Report 1: Productivity and Economic Growth

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# Introduction

Productivity in Brazil has not grown – rather, it has grown very little – since the late 1970s. This finding is as true as it is discouraging. Regardless of the indicators analyzed, the outlook remains very much the same and, despite a slight upward movement in the early 2000s, there have not been many significant advances.[[3]](#footnote-3) Considering that long-term economic growth is a consequence of the countries’ ability to produce more using the same amount of work,[[4]](#footnote-4) the weak productivity performance has limited the country’s growth during the last decades. Even during Brazil’s last economic growth period, between the early 2000s and the 2008 crisis, productivity did not grow significantly. Most of the economic growth during this period was due not to productivity gains, but to the positive performance of the labor market, expressed as better employment and labor participation rates.

The growth in labor productivity is largely derived from the increase in capital stock in the economy. The low level of investment and the reduced capital/labor ratio existing in Brazil are, therefore, key variables in explaining its low levels of productivity and its insufficient growth in recent years. But, these variables are not the only ones. Aspects such as human capital, innovation, and business climate are strongly correlated with productivity levels. In Brazil, infrastructure deficiencies and the persistence of productive disparities between regions or between groups of companies entail an element of complexity in this scenario.

Therefore, creating conditions to restore economic growth requires public policies explicitly aimed at increasing the country’s productivity. Among the policy instruments available, credit from the National Economic and Social Development Bank (BNDES) may be the most powerful, both in terms of the volume of resources available and in terms of the costs and terms of its lines of credit. Thus, it is crucial that this instrument be increasingly geared toward investments that allow the expansion of economic productivity.

Therefore, the overall objective of this study is to contribute to the development of documentation to support a lending operation from the Inter-American Development Bank (IDB) for BNDES (operation BR-L1442), whose objective is to provide financing for specific segments, in order to stimulate the Brazilian economy’s productivity growth. To do this, we have collected information and analyses about the relationship between productivity growth and the increase of investments in segments of interest, namely: *i)* Micro, small and medium enterprises (MSMEs); *ii)* Infrastructure; and *iii)* Renewable energy. The emphasis of the study lies in the potential impacts of these activities and economic segments on the country’s aggregate productivity. In addition, it seeks to develop indicators that can be used by the IDB to monitor and evaluate this operation.[[5]](#footnote-5)

# Productivity in Brazil: Developments and Bottlenecks

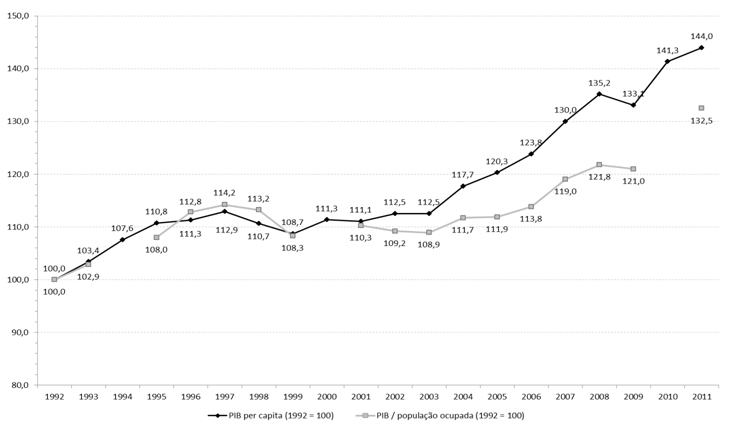
One of the main results shown in the book “Productivity in Brazil: performance and determinants” (“Produtividade no Brasil: desempenho e determinantes” by Negri; Cavalcante, 2014, 2015) is that, regardless of the measurement method of the indicator , the aggregation level used, or even the reference country for comparison, the country’s productivity has had a very weak performance in recent decades. In fact, the general sign of the total productivity factors (TPF) or labor productivity indicators point in this direction.

Ellery Jr (2014) calculates the TFP for the period between 1970 and 2011 based on different combinations of deflators, labor quantity and human capital measurements, and adjustments for use of installed capacity, concludes that, for any combination thereof, productivity increased slightly during this period in Brazil. According to the author, “the TFP trajectory […] consists of growth during the first half of the 1970s, irregular growth in the second half of the 1970s, a fall in the 1980s, and a recovery beginning in the 1990s, which was insufficient for recovering the losses experienced in the 1980s.”

Meanwhile, the average annual rate of aggregate labor productivity growth in Brazil, defined as the ratio between gross domestic product (GDP) and total employed population, was 1.09% from 1992 to 2001 and 1.17% from 2001 to 2009. Although the different methods used to adjust the series of the employed population – and, sometimes, the different time period aggregations – may lead to slightly different results, it can be said that the labor productivity maintained, during the 1990s and 2000s, a steady, though reduced, growth trajectory (around 1% per year).[[6]](#footnote-6)

As can be seen in Chart 1, in the 1990s, growth rates for productivity and GDP per capita remained at similar levels. However, in the following decade, despite the reduced growth in labor productivity, the growth rates for the GDP per capita observed were reasonable.

**Chart 1: GDP per capita and Labor Productivity – Brazil (1992-2011) (1992 = 100)**



Source: De Negri and Cavalcante (2014).

|  |  |
| --- | --- |
| PIB per capita (1992=100) | GDP per capita (1992=100) |
| PIB / população ocupada (1992=100) | GDP / employed population (1992=100) |

One way to explain the reasons for this disconnect is through the algebraic identity *GDP* = (*GDP* / *PO*) x *PO*, in which *GDP* is the gross domestic product and *PO* represents the employed population. The algebraic manipulation of this identify allows us to conclude that the growth rate of the GDP corresponds to the sum of the labor productivity growth rate and the employed population growth rate.[[7]](#footnote-7) In the first decade of the 2000s, the growth of the employed population at rates higher than the total population growth explains why the GDP *per capita* is separate from the labor productivity when their trajectories are shown in a chart. Thus, it was the incorporation of a large portion of the population into the labor market and the reduced unemployment rate that explain a significant portion of the growth in GDP *per capita* between 2001 and 2009. However, this disconnect is sustained for only a short period of time. In fact, the weak performance of the labor market in Brazil as of 2014 makes productivity a key variable in restoring the country’s economic growth process.

The low aggregate productivity growth in Brazil is, therefore, the result of a wide set of factors ranging from the quality of education to an extremely harsh business climate, creating a non-competitive economy that is not very open to international competition and our low capacity for innovation.

Despite all of these factors, the low labor productivity growth, in particular, is strongly related to the low capital/labor ratio (and, therefore, investments) in the Brazilian economy. Increasing the capital stock in the economy would, therefore, be one short-term method of increasing labor productivity in the country, making the increase in investment rates one of the key variables for restoring short-term economic growth in the country.

# Strategic Issues and their Effects on Productivity

This section presents data and empirical evidence to show the relationship between certain activities and selected segments and the aggregate productivity in the economy. Thus, we seek to obtain more elements that allow anticipating the probable effects that stimulating investment in these sectors could have on the economy’s aggregate productivity. We also seek to list indicators that allow for more accurate monitoring of the IDB operation with BNDES.

Both because of its potential to increase the capital stock in the economy and because of its direct impacts on economic efficiency, increasing investments in infrastructure could be one of the main drivers of productivity growth in the short term in Brazil. In particular, matters related to energy supply and diversification of energy sources can have relevant impacts on the country’s productivity levels, for reasons that will be discussed in the following sections.

The proportionately lower productivity levels in some groups of companies or in some specific regions may, in turn, affect the aggregate indicators and, therefore, require specific interventions. This is the case, for example, of the MSMEs, which play a key role in generating jobs and which require public policies that support productivity gains with features specifically designed for this segment. Thus, in order to support this analysis, this section contains specific information and indicators concerning the impact of the MSMEs and the investments in infrastructure and in renewable energy on the country’s aggregate productivity.

## Micro, Small and Medium Enterprises

One of the main characteristics of less developed countries is the persistence of high productivity disparity among different groups of companies, economic activities, or regions. This disparity is particularly relevant among efficiency indicators for smaller and larger companies. Figure 1 shows the productivity differences among groups of companies, according to size ranges, in the Brazilian industry. Companies with up to 50 employees, which accounts for approximately 30% of employment in the industry, have a labor productivity that is about four times lower than the productivity of large companies (with more than 500 employees). Furthermore, in the group of companies with 250 to 499 employees, the productivity level is a little over half of that seen in the large companies (more than 500 employees).

**Chart 2: Labor productivity (bars) and participation in the employment population (line) of industrial companies with one or more employed persons, according to the employment population range, 2014**

Source: AIS/IBGE (SIDRA table 1839). Available at <http://goo.gl/hXiL1Y>. Accessed on July 29, 2016.

In the commercial sector, the disparity of productivity levels is slightly lower among different groups of companies. The productivity of the smallest companies, with up to 19 employees, is nearly half of that seen in the large companies (over 500 employees). However, upon reaching 50 employees, the productivity level among different groups of companies stays quite homogenous, reflecting lower economies of scale in the commercial sector versus the industrial sector. Yet, in the commercial sector, 54% of the employment is in companies with up to 19 employees, which are the least productive companies. The productivity growth of this group of companies could have an important impact on the productivity of the sector as a whole.

**Chart 3: Labor productivity and participation in the employed population of commercial companies, according to the employment population range, 2013**

Source: PAC/IBGE (2013)

|  |  |
| --- | --- |
| Produtividade (R$ 1000) | Productivity (R$ 1000) |
| Participação no emprego | Employment Participation |
| Total | Total |
| Até 19 pessoas | Up to 19 people |
| De 20 a 49 pessoas | 20 to 49 people |
| De 50 a 99 pessoas | 50 to 99 people |
| De 100 a 249 pessoas | 100 to 249 people |
| De 250 a 499 pessoas | 250 to 499 people |
| 500 ou mais pessoas | 500 or more people |

This phenomenon, which the structure-based literature generally refers to as “productive homogeneity,” limits the aggregate productivity growth potential as a result of several factors.

First of all, there is a clear selection problem: low levels of competition in the domestic market enable the survival of companies with low efficiency levels. On the other hand, micro, small, and medium enterprises encounter other types of problems that affect their productivity indicators and the growth potential of these indicators. Among these problems are:

* Management problems, more common in smaller companies, in which modern management methods are not always implemented;
* Difficulties with bureaucracy and the business climate, which more strongly affect smaller companies. and
* Access to credit, less available for small companies, since aspects related to the reduced scale of operations, the asymmetry of information and the lack of real guarantees can inhibit the presence of private agents in the financing of these companies[[8]](#footnote-8).

These difficulties may contribute significantly to the growing efficiency levels of these companies and, consequently, an increase in the aggregate productivity indictors. In fact, given the weight of these companies in total employment, it is easy to see that a small increase in the productivity of this group of companies could generate significant gains in the aggregate productivity of the economy.

Upon analyzing the economies of scale and the scope of the Brazilian manufacturing industry, Esteves (2015), argues that productivity gains could occur through the reallocation of resources and also the implementation of measures that reduce the dispersion of technical efficiency indices, more related to institutional factors or technical progress. In this sense, the author suggests that factors such as benchmarking the best corporate practices and local public administrations could be as significant in determining and increasing productivity as macroeconomic factors. Additionally, the removal of barriers that hinder access to credit – through the actions of development banks – may contribute to these companies achieving higher productivity levels, through investments in modernization or the expansion of production capacity.

## Infrastructure

Investments in infrastructure involve projects in the areas of *i)* water, sewage and garbage; *ii)* electricity and gas; *iii)* telecommunications; and *iv)* transportation (air, water and ground). The relationship between the investments in these segments and economic growth are highly documented in economic literature, although it is difficult to econometrically estimate their impacts. Perhaps one of the main bottlenecks for productivity growth in Brazil are the poor conditions of the infrastructure, which affect productivity through various channels, namely:

* Increased transportation and logistics costs;
* The impacts that the issues of urban mobility and sanitation have on workers’ productivity due to absenteeism, delays, fatigue, etc.;
* The impacts that a deficient communications infrastructure has on companies’ transaction costs; and
* The price, supply, and security of energy supply.

Additionally, increasing investments in infrastructure is one of the main avenues to restoring Brazilian economic growth and increasing the capital stock in the economy. Thus, Campos Neto et al. (2015) estimated the impact of public investment in transportation on the Brazilian GDP, using an autoregressive model. The study’s primary conclusion is that investments in transportation infrastructure are, in fact, significantly important to the economic growth of Brazil. Additionally, in the estimated model, the impact of public investments in transportation is growing over time. The authors show that, in the first year, the elasticity of the public investment in transportation infrastructure, with regard to the GDP, is 0.012, that is, for each 1% increase in public investment, there is a 0.012% increase in GDP. In the fourth year, the elasticity rises to 0.023 and, in the long term, it reaches 0.032. Moreover, the authors also noted that public investments in transportation and private investments in transportation have a high positive correlation. This leads them to reaffirm the complementarity between the two.

Schettini and Azzoni (2015), on the other hand, relate the productivity of companies to the availability of infrastructure in the region in which they are established, using a panel data on productivity in the manufacturing industry by Brazilian mesoregions between 2000 and 2010. The authors conclude, among other things, that a 1% increase in regional highway coverage leads to an increase in the regional production efficiency indicator (which varies between zero and one) of around 0.1289 points and 0.121% in the regional industrial product. A similar increase in urban infrastructure (composed of water, sewage disposal, and public lighting supply) leads to an increase in efficiency of around 0.2801 points and 0.247% in the product. Regarding telephony[[9]](#footnote-9), which appeared to be only marginally significant, the result is an increase of 0.152 points in the efficiency index and 0.142% in the product.

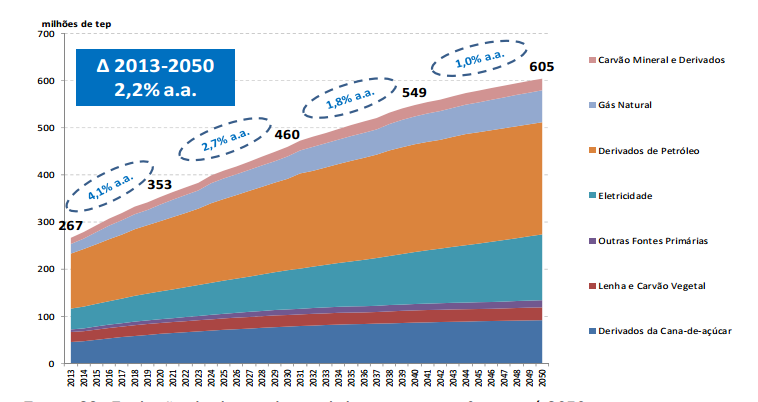
However, investments in infrastructure may face restrictions to adequate access to financing sources with respect to volume and terms in developing countries. This is because the long-term nature of the projects and their prolonged life are often incompatible with the credit supply in these countries, which is mostly focused on the short-term. Thus, development banks may be required to incentivize investments in this sector in countries such as Brazil.

## Renewable energy

For all investments in infrastructure, projects aimed at generating, transmitting, and distributing electricity play an especially important role in determining the productivity levels. In fact, the price, supply, and security of the energy supply form one of the pillars for sustaining economic growth.

The Energy Research Company (EPE) estimates a growth in energy demand in Brazil, from the current (in 2013) 267 million tons of oil equivalent (TOE) to nearly 605 million TOE in 2050, representing a growth of over 120% during the period, which equals close to 2.2% per year.

Figure 1. Evolution of total energy demand by source (projection): 2013 to 2050.



Source: Extracted from the Energy Research Company – EPE, Technical Note DEA 13/14. Available at: (<http://www.epe.gov.br/Estudos/Documents/DEA%2013-14%20Demanda%20de%20Energia%202050.pdf>)

|  |  |
| --- | --- |
| Milhões de tep | Million TOE |
| Carvão Mineral e Derivados | Coal and Derivatives |
| Gás Natural | Natural Gas |
| Derivados de Petróleo | Oil Derivatives |
| Eletricidade | Electricity |
| Outras Fontes Primarias | Other Primary Sources |
| Lenha e Carvão Vegetal | Firewood and Charcoal |
| Derivados da cana-de-açúcar | Sugarcane Derivatives |

Also according to the EPE, the share that oil products represent in meeting this demand will rise from 43.7% of the total to nearly 39.4% of the total, while the electricity share will rise from 16.6% to 23.1% of the total energy demand in 2050. The share of renewable energy sources in the national energy matrix is one of the highest in the world, at nearly 40% (and more than 75% in the energy matrix)[[10]](#footnote-10). However, there is ample space for diversifying the country’s renewable energy sources, given that the majority of these sources come from the sugarcane biomass (16.9%) and hydraulic sources (11.3%). Only 4.7% of the country’s total energy supply comes from other renewable sources, which includes lixivium, wind, and solar power. Despite the low share, other renewables experienced a much higher supply growth than other sources between 2014 and 2015; 14.9% versus 5.1% of sugarcane biomass and compared to a 3.2% decrease in hydraulic energy and 7.2% decrease in oil products[[11]](#footnote-11).

Industry accounts for over 30% of energy consumption in Brazil. Annual Industrial Survey data (AIS) from the Brazilian Institute of Geography and Statistics (IBGE) reveal the importance of electricity in the industry’s cost structure and productivity levels in Brazil. According to the data for 2014, the cost of purchasing electricity used for production represents, on average, 1.13% of the total costs and expenses of industrial companies with thirty or more employees in Brazil. This percentage comes from 1.00% for the mining industry and 1.14% for the manufacturing industry. Given the segment’s share, the direct cost of purchasing electricity used solely for production, the estimated percentage reaches 17.32% on average. This ratio consists of about 5.55% for the mining industry and 19.16% for the manufacturing industry. As such, reductions in the price of energy may have significant impacts on the direct production costs and on the total costs and expenses of the industry in Brazil and, consequently, on its productivity indicators, which are measured based on the added value.

**Chart 3: Share of electricity expenses in the total costs and costs directly linked to the companies’ production.**

Source: Annual Industrial Survey (AIS) / IBGE (2013)

|  |  |
| --- | --- |
| Energia / custos ligados á produção | Energy / production-related costs |
| Energia /custos totais | Energy / total costs |
| Indústria total | Industry Total |
| Indústrias Extrativas | Extractive Industries |
| Indústrias de transformação | Manufacturing Industries |

There are some energy-intensive sectors, however, in which the aforementioned percentages reach much higher values. In the case of metallurgy of non-ferrous metals, for example, the cost of purchasing electricity used for production, when compared to the total costs and expenses and the direct production costs represents 5.30% and 37.37%, respectively. For metallurgy of aluminum and its alloys, these percentages reach 7.66% and 43.66%. Some groups that comprise the “chemical product manufacturing” division in the National Classification of Economic Activities (CNAE), whose average percentages are around 1.24% and 26.36% (slightly higher than the average for the manufacturing industry) may also be heavily affected by the reduced price of electricity. This is the case of industrial gas manufacturing (16.60% and 73.36%) and chlorine and alkalis manufacturing (12.82% and 65.26%). Some industrial sectors in which the presence of smaller companies is more remarkable, may also obtain significant productivity gains with reduced energy costs. The relative share of the cost of purchasing electricity, compared to the total costs and expenses and direct production costs in the manufacturing sector of laminated wood and plywood, pressed wood and particleboard sheet reach 3.95% and 35.43%, respectively. Additionally, smaller companies – for which the cost of raw materials is often particularly important to their cost structure – may indirectly benefit from reduced electricity prices. This tends to occur if the productivity gains of the upstream industries are partially transferred to the products used as inputs by micro, small and medium enterprises.

The example of Brazil’s 2001 energy crisis shows how energy supply restrictions can significantly impact the country’s economic growth. Estimates by the Central Bank of Brazil indicate that “the impacts of the energy crisis on the evolution of the GDP range between one and two negative percentage points.”[[12]](#footnote-12) Results such as these indicate that the insufficient supply of energy can be more costly than investments in this segment.

The price, supply, and security of the energy supply are linked not only to the investments stock in the sector, but also to its composition. In fact, a more diversified matrix is less vulnerable to events capable of affecting the energy supply. These events involve, for example, prolonged droughts, in the case of hydroelectric power, or increases in fuel prices, in the case of thermoelectric power. In Brazil, the energy matrix’s concentration in hydroelectric power has attracted attention, especially after the rationing threats that occurred in early 2010, when low reservoir levels and a lack of new investments resulted in supply constraints. On the other hand, the high cost associated with thermoelectric power generation and its vulnerability to international oil and gas prices (which the country has limited ability to manage) strengthen the option for increasing investments in renewable energy in Brazil. The incentive to invest in this energy generation modality may, then, contribute to increasing the energy supply and guaranteeing a more secure supply.

Given the demand projections made by the EPE, already mentioned at the start of this section, the company estimates[[13]](#footnote-13) that a 3.7% growth in the energy supply per year is needed to respond to the growing demand and to avoid supply shortages, especially in the northern, northeastern, and southern regions where, between 2013 and 2014, electricity consumption has grown more than the national average.

Tolmasquim (2016) shows how hydroelectricity production costs are lower than the gas and coal thermoelectricity sources, which are lower than the production costs of some renewable sources, such as wind and solar. However, there are costs not directly associated with hydroelectricity production, which have become increasingly important over the last few years. Among them, the cost of transmission, given the installation of hydroelectric power plants in increasingly remote regions, in addition to environmental costs, which tend to be much higher at thermal sources. Over the long term, however, the trend indicates increasing costs for traditional sources while technological innovations tend to reduce the cost of wind and solar power, for example, through the maturity of these technologies. In this sense, investing in these sources is essential so that, in the future, energy costs do not outweigh technical efficiency gains possibly obtained by the Brazilian industry.

Some studies have also estimated the direct effects of renewable energy on productivity. Chien and Hu (2007), for example, analyzed the effects of renewable energy on technical efficiency indicators for 45 countries, between 2001 and 2002, using the DEA method (“*Data Envelopment Analysis*”). Although the authors do not elaborate on the transmission channels between the consumption of renewable energy and technical efficiency and even though the period under analysis (only two years) is very short, the authors found that the increase in the use of renewable energy sources has increased the economies’ technical efficiency levels.

# Final Considerations

In this document, we have gathered information about *i)* micro, small, and medium enterprises; *ii)* Infrastructure; and *iii)* renewable energy with the aim of contributing to the development of supporting documentation for the loan operation from IDB to BNDES. In line with the focus of this operation, we have gathered some indicators that may be used by the IDB in its evaluation of the actions to be taken. Those aspects related to the financing are discussed in another document referred to in this work.

In general, the information collected about MSMEs in Brazil indicates that their productivity levels are lower than those of the larger companies. Aspects related to the competition pattern, management problems, business climate and access to credit under conditions consistent with the characteristics of this segment were indicated as the main reasons for the lower productivity levels in the MSME. In this sense, strengthening the lines of credit specifically offered to this segment by BNDES, could contribute to increasing their productivity levels.

With regard to the infrastructure, we have shown the main transmission channels that associate it with aggregate productivity indicators in the country, and we have indicated the results obtained in specific studies that relate it to the GDP growth rate. It is further stated that infrastructure projects – characterized by long-term maturity and a prolonged life – are not compatible with the credit markets, which mostly focus on the short-term. As such, in Brazil, the incentive to invest in these projects may require actions by the development banks.

Finally, we noted the relationship between investments in the generation, transmission, and distribution of electricity and the productivity levels of the Brazilian economy. Data calculated based on the AIS indicated the relative share of electricity costs compared to the total costs and expenses of the industry in Brazil. In particular, it was argued that the concentration of the energy matrix on hydroelectricity production could make the supply vulnerable to climate events and the incentive to invest in renewable energy could contribute to mitigating any problems related to the price, supply, and security of energy supply in Brazil.

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1. \* Director of DISET / Ipea. [↑](#footnote-ref-1)
2. \*\* Legislative Consultant to the Federal Senate. [↑](#footnote-ref-2)
3. This conclusion was clear in De Negri and Cavalcante (2014). [↑](#footnote-ref-3)
4. “*A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker*” (Krugman, 1997). [↑](#footnote-ref-4)
5. The other document referred to in this report (entitled “Report 2: Development Financing”) includes information on financing of MSMEs, infrastructure and power generation projects from renewable sources. [↑](#footnote-ref-5)
6. The sector performance, however, varies greatly, with clear signs of decline in labor productivity in the manufacturing industry. While the agriculture and the mining industries showed labor productivity growth rates of 3.8% and 2.0% over the past decade. [↑](#footnote-ref-6)
7. Bonelli (2014) presents a more detailed breakdown. [↑](#footnote-ref-7)
8. Detailed information about access to credit for micro, small and medium enterprises in Brazil is presented in the second report, which deals specifically with financing. [↑](#footnote-ref-8)
9. Does not include Internet access (dial-up or broadband), which was addressed separately. [↑](#footnote-ref-9)
10. According to the 2016 National Energy Balance of the Energy Research Company. [↑](#footnote-ref-10)
11. Idem. [↑](#footnote-ref-11)
12. Available at: <http://goo.gl/dIh8YS>. Accessed on: August 24, 2016. [↑](#footnote-ref-12)
13. <http://www.epe.gov.br/mercado/Documents/DEA%2003-2015-%20Proje%C3%A7%C3%B5es%20da%20Demanda%20de%20Energia%20El%C3%A9trica%202015-2024.pdf> [↑](#footnote-ref-13)