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Víctor Adame García, Javier Alonso Meseguer, Luisa Pérez Ortiz, David Tuesta

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Abstract

In a context of extended global economic fragility, multilateral institutions and governments have been recommending to increase infrastructure investment to spur economic growth. However, the impact of this policy can widely differ depending on many aspects. We conducted an exhaustive meta-analysis to estimate "consensus" infrastructure elasticity's to growth. Compared to other studies, our paper has various remarkable highlights: a wider meta-sample of 794 observations from more than 150 peer-reviewed papers; different methodological approaches; the use of a meta-regression to control heterogeneity; a publication-bias correction to estimate the true size of the effect; and the distinction of different impacts depending on economic development. We see that the results are widely dispersed, varying between the value of 0.169 and 0.09, meaning that not "all the roads lead to Rome referring to the impact of infrastructure to growth. Focusing only on the valid methodology for us, the elasticity of infrastructure to growth is equal to 0.132, although the results differ when introduced publication-bias correction, meta-regression analysis or when we focused or not on OECD countries.

Keywords: Economic growth, meta-analysis, Infrastructure.

JEL classification: O40, H54, R15.

1. Introduction

From the seminal work of Aschauer (1989a; 1989b), a significant number of publications have empirically shown the positive causal link between infrastructure investment and economic growth. However, a more thorough review of this literature would show that this relationship is not unanimously accepted, nor the magnitude of said impact. The heterogeneity of the results obtained in the literature may be related also to the enormous heterogeneity of the estimated models (e.g. different geographies, a variety of econometric techniques, data availability.).

The economic crisis and post-crisis has left us with a global macroeconomic scenario characterized by the registration of lower rates of economic growth. One of the policies proposed by different multilateral institutions and governments to relaunch economic growth is precisely that of increasing investment in infrastructure[1]. However, we observe that many policy makers do not have a clear idea about the real economic impact and usually draw upon to the most convenient calculus.

Moreover, and as economic theory tells us, the law of diminishing returns on the capital factor (in this case infrastructure), would show that least developed countries (with a lower stock of infrastructure) should have a higher return on their investment than developed countries. A higher estimated elasticity for developing countries would further justify the need to see that increased efforts be put into the financing and construction of infrastructure. If public budgets are not able to, then the necessary and sufficient conditions should be articulated so that the private sector can take on this function, and thus help reduce the huge infrastructure gap observed in the region (Serebrisky et al., 2015).

Considering the different impacts of infrastructure on growth that can be obtained and the need from policy perspective to discern adequately among different estimates, we conducted an exhaustive meta-analysis to estimate "consensus" infrastructure elasticity's to real growth. Meta-analysis is a formal strategy of qualitative and quantitative synthesis based on the use of statistics that seeks to combine results from different studies, so that it is possible to estimate a common effect value from among them. Thus, the scientific evidence regarding a parameter under study is synthesized. The objective of meta-analysis is to investigate the sources of systematic variations in empirical findings.

The technique of meta-analysis was initially proposed by Pearson in 1934 and has been widely used in medical studies. However, it was not used in the field of economy until the late eighties and early nineties (see Stanley & Jarrell, 1989; Jarrell & Stanley, 1990). Reviewing the impact of infrastructures on output is not unheard of. Some authors have evaluated this issue through reviews of literature where the main purpose of these was to summarize the main findings of previous academic discoveries[2]. However, other works such as

1: There is a global sense of urgency to spur economic growth through increasing infrastructure investment. The International Monetary Fund has called for action in 2016.
(https://www.imf.org/external/np/sec/pr/2016/pr1683.htm). More specifically, the Juncker Plan of the European Commission contemplates resource mobilization of more than 315 billion Euros in three years (http://ec.europa.eu/priorities/jobs-growth-and-investment/investment-plan_en).
2: See for example, Munnel (1992), Button (1998), Stum et al., (1998) or Straub (2008).

Button (1998)[3], Bom & Lighart (2008),[4] Bom & Lighart (2011)[5] and Lighart & Suaréz (2011) [6]have used meta-analytical techniques to estimate the effect of public capital on productivity.

Compared to those previous studies we think that our paper contributes to this literature in different aspects. First, our research is based on a much wider meta-sample (794 observations) from more than 150 peer-reviewed papers, both published and unpublished, and available at a more recent date. The final sample has resulted in 46 articles, which incorporate the standard error. Second, this piece of research employs various methods of estimation, to highlight the fixed effects model and random effects model. Third, we developed a complete analysis of the method using meta-regression, where up to 42 moderating variables were used in order to control heterogeneity between studies. Fourth, we introduce a publication bias correction in the various models, to thereby correctly estimate the true size of the effect. Finally, we show the existence of a greater impact of infrastructure on growth in economies outside the OECD.

The organization of the document is established as follows. In Section 2, we conducted a thorough review of the literature on infrastructure and growth that has served for the preparation of the meta-sample, highlighting its heterogeneity and limitations. In Section 3, we review the most common estimation techniques of meta-analysis exercises and justify the methodology that is finally adopted. In Section 4, we describe the meta-sample that is finally adopted in this paper. Section 5 shows the results obtained in the different estimated models, based both on the technique of meta-analysis and meta-regression. We conclude in section 6.

3: In Button (1998), it was reviewed 26 studies where 28 observations were considered for the estimate.
4: Bom and Lighart (2008) reviewed 76 studies where only one observation was selected from each of these.
5: In Bom and Lighart (2011), the sample was restricted to 68 studies, although in this case, all estimated elasticities were taken into account resulting in a meta-sample of 578 observations.
6: Lighart and Martin (2011) considered 55 studies where 248 observations were considered.

2. Review of literature on the relationship between infrastructure capital and output

In this section, we briefly review the main methodological differences in the quantification of the impact on the output of investment in infrastructure. To do this, up to six key methodological aspects, which are able to explain the great variability in the vast empirical literature, are analysed separately. The purpose of this exercise is to extract as much information, common aspects from all the articles, but treated disparately by their authors. This allows us to control all possible sources of heterogeneity and thus quantify a true common effect. In total, 42 moderating variables grouped into thirteen categories and substantiated in the six treated aspects have been picked up, we will explain these briefly (see Table 2).

Production function

Most studies opt to use a standard production function of a Cobb-Douglas nature, with scaled declining yields for each factor and constant returns for the whole group of them. Investment in infrastructure is included as an additional independent variable in the model, although there are other studies where investment in infrastructure is incorporated as a variable that indirectly affects production.

On the other hand, some authors consider translog production functions (see Khanm, 1999)[7], or their own production functions which are not similar to the above[8]. Authors such as Straub and Hagiwara (2010), among others, estimate the impact of various infrastructures on production growth rate by checking a series of variables such as the initial level of production. Furthermore, Siyan et al. (2015) estimate the impact of road infrastructures on production, considering the use of capital, government spending on transportation and the exchange rate. In other studies, a cost function where the prices of factors are taken into account is used, however, items that implement these models have not been included in the meta-sample, since the impact of infrastructure does not directly relate to production.

Regarding estimations with the Cobb-Douglas production function, it is usually evaluated as a linear relationship in logarithms. However, we find that in studies such as Kamara (2007) and Straub (2008), initial differences are incorporated to avoid problems of seasonality; or delayed variables t periods to differentiate between short-term and long-term effects[9].

7: Khanm (1999) uses of a production function translog since considered more flexible than the Cobb-Douglas both. It also establishes the assumption of increasing returns to scale.
8: See, among others, Straub and Hagiwara (2010), Siyan et al. (2015) or Crescenzi and Pose (2008).
9: For a more detailed explanation, see Demetriades and Mamuneas (2000), Ozbaya et al. (2007), and Shanks and Barnes (2008).

Productive factors in the estimated production function

In most of the reviewed studies, we have found that they use a similar explained variable, that of the gross domestic product (GDP), although it sometimes appears expressed in terms of per capita or per worker employed (see Yamarik, 2000); and/or in percentage changes, growth rates[10]. Productive factors of private capital and labour are included in a fixed form, and their measurement is virtually unchanged. Private capital is usually valued by the perpetual inventory method. As for the labour factor, this is quantified as the number of people in employment in an economy; however, sometimes it is not introduced independently, but appears implicitly in the function where all parameters are expressed in terms of units of work. It is also possible to find the work factor in a disaggregated form, according to the economic sector of origin (see Del Bo and Florio, 2008). Often human capital is introduced into the production function, although there are different methods of quantification. Some authors only consider human capital in its most restrictive version, the number of workers with higher education or the number of dedicated research and development, science and technology sector workers. By contrast, in other studies (see Canning and Fay, 1993; Urrunaga and Aparicio, 2012) the years of schooling for people over 15 years and the rates of enrolment in primary education, secondary or higher are considered. Although less common in the literature, there are other factors that have been analysed and included in the production function, for example, spatial effects in Crescenzi and Pose (2008), the ratio of exports to GDP in Fedderke and Bogeti (2005), or the exchange rate in Siyan et al. (2015).

The definition of capital in infrastructure

Although all studies pertaining to this branch of economic literature try to estimate the impact of infrastructure on production or growth, it is not common to choose the same type of infrastructure, nor is it measured in the same way. Thus, in several papers on infrastructure, it is expressed in monetary units (investment)[11] or as a variable stock through physical indicators: Km of road, number of telephone lines, number of schools and hospitals[12]. Another way to analyse the impact of infrastructure is by creating an index to collect different types and forms of measurement. In this regard, the indexing strategy based on principal component analysis is most often used.

In general, to measure the level of infrastructure an aggregate composed of transport, telecommunications and electricity or energy is used. Although in other cases education and health infrastructure is included (Kara, Taş and Ada, 2015), postal services, hydraulic services and those related to the prevention of natural disasters (Mizutani and Tanaka, 2008).

Particularized by the type of infrastructure, transport is the most used, where kilometres of road and railway are highlighted. However, other authors have also introduced port and airport infrastructures into the transport category (see for example, Fumitoshi and Tomoyasu, 2005). Infrastructure-based telecommunications and electricity have also frequently been studied. The first one is usually measured mainly by the number of fixed and mobile telephone lines (Kamara, 2008), and the second by power generation capacity in kilowatts (Straub et al, 2009), or even by the number of household electrical outlets, distribution transformers and line length

10: See works such as Bosede et al. (2015), Rodriguez-Oreggia and Rodríguez-Pose (2004) and Kalyvitis (2002), among others.
11: See La Ferrara and Marcellino (2000), Holtz-Eakin (1994) or Rivera and Toledo (2004), among others.
12: As Straub et al., (2009) and Daiji., et al (2005).

(Bustillos et al, 2012). In addition, authors like Straub et al (2008) have chosen to somehow quantify the quality of infrastructure, where telephone breakdowns, losses in electricity generation or the percentage of paved roads in good condition have been taken into account.

Econometric Methodology

Regarding the econometric methods employed, we have shown that researchers often mainly use estimation by ordinary least squares (OLS), although sometimes this method is supplemented with more robust and accurate developments, where models of simultaneous equations are estimated by OLS in two or three stages (MC2E and MC3E). Other authors, such as Shioji (2001) and Gruber and Koutroumpis (2010), apply the generalized method of moments (GMM) in order to check on possible endogenous problems between the explanatory variables in the model. Another estimation procedure often used to estimate causal relations is the method of instrumental variables (IV). Although less common, other methods based on autoregressive models (the VAR Family) have been of great interest. Finally, a large number of documents alternate between the use of both fixed-effect models and random effect models.

Information aggregation and organization of data

The estimated models are often international in scope (from various geographies) or regional from a particular country. All this hinders comparability and produces various problems that have to be addressed in order to find the true size of the effect. In this regard, some authors argue that the estimated impact of infrastructures is inferior when information for the latter comes from regions[13].

The models were estimated mainly through time series, cross-section data and panel data. In this sense, most studies analyse this impact for several countries or regions, and for different periods[14]. Conversely, the time series is the least available models. In addition, it should be noted that the data sources used and the time period and the years considered for estimating the effect of infrastructure on output differs markedly in the literature.

The source of the data

In the vast majority of the analysed studies, databases developed by official bodies (national and international) are used. In the first, they are from the National Institutes of Statistics, the Central Bank and the Ministries in charge of producing official statistics for States. In the second, organizations like the World Bank, the Bureau of Economic Analysis or the World Economic Forum of the Organisation for Economic Co-operation and Development (OECD). Finally, most studies estimate the elasticity of infrastructure and growth in the time interval between 1975 and 1995 (see Figure 2).

13: Munnel (1992)
14: See for example, Kamara (2007) or Crescenzi y Pose (2008).

3. Meta-analysis

Despite the undoubted usefulness of meta-analytical techniques, there are certain limitations that may affect the consistency of estimates: methodological heterogeneity between studies is one of the biggest problems in integrating different items. Since the main purpose of meta-analysis is to estimate the true value of the parameter under study, it is absolutely necessary to consider the sources of any variability in the results. Another problem associated with meta-analysis is the so-called publication bias, which refers to the increased interest of academic journals in publishing studies that report statistically significant results; as well as the rejection of those results which are not, that go against the mainstream thinking in literature, or are even self-censored by the authors themselves who are unable to find enough solidity in their results. Begg (1994) proposed a way to check against publication bias in meta-samples by including in the latter, both articles published in journals as well as those that remained unpublished (working documents and reports, among others). An additional problem that we found is the selection criterion regarding the number of estimates to consider for each article, since this depends on the judgement of the researcher and can be subjective. Needless to say, there is no consensus on this question in the literature; some authors, such as Bijmolt and Pieters (2001), claim that all estimates should be selected, however, Stanley (1998, 2001), defends the possibility of opting to include only the average of the values thrown up in each study.

Bom and Ligthart (2008) argue that the distribution in the number of estimates extracted per article is very biased and, therefore, they only include an observation per study using self-preference criteria or a series of predefined selection rules. However, Bom and Lightar (2011) propose the selection of all estimates included in each study, provided a dummy variable to point to the country that is being analysed is included in the meta-analysis, in order to check on the possible correlation between estimates in a study, since it is common to use the same database.

3.1. Econometric methodology of meta-analysis

Although there are various proposals for combining statistical studies, there are two fundamentals upon which most meta-analytic studies are based. The first one, known as the ***fixed effects model***, establishes the assumption of homogeneity between studies and, therefore, assumes that all studies are estimating a true common effect. This method, also known as one that is weighted by the inverse of the variance, is estimated by least squares (WLS) establishing a weighting equal to the inverse of the variance of the observations, because the variance is a measure of dispersion and, therefore, its inverse is a measure of accuracy. Let us denote the estimates contained in each meta-sample study of size N by the parameter $\hat{\theta}_i$, and the true value of the unknown parameter by $\hat{\theta}_i$, y el verdadero valor del parámetro desconocido por θ_i, such that:

$$\hat{\theta}_i = \theta_i + \varepsilon_i \qquad para\ todo\ i = 1, \ldots, N.$$

where ε_i the sampling error that complies with the standard assumptions. So, if all studies are estimating a true common effect then the conditional and unconditional variances $\hat{\theta}_i$ are equal and, therefore, any variation will be explained by the sampling error. The unconditional variance $\hat{\theta}_i$ is defined as $Var(\hat{\theta}_i) = Var(\theta_i) +$

$Var(\varepsilon_i)$ and the conditional variance of $Var(\hat{\theta} \mid \theta_i) = Var(\varepsilon_i)$, which represents the variance within each study. Thus, the sampling weights in the fixed effects model are obtained such that:

$$w_i = \left(\frac{1}{\sigma_i^2}\right)$$

where σ_i^2 is the variance of each estimator of the meta-sample w_i is the weight associated with each of them. Thus, the most accurate estimates with lower variance, will receive a higher weight.

The second model considered, called the ***random effects model***, assumes that the studies are a random sample of the study population, therefore, it is assumed that the parameter θ_i is randomly drawn from a distribution (θ_0, τ^2) , where τ^2 is the variance between studies and will be reflecting the methodological heterogeneity between them. In this case, the unconditional variance $\hat{\theta}_i$ will be $Var(\hat{\theta}_i) = Var(\tau^2) + Var(\varepsilon_i)$, so that all the variability found will be an amalgam of sampling heterogeneity and error. Thus, the sampling weights are obtained as the inverse of the sum of the variances between and within studies, such that:

$$w_i = \left(\frac{1}{(\sigma_i^2 + \tau^2)}\right)$$

To choose between the fixed effects or random effects model, homogeneity Test Q, proposed by Shadish and Haddock (1994), is used. It evaluates if τ^2 is statistically different from zero, i.e., if there is no heterogeneity among the studies. The rejection of hypothesis $H_0: \tau^2 = 0$ involves discarding the fixed effects model since the variance between studies is relevant[15]. Now, discarding the fixed effects model means accepting the existence of sufficiently high differences among studies, however, heterogeneity is not being modelled, nor are the main determinants that can give an answer to the observed excess of variability between different studies. This is the argument commonly used to justify the introduction of meta-regressors in the simple-meta analysis model leading to meta-regression analysis.

3.2. Econometric methodology of meta-regression.

The purpose of meta-regression is to explain the causes of heterogeneity between the studies so that it is feasible to control the same, by introducing a series of explanatory dichotomous variables in order to capture the particular characteristics of the different papers, which for that matter are the source of the systematic variation in the results (heterogeneity). To do this, a review of the literature is necessary in order to be able to select the exact characteristics that may distort the results obtained by empirical studies. The model of meta-regression is derived from simple meta-analytical analysis, in which K explanatory variables are introduced, such that:

$$\hat{\theta}_{ip} = \theta + \sum_{k=1}^{K} \beta_k \; C_{ip,k}, \varepsilon_{ip}$$

15: For a more complex description of the Q-Test, see Shadish and Haddock (1994).

where *i* y *p* denote the estimated elasticity and the study to which it belongs. $\hat{\theta}_{ip}$ are the estimates contained in each study *p,* θ is the true value of the parameter that we wish to estimate (elasticity between investment in infrastructure and output); $C_{ip,k}$ denotes the meta-regresor *k* and β_k measures its effect on the estimated elasticity (see Melo et al., 2013). Since the meta-regression is derived from the standard model of meta-analysis, it is once again possible to consider both the fixed effects model and the random effects model, so that the estimation and validation procedure is exactly the same.

To test whether our sample is affected by the so-called publication bias, we consider only those studies where the standard error associated with each estimate is presented. To demonstrate the existence of the cited bias, a funnel graph (see Figure 2) shows the relationship between the standard error (vertical axis) and the estimated size of the effect (horizontal axis), where we add the limits for a 95% confidence interval differentiating between published and unpublished articles. As can be seen, a large number of points, especially in the case of published documents (a high and clear degree of asymmetry with a greater tendency to report positive elasticities), are outside the confidence interval; which is a symptom of the existence of publication bias, there is also clear evidence of a positive relationship between estimates higher than zero and the standard error associated with them, indicating that publication bias may be bidirectional. For this reason, we include a correction in the parameter estimate θ_{ip}, derived from the linear introduction of standard errors of $\hat{\theta}_{ip}$ (Card and Krueger, 1995):

$$\hat{\theta}_{ip} = \theta_{ip} + \beta_{se} SE\left(\hat{\theta}_{ip}\right) + \varepsilon_{ip}$$

In addition to the standard quadratic errors (Doucouliagos and Stanley, 2009):

$$\hat{\theta}_{ip} = \theta_{ip} + \beta_{se} SE^2\left(\hat{\theta}_{ip}\right) + \varepsilon_{ip}$$

In addition, we introduce separately of standard errors corresponding to positive and negative elasticities (Bom and Lighart, 2011).

$$\hat{\theta}_{ip} = \theta_{ip} + \beta_{se_1} SE\left(\hat{\theta}_{ip}\right)E^{+} + \beta_{se_2} SE\left(\hat{\theta}_{ip}\right)E^{-} + \varepsilon_{ip}$$

where E^{+} and E^{-} refer to dichotomous variables, which take the value of 1 if the elasticity is positive (+), or the value of 1 if this is negative (-). Although for reasons of space, the results are only presented when standard errors are introduced linearly and these are differentiated by the sign that accompanies elasticity. In addition, the meta-sample has been made up by integrating both papers which have been published in scientific journals and unpublished working papers, reports, papers etc. In order to contrast the size and effect of that publication bias, two binary variables are also included in the meta-regression analysis, in the first, we differentiate if the considered articles have been published or not, and in the second, if the authors have certified their particular interest in any of their results. Following the work of Bom and Lightar (2011), we have chosen to select all the estimates included in each study, including in the meta-analysis as well as in the meta-regression a series of dichotomous variables indicating the country for which the elasticity is estimated, as long as they have an observation number of above 2.5% of the total sample (from 20 observations).

4. Meta-samples

More than 150 studies estimating the relationship between infrastructure and output were reviewed for the preparation of the meta-samples. Finally, the sample was restricted to 46 documents as not all included all the information, that a priori, was established as necessary to produce the document. Often researchers do not show the standard errors of each estimate in their results, so all documents where this elasticity is not accompanied by its error have been discarded. Due to the latter, the final meta-sample is composed of a total 794 elasticities. The selection process is shown below:

Firstly, only studies that estimate the elasticity between infrastructure and product were selected; where studies published in academic journals and working documents or reports were included, among others, and they were not peer-reviewed. The non-publication of this series of documents was checked thoroughly. The search for them was conducted by entering, in academic journals and Google Scholar, the keywords: "Economic growth", "production" and "GDP" along with elasticity in "infrastructure", "infrastructure investment", "capital in infrastructure", "public capital"; and by "name of authors" who have researched the issue that concerns us here. In addition, each document in question must provide the information required to classify its content, according to all the indicators considered relevant and summarized in Table 2. So any work that meets the filed requirements has been considered valid and, therefore, included in the meta-samples.

At first, we considered 50 meta-regressors to check on the methodological heterogeneity between studies, however, we discarded eight of them for not being sufficiently valid in most observations (elasticities). Therefore, 42 variables were built up, not forgetting the "country variables" included when at least 2.5% of the elasticities are estimated for a particular country (9 variables).

Based on the average elasticity of the observations (0.169), the results conditioned by the common characteristics the studies shared, where a higher average elasticity is evident in the published articles (0.204), the average of the unpublished analyses equalled 0.089. These also vary considerably depending on the level of development of countries or if they are integrated into the OECD, the average elasticity estimated for countries outside the OECD is 0.216, and 0.076 for those not covered by that organization. In the case of data organization, the average elasticity is much higher for time series and data panel (0.198 and 0.211, respectively), in contrast to cross-section (0098).

Regarding the method of valuation of infrastructure, the documents that develop a composite index throw up on average some high elasticities (0.254); the same is true when the infrastructure is quantified as a variable flow (0.261). By type of infrastructure, those related with electric power show a near zero (0.002) elasticity, however, when one considers infrastructure in a broad sense (general), this increases to 0.330. We also appreciate that when the impact of infrastructure on a particular economic sector is estimated, in this case the industrial sector, the effect is substantially increased to 0.318.

The econometric methodology implemented also seems to affect the elasticity value. For studies estimating auto-regressive vector models, the average elasticity decreases to 0.097, however, there is not much difference between MCO or GMM estimation (0.171 and 0.218, respectively). Conversely, when corrections are made in the models or the variables introduced are expressed in ratios, the average elasticity increases to about 0.400. Moreover, the preference researchers show for some of their estimates (on average 0.1743) does not seem to exert any effect on the estimate of average elasticity (see Table 2). Based on the various articles included in the meta-sample, estimated elasticities vary considerably between 2.951 in Fedderke and Bogeyi's study (2005) for South Africa, and -2.823 in Straub et al. (2008) where 93 countries are analysed. The number of elasticities shown in each document varies between 2 (among others, Albújar, 2016) and 75 (Kara, Taş, and Ada, 2015), the average of the latter being 17. By country, the United States takes up most interest since it was the most studied country in various documents, up to 6 times; although Turkey is the country for which we have a greater number of observations (75), see Table 1 for a summary of the work included and Figure 1 for the distribution of observations.

5. Results

In this section shows the results obtained in the different estimated models, based both on the technique of meta-analysis and meta-regression. In addition, it evaluates and quantifies the so-called publication bias, which allows us to incorporate a correction in order to minimize the impact of this on estimates. In Table 3, the results produced by different estimation methods are presented, as are ordinary least squares, weighted least squares (weight proportional to the number of observations used in each study), the fixed effects model and random effects model (see section 3.1 of this document). In addition, we evaluated the effect of infrastructure on output through a differentiation of the various characteristic elements, among others, countries within and outside the Organisation for Economic Co-operation and Development (OECD). Table 4 shows the results corrected by publication bias (Figure 2), where the direction of this is quantified. In Table 5, the results derived from the meta-regression estimation model (Section 3.2) are presented using the random effects model, where in addition to different control variables, we include standard errors associated with each elasticity (correction of publication bias). For reasons of space, we have excluded some variables that are not significant. Additionally, and once the true effect of infrastructure on production is estimated, we break this down for OECD countries and for non-OECD countries. In this respect, we found a greater effect of infrastructure in countries that do not belong to that organization.

Based on the results achieved by the four estimation methods used in the meta-analysis (Table 3), we see how the results are quite disparate, these vary between the value of 0.169 estimated by the OLS method and the value of 0.09 obtained by the fixed effects model. While the OLS and WLS (Obs) methods are included only as a comparative (columns 1 and 2). Therefore, we focus on assessing the estimates provided by the fixed-effects (column 3) and random effects (column 4) models. With regard to this, we show the existence of a high heterogeneity between studies using the Q test, where the null hypothesis $H_0: \tau^2 = 0$ is strongly rejected, which involves discarding the fixed effects model since the variance between studies is relevant. Thus, the real effect will be estimated by the random effects model, where the elasticity of infrastructure for the product is equal to **0.132**. In this regard, it is noteworthy that the estimated effect is slightly higher for countries not integrated within the OECD (0.157 vs. 0.145).

On the other hand, we proposed to assess the size of publication bias and its correction, since we had evidence of its possible existence. So we present a funnel graph (Figure 2) where the value of each observation (elasticity) is related to the standard error associated with it. In addition, we differentiate between published and unpublished documents; in this respect it is noteworthy that most of the unpublished work is within the confidence interval, however, few published works are within it. Similarly, there is a clear positive relationship between the value taken for each observation and the associated standard error. Given the evidence of the cited bias, in the random effects model, we introduced standard errors which were linearly differentiated by the sign of the elasticity derived from the same (Table 4).

Once standard errors were introduced into the model, it is observed, as in in all cases, that the estimated effect decreases, where the elasticity between infrastructure and the product is reduced to 0.070, or what is the same, a subsequent decrease to near 50% (Column 1). As was the case in estimating the uncorrected random effects model, elasticity for countries outside the OECD is higher (0.108), although in this case the gap increases to 0.039. At the bottom of Table 4 adjustment and benign criteria for the estimation models is shown.

Regarding the meta-regression estimation model (Table 5), 42 variables has been included in this and considered as explanatory regarding the degree of heterogeneity between studies, previously evidenced by the Q Test. In addition, nine other control variables have been incorporated to differentiate between reference countries when there have been at least 20 observations (2.5% of the total). In Table 5, columns 1 and 2, the results for fixed and random effects models without correction of publication bias are presented; in columns 3 and 4, the bias correction proposed earlier is introduced in both models. Columns 5, 6 and 7 show 3 estimates from the random effects model, which have been adjusted for publication bias in a limited way for the total sample, and for the countries included in and excluded from the OECD, respectively. In addition, we have included the adjustment and benign criteria for the estimation models. For reasons of space, in the random effects model adjusted for publication bias, only those that were found to be significant moderating variables (16) are shown.

Uncorrected fixed and random effects models estimate an impact of infrastructure on output, which is very similar, **0.114** and **0.119**, respectively. However, the average effect decreases considerably when bias correction is introduced and the same moderating variables remain. As was previously the case, the estimated effect of the random effects model (0.075) is superior to that of the fixed effects model (0.063), although with the introduction of the proposed correction we obtain a better fit and precision in the model. Now, we have introduced certain control variables that are not significant but may be affecting the estimate of the true effect of infrastructure projects, meaning that we have limited or restricted the random effects model. Thus, only the moderating variables that proved significant have been included in the estimation of the effect, finally obtaining an estimated **0.121** effect, that is, the true effect of infrastructure on the product. Furthermore, using this procedure we obtain a benign degree of adjustment which is higher than shown in the previous case, and equal to 0.659.

Following this procedure, we evaluate 2 other random effects models with limited bias correction, in order to differentiate between the impact of infrastructure for member countries and non-OECD member countries. Although, for the best comparative and most robust results, only those moderating variables that significantly influenced the estimate of the effect for OECD countries (Columns 6 and 7 of Table 5) were considered in both cases. Where again, a greater effect is obtained in countries outside the OECD (**0.139** vs. **0.112**) that is consistent with level of development.

6. Conclusions

The economic crisis and post-crisis has left us with a global macroeconomic scenario characterized by the registration of lower rates of economic growth. One of the policies proposed by different multilateral institutions and governments to relaunch economic growth is precisely that of increasing investment in infrastructure. However, many policy makers do not have a clear idea about the real economic impact. Governments usually refer to the most convenient calculus that differs depending on the methodology used, the period of analysis, the scope of the research, as well as how the variable infrastructure is defined.

Considering the different impacts of infrastructure on growth that can be obtained and the need from policy perspective to discern adequately among different estimates, we conducted an exhaustive meta-analysis to estimate "consensus" infrastructure elasticity's to real growth. Compared to those previous studies we think that our paper contributes to this literature in different aspects. We provide a much wider meta-sample that includes 794 observations from more than 150 peer-reviewed papers, that resulted in 46 articles which incorporate the standard error. Additionally, we employ various methods of estimation, to highlight the fixed effects model and random effects model and we develop a complete analysis of the method using meta-regression, where up to 42 moderating variables were used in order to control heterogeneity between studies. Furthermore, we introduce a publication-bias correction in the various models referred to, in order to estimate the true size of the effect. Finally, we show the existence of a greater impact of infrastructure on growth in economies outside the OECD.

Based on the results achieved by the four estimation methods used in the meta-analysis, we see that the results are widely dispersed, varying between the value of 0.169 and 0.09. These are very different results that suits everyone tastes, meaning that not "all the roads lead to Rome" when looking for a unique impact of infrastructure investment on economic growth based on the literature.

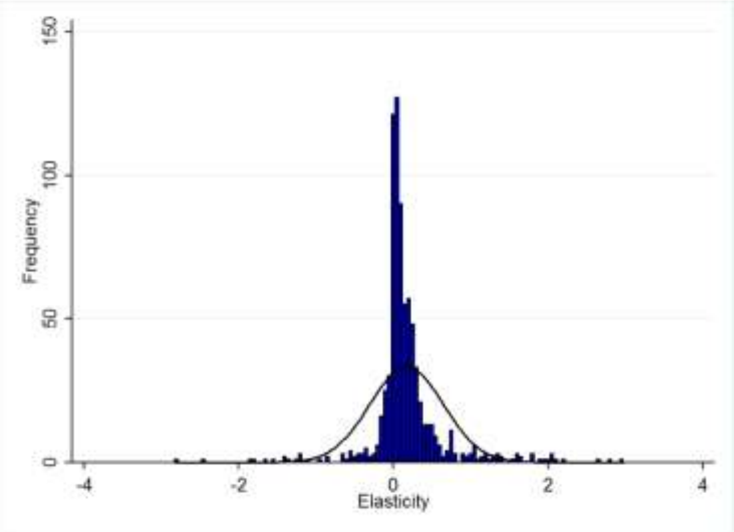
Focusing only on estimates based on random effect models, which is the valid methodology for us based on the statistical tests described before, the elasticity of infrastructure to growth is equal to **0.132**. In this regard, it is noteworthy that the estimated effect is slightly higher for countries not integrated within the OECD (0.157 vs. 0.145). However, when we introduced publication-bias correction to demonstrate the existence of this through the funnel graph and the significance of standard errors in the estimates within the proven model, the effect is reduced to 0.07.

Finally, we developed a comprehensive meta-regression analysis where heterogeneity between studies and publication bias is controlled, obtaining an effect of infrastructure on the output of 0.121. In addition, we particularized the meta-regression analysis for the countries belonging and not belonging to the OECD. In this regard, the estimated effect of infrastructure is considerably higher in countries outside the OECD (0.139) compared to those included in the organization (0.112).

Annex

Figure 1

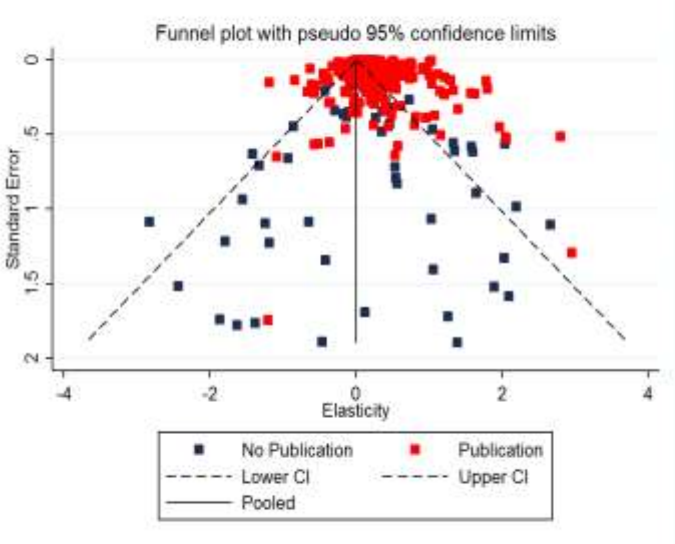
Frequency of observations



Source: BBVA Research

Figure 2

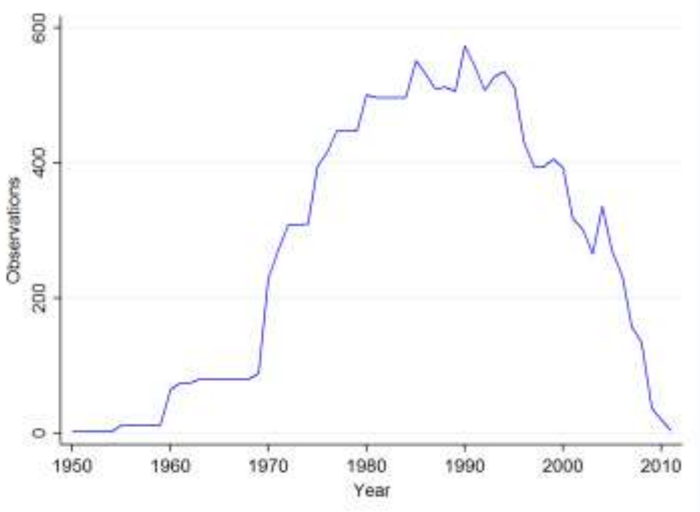
Relationship between estimated elasticity and period



Source: BBVA Research

Figure 3

Figure of funnel with confidence intervals. Differentiation between published and unpublished documents



Source: BBVA Research

Table 1

Descriptive statistics: Articles included in the meta-sample

Nº paper	Autor	Geography	Obs.	Mean	Median	S. Dev	Max	Min	Sig.
1	Del Bo, C., & Florio, M. (2008)	UE27	17	0.089	0.075	0.046	0.173	0.031	100%
2	Albújar Cruz, A. (2016)	Perú	2	0.128	0.128	0.004	0.130	0.125	100%
3	Kamara, I.B (2007)	África Subsahariana	17	0.112	0.072	0.418	1.337	-0.660	100%
4	Straub, S. & Hagiw ara, A. (2010)	102 países	72	0.137	0.171	0.260	0.961	-1.204	54%
5	Canning, D. & Fay, M. (1993)	OCDE	21	0.635	0.271	0.765	2.097	-0.421	43%
6	Urrunaga, R. & Aparicio, C. (2012)	Perú	15	0.092	0.092	0.025	0.122	0.046	100%
7	Fedderke, J.W. & Bogeti, Z. (2005)	Sudáfrica	52	0.174	0.035	0.683	2.951	-1.087	81%
8	Nannan, Y. & Jianing, M. (2012)	China	2	0.846	0.846	0.776	1.395	0.297	100%
9	Eakin, D. & Schw artz, A. (1994)	USA	2	0.004	0.004	0.059	0.045	-0.038	100%
10	Demetriades, p. & Mamuneas, T. (2000)	OCDE	36	1.057	0.955	0.516	2.056	0.355	100%
11	Holtz-Eakin (1994)	USA	3	0.016	-0.002	0.063	0.086	-0.035	100%
12	Straub, S. et al (2008)	93 países	64	-0.179	0.012	0.819	1.892	-2.823	33%
13	Kara, M. A., Taş, S., & Ada, S. (2015)	Turquía	75	0.222	0.220	0.127	0.600	-0.040	81%
14	Siyan, P. et al (2015)	Nigeria	2	0.185	0.185	0.035	0.210	0.161	100%
15	Bosede, A. et al (2015)	Nigeria	2	0.367	0.367	0.437	0.676	0.058	100%
16	Yamarik, S. (2000)	USA	35	0.054	0.050	0.036	0.160	0.002	66%
17	Shanks, S. & Barnes, P. (2008)	Australia	31	0.083	0.025	0.143	0.490	-0.016	68%
18	Ozbaya, K. et al (2007)	Nueva York	7	0.088	0.057	0.072	0.206	0.017	100%
19	Mizutani, F. & Tanaka, T. (2008)	Japón	3	0.078	0.074	0.007	0.086	0.073	100%
20	Khanm, B. (1999)	Canadá	9	0.144	0.120	0.086	0.360	0.080	56%
21	La Ferrara, E. & Marcellino, M. (2000)	Italia	28	0.154	0.170	0.298	0.820	-0.219	54%
22	Aschauer, D. (1998)	46 países	7	0.257	0.280	0.075	0.340	0.110	86%
23	Boarnet, M.G. (1998)	California	6	0.225	0.241	0.082	0.30	0.065	100%
24	Bronzini, R. & Piselli, P. (2008)	Italia	12	0.080	0.101	0.121	0.239	-0.128	75%
25	Crescenzi, R. & Pose, A. (2008)	UE15 y UE27	66	0.031	0.027	0.158	0.542	-0.373	52%
26	Shioji (2001)	USA y Japón	6	0.188	0.186	0.035	0.241	0.137	100%
27	Daiji, K. et al (2005)	Japón	4	0.020	0.020	0.012	0.030	0.010	100%
28	Daiji, K. et al (2009)	Japón	3	0.103	0.130	0.046	0.130	0.050	100%
29	Marrocu, E. & Paci, R. (2010)	Italia	4	0.054	0.054	0.048	0.096	0.011	75%
30	Bonaglia, F. et al (2000)	Italia	15	0.157	0.114	0.350	1.001	-0.390	60%
31	Sridhar, K. S., & Sridhar, V. (2007)	60 países	5	0.107	0.140	0.059	0.150	0.007	100%
32	Fumitoshi, M. & Tomoyasu, T. (2005)	Japón	5	0.055	0.052	0.005	0.061	0.050	100%
33	Andersson, Å. E. et al (1990)	Suecia	16	0.102	0.036	0.117	0.293	-0.006	50%
34	Rodriguez-Oreggia, E., & Rodríguez-Pos	México	2	0.001	0.001	0.010	0.008	-0.005	100%
35	Gruber, H. & Koutroumpis, P. (2010)	19 países	13	0.123	0.062	0.103	0.329	0.022	100%
36	Kalyvitis, S. (2002)	Canadá	10	0.767	0.741	0.075	0.975	0.726	100%
37	Straub, S. et al (2009)	102 países y África	38	0.063	0.103	0.391	0.568	-1.547	39%
38	Lew is, B. (1998)	Kenia	4	0.013	0.010	0.009	0.026	0.007	50%
39	Idrovo, B. (2013)	Chile	12	0.170	0.156	0.083	0.278	0.078	92%
40	Rivera, J. & Toledo, P. (2004)	Chile	2	0.640	0.640	0.679	1.120	0.160	100%
41	Bustillos, B. et al (2012)	México	16	0.002	0.031	0.489	0.616	-1.182	63%
42	Calderón, C. & Serven, L. (2004)	121 países	16	0.025	0.019	0.033	0.145	0.008	81%
43	Nombela, G. (2005)	España	5	0.088	0.101	0.086	0.175	-0.031	20%
44	Aschauer, D. (2000)	46 países	16	0.269	0.280	0.049	0.340	0.110	100%
45	Evans, P. & Karras, G. (1994)	USA	12	-0.057	0.040	0.212	0.102	-0.630	58%
46	Calderón, C. & Serven, L. (2008)	100 países	4	1.986	2.109	0.673	2.664	1.061	75%
	All		**794**	**0.169**	**0.095**	**0.476**	**-2.823**	**2.951**	**69%**

Source: BBVA Research

Table 2

Descriptive statistics: Meta-regressors

Group	Meta-regresores	Nº obs	% obs	Mean	S. Dev	Median	Max	Min
Published	Publisehd	553	69,65%	0,204	0,404	0,120	2,951	-1,204
	Unpublished	241	30,35%	0,089	0,604	0,038	2,664	-2,823
Geography	Country	234	29,47%	0,122	0,254	0,071	1,395	-1,182
	Regional	170	21,41%	0,144	0,261	0,150	1,001	-1,547
	Various countries	406	51,13%	0,199	0,616	0,073	2,951	-2,823
Development level	OECD	400	50,38%	0,216	0,377	0,102	2,056	-1,182
	No OECD	299	37,66%	0,076	0,542	0,089	2,951	-2,823
	High level	443	55,79%	0,204	0,373	0,100	2,056	-1,182
	Medium level	208	26,20%	0,062	0,628	0,057	2,951	-2,823
Data	Time series	93	11,71%	0,198	0,294	0,081	1,120	-0,219
	Cross section	281	35,39%	0,098	0,381	0,095	1,892	-1,862
	Panel data	420	52,90%	0,211	0,555	0,096	2,951	-2,823
Production function	Cobb-Douglas	613	77,20%	0,179	0,506	0,093	2,951	-2,823
	Others	181	22,80%	0,138	0,355	0,096	2,664	-1,204
Prod. Factors	Work	430	54,16%	0,277	0,493	0,148	2,951	-1,182
	Human capital	424	53,40%	0,137	0,545	0,072	2,951	-2,823
	Technology progress	365	45,97%	0,282	0,490	0,140	2,951	-1,182
	Private capital	685	86,27%	0,177	0,486	0,110	2,951	-2,823
Infrastructure measure	Index	43	5,42%	0,254	0,672	0,117	2,664	-1,182
	Flow	358	45,09%	0,261	0,380	0,160	2,056	-0,630
	Stock	397	50,00%	0,079	0,510	0,079	2,951	-2,823
	Quality	36	4,53%	0,069	0,970	0,022	2,664	-2,823
Infrastructura type	Transport	273	34,38%	0,115	0,556	0,071	2,951	-2,823
	Energy	56	7,05%	0,002	0,507	0,049	1,337	-2,427
	Telecomunications	120	15,11%	0,053	0,240	0,037	1,050	-1,380
	General	215	27,08%	0,330	0,454	0,220	2,056	-0,630
Economic sector	Global	627	78,97%	0,130	0,430	0,102	2,664	-2,823
	Industrial	167	21,03%	0,318	0,597	0,070	2,951	-1,087
Estimation method	OLS	473	59,57%	0,171	0,520	0,102	2,097	-2,823
	GMM	129	16,25%	0,218	0,366	0,150	2,664	-0,660
	VAR	166	20,91%	0,097	0,428	0,026	2,951	-1,087
Additional accessories	Derivations of the method	381	47,98%	0,224	0,518	0,102	2,951	-1,879
	Estimation corrections	99	12,47%	0,463	0,590	0,280	2,056	-1,182
	Fixed effects	244	30,73%	0,129	0,393	0,090	2,097	-2,823
	Economic Cycle	177	22,29%	0,164	0,364	0,071	2,097	-0,660
Transformed variables	Ratios	27	3,40%	0,404	0,354	0,308	0,975	-0,373
	Logs	568	71,54%	0,155	0,488	0,093	2,951	-2,823
	Delayed	111	13,98%	0,380	0,568	0,059	2,056	-0,660
	Differences	434	54,66%	0,115	0,447	0,071	2,802	-2,823
Reliability of results	Significance	545	68,64%	0,237	0,486	0,130	2,951	-2,823
	Conclusions	25	3,15%	0,321	0,802	0,064	2,664	-0,630

Source: BBVA Research

Table 3

Meta-analysis results

	OLS						WLS (OBSERVATIONS)					WLS (FIXED EFFECTS)					WLS (RANDOM EFFECTS)					Q TEST		
Different inputs	Obs	$\bar{\theta}$	S.D.	IC -	IC +	P-value	$\bar{\theta}$	S.D.	IC -	IC +	P-value	$\bar{\theta}$	S.D.	IC -	IC +	P-value	$\bar{\theta}$	S.D.	IC -	IC +	P-value		Q-Test	P-value
ALL	794	**0.169**	0.017	0.136	0.202	0.000	**0.126**	0.015	0.097	0.156	0.000	**0.090**	0.001	0.088	0.093	0.000	**0.132**	0.007	0.119	0.145	0.000	**0.0018**	**14536**	**0.000**
OECD	400	**0.216**	0.019	0.179	0.254	0.000	**0.118**	0.016	0.087	0.149	0.000	**0.055**	0.001	0.054	0.056	0.000	**0.145**	0.009	0.127	0.164	0.000	**0.0002**	**6058**	**0.000**
NO OCDE	299	**0.076**	0.031	0.015	0.138	0.015	**0.094**	0.033	0.029	0.159	0.005	**0.122**	0.001	0.119	0.124	0.000	**0.157**	0.010	0.137	0.178	0.000	**0.0012**	**14252**	**0.000**
TIME SERIES	93	**0.197**	0.030	0.137	0.258	0.000	**0.115**	0.026	0.064	0.166	0.000	**0.094**	0.017	0.060	0.129	0.000	**0.192**	0.029	0.134	0.250	0.000	**0.0304**	**232**	**0.000**
CROSS SECTION	281	**0.097**	0.023	0.053	0.142	0.000	**0.100**	0.012	0.077	0.124	0.000	**0.118**	0.002	0.114	0.122	0.000	**0.125**	0.009	0.107	0.143	0.000	**0.0018**	**14047**	**0.000**
PANEL DATA	420	**0.211**	0.027	0.158	0.264	0.000	**0.134**	0.023	0.089	0.180	0.000	**0.057**	0.001	0.056	0.058	0.000	**0.103**	0.006	0.092	0.114	0.000	**0.0001**	**6141**	**0.000**
COUNTRY	234	**0.122**	0.017	0.090	0.155	0.000	**0.051**	0.011	0.029	0.073	0.000	**0.093**	0.002	0.087	0.097	0.000	**0.124**	0.012	0.099	0.148	0.000	**0.0017**	**14677**	**0.000**
OLS	473	**0.171**	0.024	0.124	0.218	0.000	**0.152**	0.020	0.112	0.191	0.000	**0.090**	0.002	0.087	0.094	0.000	**0.119**	0.008	0.104	0.134	0.000	**0.0018**	**14526**	**0.000**
GMM	129	**0.212**	0.032	0.154	0.282	0.000	**0.239**	0.044	0.153	0.326	0.000	**0.078**	0.005	0.069	0.087	0.000	**0.171**	0.012	0.147	0.199	0.000	**0.0027**	**516**	**0.000**
SIGNIFICANT	545	**0.237**	0.021	0.196	0.278	0.000	**0.184**	0.020	0.146	0.222	0.000	**0.092**	0.002	0.089	0.095	0.000	**0.164**	0.008	0.149	0.179	0.000	**0.0017**	**14671**	**0.000**
TRANSPORT	272	**0.115**	0.034	0.048	0.181	0.001	**0.087**	0.025	0.038	0.135	0.000	**0.063**	0.005	0.053	0.072	0.000	**0.083**	0.008	0.068	0.097	0.000	**0.0030**	**506**	**0.000**
TELECOMUNICATIONS	119	**0.053**	0.022	0.001	0.097	0.016	**0.067**	0.015	0.038	0.096	0.000	**0.024**	0.002	0.020	0.029	0.000	**0.052**	0.006	0.040	0.064	0.000	**0.0007**	**364**	**0.000**
ENERGY	54	**0.002**	0.068	-0.135	0.138	0.973	**-0.037**	0.072	-0.181	0.108	0.614	**0.071**	0.006	0.058	0.083	0.000	**0.082**	0.012	0.059	0.105	0.000	**0.0016**	**178**	**0.000**
INFRASTRUCTURE STOCK	358	**0.261**	0.020	0.222	0.301	0.000	**0.176**	0.018	0.140	0.211	0.000	**0.093**	0.002	0.089	0.097	0.000	**0.171**	0.010	0.151	0.191	0.000	**0.0017**	**14708**	**0.000**

Source: BBVA Research

Table 4

Meta-analysis results with correction of publication bias

	WLS (RANDOM EFFECTS) CORRECTION BIAS													
Variables	ALL	OECD	NO OECD	TIME SERIES	CROSS SECTION	PANEL DATA	COUNTRY	OLS	GMM	SIGNIFICANT	TRANSPORT	TELECOMUNICATIONS	ENERGY	INFRASTRUCTURE STOCK
$\bar{\theta}$	**0.070**	**0.069**	**0.108**	**0.097**	**0.074**	**0.068**	**0.035**	**0.071**	**0.108**	**0.060**	**0.044**	**0.040**	**0.026**	**0.073**
	(0.007)	(0.011)	(0.011)	(0.027)	(0.009)	(0.010)	(0.016)	(0.007)	(0.015)	(0.009)	(0.008)	(0.008)	(0.024)	(0.013)
	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.285	0.000
SE POSITIVE	**1.686**	**1.854**	**1.159**	**1.919**	**1.271**	**1.757**	**2.498**	**1.282**	**1.586**	**2.831**	**1.216**	**2.345**	**2.533**	**2.064**
	(0.161)	(0.271)	(0.158)	(0.414)	(0.154)	(0.280)	(0.514)	(0.123)	(0.315)	(0.256)	(0.164)	(0.087)	(0.995)	(0.286)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000
SE NEGATIVE	**-0.978**	**-1.148**	**-0.927**	**-1.098**	**-0.880**	**-1.260**	**-1.705**	**-0.914**	**-3.962)**	**-2.867**	**-0.890**	**-0.908**	**-1.062**	**-1.555**
	(0.129)	(0.188)	(0.121)	(0.485)	(0.108)	(0.191)	(0.569)	(0.118)	(0.357)	(0.442)	(0.108)	(0.073)	(0.250)	(0.522)
	0.000	0.000	0.000	0.026	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
OBS	794	400	299	93	281	420	234	473	129	545	273	120	56	358
F	94.94	56.08	61.90	14.96	72.88	53.78	23.13	93.14	111.47	104.72	71.34	481.39	13.3	36.7
P-VALUE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.416	0.349	0.644	0.322	0.587	0.405	0.402	0.491	0.276	0.524	0.624	0.696	0.493	0.330
AIC	-812.72	-325.52	-430.17	-3.60	-505.57	-496.90	-232.90	-675.85	-186.17	-689.83	-460.59	-340.90	-121.51	-294.10
BIC	-798.69	-313.55	-419.07	3.989	-494.66	-484.78	-222.54	-663.39	-177.59	-676.92	-449.76	-332.54	-115.43	-282.46

Source: BBVA Research

Table 5

Meta-regression results

Variables	NO BIAS CORRECTION FIXED EFFECTS	NO BIAS CORRECTION RANDOM EFFECTS	BIAS CORRECTION FIXED EFFECTS	BIAS CORRECTION RANDOM EFFECTS	LIMITED MODEL WITH CORRECTION BIAS RANDOM EFFECTS	LIMITED MODEL WITH CORRECTION BIAS OECD Countries	LIMITED MODEL WITH CORRECTION BIAS NO OECD Countries
$\bar{\theta}$	**0.114*****	**0.119*****	**0.063*****	**0.075*****	**0.121*****	**0.112*****	**0.139*****
	(0.008)	(0.009)	(0.010)	(0.008)	(0.010)	(0.013)	(0.034)
No Publication	**0.067*****	**-0.050***	**0.069*****	**-0.021**	-----	**0.033***	**-0.133*****
	(0.022)	(0.027)	(0.022)	(0.023)		(0.019)	(0.046)
Conclusion	**-0.009***	**0.041**	**0.000**	**0.013**	-----	-----	-----
	(0.005)	(0.027)	(0.001)	(0.018)			
Countries	-----	-----	-----	-----	**-0.098*****	**-0.182*****	**0.247*****
					(0.014)	(0.043)	(0.089)
Region	**-0.113*****	**0.008**	**-0.058*****	**-0.030**	**-0.068*****	**-0.096****	**0.106***
	(0.025)	(0.023)	(0.021)	(0.019)	(0.019)	(0.040)	(0.056)
No OCDE	**0.327*****	**0.113****	**0.244*****	**0.104****	-----	-----	-----
	(0.031)	(0.054)	(0.028)	(0.047)			
High development	**0.184*****	**0.087***	**0.169*****	**0.100*****	-----	-----	-----
	(0.028)	(0.048)	(0.024)	(0.042)			
Medium development	**-0.174*****	**-0.147*****	**-0.115*****	**-0.113*****	-----	-----	-----
	(0.022)	(0.048)	(0.020)	(0.037)			
Cobb Douglas	-----	-----	-----	-----	**0.044*****	-----	-----
					(0.017)		
Work	-----	-----	-----	-----	**0.056*****	**0.008**	**0.099***
					(0.014)	(0.014)	(0.061)
Human Capital	**0.057*****	**0.084*****	**0.042*****	**0.080*****	**0.074*****	**0.225*****	**0.010**
	(0.016)	(0.025)	(0.015)	(0.020)	(0.017)	(0.053)	(0.064)
Tecno Capital	**0.018*****	**0.112*****	**0.020*****	**0.068*****	**0.097*****	-----	-----
	(0.002)	(0.025)	(0.002)	(0.020)	(0.014)		
Private Capital	**0.111*****	**0.046***	**0.073*****	**0.049*****	-----	**0.327*****	**-0.157***
	(0.017)	(0.024)	(0.016)	(0.019)		(0.052)	(0.087)
Infrastructure Stock	**0.058*****	**0.034**	**0.016**	**0.011**	-----	**-0.062****	**-0.235*****
	(0.021)	(0.022)	(0.016)	(0.019)		(0.026)	(0.078)
Infrastructure Index	**-0.033***	**0.006**	**-0.009**	**0.010**	-----	**0.148*****	**-0.150***
	(0.018)	(0.035)	(0.015)	(0.024)		(0.053)	(0.063)
Infrastructure Quality	**0.012*****	**-0.075****	**0.017*****	**-0.058*****	**-0.085*****	-----	-----
	(0.001)	(0.031)	(0.001)	(0.023)	(0.023)		
General Infrastructure	**-0.053****	**-0.004**	**-0.014**	**0.006**	-----	**0.013**	**0.295*****
	(0.023)	(0.018)	(0.016)	(0.016)		(0.019)	(0.068)
Transport	**-0.012****	**-0.035****	**-0.005*****	**-0.029*****	**-0.055*****	**-0.034****	**-0.029**
	(0.005)	(0.015)	(0.002)	(0.011)	(0.011)	(0.014)	(0.035)
Energy	-----	-----	-----	-----	**-0.042*****	**-0.087****	**-0.002**
					(0.014)	(0.036)	(0.038)
Telecomunications	-----	-----	-----	-----	**-0.056*****	**-0.090***	**0.025**
					(0.015)	(0.031)	(0.040)
Industrial Sector	**-0.244*****	**0.005**	**-0.169*****	**-0.038**	-----	-----	-----
	(0.030)	(0.043)	(0.027)	(0.039)			
OLS	-----	-----	-----	-----	**-0.054****	**-0.074**	**-0.144**
					(0.021)	(0.046)	(0.156)
GMM	-----	-----	-----	-----	**-0.130*****	**-0.004**	**-0.156**
					(0.029)	(0.054)	(0.155)
Instrumental variables	**0.030****	**0.007**	**0.030*****	**0.027**	**0.040*****	**0.023**	**0.110*****
	(0.013)	(0.021)	(0.008)	(0.017	(0.015)	(0.019)	(0.027)
Fixed effects	**-0.006*****	**-0.066*****	**-0.005*****	**-0.051****	**-0.072*****	**-0.052*****	**-0.085***
	(0.002)	(0.025)	(0.002)	(0.023)	(0.019)	(0.019)	(0.049)
Variables in ratios	**0.106*****	**0.078**	**0.015**	**0.030**	-----	**0.161***	**-0.017**
	(0.028)	(0.066)	(0.031)	(0.046)		(0.085)	(0.027)
Variables in logs	**-0.122*****	**-0.096*****	**-0.091*****	**-0.078**	-----	**-0.079****	**0.056**
	(0.017)	(0.026)	(0.017)	(0.021)		(0.038)	(0.046)
Variables in delayed	**-0.031*****	**0.010**	**-0.031*****	**0.013**	-----	**-0.042****	**-0.035**
	(0.012)	(0.023)	(0.008)	(0.017)		(0.018)	(0.095)
Cycle correction	**0.051*****	**0.002**	**0.029**	**-0.008**	**-0.037*****	**-0.17**	**0.015**
	(0.019)	(0.022)	(0.020)	(0.017)	(0.011)	(0.015)	(0.036)
Post-estimation correction	**-0.005*****	**-0.002**	**-0.004*****	**-0.010**	**-0.038****	**0.060*****	**0.038**
	(0.000)	(0.026)	(0.000)	(0.019)	(0.016)	(0.020)	(0.032)
SE positive	-----	-----	**1.616*****	**1.293*****	**1.255*****	**1.073*****	**1.012*****
			(0.218)	(0.124)	(0.122)	(0.201)	(0.174)
SE negative	-----	-----	**-0.747*****	**-0.918*****	**-0.918*****	**-1.203*****	**-0.878*****
			(0.151)	(0.108)	(0.105)	(0.313)	(0.093)
Obs	794	794	794	794	794	400	299
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.991	0.382	0.994	0.636	0.659	0.777	0.750
Root MSE	0.004	0.152	0.003	0.116	0.112	0.092	0.094
AIC	-6600.48	-714.54	-6906.46	-1130.69	-1195.62	-751.31	-541.28
BIC	-6464.84	-578.91	-6766.15	-985.68	-1078.69	-643.54	-441.36

Source: BBVA Research

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Contact details:

BBVA Research
Azul Street, 4
La Vela Building - 4 and 5 floor
28050 Madrid (Spain)
Tel.: +34 91 374 60 00 and +34 91 537 70 00
Fax: +34 91 374 30 25
bbvaresearch@bbva.com
www.bbvaresearch.com