

## Considerations on Brazil's output gap

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**Estimating what stage of the economic cycle a country is in is key to inferring the variables of the future economic outlook.** In other words, determining the level of slack in the economy allows us to understand whether there is any mismatch between supply and demand and, therefore, whether or not there is persistent inflationary pressure. Thus, the so-called output gap (the difference between observed growth and potential growth) is a fundamental instrument to indicate whether there is any inflationary pressure in the economy. As such, estimating the output gap is an important part of monetary policy decision-making.

**But while it is key to monetary policy, the gap is an unobservable variable and needs to be estimated through other variables.** There are different ways to estimate the amount of slack in the economy, so there are numerous calculations performed by market analysts, governments and academic studies. Leading methods include more theoretical approaches, such as the production function<sup>1</sup> and the decomposition of the labor market gap and Capacity Utilization (CU)<sup>2</sup> gap, and more statistical methods, such as the Hodrick-Prescott (HP) Filter and Factor Analysis. Below are our estimates for these methods.

### 1. Output gap via Hodrick-Prescott (HP) Filter

One of the most traditional methods to estimate the output gap is to use statistical filters. Since the ultimate goal is to estimate the difference between actual and potential GDP, one idea is simply to filter out fluctuations in actual GDP, as it would gravitate towards a long-term trend.

These statistical filters include: linear trend extraction, exponential trend extraction, quadratic trend extraction, four- to eight-quarter moving averages and Hodrick-Prescott Filter or, simply, HP Filter. The latter is one of the most used for this purpose and the focus of our analysis, despite the criticism it's been known to receive<sup>3</sup>. One of the problems of the method is the filter bias at the ends of the series, implying a sub-optimal decomposition at the edges, although it is considered satisfactory in the middle part of the sample<sup>4</sup>. One way to minimize, but not fully solve the problem at the ends, is to consider not only the end of the series, but actual GDP forecasts as well. The idea is to prevent the filter from excessively "cleaning" the oscillations at the end of the series, allowing for a less volatile reading of the output gap.

According to these estimates, the gap was already nearing zero by the end of 2019, that is, GDP was growing at practically the same pace as its potential. The pandemic had a strong impact on the Brazilian economy, leading to the gap widening to 13.4 p.p. in the second quarter of 2020. After the shock, GDP began to recover and, in the first quarter of 2021, the gap was still at 3.3 p.p.

<sup>1</sup> For more details, see: Da Silva Filho, T. N. T. (2001), "Estimando o Produto Potencial Brasileiro: Uma Abordagem de Função de Produção" (<https://www.bcb.gov.br/pec/wps/port/wps17.pdf>).

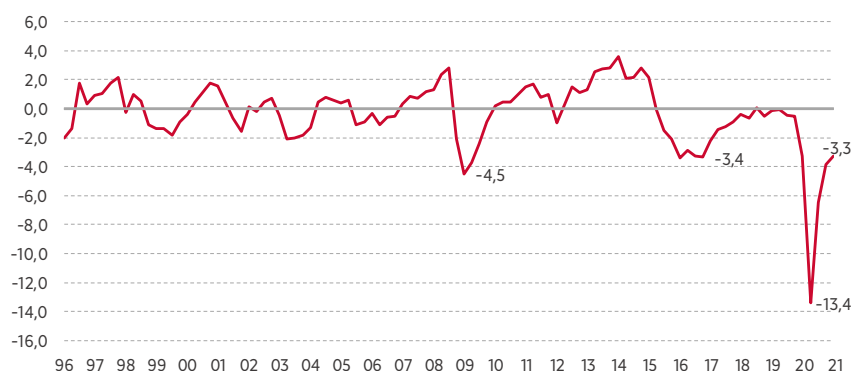
<sup>2</sup> For more details, see: Areosa, M. (2008), "Combining Hodrick-Prescott Filtering with a Production Function Approach to Estimate Output Gap" (<https://www.bcb.gov.br/pec/wps/ingl/wps172.pdf>).

<sup>3</sup> In a 2017 article, James Hamilton, an academic in the field of theoretical econometrics, criticizes the HP Filter: "Why you should never use the

<sup>4</sup> Hodrick-Prescott Filter" (<https://econweb.ucsd.edu/~jhamilto/hp.pdf>).  
For more details, see: St-Amant, P. and Norden (1997), "Measurement of the Output Gap: A Discussion of Recent Research at the Bank of Canada"; Cerra, V. and S. C. Saxena (2000), "Alternative Methods of Estimating Potential Output and the Output Gap: An Application to Sweden"; e Mise, E., Kim, T., Newbold, P. (2005), "On Suboptimality of the Hodrick-Prescott Filter at Time Series Endpoints".

### Chart 1: Output Gap - Hodrick-Prescott Filter

Percentage difference between actual GDP and potential GDP



Source: IBGE, Central Bank of Brazil and Bradesco

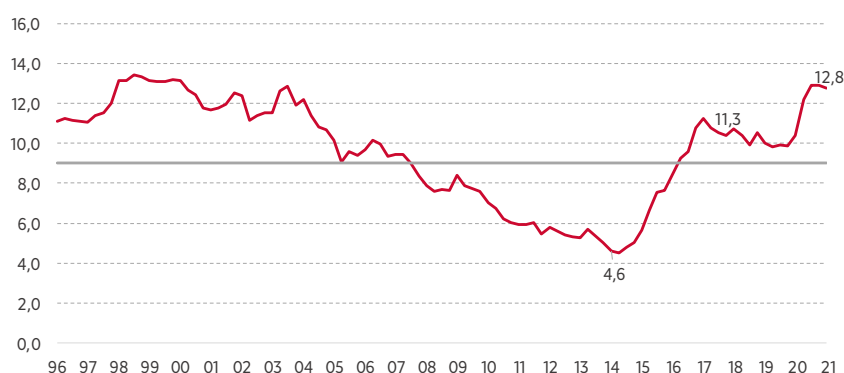
## 2. Output gap through factor analysis

Another statistical method that can be used, although not as traditional, is factor analysis. Basically, this method seeks to represent, through “new variables,” the common behavior derived from several other variables. In other words, it extracts common movements among the series used. Employing this method allows the integration of information from economic activity indicators that sometimes differ from each other. For example, if the unemployment rate measured by the Pnad survey points to a high level of slack in the formal and informal labor market, but the CAGED (formal employment) and NUCI indicators suggest much lower levels in recent quarters.

In Chart 2, we can see that the unemployment rate is above the Non-Accelerating Inflation Rate of Unemployment (NAIRU), indicating some slack in the labor market. On the other hand, CAGED shows much less slack in the formal labor market than the IBGE data metric, according to Chart 3. Finally, the CU indicator for the industrial sector also seems to confirm the CAGED data, since it is already very close to its historical average.

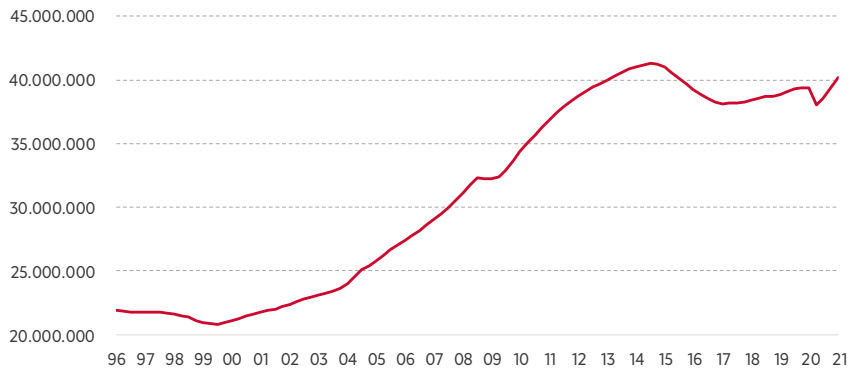
### Chart 2: Unemployment rate and NAIRU

Unemployment rate, seasonally adjusted (% of EAP)



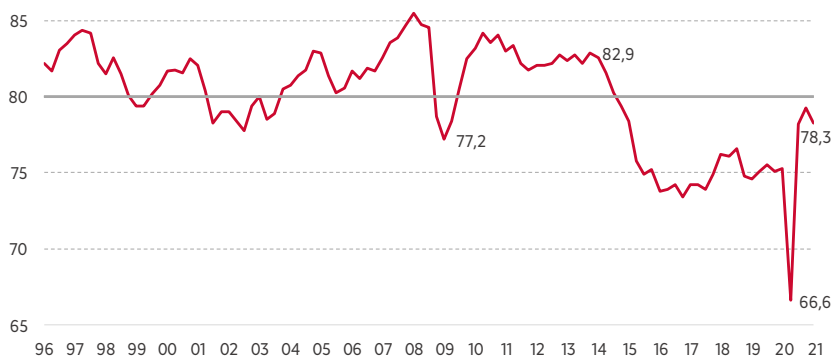
Source: IBGE, Central Bank of Brazil and Bradesco

**Chart 3: CAGED**  
Formal job market



**Source:** Ministry of Labor and Employment, IBGE, Bradesco

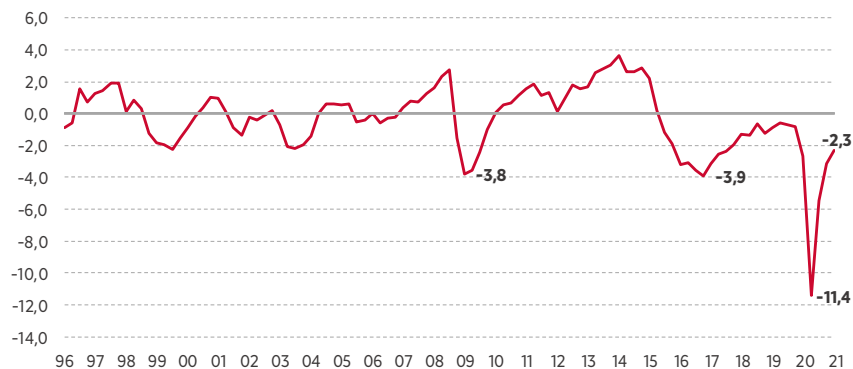
**Chart 4: Capacity Utilization, industrial sector vs. historical average**  
Seasonally adjusted CU (%)



**Source:** FGV, Central Bank of Brazil and Bradesco.

Performing the factor analysis exercise, by combining the movement of the unemployment rate measured by the PNAD, the movement of the formal market by CAGED, the industrial sector CU and the GDP itself, we found a single common factor that helps explain more than 80% of the movement of these variables. As shown in Chart 5, the output gap estimated via factor analysis shows that, after the gap widened to 11.4 p.p. in the second quarter of 2020, the recovery brought it down to 2.3 p.p. by the first quarter of 2021.

**Chart 5: Output gap through factor analysis**  
Deviation (%)



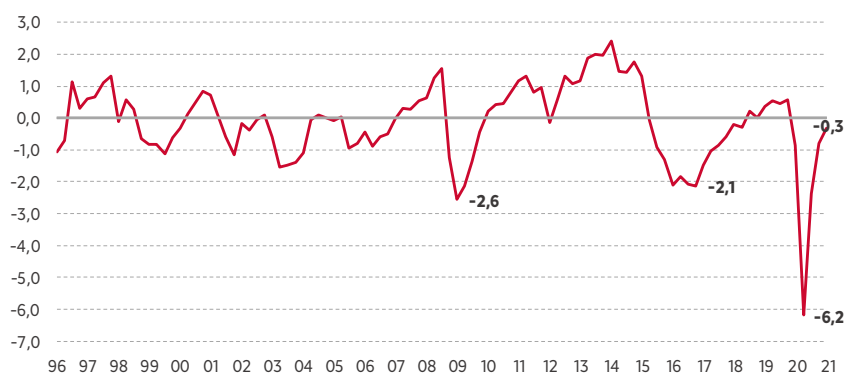
**Source:** Ministry of Labor and Employment, FGV, IBGE, Central Bank of Brazil and Bradesco.

### 3. Labor market and industrial sector gaps

Another widely used approach to estimate the output gap is its decomposition into the labor market gap and the CU gap, as described by Areosa (2008). In a way, it is a gap that seeks to combine the statistical (filters) and production function (employment and industrial sector gap) methods. Chart 6 shows the result and points to a much narrower gap than the other methods discussed so far. This mainly reflects the narrowing of the goods gap (measured through the industrial sector CU). The unemployment gap indicates that there is more slack in the labor market.

**Chart 6: Output gap through the Areosa method**

Deviation (%)



**Source:** FGV, IBGE, Central Bank of Brazil and Bradesco.

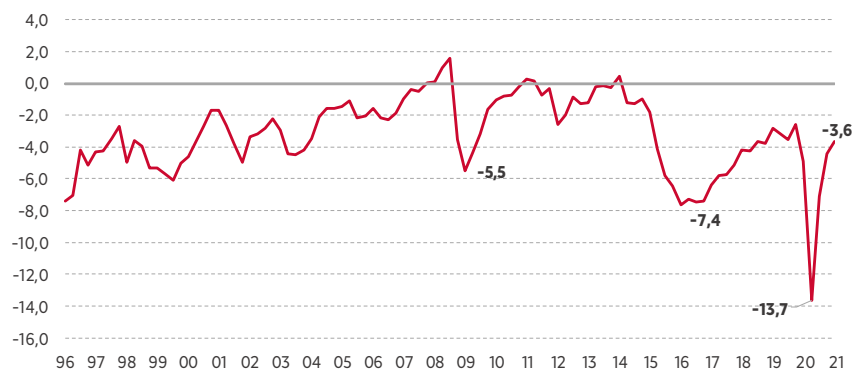
### 4. Output gap through production function

Production function is a simplified version of the traditional Cobb-Douglas function, in which the output of the economy is determined by capital, labor and the total productivity of the factors. To calculate the output gap, we need to calculate the potential GDP when the production factors are fully used up and there is no slack (employment at its natural level and industry using all of its capacity). The estimation of the production function and the output gap was based on Silva Filho (2001). To that end, we used the series of GDP, Gross Formation of Fixed Capital (GFCF), the Utilization Rate of the Installed Capacity of Industry (CU) and data from the labor market – unemployment rate, Economically Active Population, Employed Population and Working Age Population. All data is made available on a non-seasonally adjusted basis, from the first quarter of 1996 to the first quarter of 2021.

According to our calculations, after the output gap reached its lowest level during the second quarter of 2020 (14.4 p.p.), the economic recovery accelerated in the following quarters, in line with an increase in the CU level and, to a lesser extent, improvements to the labor market. Thus, the slack in the economy was 3.6 p.p. in the first quarter of this year, higher than at the end of 2019 (2.6 p.p.), when the Brazilian economy was still recovering from the strong recession of 2015/2016, as shown in Chart 7. In turn, Chart 8 shows a comparison between the actual GDP and the estimated potential GDP.

### Chart 7: Output gap

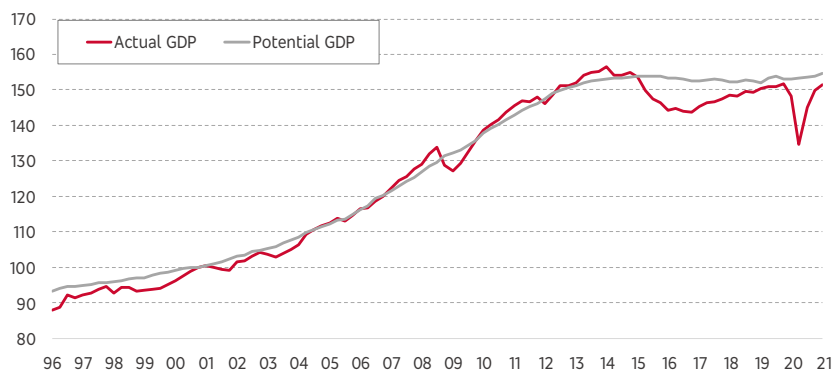
Percentage difference between actual GDP and potential GDP (%)



Source: IBGE, FGV, Central Bank of Brazil and Bradesco.

### Chart 8: Actual and potential GDP

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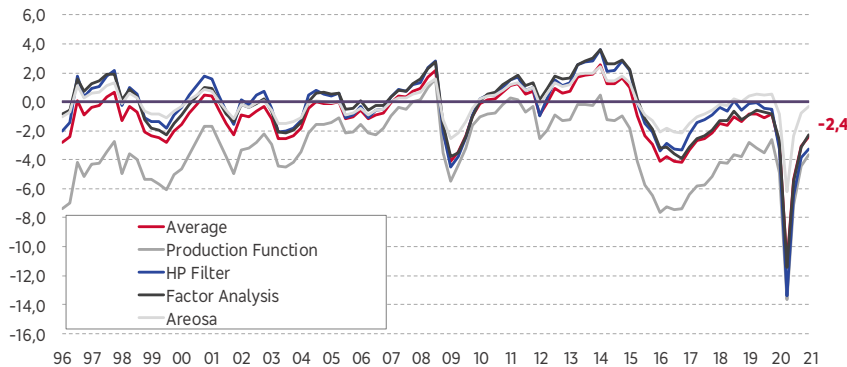
Source: IBGE, FGV, Central Bank of Brazil and Bradesco.

**According to the methods used in this text, the output gap would be between 3.6% and 0.3% in the first quarter of 2021.** As mentioned above, with the exception of the method extracted from Areosa (2008), which points to near zero slack, the other methods continue to indicate an actual GDP far from its potential. By averaging all of the methods, we get an output gap of around 2.4% in the first quarter (Chart 9), reinforcing the fact that, even though the economy is recovering from the pandemic, there is still some slack, especially in the labor market.

Our metric points to a “narrower” gap at the beginning of the year, when compared to the number released by the Central Bank in its last Inflation Report (3.1%) as well as to a recently reported figure on the IBRE Blog (3.9%).

### Chart 9: Output gap – multiple metrics and average

Percentage difference between actual GDP and potential GDP (%)



**Source:** IBGE, FGV, Ministry of Labor and Employment, Central Bank of Brazil and Bradesco.

**We forecast 2022 inflation to come in at 3.30%, below the Central Bank's target (3.50%).** Once the recent inflationary shocks (currency devaluation, higher commodity prices and water crisis) fade, the maintenance of the gap in negative territory, anchored inflation expectations and the monetary policy normalization started in the past few months by the Central Bank should help bring consumer inflation (IPCA) from a 12-month rate of 8.3% to below the center of the target range for next year.

It is worth noting that there is a certain lag between monetary policy and its effects on the output gap and, consequently, on inflation, which has made the Central Bank push interest rates faster towards their neutral level, already looking at the inflation rate for 2022 and 2023.

In this scenario, we expect the Central Bank to continue raising the Selic rate to its neutral level (6.50% p.a.) later this year, and keeping it at this level over the next year.

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