DOI: http://dx.doi.org/10.1590/0103-6351/8153 **Original article**

Determinants of Economic Growth in Latin America: Application of Bayesian Model Average (BMA)

Determinantes do crescimento econômico na América Latina: aplicação da média do modelo bayesiano (BMA)

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Abstract

The Latin American region has been characterized by low growth in recent decades, for this, different empirical studies have been developed to identify both microeconomic and macroeconomic elements that influence its performance. The heterogeneity of the results, from an empirical point of view, generates a problem of uncertainty, due to the large number of suggested determining factors. Thus, in order to reduce uncertainty, the Bayesian Model Average (BMA) methodology is proposed. Twenty-seven possible determinants are considered in a sample of 19 Latin American countries covering the period 1996-2021. In the same way, the BMA with instrumental variables (IVBMA) is used to consider possible endogeneity problems that have their origin in the reverse causality of some explanatory variables. The results show some economic and institutional factors significant to understand economic growth in Latin America. Additionally, a non-linear relationship of corruption with economic growth is found.

Keywords

bayesian model average, corruption, economic growth, Latin America.

JEL Codes C01, C11, C26, O40, O47.

Resumo

A região da América Latina tem se caracterizado por baixo crescimento nas últimas décadas, para isso, diferentes estudos empíricos têm sido desenvolvidos para identificar elementos tanto microeconômicos quanto macroeconômicos que influenciam seu desempenho. A heterogeneidade dos resultados, do ponto de vista empírico, gera um problema de incerteza, devido ao grande número de fatores determinantes sugeridos. Assim, para reduzir a incerteza, é proposta a metodologia Média do modelo bayesiano (BMA). São considerados 27 possíveis determinantes em uma amostra de 19 países latino-americanos cobrindo o período 1996-2021. Da mesma forma, a BMA com variáveis instrumentais (IVBMA) é usada para considerar possíveis problemas de endogeneidade que têm sua origem na causalidade reversa de algumas variáveis explicativas. Os resultados mostram alguns fatores econômicos e institucionais significativos para entender o crescimento econômico na América Latina. Além disso, é encontrada uma relação não linear da corrupção com o crescimento econômico.

Palavras-chave

média do modelo bayesiano, corrupção, crescimento econômico, América Latina.

Códigos JEL *C01, C11, C26, O40, O47.*

1 **Introduction**

The economic performance of Latin American countries is characterized by high volatility and growth deficit, this behavior is reinforced in recent decades where the Gross Domestic Product (GDP) per capita has shown an unstable trajectory. According to Orozco (2021), the annual growth of GDP per capita between 1962 and 2017 oscillates between 0% and 3% per year[1], the author argues that, in the region, it has become difficult to achieve high levels of growth since the advances of some years are offset by others where growth has been negative.

Suffice it to remember that the region was immersed in the external debt crisis in the 80s. Later, the Latin American countries experienced a boom period from 1990 to 1997 resulting in an average annual rate of 3.2% of growth in the region.

Following the Asian and Russian financial crises in the 90s, the region experienced a slowdown in growth rates. According to the World Bank (2022), the countries of Latin America and the Caribbean in the period from 2000 to 2019 obtained an average annual growth of 1.6%, which means poor performance, compared to other regions such as East Asia (4.8%), Europe, and Central Asia (1.9%), the Middle East (2.9%), South Asia (6.5%) and Sub-Saharan Africa (3.5%).

In addition to the inertia of low growth showing in Latin American countries in the past years, the pandemic caused by Covid-19 (Sars-Cov-2 virus) induced an economic recession during the year 2020. According to the World Bank, Venezuela was the most affected Latin American country with a 30% GDP contraction, followed by Panama (–17.95%), Peru (–11.12%), Argentina (–9.96%), and Mexico (–8.24%).

As a whole, income and employment levels have been recovering after the pandemic. However, the Economic Commission for Latin America and the Caribbean (2021), mentions that the low growth of investment in the last three decades has been transformed into a structural limitation of development, reason for which the region is expected to return to the path of low growth observed before the Covid-19 pandemic.

1 The countries considered are: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Jamaica, Mexico, Peru, Dominican Republic, Trinidad, and Tobago, Uruguay, and Venezuela.

The different theoretical visions of economic growth give way to the need to contrast what is proposed with what is observed in reality. Thereby, the empirical literature on economic growth comes to light. The model proposed by Solow (1956), and Swan (1956), can be taken as the reference empirical growth model. Within these studies, initial GDP, physical capital accumulation rates, and population growth are considered determinants of economic growth. With the emergence of the endogenous growth theory, new research was made, to incorporate the capacity of economies to generate technical progress. Within these applications we can point out the research by Barro (1991), Levine and Renelt (1992), Easterly (1993), Barro and Lee (1994), and Sala-i-Martin (1994), among others.

Subsequently, other authors joined this effort, proposing a new determinant in each case, as well as new techniques to establish its relationship with economic growth. The literature review conducted by Durlauf *et al*. (2005), identified 43 different growth theories and 145 proposed regressors.

The heterogeneity of the results, from an empirical point of view, generates a problem of uncertainty, due to the large number of suggested determining factors, making it difficult to guide the selection of appropriate variables that will integrate the empirical model. On the other hand, if all possible regressors were taken into account, there is a risk of generating an excessive parameterization problem (Rodríguez *et al*., 2009).

To solve this problem, studies such as Fernández *et al*. (2001), and Sala-i-Martin *et al*. (2004), propose the Bayesian Model Average (BMA) estimation technique, which is not based on a particular model but could combine an average of the distinctive specification of the models to find the determinants more robust. Since then, the BMA has been used in several empirical studies of growth (Moral-Benito, 2010; Koop *et al*., 2012; Leon-Gonzalez; Vinayagathasan, 2015). However, a BMA application for the analysis of economic growth in the context of Latin American countries was not located. Therefore, in this research, the BMA methodology is used with a sample that includes 24 possible regressors and 19 Latin American countries.

By way of an alternative, the estimates of economic growth face problems of endogeneity which stems from the inverse causality of some explanatory variables. For example, richer countries tend to have a robust rule of law, but in turn, having a robust rule of law can promote better conditions for investment by reducing uncertainty, and causing income growth (Ferrer; Cedeño, 2022). This problem is addressed using the BMA technique with instrumental variables (IVBMA), this technique is developed by Karl and Lenkoski (2012), and Koop, et. al., (2012). The IVBMA consists of using instruments for potentially endogenous variables, allowing greater consistency in the estimates compared to those obtained by the BMA, same which does not contemplate this problem anywise.

Additionally, empirical evidence reveals that corruption has a non-linear effect on economic growth. Specifically, Mushfiq (2011), points out that corruption does not reduce economic growth at all levels, that is, in countries with a lower incidence of corruption the effect is negative, while in countries with a high incidence, the effect is positive. Similarly, Trabelsi (2024), describes that corruption is positive for growth when corruption levels are high; however, this relationship reverses as countries gain in governance.

Ergo, this work has three main contributions. First and foremost, the identification of robust factors that affect economic growth in 19 Latin American countries using the Bayesian estimation technique (BMA), a novel methodology for the analysis of the phenomenon in the region, resulting in the uncertainty of the model reduction. Secondly, the estimation using the IVBMA method, which takes into account the use of the potential endogeneity problems of the institutional variables. As for the third one, the inclusion of a non-linear function of corruption in the estimated models as a determinant of economic growth in the context of Latin American countries stems out, contrasting with the literature that finds a linear and negative relationship between these two variables (Cieślik; Goczek, 2018; Hongdao *et al*., 2018).

Finally, the document is made up of five sections, the second one describes the economic growth in Latin America region, the third one present the variables and data used, in addition to the BMA and IVBMA methodology, the fourth one discusses the results, and as a fifth instance, conclusions are hereby presented

2 **Economic growth in Latin America region**

In the 1980s, the Latin American region was immersed in the external debt crisis, which forced the establishment of the economic policy recommendations prescribed by the Washington Consensus (Williamson, 1990). In this context, the neoliberal model based on openness to foreign trade, the promotion of competition in local markets and structural reforms to limit the presence of the State in the economy. As a result of the change to the neoliberal model, economic growth in Latin American countries has been marked by constant ups and downs (Guillen, 2012). In particular, at the beginning of the 1990s and until 1997, a period of economic recovery was identified after the stagnation suffered by the debt crisis in the 1980s. During these years, the Latin American region presented an average annual GDP growth rate of 3.2%, which represents a better performance than the average of the OECD countries (2.4%).

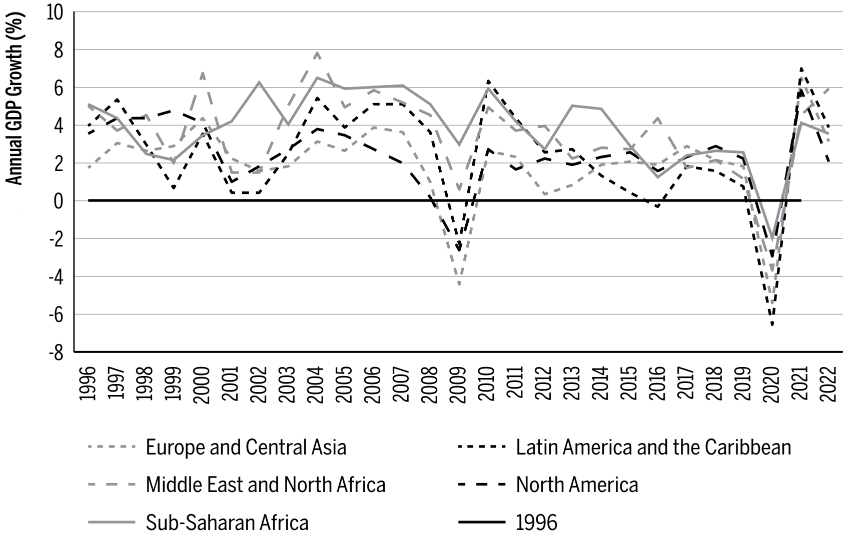
Subsequently, the contagion of the crises in Asian countries and Russia affected the majority of economies in the region. The effects materialized in 1998, with a contraction in the average annual growth rate, reducing it to 2.1%. Slow growth phase extends for several years; on average, the region grew at a rate of 1.6% annually, well below the OECD average (2.3%) for that period (Jorgenson; Vu, 2010).

After the stagnation caused by the international financial crises, Latin American economies experienced an economic boom in the period from 2004 to 2008, driven by favorable external financing conditions and rising prices of raw materials, the region presented an average GDP growth of 5.4%, above the average presented by the OECD countries (2.3%). However, by 2009 the region began to suffer the effects of the international financial crisis caused by the mortgage crisis in the United States, causing a drop in GDP of –1.9% (Jorgenson; Vu, 2010).

Latin American countries are characterized not only by low growth, compared to other emerging economies, but also by significant fluctuations induced by external shocks. Figure1 shows the behavior of economic growth in Latin America in comparison with different regions of the world, although it is observed that economic growth in Latin America follows global fluctuations, contractions and recoveries are more pronounced. This trend continues with the economic impact of the pandemic caused by COVID-19 in 2020, which affected the GDP of all countries in the world; however, the impact on Latin American economies was significantly greater.

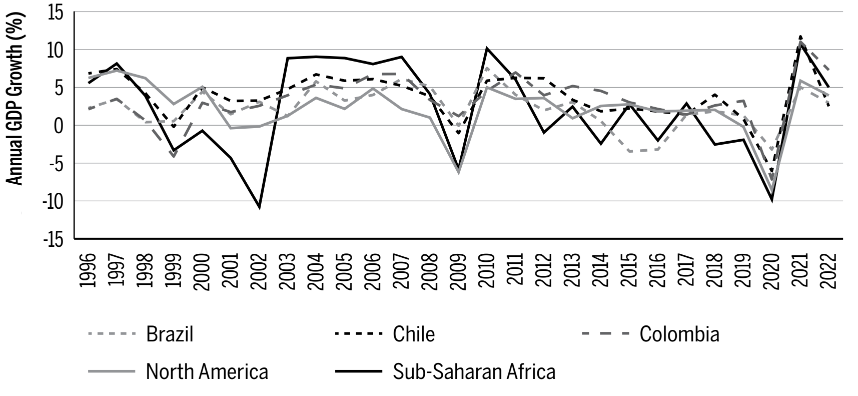
Even between 2000 and 2009, when the financial crises hit advanced economies particularly hard, the standard deviation of growth is higher in Latin America than in the rest of the world. According to Loayza *et al*., (2007), the volatility presented by Latin American economies becomes a barrier to long-term growth, by promoting the decrease in savings, consumption and investment.

Figure 1 **GDP growth rate (%) in different regions of the world**



Source: Own elaboration based on data from the World Bank.

Figure 2 **GDP growth rate (%) of the five largest economies in Latin America**



Source: Own elaboration based on data from the World Bank.

Alternatively, the economic performance within the countries that make up the region follows the same trend; however, we find differences regarding their sensitivity to external shocks. figure 2 shows that Mexico presents greater sensitivity to crisis scenarios, presenting a greater contraction. According to data from the World Bank (2022), the Mexican economy presented an average growth of just over 2% annually between 1980 and 2022, which means a poor performance compared to other countries in Latin American such as: Chile (4.1%); Peru (3.2%); and Brazil (2.4%). Otherwise, Peru is less sensitive to crisis scenarios, but is more sensitive to expansionist scenarios, causing a greater acceleration of growth compared to other countries in the region.

3 **Variables and data**

The database includes 27 possible determinants and uses statistics from different sources, that is, the World Bank, the Heritage Foundation, Transparency International, and Freedom House. An unbalanced data panel is used with observations from 1996 to 2021, contemplating a 26-year horizon estimation to reduce the effect of fluctuations in the economic cycle, the variables are used as non-overlapping two-year period averages, halving the real number of observations for the selected countries (see table 1).

Table 1 **Latin American countries considered in the study**

1	Argentina	11	Guatemala
2	Bolivia	12	Honduras
3	Brazil	13	Mexico
4	Chile	14	Nicaragua
5	Colombia	15	Panama
6	Costa Rica	16	Paraguay
7	Cuba	17	Peru
8	Dominican Republic	18	Uruguay
9	Ecuador	19	Venezuela
10	El Salvador		

Source: Own elaboration.

According to Leon-Gonzales and Vinayagathasan (2015), several studies estimate the determinants of economic growth by taking the averages of five-year periods, however, when the number of countries is small, an average of two non-overlapping years can be used to maximize the number of observations. The temporality of the information occurs upon the data unavailability of some variables for years after 2021.

No specific theoretical approach to economic growth is followed. However, a broad set of potential determinants is proposed (see Table 2).

Table 2 **Potential determinants of economic growth**

Variable	Definition	Source
Endogenous variable		
GDP Growth Rate	Annual GDP per capita growth rate.	World Bank
Exogenous variables		
Institutional Factors		
Accountability Index	This Indicator makes it possible to assess the degree of control that exists in legal and political terms in the countries. It ranges from −2.5 (weak) to 2.5 (strong).	World Bank
Civil Liberty	Civil Liberty Index. On a scale of 0-100, higher scores indicate greater civil liberty.	Freedom House
Corruption Perception Index (CPI)	It rates the perceived levels of corruption in the public sector of each country, according to the opinions of experts and businessmen. A country's score is the perceived level of corruption in the public sector, on a scale of 0 to 100, where 0 means highly corrupt and 100 means very clean.	International Transparency
Economic Freedom Index	The composite index, which measures economic freedom on a scale from 0 to 100. Higher values indicate greater economic freedom.	Heritage Foundation
Government Effectiveness	The indicator that measures the effective performance of the government. It ranges from −2.5 (weak) to 2.5 (strong).	World Bank
Political Rights	Index of freedom of political rights. On a scale of 0-100, higher scores indicate greater freedom to exercise political rights.	Freedom House
Political Stability	An indicator that measures the possibility of instability in the Government. It ranges from −2.5 to 2.5. higher values correspond to less political instability.	World Bank
Property Rights	The composite index, which measures the protection of property rights on a scale of 0 to 100. Higher values indicate greater protection of property rights	Heritage Foundation
Regulatory Quality	Indicator that measures the government's ability to formulate and implement sound policies and regulations to enable and promote private sector development. It ranges from −2.5 (weak) to 2.5 (strong)	World Bank
Rule of Law	Indicator that measures the rule of law in a society. It ranges from −2.5 (weak) to 2.5 (strong)	World Bank

(continues on the next page)

Table 2 **(continuation)**

Variable	Definition	Source
Economic Factors		
Commercial Opening	Imports plus exports as a percentage of GDP.	World Bank
Commodities Price Index	The index was computed by the Laspeyres formula. Non-Energy Price Index is comprised of 34 commodities. U.S. dollar prices of each commodity is weighted by 2002-2004 average export values. Base year reference for all indexes is 2010.	World Bank
Foreign Direct Investment	Foreign direct investment as a percentage of GDP.	World Bank
Gini Coefficient	The Gini coefficient ranges from the lowest value, 0 (perfect equality) to the highest value, 100 (perfect inequality).	World Bank
Government Spending	Public spending as a percentage of GDP.	World Bank
Gross Capital Formation	Gross capital formation as a percentage of GDP.	World Bank
Higher Education	Higher education gross enrollment ratio.	World Bank
Household Consumption	Household consumption as a percentage of GDP.	World Bank
Inflation	Annual inflation rate.	World Bank
Initial GDP Per capita	Natural logarithm of GDP per capita in the initial year (1996).	World Bank
Interest Rate Differential	Represent the differential between the real interest rate of each Latin American country with respect to the real interest rate of the United States.	World Bank
Population Growth Rate	Annual population growth rate.	World Bank
Primary Education	Primary education gross enrollment rate.	World Bank
Real Exchange Rate	Refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).	World Bank
Saving	Saving as a percentage of GDP.	World Bank
Secondary Education	Gross enrollment rate secondary education.	World Bank

Source: Own elaboration based on the information collected from the different sources.

The study incorporates variables that capture physical capital and infrastructure, particularly with initial GDP per capita, savings, and gross fixed capital formation. Levine and Renelt (1992), state that investment together with the initial income level are the most robust variables when explaining economic growth. Their study contemplates a sample of 119 countries (including Latin American countries) for the period 1960-1985. Additionally, Aghion *et al*., (2016), mentions that in developing countries local entrepreneurs depend on joint ventures with foreigners for the adoption of frontier technology, which is financed with domestic savings. In this way, savings encourage innovation and growth.

Regarding human capital and education, gross enrollment rates for primary, secondary, and higher education are used. Lucas (1988), points out that formal education and learning about practice are the mechanisms by which the accumulation of human capital occurs, likewise, he mentions that the differences in growth between countries are due to the different capacities to accumulate human capital.

To capture the effect of structural policies, variables that are related in particular to the conditions of each nation and that are difficult to change in the short term are taken into account. Therefore, trade openness, the Gini coefficient, government spending, and household consumption are considered. This way, authors such as Frankel and Romer (1999), emphasize the positive effect of trade on the long-term growth rate by encouraging technological progress.

On the other hand, income inequality presents an inconclusive relationship with economic growth. The literature shows evidence of both, a positive relationship (Forbes, 2000; Barro, 2000), and a negative one (Alesina; Rodrik, 1994; Perotti, 1996).

Regarding public spending, works such as that of Barro and Sala-i-Martin (1992), point out a differentiating effect, while current spending is negative, investment spending is positive. Concerning household spending, this has a multiplier effect on growth by encouraging production and investment in productive capacities (Al Rasasi *et al.*, 2021).

The impact of stabilization policies is approximated by the annual inflation rate, regardless the literature that relates it to the level of long-term growth which is not conclusive (Easterly; Levine, 2002). Other authors such as Barro (1999), emphasize their negative relationship.

The influence of external conditions on the growth of Latin American countries is captured through foreign direct investment (FDI) and the interest rate differential for the Latin American countries and United states. Cerquera and Rojas (2020), identify that the increase in FDI flows does not necessarily translate into greater economic growth. However, the success of FDI in the countries depends on the initial conditions of each economy.

Likewise, Bresser-Pereira (2009), argues that the slow growth is due to the appreciation of the real exchange rate; This has affected competitiveness and caused lower returns on investment in the tradable goods sector. Moreover, the exchange rate can affect the Latin America countries trade balance, generating a restriction in the balance of payments. Pacheco (2019), concludes that the economic performance in several Latin American countries is restricted by the balance of payments, thus there is a limit to systematically sustain the trade deficit and accumulate external debt.

Additionally, the phenomenon of Latin American growth of last years coincided in time with a significant recovery in the value of commodities, generated largely by the growing prominence of demand from China and India. This coincidence of bullish phases in Latin American economies and in raw material prices accompanied by low interest rates in the United States suggests that both phenomena are linearly related whit economic growth in Latin American countries (Sanahuja, 2016).

According to Rodrik *et al.*, (2004), long-term economic growth requires building institutions that foster favorable conditions for investment and development, as well as facilitating the equitable distribution of resources. In this way, institutions must be established to regulate, stabilize and legitimize the market through the protection of civil, political, and property rights. Similarly, Przeworski and Curvale (2006), conclude that the different quality of institutions explains the growth gap between the United States and Latin American countries. To approximate the institutional conditions in the countries, the largest number of variables available are considered, namely, the indices of perception of corruption, government effectiveness, accountability, protection of political and property rights, rule of law, political stability, regulatory quality, civil liberty, and economic liberty.

In the case of corruption, two variables are constructed to find a threshold effect due to the recognition of the non-linear effect on economic growth:

$$CPI\_high = CPI * d1 \tag{1}$$

$$CPI\_low = CPI * (1 - d1) \tag{2}$$

where $d1$ is a dichotomous variable that takes the value of 1 when the corruption indicator is above the threshold and 0 otherwise. To approximate the value of the threshold, the average of the levels of corruption of the countries that make up the index in each period is taken[2].

2 The average values of the CPI range between 42.54 and 43.34 for the total sample of countries in the period 2012-2021.

Finally, population conditions are captured with the population growth rate. The work carried out by Huarancca and Castellares (2021), establishes that population growth has a positive relationship with labor productivity, that is, changes in the age structure of the labor force have a significant and strong correlation with GDP per capita.

It should be noted that no geographical variable was incorporated, since the study is regional, therefore, the selected countries have similar geographical conditions. The descriptive statistics of the variables used are found in the appendix (see Table A1).

3.1 Bayesian model averaging methodology

The first to adopt the BMA methodology for the analysis of economic growth are Brock and Durlauf (2001), Fernandez *et al*., (2001), and Sala-i-Martin *et al*., (2004). Later work was carried out with similar exercises (Durlauf *et al*., 2012; Mirestean; Tsangarides, 2016).

Using Bayesian inference, one can obtain not only the posterior probability of the model, but also the posterior characteristics of the parameters, such as the mean, the variance, and the quantiles (Koop, 2003). Since you have the characteristics of all the models, you can compute some interesting measures over the entire model space, instead of making inferences based on a single model. Consider the generic liner model of a cross-country growth regression:

$$y = \alpha I_N + \beta_j X_j + \varepsilon \tag{3}$$

where y is the growth rate of per capita GDP over a particular period, α is a constant, I_N is an identity matrix of size N, X_j is an matrix of regressors in model M_j, and β_j is a vector of parameters, and ε is a vector with a normal distribution $N(0,\sigma^2 I_N)$ where σ^2 is the variance of random error ε. Data are taken from $i = 1, 2,\ldots,N$ objects.

The combination of distinct regressors generate a large model space. Since the growth determinants are represented by K variables, the model space consists of 2^K different models including the full model (with all possible explanatory variables).

The BMA treat the true model as an unobservable random variable, therefore, incorporate the model uncertainty into statistical inference (Hoeting *et al*., 1999). According to Eris and Ulasan (2013), the data for a random variable y are generated by a particular model in the model space that encompasses all possible models. That is, assume that there are 2^K possible different models and the model space can be defined such that $M = \left\{ M_1, \ldots, M_{2^K} \right\}$ where M denotes the model space and M_j is one of its typical elements as follows:

$$M_j = \left\{ p\left(\beta_j, y\right); \beta_j \in \Omega_j \right\} \tag{4}$$

where β_j is the vector of unknown parameters, y is a vector of sample observations for Y and $p(\beta_j y)$ is the joint density function for β given y in M_j model. The BMA takes into account all possible models instead of focusing on a selected one, as a result of, combines posterior estimates across the model space in the following manner:

$$p\left(\beta \mid y\right) = \sum_{j=1}^{2^K} p\left(\beta_j \mid y, M_j\right) \, p\left(M_j, y\right) \tag{5}$$

where $p\ (M_j \mid y)$ is the posterior probability of model M_j being the true model conditional on the observed data. In order to obtain a BMA estimate of β first need to specify prior probabilities $p\ (M_j)$ for each model indicating how likely it is the true model, given the model space. In this context, the likelihood function for model M_j is expressed by $\boldsymbol{I}_j = (\beta_j \mid y, M_j)$.With the variance:

$$\operatorname{var}\left(\beta \mid y\right) = \sum_{j=1}^{2^K} \left[\operatorname{var}\left(\beta_j \mid y, M_j\right) + E\left(\beta_j \mid y, M_j\right)^2 \right] p\left(M_j, y\right) + \\ + E\left(\beta \mid y\right)^2 \tag{6}$$

where $p\ (M_j \mid y)$ denotes the posterior probability of the model $M_j \sum_{j=1}^{2^K} \Pr\left(M_j \mid y\right) = 1$, also $E(\beta|y)$ and $Var(\beta|y)$ are the expected value and the variance of the parameters, furthermore, 2^K is the total number of all linear combinations in the regression model. The calculation of the posterior probability of the model and the estimation of parameters in the linear regression model is a well-known topic in the Bayesian statistics literature, so only the main steps used are described here generally, especially those related to the model averaging framework.[3]

To simplify the calculations, a natural normal-Gamma conjugate is used before the regression parameters (DeGroot, 1970; Koop, 2003). Therefore, the non-informative standard priors for the α-intercept are assumed, which are common parameters in all regression models:

$$p\left(\alpha,\sigma^2 \mid M_j\right)\alpha\sigma^{-2} \tag{7}$$

For the coefficients, β_j a normal prior distribution with mean 0 and covariance matrix is assumed $\sigma^2[g_jX^TX]^{-1}$:

$$\beta_j \sim N\left(0,\sigma^2\left[g_jX^TX\right]^{-1}\right) \tag{8}$$

From equation (9), it can be seen that the covariance of the prior distribution β_j depends on σ^2. Furthermore, the above covariance matrix is proportional to the covariance matrix of the base data and g-prior (g_j).

The basic idea of g-prior is taken from Zellner (1986), which consists of assuming a uniform prior distribution for the regression coefficients. In this case, the prior distribution (g-prior) is widely used in Bayesian studies, proposed by Fernández *et al.*, (2001), and Ley and Steel (2009), in this approach, $g_j = 1/K^2$ for many regressors, that is, $N \leq K^2$ and $g_j = 1/N$ where $N > K$.

The residuals in the regression model are assumed to be normally distributed, therefore, the likelihood function has the following form:

$$p\left(y \mid \alpha,\beta_j,\sigma^2,M_j\right)\alpha\frac{1}{\sigma^N}\left\{\exp\left[\frac{\left(y-\alpha l_N - X_j\beta_j\right)^T\left(y-\alpha l_N - X_j\beta_j\right)}{2\sigma^2}\right]\right\} \tag{9}$$

According to the Bayesian literature, the posterior distribution for the vector β_j follows a multivariate Student's t distribution (Fernández *et al.*, 2001; Koop, 2003). Which when integrating the posterior mean and the covariance matrix, the density of the marginal distribution of the vectoris given by:

3 For more technical details, consult the references: Hoeting *et al.*, (1997, 1999), Fernández *et al.*, (2001), and Gnimassoun (2015).

$$P\left(y \mid M_j\right) \alpha \left(\frac{g_j}{1+g_j}\right)^{\frac{K_j}{2}} \left[\frac{1}{1+g_j} y^T P X_j y + \frac{g_j}{1+g_j} \left(y - \tilde{y} I_N\right)^T \left(y - \tilde{y} I_N\right)\right]^{\frac{N-1}{2}} \tag{10}$$

where:

$$PX_j = I_N - X_j \left(X_j^T X_j\right)^{-1} X_j^T \tag{11}$$

Since there is the marginal density $P(y|M_j)$ in equation (10), the posterior probability of any variant of the regression model of the models M_j can be calculated by the following formula, essential for Bayesian model averaging:

$$p\left(M_j \mid y\right) = \frac{p\left(y \mid M_j\right) p\left(M_j\right)}{\sum_{l=1}^{2^K} p\left(y \mid M_j\right) p\left(M_j\right)} \tag{12}$$

where:

$$p\left(y \mid M_j\right) = \int \mathrm{I}_j \left(\beta_j \mid y, M_j\right) p\left(\beta_j \mid M_j\right) d\beta_j \tag{13}$$

On the other hand, the BMA faces the drawback of obtaining posterior quantities for a large set of exogenous regressors. For example, if we consider $K = 27$ independent variables, we would have to estimate more than 134 million linear combinations, which would require enormous computer processing time. Instead, a much better idea is to use a “smart" algorithm that finds the most likely models and ignores the least likely ones with a reasonable computational time (Błażejowski *et al.*, 2019).

Markov Chain Monte Carlo (MCMC) Model Composition algorithm, developed by Madigan *et al.*, (1995), this technique makes it easier to identify models with greater explanatory power, discarding the less probable ones.

Since no given theoretical approach is used for the analysis of numerous determinants, the use of BMA with MCMC is central to the study. Thereby, the candidate model M* is accepted with the probability:

$$\min\left\{\frac{p\left(y \mid M^*\right) \Pr\left(M^*\right)}{p\left(y \mid M_j\right) \Pr\left(M_j\right)}, 1\right\} \tag{14}$$

where M_j denotes the model previously accepted in the MCMC. After a sufficient number of iterations, an equilibrium distribution is obtained: $p(M_j|y)$ to the posterior probabilities, the posterior mean, and the variance, which are computed over the entire space of the BMA. Using Monte Carlo simulation, the posterior inclusion probability (PIP) can be derived. The PIP value indicates the importance of an independent variable in the regression model.

3.2 **Instrumental variables method in bayesian model average (IVBMA)**

Endogeneity occurs when an independent variable is correlated with the error term in a regression. Regarding economic growth, the literature has pointed out the effect of this on the quality of institutions. In consequence, it is expected that countries with higher incomes have more solid institutions, while having appropriate institutions can reduce uncertainty and encourage investment and therefore growth (Martín, 2009). In this context, the relationship between these two variables is bidirectional. For the estimation of the IVBMA proposed by Karl and Lenkoski (2012), the variables with institutional origin are instrumented. Thus, the two-stage endogenous model for country i is:

$$y_i = \alpha X_i + \beta W_i + \varepsilon_i \tag{15}$$

and

$$X_i = \gamma Z_i + \delta W_i + \rho_i \tag{16}$$

where y_i is the growth rate of per capita GDP, X_i indicates the vector of endogenous independent variables. W_i denotes the vector of exogenous regressors, while Z_i constituting a vector of instrumental variables, ε_i and ρ_i they represent idiosyncratic error terms.

The use of lagged values of endogenous variables as instruments is a common practice in the empirical literature on economic growth (Temple, 1999; Schularick; Steger, 2010; Mirestean; Tsangarides, 2016). Thus, the use of lagged values averaged every two years for each endogenous variable as an instrument is proposed.

For endogenous variables the first lag is used as an instrument, although more lags can be used as instruments, there is no clear general rule on the optimal number of instruments when using Monte Carlo simulation. However, research such as that carried out by Roodman (2009), established that increases in instrument count tend to artificially raise the estimate of a parameter, similarly Windmeijer (2005), shows that models that use nearer lags as instruments have larger posterior probability.

All in all, a valid instrument needs to satisfy two characteristics: a strong correlation with the potentially endogenous variable and the possibility of exclusion (Angrist; Pischke, 2008). Regarding the first point, lagged values are particularly attractive, since the corresponding institutional conditions are relatively dependent on the historical trajectory.

The exclusion restriction refers to when the excluded instruments are correlated with the endogenous regressors. This condition is more difficult to meet and even to prove. As such, the specification of an instrumental variables model states that the excluded instruments affect the independent variable only indirectly. As an example, past conditions of institutional quality tend to be strong predictors of current conditions, but not vice versa. Causality ceases to be a concern as future levels increase, in other words, it becomes very unlikely that the quality of institutions in the future will affect quality levels in the past.

4 **Results**

The programming language "R" is used to carry out the estimates. In the case of the BMA, the “BMS” package developed by Zeufner and Feldkircher (2009), is used, and for the IVBMA the "ivbma" package was developed by Lenkoski, *et al*., (2014), a total of 2,000,000 MCMC simulations were executed for each estimated model and the first 200,000 iterations were discarded to eliminate the influence of the initial values. All the models presented adequate levels of convergence[4].

A uniform prior probability is assumed for all potential determinants. Thus, the initial distributions are non-informative. This means that there

4 The correlation coefficient between the probability of the numerical and analytical model was presented above 0.95, indicating the good performance of the algorithm (Fernández *et al*., 2001).

was no preference for any variable associated with any theory of economic growth or other fixed assumption, and the models were used to find the most robust ones (Błażejowski *et al*., 2016).

The estimation of the BMA is performed assuming that all the regressors are exogenous, the posterior means of the regression parameters (Post Mean), the posterior standard deviations (Post SD), as well as the Posterior Inclusion Probabilities (PIP) corresponding to the analysis. BMA is shown in column [1] of Table 3. The determining variables are listed in alphabetical order and their statistical significance is determined as proposed by Eicher *et al*., (2012)[5].

The results of the BMA indicate a strong association of gross capital formation with economic growth, exhibiting a PIP of 100%. These results coincide with those presented by Munnell (1992), and Dedrick *et al*., (2003), pointing out that investment in infrastructure, machinery, and equipment are the main drivers of total factor productivity, this condition causes a boost to economic growth. Hence, physical capital can be a key factor to understand the dynamics of economic growth in the Latin American countries hereby considered.

On the other hand, property rights, the population growth rate, and the initial GDP per capita exhibit a high PIP (98%, 92%, and 92% respectively) with the mean of the positive coefficient for the case of rights property and negative for the population growth rate and initial GDP per capita.

Accordingly, the protection of property rights promotes economic growth, through increased investment. This vision agrees with authors such as Rodrik *et al*., (2004), who establish the need to create solid institutions that foster an environment suitable for increased investment and development.

The population growth rate exhibits a negative relationship, a result that conforms to the Solow (1956), growth model, which specifies that the higher the population growth rate of an economy, the lower the capital per capita. This is, a higher growth rate is required to compensate for population growth.

The initial GDP per capita is used to test the economic convergence hypothesis proposed by Solow (1956), and later extended by Mankiw *et al*., (1992), the concept of conditional convergence establishes that, in the long

5 PIP values > 0.99 provide conclusive evidence, $0.95 < PIP < 0.99$ strong evidence, $0.75 < PIP < 0.95$ positive evidence, and $0.50 < PIP < 0.75$ suggest weak evidence. values below 0.50 are not considered significant.

term, per capita income tends to equalize as long as the group of countries has certain common characteristics. Therefore, the evidence of the initial GDP per capita with a negative coefficient suggests the existence of conditional convergence in Latin American countries. This result agrees with Serra *et al.*, (2006), who find evidence of convergence in the per capita product of the middle-income countries of Latin America.

Regarding savings, government spending, and the Gini coefficient, reflecting a relatively high PIP (89%, 75%, 81%, respectively). In the case of savings, the mean of the coefficient has a positive sign. Savings are reinvested to generate new capital. The accumulation of capital generates greater production and income, which in turn is used for consumption and savings causing a virtuous circle that makes growth possible. Authors such as Kuhe (2020), argue that domestic savings have a positive effect on economic growth, by transforming it into investment in physical and human capital, raising productivity and production.

Contrary to expectations, the mean of the public spending coefficient shows a negative sign. An explanation for this result is derived from Keynesian thought, which states that public investment can have a displacement effect on private investment, causing its reduction. Gutierrez *et al.*, (2021), made a study for Mexico where they present evidence of the displacement effect of public investment over private investment, although they mention that this effect is reversed in later periods.

Regarding the Gini coefficient, which is negatively related to growth, greater inequality can reduce the opportunities of the most vulnerable population, this limits social mobility and creates a barrier to the potential growth of the economy. Similarly, Chetty *et al.*, (2017), state that inequality can affect the performance of the economy through a reduction in investment opportunities, essentially in education, for the poorest segments of the population.

On the other hand, commodities price index and the CPI_high have a substantially significant PIP (100% and 64% respectively). Sanahuja (2016), argues that the fluctuation of raw material prices has a close relationship in the evolution of Latin American economies.

The CPI_high shows a positive average coefficient, in other words, corruption is negative to growth. The transmission mechanism may be institutional quality since corruption erodes institutions and weakens their actions, generating a climate of uncertainty for businessmen, discouraging investment. However, this hypothesis can only be confirmed for the countries that present a higher-than-average CPI score (42.53), in the case of Latin America, they are the countries of Chile, Uruguay, Cuba, and Costa Rica. In other countries, there is no connection between corruption and growth.

Finally, the secondary education is positively related whit economic growth (PIP 50%). Ranis and Stewart (2002), establish that the expansion of opportunities through the education that people have contributes to improving the quality of life of the workforce, therefore, it significantly favors economic growth. For the other potential determinants used, the PIP displayed is less than 50%. Therefore, there is no evidence of its connection with economic growth (see Table 3).

Now, the IVBMA is estimated, assuming the variables of institutional origin as endogenous (in addition to the initial GDP per capita). The association of property rights, the CPI_high, the initial GDP per capita, gross capital formation, the population growth rate, the Gini coefficient, the government spending, the population growth rate and savings, with economic growth, are confirmed. Variables maintain the sign of the mean of their coefficients in both models. Additionally, household consumption has a substantially significant (PIP 80%). Households are ultimately the owners of companies, therefore, they are the source of a significant surplus that drives the mechanisms of social accumulation in Latin American countries. Bald *et al*. (1996), states that periods of economic growth in Latin America would be identified by the presence of strong increases in consumption.

The results of the IVBMA are shown in column [2] of Table 3. When the endogeneity of the variables with institutional origin is assumed, these become more relevant to understand economic growth in Latin American countries. Thus, the effectiveness of the government, the rule of law and the CPI_low show significant PIP values (52.3%, 55.3%, 71.2%, and 58.9%, respectively). It should be noted that the effectiveness of the government, regulatory quality, and the rule of law, are variables that contribute to the institutional strength of a nation. In this way, its actions are related to a climate of greater certainty in the market, generating an increase in investment, fostering economic growth.

Finally, the existence of a non-linear relationship between corruption and economic growth in the countries considered is verified, in line with Mushfiq, (2011), and Trabelsi, (2024), the CPI_high has a mean coefficient with a positive sign and the CPI_low a mean coefficient with a negative sign. In other words, in the countries with scores higher than the mean (42.53), corruption is negative for growth, probably these countries have adequate institutions. Therefore, corruption is detrimental by degrading their actions, generating uncertainty and discouraging investment.

Conversely, in countries with scores below the average, corruption is positive. Possibly, high levels of corruption in these countries generate a distortion in the quality of their institutions, so the negative effect of corruption can be offset by the positive effect it has in economies where corruption is orchestrated as a mechanism to solve bureaucratic inefficiency by helping to allocate resources when agents compete for the same service. This vision agrees with the authors Leff (2002), and Lui (1985), who describe that corruption acts as oil that lubricates the economy in countries with inefficient bureaucratic apparatus. The inverted U relationship proposed by Trabeski (2023), is confirmed for the Latin American countries considered in this study.

Table 3 **Results of the BMA and IVBMA in 19 Latin American countries (Depend variable: GDP Per capita growth rate)**

Explanatory Variables	**BMA [1]**			**IVBMA [2]**		
	g-prior: Uniform			**g-prior: Uniform**		
	PIP	**post mean**	**Post SD**	**PIP**	**post mean**	**Post SD**
Accountability*	0.28	−0.15	0.50	0.42	0.30	0.65
Civil Liberty*	0.30	−0.10	0.27	0.29	0.04	0.01
Commercial Opening	0.49	0.01	0.02	0.03	0.00	0.03
Commodities Price Index	**1.00**	**0.04**	**0.01**	0.33	0.00	0.00
CPI_high *	**0.64**	**0.02**	**0.03**	**0.61**	**0.00**	**0.02**
CPI_low *	0.34	−0.03	0.01	**0.59**	**−0.05**	**0.05**
Economic Freedom Index*	0.32	0.02	0.04	0.10	0.01	−0.41
Foreign Direct Investment	0.38	0.03	0.06	0.34	0.05	−0.01
Gini Coefficient	**0.81**	**−0.01**	**0.01**	**0.57**	**0.01**	**0.01**
Government Effectiveness*	0.29	0.18	0.52	**0.59**	**0.68**	**0.84**
Government Spending	**0.75**	**−0.17**	**0.13**	**0.83**	**−0.11**	**0.07**
Gross Capital Formation	**1.00**	**0.32**	**0.06**	**0.50**	**0.06**	**0.08**
Higher Education	0.27	0.00	0.01	0.40	−0.01	0.00

(continues on the next page)

Table 3 **(continuation)**

Explanatory Variables	BMA [1]			IVBMA [2]		
	g-prior: Uniform			g-prior: Uniform		
	PIP	post mean	Post SD	PIP	post mean	Post SD
Household Consumption	0.69	0.04	0.04	**0.80**	**0.05**	**0.50**
Inflation	0.39	0.01	0.02	0.02	0.00	−0.01
Initial GDP Per capita*	**0.92**	**−3.43**	**1.70**	**0.52**	**−0.24**	**−0.41**
Interest Rate Differential	0.27	0.00	0.01	0.48	−0.01	0.01
Political Rights*	0.24	−0.01	0.15	0.44	0.17	0.13
Political Stability*	0.26	−0.03	0.14	0.35	0.09	0.01
Population Growth Rate	**0.92**	**−1.71**	**0.78**	**0.87**	**−0.81**	**−0.02**
Primary Education	0.46	0.00	0.01	0.01	0.00	0.01
Property Rights*	**0.98**	**0.06**	**0.02**	**0.67**	**0.04**	**0.01**
Real Exchange Rate	0.32	0.00	0.00	0.33	0.00	0.00
Regulatory Quality*	0.24	0.02	0.19	0.41	−0.15	0.32
Rule of Law*	0.30	0.20	0.54	**0.71**	**0.78**	**0.00**
Saving	**0.89**	**0.11**	**0.07**	**0.99**	**0.11**	**0.03**
Secondary Education	**0.50**	**0.01**	**0.01**	0.32	0.00	0.00

*Source: Own elaboration based on estimates made in "R" software. Note: *First lag as a instrumental variable is used, values in bold, are values with PIP > .50.*

To verify the robustness of the results, the model is estimated using a g-prior function different from the uniform (previously used), particularly, the model is estimated using the g-prior: hyper, which uses a predetermined hyperparameter to a set of such that the expected contraction factor fits the a priori information unit (UIP). This hyperparameter can be set between 2 < to ≤ 4. The model size distribution generated in this way is the so-called beta-binomial distribution described by Ley and Steel (2009)[6]. In this context, the authors propose to set the values of $a = 1$ and $b = (K - m) / m$, where, only the mean size of a prior model (m) has to be specified.

The results of the model with the g-prior: beta-binomial, are shown in the appendix (see column [1] of table A2), the model is estimated by setting $m = K / 2$, and the results coincide with those found with the g-prior:

6 Ley and Steel (2009), propose a hierarchical prioritization on the size of the model (W) given by: $W \sim Bin(K,\xi)$ *y* $\xi \sim Be(a,b)$, where $a,b > 0$ are hyperparameters to be set by the researcher. The size of the model W will then satisfy: $E(W) = a / (a + b) K$

uniform, the PIPs tend to be systematically significant for the same variables across the two specifications. Likewise, the signs of the coefficients tend to persist and their values remain in the same range, confirming the strength of the results when determining different prior distributions. Additionally, it is estimated by setting a $m = 5$. The results do not present significant differences (see column [2] of table A2). However, when the size of the g-prior is limited, only the variables maintain their significance: gross fixed capital formation, initial GDP per capita, property rights, population growth rate, and savings.

Additionally, the method of the generalized system of moments (Sys-GMM) proposed by Blundell and Bond (1998), is used. This methodology addresses the problem of endogeneity, since the model includes a lagged dependent variable that may imply a correlation between the lagged regressor and the error term. Furthermore, the variables on the right show correlation with the past and current error term, so the approach uses lagged endogenous variables as instruments to control for endogeneity. Likewise, by construction, there is heteroskedasticity and autocorrelation within the individual unit errors, but not between them. That is, the residuals of the differentiated equation should have serial correlation, but the differentiated residuals should not exhibit significant AR(2) behavior (Baum *et al.*, 2003).

$$y_{it} - y_{it-1} = \alpha + \beta_1 \left(y_{it-1} - y_{it-2} \right) + \sum\nolimits_{k=1}^{n} \beta_k \left(X_{kit} - X_{kit-1} \right) + \left(\mu_{it} - \mu_{it-1} \right) \tag{17}$$

The dynamic equation in first differences, where the variable on the left depends on its own past realizations, is expressed by the generalized system of moments method (Sys-GMM) proposed by Blundell and Bond (1998), which combines the lagged first differences of the dependent variable with its lagged levels. The instruments of the regression in levels are the lagged differences and the instruments for the regressions in first differences are the lagged levels.

The results of the Sys-GMM are presented in the appendix (see column [3] of table A2), these show a coincidence with the results of the BMA and the IVBMA, specifically, with the variables: initial GDP per capita, the expenditure of the government, the commodities price index, the gross capital formation, the Gini coefficient, the savings and the household consumption.

Thus, it remains confirmed, for these variables, the robustness of their association with economic growth in the face of different estimation methods.

5 **Conclusions**

The results of the BMA (assuming all the exogenous regressors) register 10 significant regressors, 8 have an economic origin and only 2 institutional origins. Economic variables have greater weight in explaining the dynamics of economic growth in Latin American countries. A result that coincides with studies that focus on the formation of physical capital and infrastructure and on the structural conditions of the economy to determine its growth (Levine; Renelt, 1992; Alesina; Rodrik, 1994).

However, when estimating the IVBMA, taking into account the possible endogeneity of the institutional variables, the results differ; institutions take on greater importance in determining economic growth in Latin America. These results are more consistent when dealing with the endogeneity problem that can generate bias in the BMA estimate.

It is observed that for Latin American countries it is necessary to promote the creation of solid institutions that create conditions of greater certainty for entrepreneurs, favoring investment and therefore economic growth. This vision coincides with the authors Acemoglu *et al*., (2001), who point out that countries with better institutions more adequately guarantee property rights and avoid policies that distort the investment decisions of private agents.

Regarding corruption, a non-linear relationship with economic growth is confirmed in the Latin American countries considered, contrasting with research that indicates a linear relationship between these variables (Leff, 2002; Bigio; Ramírez-Rondán, 2006; Haque; Kneller, 2015; Cieślik; Goczek, 2018). In particular, the weakness of the institutions of countries with high levels of corruption generates a distorting effect, since they allow the appearance of corruption as a mechanism that compensates for inefficiency and facilitates economic activity. However, this is reversed when countries improve the quality of their institutions, consequently, corruption is not necessary to boost the economy, and it appears as an harmful phenomenon that erodes the performance of institutions, generating uncertainty and discouraging investment.

Corruption indeed represents an incentive for growth in Latin American countries that have high levels of corruption. Despite this, this does not necessarily mean that corruption is beneficial for countries and that it should not be fought, since it only represents a second-level equilibrium. Consequently, in economies with institutional weakness, the optimal conditions of non-corruption are not satisfied, which, as Welsch (2008), points out, would imply greater well-being or, in terms of this document, the economic activity requires a certain level of acts of corruption to flow and counter institutional inefficiency which means costs for the economies. On the contrary, in light of the findings of this document, it is suggested that countries need to take a strong stance to combat it and provide adequate monitoring and control over the factors that generate it.

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About the article

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APPENDIX

Table A1 **Descriptive statistics of the data used (1996-2021)**

Variable	Obs.	Mean	SD	Min.	Max.
Endogenous variable					
GDP per capita growth rate	494	1.86	4.05	−19.13	16.28
Exogenous Variables with the economic origin					
Commercial Opening	494	62.56	28.15	15.68	166.7
Commodities Price Index	494	76.38	25.39	35.24	118.07
Foreign Direct Investment	494	3.44	2.86	−5.09	16.23
Gini Coefficient	494	49.63	4.96	38	61.6
Government Spending	494	14.28	5.42	5	39.88
Gross Capital Formation	494	21.54	6.03	7.61	44.31
Higher Education	494	41.75	21.3	1.42	117.1
Household Consumption	494	67.8	9.51	46.75	92.3
Initial GDP Per capita	494	8.54	0.65	7.14	9.69
Interest Rate Differential	494	2.533	12.62	0	87.59
Population Growth Rate	494	1.23	0.67	−2.9	2.77
Primary Education	494	109.15	8.48	78.36	165.65
Real Exchange Rate	494	489.82	1351.47	0	11786
Saving	494	17.6	9.3	−7.01	42.19
Secondary Education	445	83.33	19.49	24.54	142.02
Exogenous Variables with Institutional origin					
Accountability	494	0.05	0.69	−3.11	2
Civil Liberty	494	3.02	1.28	1	7
CPI_high	494	10.79	23.18	0	75
CPI_low	494	23.62	16.79	0	94
Economic Freedom Index	494	59.82	11.1	25.2	79
Government Effectiveness	494	−0.27	0.56	−1.87	1.34
Inflation	494	6.26	14.86	−1.55	254.95
Political Rights	494	2.77	1.49	1	7
Political Stability	494	−0.2	0.9	−2.38	7.84
Property Rights	494	41.39	19.28	0	90
Regulatory Quality	494	−0.11	0.81	−3.16	5.68
Rule of Law	494	−0.48	0.67	−2.7	1.45

Source: Own elaboration based on information from the different sources.

Table A2 **Robustness check (Depend variable: GDP per capita growth rate)**

Explanatory Variables	**BMA [1]**			**BMA [2]**			**Sys-GMM[3]**		
	g-prior: beta binomial m = k/2			**g-prior: beta binomial m = 5**			**g-prior: uniform**		
	PIP	**post mean**	**Post SD**	**PIP**	**post mean**	**Post SD**	**Coef.**	**SD**	**P >|z|**
Accountability	0.42	–0.34	0.59	0.06	–0.02	0.22	**–1.751**	**0.842**	**0.037**
Civil Liberty	0.30	–0.10	0.27	0.10	–0.03	0.16	0.103	0.494	0.835
Commercial Opening	0.49	0.01	0.02	0.21	0.01	0.01	0.007	0.017	0.698
Commodities Price Index	**1.00**	**0.04**	**0.01**	**1.00**	**0.05**	**0.01**	**0.057**	**0.009**	**0.000**
CPI_high	0.31	0.00	0.01	0.14	0.00	0.01	–0.009	0.029	0.756
CPI_low	**0.65**	**–0.02**	**0.02**	**0.50**	**–0.02**	**0.02**	–0.015	0.016	0.329
Economic Freedom Index	0.26	0.00	0.02	0.09	0.00	0.02	**–0.165**	**0.065**	**0.011**
Foreign Direct Investment	0.28	0.02	0.05	0.09	0.01	0.03	0.117	0.090	0.190
Gini Coefficient	**0.73**	**–0.01**	**0.01**	0.39	–0.01	0.01	**–0.022**	**0.009**	**0.020**
Government Effectiveness	0.29	0.18	0.52	0.08	0.05	0.28	**1.833**	**0.971**	**0.059**
Government Spending	**0.77**	**–0.17**	**0.13**	0.36	–0.07	0.12	**–0.528**	**0.087**	**0.000**
Gross Capital Formation	**1.00**	**0.32**	**0.06**	**1.00**	**0.35**	**0.06**	**0.250**	**0.056**	**0.000**
Higher Education	**0.95**	**–0.02**	**0.01**	0.09	0.00	0.00	0.009	0.009	0.344
Household Consumption	**0.99**	**0.06**	**0.02**	0.21	0.01	0.03	**0.104**	**0.026**	**0.000**
Inflation	0.38	0.01	0.02	0.15	0.01	0.02	–0.002	0.012	0.858
Initial GDP Per capita	**0.92**	**–3.45**	**1.69**	**0.93**	**–4.23**	**1.66**	**–5.649**	**0.999**	**0.000**
Interest Rate Differential	0.24	0.00	0.01	0.06	0.00	0.00	**0.091**	**0.025**	**0.000**
Per capita, GDP Growth Rate lagged 1 period	–	–	–	–	–	–	**–0.102**	**0.035**	**0.003**
Political Rights	0.24	–0.01	0.15	0.06	0.00	0.07	–0.630	0.399	0.115
Political Stability	0.26	–0.03	0.14	0.08	–0.02	0.09	0.484	0.224	0.031
Population Growth Rate	**0.94**	**–1.72**	**0.77**	0.15	–0.07	0.22	–0.486	0.610	0.426
Primary Education	0.46	0.00	0.01	0.22	0.00	0.01	**–0.013**	**0.007**	**0.051**
Property Rights	0.42	–0.01	0.01	**0.88**	**–0.05**	**0.02**	–0.011	0.023	0.632
Real Exchange Rate	0.28	0.00	0.00	0.07	0.00	0.00	**0.001**	**0.000**	**0.011**
Regulatory Quality	0.24	0.02	0.19	0.06	0.00	0.10	0.296	0.488	0.544
Rule of Law	**0.65**	**0.82**	**0.82**	**0.59**	**0.84**	**0.82**	0.256	0.994	0.797
Saving	**0.98**	**0.10**	**0.03**	**0.98**	**0.10**	**0.03**	**0.143**	**0.043**	**0.001**
Secondary Education	0.49	0.00	0.01	0.29	0.00	0.01	–0.010	0.008	0.172

Source: Own elaboration based on estimates made in R. Note: the values in bold are the statistically significant values (in the case of column 1 and 2 it represents PIP values > .50 and for column 3, they are the *p values < .10). The Arellano-Bond autocorrelation test was performed for the Sys-GMM model, confirming first-order autocorrelation (Z = −2.32 and a p-value = 0.021) and no second order autocorrelation (Z = −0.1545 and a p-value = 0.8771). Additionally, the Sargan over-identification test was performed (Chi2 = 3.65 and p value = 1.00) which confirms the validity of the instruments used in the model.*