non Financial State-owned Enterprises[4]	= CNG + STF + NFSE
Utilities	0.10		0.01		0.04	**0.14**
Transport	0.29		0.07		0.02	**0.37**
Communications	0.01		(..)		0.00	**0.01**
Water & Sanitation	0.12		(..)		(..)	**0.12**
Expended Budget 2018	**0.51**		**0.08**		**0.06**	**0.64**

Source: Ministerio de Hacienda (Presupuesto Abierto + Empresas Públicas & Fondos Fiduciarios)

[1] *We define Capital Expenses as the sum of Real Direct Investment and Capital Transfers, thus deliberately excluding Financial Investment.*

[2] *Based on FMF - FIEL forecasts and estimates to date (08/02/2019)*

[3] *Expended budget (cash basis) accumulated at year's closing*

[4] *For STF and NFSE Capital Expenses taken into account are net from Capital Transfers from the Central National Government, according to approved budgets.*

Evidence is consistent in showing that in 2018 the level of capital expenses undertaken in concept of economic infrastructure not performs well below the region's average but also falls short in comparison to Argentina's average from the last years (which already had an underinvestment diagnosis signaling a need for heavier capital expenses).

The estimates for investment on infrastructure result being lower than the ones published in the IMIG and the possible sources for the difference can be spotted with ease. The sectors where the estimates show discrepancies are Transport (0.37% of GDP against 0.43% published in the *IMIG*) and Utilities (14% against 21% published). Part of the difference is explained by the fact that we do not compute financial investment as a capital expense item, whilst the methodology of *Ministerio de Hacienda* does so. This is especially relevant for the case of Transport, where upon computing financial investment the difference between estimates reduces from 0.06% of GDP to 0.02%; this also applies to the Utilities sector, although not with the same impact.

Another possible cause for estimate differences arises from the fact that our own estimates add up the approved budget items for capital expenses corresponding to State-owned Trust Funds and Enterprises (Non-Financial), whilst the estimates published in *IMIG* are probably based on the actually expended amounts, not publicly available. Specially for the case of Utilities where the difference is the highest, it is possible for the IMIG estimates to include other entities included in the Non Financial Public Sector whose information is not available (e.g.: IEASA (ENARSA), YPF).

A similar study on budget items can be done in a preliminary fashion using the active budget for 2019 (which is constantly updated by *Ministerio de Hacienda*), detailed in **Table B.4**. Although no proper information is yet available on State-owned Trust Funds or Enterprises, at a Central National Government level we observe that the active and projected capital expenses on infrastructure for the rest of 2019 do not show an increased effort on the matter of sector focusing. In particular, the decline for the Utilities sector is such that its projected investment is actually exceeded by the items for Water & Sanitation (although this could be explained by further fund-delegation to provinces, trust funds or state-owned enterprises belonging to the sector).

Table B.4

Argentina: Capital Expenses[1] as % of GDP[2] - 2019	
	Central National Government[5]
Utilities	**0.04**
Transport	**0.38**
Communications	**0.01**
Water & Sanitation	**0.12**
Active Budget 2019[6]	**0.54**

Source: Ministerio de Hacienda (Presupuesto Abierto + Empresas Públicas & Fondos Fiduciarios)

[1] We define Capital Expenses as the sum of Real Direct Investment and Capital Transfers, thus deliberately excluding Financial Investment.

[2] Based on FMF - FIEL forecasts and estimates to date (08/02/2019)

[3] Active Budget up to 08/02/2019

[4] STF & NFSE are excluded for lack of information up to date

Annexes B.2 and B.3 exhibit the detailed budget items expended in 2018 and programmed for 2019 divided into infrastructure investment programs. An initial observation must be made upon the fact that with the exception of Transport, most of the investment efforts are delegated in form of capital transfers to State-owned Enterprises and other entities corresponding to each sector. A major share of capital expenses for Utilities, Communications and Water & Sanitation are made as capital transfers to be administered by entities not under the orbit of the Central National Government.

A last comment is to be made on the actors involved in these estimates: no consistent data is available for measuring capital expenses undertaken by provinces and municipalities using own funds (rather than capital transfers from the Central National Government). Thus, all of our calculations excluded investment done at a sub-national level with the use of resources other than transfers from the national sphere. As a note, we refer to a report elaborated by the DNCFP from *Ministerio de Hacienda* in 2015 which estimates the composition at every jurisdictional level for real direct investment corresponding to where the resources come from in the Non-financial Public Sector, for year 2013 only. Annex C.5 displays the detail for the composition of investment: most of it is undertaken at a national level (whether in form of real direct investment or capital transfers), but provinces and municipalities add up to some 39% of total real direct investment in 2013. It is not possible to conclude how these capital expenses are distributed amongst sectors (i.e.: the share of expenses on economic infrastructure sectors of our interest) so no further analysis can be made, but its order of magnitude must be duly noted as a rough approximation.

Annex B. 2. Central National Government: expended budget in concept of capital expenses by infrastructure sector and program item – 2018.

Argentina: Central National Government's expended budget[1,2] in concept of capital expenses[3] by infrastructure sector and by program - 2018

Sector / Program	Real Direct Investment	Capital Transfers	Total	% of GDP[4]	% Central Nat. Govt. + STF + NFSE[5]
Transport	**30133**	**11594**	**41727**	**0.29%**	**0.37%**
Ejecucion Obras de Rehabilitacion y Mantenimiento en Red por Sistema de Gestion Integral	9035		9035		
Ejecucion Obras de Mantenimiento y Rehabilitacion en Red por Administracion	5432		5432		
Asist. Fin. a Emp. Publicas y Otros Entes Sector Transporte		5299	5299		
Construccion de Autopistas y Autovias	5092		5092		
Infraestructura de Obras de Transporte	2548	2018	4566		
Construcciones de Obras Viales fuera de la Red Vial Nacional	565	3929	4495		
Repavimentacion de Rutas Nacionales	3073		3073		
Construccion de Rutas Nuevas y Obras de Pavimentacion	1523		1523		
Ejecucion de Obras, Operacion y Mantenimiento en Corredores Viales	1509		1509		
Coordinacion de Politicas de Transporte Fluvial y Maritimo	385	0	386		
Modernizacion de la Red de Transporte Ferroviario	0	261	261		
Ejecucion Obras de Seguridad en Rutas Nacionales	248		248		
Construccion de Tuneles y Puentes Grandes	200	0	200		
Infraestructura en Concesiones Viales	141		141		
Actividades Centrales	99		99		
Reparacion y Construccion de Puentes y Alcantarillas	97		97		
Actividades Comunes a los Programas 61 y 62	0	85	85		
Regulacion, Fiscalizacion y Administracion de la Aviacion Civil	72	0	72		
Construccion y Puesta en Valor de Infraestructura de Apoyo y Soporte al Plan Vial Nacional	39		39		
Ejecucion de Obras Menores para el Fortalecimiento de la Red Vial	29		29		
Servicios de Meteorologia Nacional	22		22		
Fiscalizacion, Regulacion y Control del Servicio de Transporte Terrestre	19		19		
Investigacion de Accidentes y Promocion de la Seguridad	1		1		
Transporte Aereo de Fomento	1		1		
Control del Sistema Nacional de Aeropuertos	0		0		
Actividades Comunes a los Programas 61, 62 y 91	0		0		
Construccion de Rutas Seguras	0		0		
Coordinacion de Politicas de Transporte Vial	0		0		
Infraestructura en Areas Urbanas	0		0		

Continues……

Sector / Program	Real Direct Investment	Capital Transfers	Total	% of GDP[4]	% Central Nat. Govt. + STF + NFSE[5]
Water & Sanitation	**1702**	**16052**	**17754**	**0.12%**	**0.12%**
Otras Asistencias Financieras a Empresas Publicas y Otros Entes		8767	8767		
Asistencia Tecnico - Financiera y Desarrollo de Infraestructura para el Saneamiento	1548	2098	3646		
Recursos Hidricos	154	3199	3353		
Asistencia Financiera a Empresas Publicas		1989	1989		
Utilities	**1642**	**12207**	**13849**	**0.10%**	**0.14%**
Asist. Fin. a Emp. Pub. y Otros Entes Sect Ener, Comb y Min		8829	8829		
Formulacion y Ejecucion de Politica de Hidrocarburos	1591	36	1627		
Desarrollo Energetico Provincial	0	1570	1570		
Acciones para la Ampliacion de las Redes Electricas de Alta Tension		1155	1155		
Formulacion y Ejecucion de la Politica de Energia Electrica	0	485	485		
Acciones para el Uso Racional y Eficiente de la Energia	0	111	111		
Actividades Centrales	19		19		
Regulacion del Transporte y Distribucion de Gas	13		13		
Formulacion y Ejecucion de la Politica Geologico - Minera	0	11	11		
Formulacion y Ejecucion de la Politica Geologico-Minera	0	11	11		
Regulacion y Fiscalizacion de las Actividades Nucleares	9		9		
Regulacion y Contralor del Mercado Electrico	7		7		
Control de Seguridad de Presas	2		2		
Otras Asistencias Financieras		0	0		

Continues……

Sector / Program	Real Direct Investment	Capital Transfers	Total	% of GDP[4]	% Central Nat. Govt. + STF + NFSE[5]
Communications	**35**	**691**	**726**	**0.01%**	**0.01%**
Asistencia Financiera a Empresas Publicas		473	473		
Asistencia Financiera a Empresas y Otros Entes del Sistema Federal de Medios y Contenidos Publicos		142	142		
Otras Asistencias Financieras a Empresas Publicas y Otros Entes		70	70		
Formulacion y Ejecucion de Planes y Programas inherentes a Contenidos	14		14		
Formulacion de Iniciativas para la Implementacion de Expresiones Federales	7		7		
Administracion y Gestion de Proyecto de Fomento y Desarrollo	0	6	6		
Control y Fiscalizacion de Servicios de T.I.C.	6		6		
Actividad Comun a los Programas 70, 71 y 72	4		4		
Actividades Centrales	2		2		
Formulacion de Iniciativas para la Implementacion de Contenidos en Parques Tematicos	1		1		
Enseñanza, Capacitacion y Habilitacion	1		1		
Atencion de Usuarios	0		0		
Administracion de Servicios de Tecnologias de la Informacion y las Comunicaciones	0		0		
Control de Servicios Postales	0		0		
Formulacion y Coordinacion de Politicas de Comunicaciones		0	0		
Total	**33512**	**40543**	**74055**	**0.51%**	**0.64%**

Source: Ministerio de Hacienda (Presupuesto Abierto)

[1] Expended budget (cash basis), accumulated at end of 2018

[2] Expressed in millions of current argentine pesos and % of GDP

[3] The computed definition excludes Financial Investment, although Ministerio de Hacienda does include it under its criteria

[4] Using FMF - FIEL 2018 GDP estimates to date (08/02/2019)

[5] Capital expenses net from capital transfers from the Central National Government in approved budgets of State-owned Trust Funds (STF) & Non-Financial State-owned Enterprises that are included under the criteria of conomics infrastructure are added. The Fondo FIduciario de Infraestructura Hídrica is excluded for executing capital investments that do not fall under our criteria for economic infrastructure corresponding to Water & Sanitation (they involve in productive land retrieval and management, flood prevention and so

Annex B. 3. National Central Government: active budget in concept of capital expenses by infrastructure sector and by program item – 2019.

Argentina: Cental National Government's active budget[1,2] in concept of capital expenses[3] by infrastructure sector and program - 2019

Sector / Program	Real Direct Investment	Capital Transfers	Total	% of GDP[4]
Transport	**59539**	**18312**	**77851**	**0.38%**
Construccion de Autopistas y Autovias	24923		24923	
Asistencia Financiera a Empresas Publicas y Otros Entes del Sector Transporte		13571	13571	
Infraestructura de Obras de Transporte	10035	3184	13219	
Ejecucion Obras de Mantenimiento y Rehabilitacion en Red por Administracion	10951		10951	
Ejecucion Obras de Rehabilitacion y Mantenimiento en Red por Sistema de Gestion Integral	4135		4135	
Ejecucion de Obras, Operacion y Mantenimiento en Corredores Viales	2386		2386	
Repavimentacion de Rutas Nacionales	2194		2194	
Construccion de Rutas Nuevas y Obras de Pavimentacion	1970		1970	
Modernizacion de la Red de Transporte Ferroviario	26	1058	1083	
Construcciones de Obras Viales fuera de la Red Vial Nacional	684	289	973	
Construccion de Tuneles y Puentes Grandes	510		510	
Coordinacion de Politicas de Transporte Fluvial y Maritimo	466	1	467	
Construccion y Puesta en Valor de Infraestructura de Apoyo y Soporte al Plan Vial Nacional	351		351	
Ejecucion Obras de Seguridad en Rutas Nacionales	276		276	
Reparacion y Construccion de Puentes y Alcantarillas	244		244	
Actividades Comunes a los Programas 61 y 62	4	210	214	
Mantenimiento y Reparacion de Obras de Arte	166		166	
Construccion de Rutas Seguras	111		111	
Actividades Centrales	51		51	
Fiscalizacion, Regulacion y Control del Servicio de Transporte Terrestre	25		25	
Regulacion, Fiscalizacion y Administracion de la Aviacion Civil	13		13	
Ejecucion de Obras Menores para el Fortalecimiento de la Red Vial	8		8	
Investigacion de Accidentes y Promocion de la Seguridad	4		4	
Control del Sistema Nacional de Aeropuertos	3		3	
Actividades Comunes a los Programas 61, 62 y 91	3		3	
Coordinacion de Politicas de Transporte Vial	2		2	
Servicios de Meteorologia Nacional	0		0	

Continues……

Sector / Program	Real Direct Investment	Capital Transfers	Total	% of GDP[4]
Utilities	**4282**	**3039**	**7322**	**0.04%**
Formulacion y Ejecucion de la Politica de Energia Electrica	2073	2144	4216	
Formulacion y Ejecucion de Politica de Hidrocarburos	1848	346	2194	
Asistencia Financiera a Empresas Publicas y Otros Entes de la Sec. de Gob. de Energia y Combustibles		549	549	
Actividades Centrales	271		271	
Regulacion del Transporte y Distribucion de Gas	42		42	
Regulacion y Fiscalizacion de las Actividades Nucleares	30		30	
Regulacion y Contralor del Mercado Electrico	14		14	
Control de Seguridad de Presas	4		4	
Acciones para el Uso Racional y Eficiente de la Energia	0		0	
Formulacion y Ejecucion de la Politica Geologico - Minera		0	0	
Asistencia Financiera a Empresas Publicas		0	0	
Water & Sanitation	**2236**	**21729**	**23965**	**0.12%**
Otras Asistencias Financieras a Empresas Publicas y Otros Entes		10359	10359	
Asistencia Tecnico - Financiera y Desarrollo de Infraestructura para el Saneamiento	1616	4724	6340	
Recursos Hidricos	620	3757	4377	
Asistencia Financiera a Empresas Publicas		2889	2889	

Continues…….

Sector / Program	Real Direct Investment	Capital Transfers	Total	% of GDP[4]
Communications	**140**	**949**	**1089**	**0.01%**
Asistencia Financiera a Empresas Publicas		509	509	
Asistencia Finan. a Empresas y Otros Entes de la Sec. de Gob. del Sist. Fed. de Medios y Cont. Pub.		400	400	
Formulacion de Iniciativas para la Implementacion de Expresiones Federales	49		49	
Control y Fiscalizacion de Servicios de Tecnologias de la Informacion y las Comunicaciones	41		41	
Administracion y Gestion de Proyecto de Fomento y Desarrollo	0	39	39	
Formulacion de Iniciativas para la Implementacion de Contenidos en Parques Tematicos	37		37	
Actividad Comun a los Programas 71 y 72	13		13	
Enseñanza, Capacitacion y Habilitacion	0		0	
Control de Servicios Postales	0		0	
Administracion de Servicios de Tecnologias de la Informacion y las Comunicaciones	0		0	
Control y Fiscalizacion de los Servicios de Comunicacion Audiovisual	0		0	
Actividades Centrales	0		0	
Atencion de Usuarios	0		0	
Total	**66198**	**44029**	**110227**	**0.54%**

Source: Ministerio de Hacienda (Presupuesto Abierto)

[1] *Active budget as to 08/02/2019*

[2] *Expressed in millions of current argentine pesos and % of GDP*

[3] *The computed definition excludes Financial Investment, although Ministerio de Hacienda does include it under its criteria*

[4] *Using FMF - FIEL 2019 GDP forecasts to date (08/02/2019)*

Annex B.4: Capital expenses in approved budgets as % of GDP – 2018. Non-financial State-owned Enterprises and State-owned Trust Funds

Argentina: Capital Expenses[1] in approved budgets as % of GDP[2] - 2018

Non Financial State-owned Enterprises

Company	Sector	Investment
NASA	*Utilities*	0.04%
Aerolíneas & Austral	*Transport*	0.01%
AGP	*Transport*	0.00%
INTERCARGO	*Transport*	0.00%
TANDANOR	*Transport*	0.00%
VENG S.A.	*Communications*	0.00%
COVIARA	-	0.00%
DIOXITEC	*Utilities*	0.00%
LT10 - UNL	*Transport*	0.00%

NFSE Subtotals	**Water & Sanitation**	-
	Communications	**0.00%**
	Utilities	**0.04%**
	Transport	**0.02%**
	NFSE Total	**0.06%**

State-owned Trust Funds

Trust Fund	Sector	Investment
FF Sistema de Infraestructura del Transporte	Transport	0.07%
FF de Infraestructura Hídrica	Water & Sanitation	0.06%
FF para el Transporte Eléctrico Federal	Utilities	0.01%
STF Total		**0.14%**

Source: Ministerio de Hacienda (Empresas Públicas & Fondos Fiduciarios)

[1] Net from capital transfers from the Central National Government

[2] Using FMF - FIEL GDP estimates for 2018

Note: NFSE & STF included are those that fall under the criteria for investing in economic infrastructure

Annex B.5: Composition of real direct investment according to jurisdiction on the Non-financial Public Sector and origin of funds

Real Direct Investment in Non-financial Public Sector by resource origin (2013)		
National	61%	% of total real direct investment
Provinces	23%	
Municipalities	16%	

Source: Informe de la DNCFP, Ministerio de Hacienda, marzo 2015

Annex C

Public-Private Participation Projects

In order to accelerate the process of investment in infrastructure required by our country, the government authorities have opted to move forward in Public Private Participation (PPP) schemes, in addition to the infrastructure capital expenditures that are taken from the different levels of government.

The Secretariat of Public Private Participation (SPPP), under the Ministry of Finance, is in charge of preparing the programs and development plans for projects under this modality, as well as understanding all the stages required by the process of implementing the projects, including the identification of best practices in ethics and transparency in the development of projects.

At the beginning of 2018, the SPPP had identified 60 projects to be developed under this modality, involving investments for USD 26 billion to be disbursed between 2018 and 2023. Due to its relative importance, the list of projects is dominated by those associated with energy and mining, transport, communication and technology and water, sanitation and housing.

By the end of 2018, the financing costs of the works have prompted the authorities to postpone the call for bids for any new project, keeping only those concessions underway for the Network of Highways and Safe Routes (RARS). Concessioned highway corridors correspond to Stage 1 of the RARS project and involved an investment of more than USD 8 billion, with more than USD 6 to be disbursed until 2022. The financing problems faced by the national government have extended the start of the concessioned projects.

Without considering the investments directed to the sectors of health (construction of hospitals), housing or to the penitentiary service (construction of jails), the priority projects identified are:

1. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 3 y 226 - Corredor A.

2. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Route N° 5 - Corredor B.

3. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Route N° 7 - Corredor C.

4. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 8 36 158 y A005- Corredor D.

5. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 9 A008 A012 1V11 34 11 y 193 - Corredor E.

6. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 9 y 33 - Corredor F.

7. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 12 16 - Corredor G.

8. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 9 34 38 66 1V66 y A016 - Corredor H.

9. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 3 33 229 249 y 252 - Red de Accesos a Bahía Blanca.

10. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Routes N° 34 y 19.

11. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Route N° 205 Autopista Buen Ayre y A002- Acceso Sur a Buenos Aires.

12. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Route N° 40 y Ruta Nacional N° 47 – Province of Mendoza, Corredor Cuyo.

13. Construction of Highways, Safe Routes, Rehabilitation, Maintenance, Operation and Financing of National Route N° 3 y Ruta Nacional N° 205 – Province de Buenos Aires, Corredor J.

14. Renovation and Improvement of Railways Bahía Blanca - Añelo (Proyecto Vaca Muerta) - Provincias de Buenos Aires Río Negro y Neuquén.

15. Extra High Voltage Line 500 kw between E.T. Río Diamente - E.T. Charlone Extensions ET - Provinces of Buenos Aires and Mendoza.

16. New Extra High Voltage Line 500 kw for the Linking of the ATucha II ET - ET Belgrano I, Expansions ET - Buenos Aires Province.

17. New Transformer Station 500/220 kw Oscar Smith and New Line Extra High Voltage 500 kw - Province of Buenos Aires.

18. New 500 kV Extra High Voltage Line for the Bonding of the Charlone ET - ET Intermedia - ET Plomer ET Extensions - Buenos Aires Province.

19. New 500 kV Extra High Tension Line for the Vivorata ET - ET Plomer ET, and ET Extensions - Buenos Aires Province.

20. New Transformer Station 500/220 kV Plomer for the connection of lines- Province of Buenos Aires.

21. New Extra High Voltage Line in 500kV to link the Choele Choel ET - ET Puerto Madryn 2 ° Te National Route No. and Expansions ET - Provinces of Chubut and Rio Negro.

22. New Extra High Voltage Line 500kV for the Bonding of ET Rodeo - ET La Rioja and Expansions ET - Provinces of La Rioja and San Juan.

23. Project of Replacement of Public Lighting.
24. Construction of Intermediate Meseta Irrigation System - Province of Chubut.
25. Mari Menuco irrigation system - Province of Neuquén.
26. Black Dead irrigation system - Province of Río Negro.
27. Acueducto Rio Subterráneo Norte Construction - Province of Buenos Aires.
28. Laferrere Water Treatment Plant and Associated Networks Construction - Province of Buenos Aires.
29. Construction of the Escobar Wastewater Treatment Plant - Province of Buenos Aires.
30. Construction of the Santa María Water Treatment Plant - Province of Buenos Aires.
31. Construction Plants North and Southwestern Wastewater Treatment Plants - Waste to Energy - Province of Buenos Aires.
32. Reduction Water not accounted Gran Mendoza, Province of Mendoza.
33. North Aqueduct System.
34. Development of the Micro Plan and Macrometering of Aguas del Norte.
35. Gran Rosario water treatment plant, Province of Santa Fe.
36. Santa Fe Water Treatment Plant, Province of Santa Fe.
37. San Miguel de Tucumán sewage system remediation and Metropolitan Area, Province of Tucumán
38. Improvement in the Railway Connectivity of Loads in Port Accesses.
39. Improvement of the Charges Network to Improve the Competitiveness of the Regional Economies.
40. Road Corridors for Access to Metropolitan Areas.
41. Improvement in Passenger Rail Connectivity in the Metropolitan Area.