



# POVERTY & EQUITY NOTES

AUGUST 2018 · NUMBER 8

## Distributional Effects of Investments in Road Infrastructure: The case of Colombia's 4th Generation Concession Program

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*Estimating ex-ante distributional impacts of road infrastructure is increasingly important to better understand the poverty effects of these investments. This note presents such analysis for the ongoing 4<sup>th</sup> generation (4G) road concessions program in Colombia, which involves the concession of 40 new roads and the transformation of 8,170 kilometers of road network. An ex-ante evaluation of the program suggests that 180,000 jobs will be created and that moderate and extreme poverty would decline by 0.5 and 0.3 percentage points, respectively.*

Improving transportation infrastructure contributes to enhance competitiveness, promote economic growth, reduce unemployment, and decrease socioeconomic gaps by easing access to education, health services and opportunities (Brenneman and Kerf, 2002; Calderon and Serven, 2010; Titheridge et al., 2014).

Businesses located in areas with poor transportation infrastructure tend to be less productive, meaning less employment and lower wages for their workers in the long run. However, investing in roads can lower transportation costs due to higher fuel consumption and delays due to congested traffic, saving significant time and effort for users, and freeing time and energy to be spent in other purposes. In turn, lower transportation costs can reduce the prices of goods and services relative to income for low-income families, making goods and services easier to access. Moreover, improving the design of roads for higher traffic safety can lead to a decrease in traffic-related accidents (Brenneman and Kerf, 2002), a frequent problem in

many developing countries because of poorly designed roads.

The Government of Colombia (GoC) aims to transform its road networks through the fourth generation (4G) of road concessions. The project includes the concession of 40 new roads and the transformation of 8,170 kilometers of road network, with more than 1,200 kilometers of double roadways, and a planned total investment of \$47 billion COP (US\$24.4 billion).

This note discusses the methodological approach to assess the potential distributional impacts of the 4G program launched by the GoC in 2012. These estimates were included as part of the Poverty and Social Impact Analysis (PSIA) of recent developing policy financing projects such as the Productive and Sustainable Cities II<sup>1</sup> and the Second Sustainable Growth and Income Convergence.<sup>2</sup> In addition, the 4G project is an example of the Maximizing Finance for Development (MfD) strategy promoted by the World Bank Group.<sup>3</sup>

<sup>1</sup> Colombia - Development Policy Loan for the Second Programmatic Productive and Sustainable Cities Operation, World Bank, 2014.

<sup>2</sup> Colombia - Second Programmatic Sustained Growth and Income Convergence Development Policy Loan (DPL) Program, World Bank, 2015.

<sup>3</sup> Mobilizing private finance for development in Latin America and the Caribbean, World Bank, 2018.

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## Ex-Ante Evaluations of the Distributional Impacts of Investments in Infrastructure

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Ex-ante analysis and evaluation of distributional impacts involves quantitative techniques to predict the effects of policies on poverty and inequality (Bourguignon and Pereira da Silva, 2003). The analysis allows to assess what would happen if certain policies were introduced or some shock affecting the economy was bound to happen—e.g., an improvement in road infrastructure.

An ex-ante analysis often requires the use of a model to create a counterfactual sample, which intends to simulate the population of interest under the counterfactual scenario in question. The simplest arithmetic approach to perform an ex-ante analysis does not assume any “policy response” by the agents, such as a pure accounting approach that computes only first-round effects and disregards any second-round effects attributable to behavioral responses. In contrast, behavioral approaches take second-round effects into account. For instance, an individual may decide to work more if new transport infrastructure improves his/her connectivity to the city; parents may decide to send their children to school or college if new urban transportation reduces travel time and is cheap enough to reduce the opportunity cost of attending school.

### Heterogeneous impacts

The geographic localization of routes and the dynamics of the local markets and social structures partially determine the size of the effects of new infrastructure on socioeconomic outcomes (Eugenio, 2010). New transport infrastructure can affect the localization of firms and workers, and increase or reduce concentration of workers in different areas. Changes in the spatial distribution of labor could lead to changes in the spatial location of goods and services provision. Infrastructure investments could display heterogeneous impacts across socioeconomic groups, due to individual preferences for transportation or externalities derived

from the localization of the new infrastructure. In addition, the type of transport infrastructure being provided can also have unequal impacts across firms. For example, some firms may benefit more from the construction of railroads than from the construction of highways if the latter provides a more expensive alternative for their distribution chain; while some firms may benefit more from having access to highways than to railroads. Thus, the importance of identifying the different users and potential beneficiaries of each type of transport investment, and to consider the externalities firms will face as a result (Eugenio, 2010).

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## The Case of Colombia: The 4G Network Investment Project

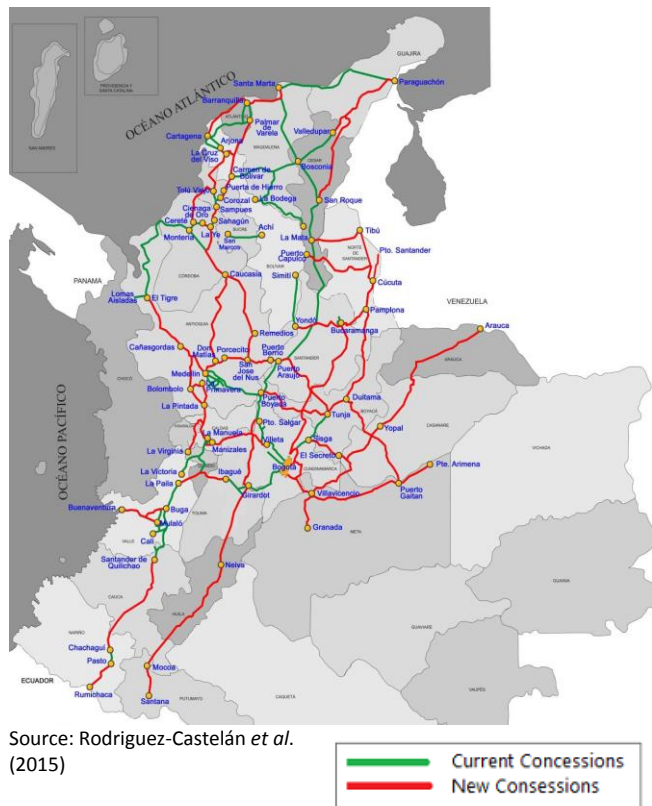
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In 2012 the GoC launched the 4G road concessions (Figure 1) to improve the existing national road network through public-private partnerships and help close Colombia’s infrastructure gap. The 4G project involves the concession of 40 new roads and the transformation of 8,170 kilometers of road network, with more than 1,200 kilometers of double roadways and a planned total investment of \$47 billion COP (US\$24.4 billion). Estimates from the GoC suggest that with increased infrastructure investments the country’s economy could reach a long-term growth trajectory of 5 to 5.3 percent, as opposed to 4.6 percent without the 4G program.

The GoC identified a pipeline of road transport concessions (approximately 8,170 kilometers of the primary road network), mandating the application of the following principles: (i) efficient project structuring to accelerate investments in infrastructure; (ii) a selection process that promotes transparent participation; (iii) contract management focused on results; and, (iv) adequate risks assignment between the public and private sector. As part of this policy, the GoC has also identified a set of “early wins” (4 projects, representing 551 kilometers), which were advanced in terms of structuring and implementation, to generate

demonstration effects and secure private investor appetite for subsequent projects.

**Figure 1: Poverty effects of Colombia's 4G road network**



Source: Rodríguez-Castelán *et al.* (2015)

The resulting investments in infrastructure are expected to have a direct and positive impact on the economy, boost public-private partnerships, and employment generation across the country, particularly in the construction sector. In addition, the investments are expected to have a positive impact on the reduction of inequality by increasing connectivity, boosting tourism and jobs in traditionally isolated regions, and improving access to markets and the supply of quality public services in rural areas. The overall positive impact on growth and income inequality suggests infrastructure development can be extremely effective to combat poverty.

### Expected impacts on social outcomes

In 2013 the *Departamento Nacional de Planeación* (DNP) used a Computable general equilibrium (CGE) model to estimate the effect of the 4G investment on

employment, growth and productivity. The project is estimated to generate from 180,000 to 450,000 jobs that will be distributed across the 24 departments where the different corridors will be built.

However, the micro-simulations conducted used the lower bound-conservative estimates (180,000 jobs). The 4G infrastructure investments could be classified in two groups: (i) Short-term investments (ongoing investments that are expected to be developed in a 2 to 5-year window), and (ii) medium-term investments. According to DNP (2013) the first will create around 32,000 jobs, while the second will create approximately 148,000 jobs. The results of these simulations are based on data of the 2012 labor force survey (GEIH).

The micro-simulation model distributes the total number of jobs at the national level by *Departamento* using as a driver the proportion of road kilometers of 4G in each *Departamento* relative to total kilometers planned in the entire 4G project. To assign jobs to the unemployed a logistic model is computed for each *Departamento*. The model uses as a binary dependent variable that defines if an employed individual belongs to the construction sector. Based on the model's coefficients the likelihood of being hired by the construction sector is computed for the unemployed. Finally, two variables are used to determine the draw of the jobs by *Departamento*. The first is a binary variable that flags unemployed individuals that have previous experience in the construction sector, and the second one is simply the probability of being hired. The micro-simulation sorts by both variables; it will hire the first unemployed who have experience in the construction sector, and with the highest probability of being hired within the same sector. Once individuals are hired, the micro-simulation imputes wages based on hot-deck methods and re-estimates household per-capita income and poverty status.

It is also important to mention the main assumptions of this approach: (i) the number of workers in the

construction sector is low in the labor survey. (ii) The simulation assumes that all employment is created simultaneously and is not a smoothing process. (iii) Job creation is lineal with respect of expected number of km. in each *Departamento*.

Results suggests that new jobs will lead to a reduction of moderate and extreme poverty by 0.5 and 0.3 percentage points, respectively. Under the more optimistic scenario, which considers the realization of both the expected short and medium-term infrastructure projects, moderate and extreme poverty are expected to fall by 1.1 and 0.5 percentage points.

Since investments are expected to take place throughout the country, poverty reduction is also expected to occur nationwide. The simulations reveal that poverty reduction exceeds 0.2 percentage points in 20 of the 24 *Departamentos*. Although the returns to infrastructure investments are expected to benefit the entire country, these are likely to have a greater positive development impact on *Departamentos* that were previously disconnected from the national and international economies. In other words, the 4G project is expected to promote regional economic convergence. Even after controlling for other determinants of GDP growth at the *Departamento* level, such as education, health and other public services, the results of a prospective conditional convergence model show that implementation of 4G investments would increase the rate of income convergence between poor and rich *Departamentos* over the period of operation.

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## Conclusions

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Transport infrastructure can play a transformative role in socioeconomic development by providing mobility

and connectivity. Transport infrastructure provides physical access to new markets, reduces geographic impediments to trade, and unleashes processes of urbanization that increase productivity by creating economies of scale. Adequate transport infrastructure also enables access to jobs and social services, increasing opportunities, incomes and welfare.

The GoC launched the 4G road concessions to improve transport infrastructure. The 4G project has the potential to boost competitiveness by reducing costs of transport and logistics, and improve social outcomes by promoting growth, employment, higher real wages and easing access to education and health services.

The resulting infrastructure investments are expected to have a direct and positive impact on the economy, boost public-private partnerships, and generate employment across the country, especially in construction. The ex-ante evaluation suggests that 180,000 jobs will be created and moderate and extreme poverty will fall by 0.5 and 0.3 percentage points. In addition, the proposed investments are also projected to have a positive impact on the reduction of inequality by increasing connectivity, boosting tourism and jobs in traditionally isolated regions, and improving access to markets and the supply of quality public services in rural areas.

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