Box 1. Updating of the potential growth of Paraguay

Potential GDP is defined as the level of production which an economy is able to create when it is using its resources at full capacity and without creating macroeconomic imbalances.

A characteristic of this variable is that it cannot be directly observed. In order to estimate potential GDP, in fact, we need to apply a number of different methods, which can generally be divided into statistical and economic methods.

Statistical methods mainly use filters to isolate the trend or long-term component (Hodrick and Prescott[1], Baxter and King[2], inter alia). Methods based on economic models adopt a more intuitive approach by using an analytical framework in which potential GDP is an endogenous variable which is related to other variables. The "production function " is one of the methods used in this latter category. This method estimates potential GDP based on its determining factors (in essence, output, employment and capital).

Production function

In this case, a Cobb-Douglas production function is used with constant returns to scale and adjusted by human capital (García-Fuentes and Lynn, 2009[3], and Hofman and Tapia, 2003[4]):

$$Y_t = A_t K_t^{\alpha} (h_t L_t)^{1-\alpha}$$

where, Y_t is gross domestic product, A_t is output, K_t is physical capital stock, h_t is the factor of human capital and L_t is the number of workers. All the variables have an annual frequency. Also, α is the participation of physical capital in GDP, while $1 - \alpha$ represents the participation of employment and human capital.

The relevant variables used in the estimate are calculated as follows:

a. **Capital stock**: As there is no direct measurement of physical capital stock

(K_t), it was decided to generate a historical series from 1994, using the perpetual inventory method:

- Conventional capital accumulation: $K_{t+1} = (1 - \delta)K_t + I_t$; where I_t is the level of investment and δ is the depreciation rate. A straight-line depreciation function, with a 30-year useful life span for the capital, is assumed.

- In order to define the initial capital stock (K_0) a steady state scenario is assumed in 1994: $K_0 = \frac{I^*}{g+d}$

  - where, I^* is the average of the Investment/GDP ratio between 1994-2015 and GDP for 1994.

  - On the other hand, g is the average of the rate of growth in GDP between 1994-2015.

b. **Capital-GDP elasticity:** The value of $\alpha = 0,42$ is taken, in line with the estimates made by the Central Bank of Paraguay[5].

c. **Human capital:** As with capital stock, there is no direct measurement of human capital (h_t). The following equation is used to generate this variable:

$$h_t = exp\left[\left(\frac{\theta}{1-\psi}\right) s_t^{1-\psi}\right]$$

where s_t represents the average years of schooling of the population aged over 15, while θ and ψ are sensitivity and curve parameters of the function which adopt values of 0.32 and 0.58 respectively, in accordance with the proposals of Bils and Klenow (1998)[6].

d. **Workforce**: The workforce is considered to be (L_t) the Occupied Economically Active Population.

1 Hodrick, R. and Prescott, E. (1997), "Postwar U. S. Business Cycles: An Empirical Investigation", Journal of Money, Credit And Banking, Vol. 29, No. 1.
2 Baxter, M. and King, R. (1995), "Measuring Business Cycles Approximate Band-Pass Filters For The Economic Time Series", National Bureau Of Economic Research, Working Paper No. 5022.
3 Garcia-Fuentes, P. and Lynn, P. (2009), "Remittances and Economic Growth in Latin America and the Caribbean: The Impact of Human Capital Development". Southern Agricultural Economics Association Annual Meeting, Atlanta, Georgia.
4 Hofman, A. and Tapia, H (2003) "Potential output in Latin America: a standard approach for the 1950-2002 period", Serie Estudios estadísticos y prospectivos No25, CEPAL.

5 See IPoM box, December 2014.
6 Bils, M. and Klenow, P. (1998), "Does Schooling Cause Growth or the Other Way Around?". National Bureau of Economic Research (Cambridge, MA) Working Paper No. 6393.

e. **Total Factor Productivity (TFP)**: The TFP is obtained as the result of the following:

$$A_t = exp[logY_t - \alpha logK_t - (1-\alpha)logh_t - (1-\alpha)logL_t]$$

Lastly, to construct the series of potential GDP, Y_t^*, the procedure is as follows:

$$Y_t^* = A_t^* K_t^{*\alpha} (h_t^* L_t^*)^{1-\alpha}$$

A_t^*, h_t^*, k_t^* and L_t^* are the trends of output, human capital and employment obtained using the Hodrick-Prescott filter.

Main results

If we analyse potential GDP, it is apparent that the growth of the economy during the boom phase was not only a temporary or cyclical phenomenon. Table 1, which contains the breakdown of the growth of potential GDP between production and output factors (controlling for human capital), shows the prominence of all the factors in the accelerated growth of the Paraguayan economy between 2002 and 2013.

This same approach also shows that not only short-term factors are behind the slowdown observed in recent years (since 2013). For example, a significant decline in the contribution made by output is apparent, which suggests that there are structural factors behind this growth trend that is shifting the economy towards permanently slower growth rates (see Table R.1.1).

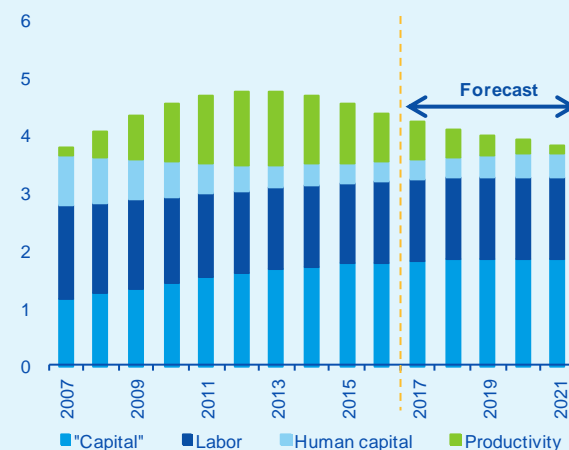Table R.1.10
Potential GDP (chge. % annual, percentage points)

	Potential growth	Contribution to growth			
		A	K	h	L
1994-2001	1.1	-1.8	1.1	0.7	1.1
2002-2013	3.7	0.1	1.2	0.8	1.6
2014-2015	4.6	1.1	1.8	0.4	1.4
2016-2020	4.1	0.5	1.9	0.4	1.4

Where, A: Output, K: Physical capital, h: Human capital, L: Employment.
Source: BCP, World Bank and BBVA Research

For the next few years, in line with our macroeconomic projections, it is estimated that the contribution of both productivity and employment to the growth of potential GDP will stagnate at the low levels currently being recorded. Meanwhile, the contribution of capital (linked to investment) would still provide support to overall activity. As a result of these projected trends, sustainable growth of the Paraguayan economy is expected to decline in future years and be in the vicinity of 4.0% (see Figure R.1.1).

Figure R.1.1
Potential GDP: contribution to growth (percentage points)

Source: BCP, World Bank and BBVA Research

DISCLAIMER

This report has been produced by the Peru Unit:

Chief Economist for Peru
Hugo Perea
hperea@bbva.com
+51 1 2112042

Francisco Grippa
fgrippa@bbva.com

Yalina Crispin
Yalina.crispin@bbva.com

Vanessa Belapatiño
Vanessa.belapatino@bbva.com

Ismael Mendoza
Ismael.mendoza@bbva.com

Marlon Broncano
Marlon.broncano@bbva.com

BBVA Research

Group Chief Economist
Jorge Sicilia Serrano

Developed Economies Area
Rafael Doménech
r.domenech@bbva.com

Spain
Miguel Cardoso
miguel.cardoso@bbva.com

Europe
Miguel Jiménez
mjimenezg@bbva.com

US
Nathaniel Karp
Nathaniel.Karp@bbva.com

Emerging Markets Area

Cross-Country Emerging Markets Analysis
Alvaro Ortiz
alvaro.ortiz@bbva.com

Asia
Le Xia
le.xia@bbva.com

Mexico
Carlos Serrano
carlos.serranoh@bbva.com

Turkey
Alvaro Ortiz
alvaro.ortiz@bbva.com

LATAM Coordination
Juan Manuel Ruiz
juan.ruiz@bbva.com

Argentina
Gloria Sorensen
gsorensen@bbva.com

Chile
Jorge Selaive
jselaive@bbva.com

Colombia
Juana Téllez
juana.tellez@bbva.com

Peru
Hugo Perea
hperea@bbva.com

Venezuela
Julio Pineda
juliocesar.pineda@bbva.com

Financial Systems and Regulation Area
Santiago Fernández de Lis
sfernandezdelis@bbva.com

Financial Systems
Ana Rubio
arubiog@bbva.com

Financial Inclusion
David Tuesta
david.tuesta@bbva.com

Regulation and Public Policy
María Abascal
maria.abascal@bbva.com

Digital Regulation
Álvaro Martín
alvaro.martin@bbva.com

Global Areas

Economic Scenarios
Julián Cubero
juan.cubero@bbva.com

Financial Scenarios
Sonsoles Castillo
s.castillo@bbva.com

Innovation & Processes
Oscar de las Peñas
oscar.delaspenas@bbva.com

Contact details: