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Abstract

Using a new dataset of construction investment in world countries for the period 2000-2011, this article provides novel evidence of a bell-shaped relationship between the share of construction in GDP and economic development. The relative level of construction activity tends to increase in developing countries, to peak during industrialization and to decrease at a slowing pace in industrialized countries, approaching stabilization in mature economies. The curve fits better if economic development is measured by alternative indicators instead of per-capita GDP, namely life expectancy and an Economic Development Index (EDI) which takes into account per capita income, life expectancy, maternal mortality ratio and the share of agriculture in employment. On average, the peak in construction activity is reached at a per capita income level of almost 5,000 Euro (PPP, 2011 prices), or when life expectancy in the country has reached around 67 years. At its peak, construction accounts for about 14% of a country's GDP. The curve is robust to the inclusion of control variables. Population density, demographic growth and credit expansion don't explain cross-country variation in the share of construction in output, while there is weak evidence that a less concentrated income distribution is positively related to the size of the construction sector.

1. Introduction

In a seminal paper in construction economics Bon (1992) proposed an inverted U-shaped pattern for the relation between construction and economic development. The share of construction in GDP tends to increase during the first stages of economic growth, to stabilize in middle-income countries and to decline in advanced economies. This pattern is often referred to as 'Bon curve'.

Providing an empirical framework to explain the level of construction activity in a country, Bon curve could help forecast construction sector dynamics and assess whether the size of the construction industry is in line with its long-run pattern or short-run factors (for example a property bubble) are influencing it in a relevant way. No less importantly, its implication that the construction sector is able to persistently 'outgrow' the rest of the economy in developing countries is relevant for the debate about whether or not construction should be actively supported as a driving force of growth by policy-makers in those countries.

Empirical studies investigating Bon's model yielded mixed results. The most recent of these works (Choy, 2011) argued that Bon curve doesn't hold across countries. In this paper, to the contrary, we will provide evidence that Bon curve does indeed explain a relevant fraction of cross-country variation in the share of construction in GDP. With respect to previous studies we employ a new dataset, which allows us to measure construction activity through gross investment instead of value added (the latter being employed in most previous works). Furthermore, we control for three sources of distortion that may have affected previous studies, namely non-stationarity, omitted-variables bias and outliers.

Besides this, we refine the model proposed by Bon from two points of view. First, we show that the curve is asymmetric with respect to its maximum. This implies that the share of construction in GDP decreases at a slowing pace after industrialization, approaching some kind of "plateau" in mature economies. Moreover, we take into account a broader definition of economic development by replacing GDP per capita with alternative indicators.

In order to be useful for forecasting and drawing more precise policy implications the model would need to be enriched with an assessment of the other structural factors that influence the share of construction in output. This is one of the tasks that we deal with here. We show that population density, demographic growth and credit expansion carry no explicative power, while there is weak evidence that a better (i.e., less concentrated) income distribution is associated with a bigger relative size of the construction sector. This appears to suggest that, on a microeconomic level, demand for housing exhibits a positive and decreasing income elasticity.

The paper is organized as follows. Section 2 briefly reviews the literature on the long-run relation between construction and development. Section 3.1 describes the data and reports preliminary tests. In 3.2 we report and discuss results, before drawing conclusions in section 4.

2. A critical review of literature

There are three main strands in the literature on the economic role of construction. The first one studies the relationship between construction and development. The second tries to assess whether construction investment leads GDP growth (De Long and Summers, 1991; Ball and Wood, 1996; Chang and Nieh, 2004). The third one employs input-output tables to study the role of construction in a national economy (Bon and Pietroforte, 1990; Pietroforte and Gregori, 2003). This paper is concerned with the first strand.

Early seminal papers investigating the role of construction in economic development are the ones of Strassmann (1970), Turin (1974), Drewer (1980), Wells (1985) and Bon (1992). They tried to assess whether "the construction sector, like agriculture or manufacturing, follows a pattern of change that reflects a country's level of development", as Strassmann (1970) put it. The most influential was probably the work of Bon (1992). He argued that the share of construction in GDP follows a bell-shaped pattern: it tends to increase during the first stages of economic growth, to stabilize in middle-income countries and to decline in advanced economies. Following some recent literature (Ruddock and Lopes, 2006; Choy, 2011) we can refer to this pattern as Bon curve[1] or, alternatively, the Construction-Development Curve (hereafter CDC).

The intuition behind Bon curve is that earlier stages of growth are characterized by intense processes of urbanization, demographic growth, creation of basic infrastructures and construction of industrial plants. Thus, the construction sector tends to grow faster than the rest of the economy during this phase, increasing its share in output. In later stages, as these processes reach maturity and start slowing down, growth in construction investment tends to slow down with respect to the overall economy. This theory is consistent with the empirical finding that both fixed capital formation and the share of durable physical assets in investment tend to be larger in developing countries and to

[1] It is fair to note, however, that well before the work of Bon this bell-shaped relation had already been highlighted by Strassmann (1970).

decline in advanced economies (Bon, 1992; Maddison, 1987) and with the S-shaped relationship that has been found between urbanization and economic growth (Berry, 1973).

Bon curve appears compatible with a Lewisian view of economic development. According to the Lewis model (Lewis, 1954) the ultimate cause of economic development is the shift of workforce from a low-productivity subsistence sector to a capitalist advanced industrial sector. Owing to underemployment, expanding capitalist industries enjoy an unlimited supply of unskilled labour at a subsistence wage. As long as profits are reinvested, the process is self-sustaining: increasing investment results in a further expansion of the industrial sector, which allows further extraction of underemployed workforce from agriculture. Within this theoretical framework there are reasons to expect the construction sector to grow faster than the rest of the economy in developing countries. The flow of labour from subsistence agriculture to industry determines urbanization. Furthermore the construction industry is particularly good in extracting underemployed workforce, because it typically requires a larger amount of unskilled labour and a less sophisticated level of entrepreneurship than other industrial sectors.

Some works have used cross-section analysis to study the relation between construction and economic development, with mixed results. In the most recent of these studies, Choy (2011) grouped 205 countries into four groups on the basis of per capita income and compared the averages of the construction's share of GDP (measured by gross value added) in the four groups in the period 1970-2009. For most years he found the average share of construction in output to be slightly higher in rich countries than in middle-income economies. Moreover he performed time-series estimations of Bon curve for each country over the period 1970-2009, finding the curve to be significant in most rich countries. On the basis of these results he argues that Bon model holds within most developed countries over time but not across countries at a given time.

Overall, empirical works on the relation between construction and development have been rather descriptive. Most of them (with the partial exception of Crosthwaite, 2000) group countries into four categories depending on per capita income and then calculate a simple average of the construction's share of GDP in each group. In some cases, these average values are taken over multi-year periods, so they are likely to be biased because of non-stationarity of the data and changes in the composition of groups. Omitted variable-bias and outliers are two further potential sources of distortion: none of these studies checked for the presence of possible outliers in their samples; none of them tried to assess whether other factors influence the share of construction in GDP beyond the level of per-capita income, so the robustness of Bon curve to the inclusion of control variables has never been tested.

3. Empirical evidence for the period 2000-2011

In what follows we test empirically Bon curve. The first part of this section describes the dataset and reports the preliminary analysis of the data. In the second part results are presented and discussed.

INSERT TABLE 1 ABOUT HERE

3.1 Overview of the data and preliminary tests

Statistical information about construction investment in world countries comes from the Simco database[2], managed by Cresme Ricerche[3]. Simco gathers data from official national sources, covering 148 countries (accounting for 99% of world GDP, 98% of world population and 98% of world surface) for the 2000-2011 period.

Global construction activity reached 5,600 billion Euro in 2011, displaying in real terms a 48% increase over 2000. Basic infrastructures represent the main component of construction investment in African and South American countries, while Europe is characterized by a major incidence of residential activities, especially those related to renewal and maintenance. Non-residential investment is the main source of construction investment in India and Russia. It is also dominant in the United States, where residential activity has not yet recovered after the burst of a huge housing bubble in the late 2000s. The composition of global construction investment by sector and macro-area in 2011 is summarized in Table 1.

As shown in Fig. 1, construction investment as a share of GDP has been increasing in Africa, Asia and South America. However, a peak in the share of construction in world output has been reached in 2006, when construction peaked in Europe (12.2%) and North America (9.8%).

INSERT FIGURE 1 ABOUT HERE

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[2] Cresme has kindly allowed the authors to provide the dataset used in this work by email to anyone who requests it for academic purposes

[3] An Italian non-profit institution whose aim is to produce research on the building sector, the real estate market and their impact on land transformation

The boom and bust in the housing market of some industrialized countries has of course affected the data. Other major episodes which happened during our sample period and are likely to have affected the data for some economies were two historical peaks in commodity prices (and a steep fall in between) and some major episodes of civil turmoil in certain countries. In some economies, especially the smaller and less diversified ones, the short-run fluctuations caused by these idiosyncratic shocks in our variable of interest (i.e. construction investment as a share of GDP) may have been huge enough to obscure and overwhelm the long-run tendency that we are trying to investigate. For this reason we used standard procedures[4] in order to detect outliers.

Three groups of outliers emerged. First, countries that have experienced and anomalous level of construction activity due to a strong housing bubble: Spain, Ireland and Iceland. Certainly other western economies have also been affected by housing speculation in the same period, most importantly the US and the UK, but in those countries the share of construction investment in GDP was relatively unaffected, because of their larger and more diversified economies (Fig. 1). Second, small oil exporting countries, such as Qatar, Bahrain and Arab Emirates. In these countries both construction investment – a large part of which is accounted for by oil-related infrastructures – and GDP are heavily affected by oil revenues and commodity market dynamics. A different case is the one of Singapore, which has been excluded because of its particular city-state nature. Third, countries which data display evidence of inconsistency, due to scarcity and/or inconsistency of statistical information. In most cases we acknowledged that different sources provided very different estimates (this is the case of some African countries, Albania, North Korea

[4] More precisely, we applied a simple k-means clustering method in a bi-dimensional space defined by construction investment as a share of GDP and per-capita GDP.

and Vietnam). In the case of Afghanistan, the lack of reliable statistical information is due to the armed conflict that the country has experienced during our period of interest. Overall, this analysis led us to exclude 20 observation units[5], reducing our sample from 148 to 128 countries. After removing those observations our sample still accounts for 94% of world population and 95% of world GDP.

Model specification

Visual inspection of the data suggests that the relation between construction investment and economic development is indeed inverted U-shaped but asymmetric with respect to the maximum. However a symmetric bell-shaped pattern seems to be recovered after logarithmic transformation of both variables (Fig. 2). A preliminary cross-section analysis confirms this intuition. We estimate a quadratic relation between the share of construction in output and GDP per capita for each year in the sample using three different specifications: taking both variables in absolute values ('lin-lin' model); taking logarithms of the independent variable ('lin-log'); taking logarithms of both variables ('log-log'). The log-log model appears to be the best choice in terms of parameters significance (Table 2).

INSERT FIGURE 2 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

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[5] Spain. Ireland, Iceland, Bahrain, Qatar, Libya, UAE, Albania, Vietnam, Singapore, Angola, Somalia, Eritrea, Lesotho, Guinea Bissau, Zambia, Democratic Republic of Congo, Afghanistan, North Korea, Tajikistan.

Estimation strategy

Different estimators can be employed in a panel setting, depending on the characteristics of the data. The nature of our panel is such that a between-groups estimator (i.e. a cross-section regression using the average value of the data over the sample period for each unit of observation) appears to be a natural choice. In our sample variability between countries is in practice the only source of relevant information, since we have countries with very different levels of economic development, while the time dimension of the panel is far too short to allow us to observe different stages of development within each single country. In such a short time span the level of economic development of a country can be considered almost as a time-invariant factor, so there would be no point in trying to exploit within-groups variability to estimate its effect.

Stationarity test

To test stationarity, we perform separate estimates of the CDC (eq.1) for each year in the sample period 2000-2011. Estimated yearly coefficients (plotted in Fig. 3) are suggestive of a break in 2006. After 2006 we observe what seems to be a structurally higher level of β_1 and a lower level of β_2, implying that the peak in construction activity level is reached on average at a lower level of income. The shift resulted from both an increase in construction activity level in developing countries and a decrease in mature economies. While in advanced countries construction has been hit harder than other economic sectors during the crisis, in some major developing countries (most notably the so-called BRICs) huge public infrastructure-related investments were put in place as an attempt to boost growth after the downturn. In order to take into account this structural change and avoid a non-stationarity bias in the estimated coefficients we split our sample into two sub-periods, 2000-2006 and 2007-2011.

INSERT FIGURE 3 ABOUT HERE

3.2 Results

On the basis of the preliminary analysis reported above, we estimate the following equation in our sample:

$$\log(\overline{Y}) = \alpha + \beta_1 \log(\overline{X}) + \beta_2 \log(\overline{X})^2 + \varepsilon \qquad \text{(eq.1)}$$

Y is construction's share in output, X is a proxy for development, ε is a random shock and the bar over a variable means that its average over the sample period is taken. Bon's hypothesis would imply $\beta_1 > 0$ and $\beta_2 < 0$.

At first we employ purchasing-power parity (PPP) per capita GDP as a proxy for economic development. Results are reported in Table 3. In 3a the share of construction in domestic output is measured by construction investment as a share of GDP, while in 3b it is measured through the construction's share of value added. In both cases the inverted U-shaped relationship holds: coefficients have the expected sign and are significant at any conventional level in both periods.

When employing investment the R^2 of the model increases significantly in the second sub-period (from 8.7% to 13.6%), while when employing value added the goodness of fit of the model does not change between the two sub-periods (R^2 is 9.6% in both). Furthermore in the specification using value added the difference in the estimated coefficients between the two sub-periods is lower. These differences are probably due to the fact that construction investment was more volatile than construction value added in our period of interest. For our purposes, however, investment appears to be a more suitable indicator, since it represents a broader measure of the weight of construction in a national economy, taking into account not only the net product of the sector but also its demand for intermediate goods.

From these results we can estimate the average level of income at which the share of construction in GDP tends to reach its maximum level. Investment in construction as a share of GDP reaches a peak of 12% at an income level of 6,500 Euro per capita in the 2000-2006 period, while in 2007-2011 it peaks at 14%, with per capita GDP at 4,900 Euro (more or less China's level of income). The construction's share of value added reaches a maximum of 5.6% at a level of per capita income of 7,900 Euro in 2000-2006, while in 2007-2011 the peak is at 6.4% at a level of per capita income of 6,500 Euro (at PPP and in 2011 prices).

INSERT TABLE 3 ABOUT HERE

3.2.1 Replacing GDP with alternative measures of development

While at the time of Strassmann's 1970 pioneering paper growth and development were almost universally considered as synonyms, nowadays there is an extensive literature showing that GDP is a rather poor and mono-dimensional measure of economic development and stressing the need for broader and more comprehensive indicators

(Stiglitz et al., 2010). We take these considerations into account by re-estimating eq.1, replacing GDP per capita with alternative indicators of economic development.

INSERT TABLE 4 ABOUT HERE

At first, we try using the Human Development Index (HDI) calculated by the UNDP, which takes into account per-capita income, average and expected years of schooling and life expectancy at birth[6]. As shown in Table 4, the use of the HDI instead of per capita GDP does not improve the fitness of our model: the relation is not significant in the first sub-period (2000-2006), while in the second (2007-2011) coefficients are statistically significant but R^2 is lower than the one obtained by using per capita income (9.8% versus 13.6%).

We then re-estimate the model employing a broader Economic Development Index (EDI)[7] which takes into account per capita income, life expectancy at birth, the share of workforce employed in agriculture and the maternal mortality ratio. The differences between our EDI and the HDI reflect the fact that we did not aim at building a measure of well-being but, more simply, an indicator of economic development. The use of the EDI as a proxy for development yields a significantly higher explanatory power in both sub-periods. R^2 is 14.6% in the first subsample (2000-2006) and 20.2% in the second (2007-2011), against 8.7% and 13.6% that we obtained by using per capita income (Table 4).

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[6] See UNDP (2011, pp. 168-169) for details. The HDI was downloaded from the UNDP at http://hdr.undp.org/en/statistics/hdi

[7] We built the EDI by principal-component analysis. It is a weighted geometric mean of the principal components, with weights proportional to the explained variance. Variables were taken from the World Bank Database.

However, and rather interestingly, an even better approximation to the actual data is obtained if we use life expectancy at birth alone as the proxy for economic development. R^2 increases to 16.9% in the first subsample (2000-2006) and to 24.2% in the second (2007-2011). This could be due to the fact that life expectancy is closely related to the level of economic development, without being distorted by country-specific factors that could instead influence other indicators. In other words, probably no country has an idiosyncratic characteristic, unrelated to economic development, which makes life significantly longer for its inhabitants. In the first sub-sample (2000-2006) construction investment as a share of GDP tends to reach a maximum of 12% when life expectancy is 68.5 years, while in the second sub-sample (2007-2011) it reaches a maximum of 14.4% in correspondence with a life expectancy of 66.8 years (Table 4).

3.2.2 Inclusion of control variables

We then enrich the model by including some further independent variables[8]. There are two reasons for doing so. On the one hand, we want to assess whether other measurable factors influence the weight of construction in GDP, beyond the level of economic development. On the other hand, the inclusion of control variables allows us to test the robustness of the CDC.

Physical characteristics, such as surface, population and population density, are natural candidates. Land is a fundamental production factor for the construction industry, while

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[8] Here we use our EDI as the proxy for development but results don't change if we use per capita GDP or life expectancy. All variables used as controls were downloaded from the World Bank Database

the number of inhabitants is a measure of potential demand for buildings and infrastructures. However, since our dependent variable is a relative measure of construction activity (i.e., construction investment as a share of GDP), which does not depend on the economy's size, the most appropriate variable to include in our model is probably population density[9].

Since a large part of construction activity consists in what Simon Kuznets famously called "population-sensitive capital formation" (Kuznets, 1961), another natural candidate for explaining cross-country variation in the share of construction in GDP is the growth rate of population.

A further factor that may help explain construction activity level is income distribution. A more equal distribution of income could result in a larger share of population which can afford decent housing and in a greater availability of public services, thus fostering demand for buildings and public infrastructures. An analogous way of seeing this relation is that of considering housing as a normal good with decreasing income elasticity: low- and medium- income families are likely to spend a larger share of their income on housing (through purchases of first homes, rents and mortgages) than high income families. We use the Gini Index as a proxy for income distribution.

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[9] It is not clear, however, which sign should be expected from this relation. On the one hand, higher population density could be associated, ceteris paribus, with greater demand for residential buildings and infrastructures; on the other hand, lower population density could result in a greater availability of land for construction projects.

Credit growth may also be thought to affect the share of construction in GDP, through mortgage loans and loans to construction firms. We thus include domestic credit to the private sector (as a % of GDP) in the regression.

As shown in Table 5, the coefficients of surface, population, population density, population growth and credit/GDP are not statistically significant. It is somehow surprising to note that countries with higher demographic growth don't exhibit a higher share of construction investment in output. The coefficient of the Gini Index is significant and has the expected (negative[10]) sign in the second sub-period, but it is not significant in the first. A better (i.e. less concentrated) distribution of income appears to be associated with a higher level of construction activity. According to our estimates in the period 2007-2011 an increase in the Gini Index by one standard deviation is associated, on average, with a 0.09 decrease in the natural logarithm of the share of construction in output. This implies that an increase in the Gini Index from the third to the second quintile (which in our case means a 10% increase in the index) is associated with a 4.4% decrease in the expected value of the share of construction in output.

The CDC is robust to the inclusion of the abovementioned control variables. Both the linear and the quadratic coefficient of the Economic Development Index remain statistically significant at any conventional level, and with the expected sign. According to our estimates, as the EDI passes from its lower value in the sample (which is 57.7 and corresponds to Burundi) to the value that maximizes the curve (that is 81, near to the value assigned to Philippines, Georgia or Moldova) the expected value of the share of

[10] In interpreting the sign of the coefficient, one has to remember that the higher the Gini Index, the more concentrated the distribution of income.

construction in GDP triples, while as we pass from the peak of the curve to the maximum value of the EDI (which is 99.4 and corresponds to Norway) the expected value of the share of construction in GDP decreases by 34.7%. This means that, on average, in the increasing part of the curve (i.e., in developing countries) a 10% increases in the EDI is associated with a 38% increase in the share of construction in GDP, while in the decreasing part of the Curve (i.e., in mature economies) a 10% increase in the EDI is associated with an 18% decrease in the relative level of construction activity.

INSERT TABLE 5 ABOUT HERE

INSERT FIGURES 4,5 AND 6 ABOUT HERE

3.2.3 Robustness checks

In order to check the robustness of our results to the method employed to detect outliers, we re-estimated the model on two different subsamples.

First, we completely ignored outliers, leaving all available observations in the sample. Estimated coefficients maintain the same sign in the model with per-capita GDP as a proxy for development, but with lower statistical significance. They remain highly significant, however, in the second sub-period in the variant with construction's share of value added as the dependent variable and in the one with life expectancy as a proxy for development, and in both sub-periods in the model employing the EDI (although with a lower R^2).

Second, we excluded only countries which data appears to display some inconsistency (very different estimates from different sources or suspiciously large changes between years), keeping in the sample countries which experienced huge housing bubbles and small oil exporters. So we excluded only Afghanistan, Albania, North Korea, Vietnam, Somalia, Eritrea, Lesotho, Guinea Bissau, Zambia and Democratic Republic of Congo. All results remain practically identical to the ones presented in previous sections and R^2 is only slightly lower.

We also tried entering control variables in logarithms, obtaining no significant change in results. On the basis of these trials – whose coefficients and test-statistics are omitted here for brevity but can be requested to the authors – our findings appear to be rather robust, since only including very low quality data partly perturbs results.

4. Conclusions

We have used panel data for world countries for the period 2000-2011 to provide evidence of a bell-shaped relationship between construction activity and economic development, consistent with the theory proposed by Bon (1992). The relation gets stronger after logarithmic transformation of the data (Table 2). This implies that the curve is asymmetric with respect to its maximum: the size of the construction sector tends to increase in developing countries, to peak in newly industrialized economies and to decline at a slowing pace afterwards, approaching stabilization in the most advanced economies.

We have also found that the curve fits better when employing alternative indicators to measure the level of economic development instead of per capita GDP. This supports the intuition that the size of the construction sector is not just a function of per capita output, but is related to broader socio-economic trends which are intimately linked with economic development, namely urbanization, industrialization and creation of basic infrastructures. In particular, we have found that the model fits better when economic development is measured through an index (EDI) composed of per capita income, life expectancy, maternal mortality ratio and the share of agriculture in employment. However, and rather interestingly, we have obtained an even better fit to the data when using life expectancy alone as the proxy for development. A possible explanation is that life expectancy at birth is not distorted by country-specific factors, unrelated to development, which could instead influence the empirical distribution of other indicators.

The curve is robust to the inclusion of control variables. Population density, demographic growth and credit availability don't explain cross-country variation in the share of construction in output. However, we find weak evidence that a better (i.e., less concentrated) income distribution is positively related to the size of the construction sector, suggesting that low and medium income families tend to spend a larger share of their income on housing. Apart from this, Bon curve appears the only factor explaining cross-country variation in the share of construction in output, at least among the variables that we were able to include in the model.

Our findings carry two main policy implications. First, in the medium-run the construction sector is able to grow faster than the rest of the economy in developing countries, acting as a driving force of growth. Since the share of construction in output is one of the variables that policy-makers usually monitor in order to spot possible overheating in real estate markets, the second policy implication is that different criteria must be employed in judging the value of this indicator in developing and mature economies, given that an higher and increasing weight of construction is physiological in industrializing countries.

A question that arises almost naturally is whether the bell-shaped pattern holds within all sub sectors of construction or it is the result of different dynamics experienced by housing, infrastructures and non-residential buildings or by new buildings as opposed to renewal and maintenance activities. Intuition and a descriptive overview of the dynamics observed in major countries – see for example Euroconstruct (2012) – would for example suggest that the bell-shaped relationship could be determined by new buildings, while the incidence of renewal and maintenance activities may be linearly related to economic development (and so could explain the tendency toward stabilization in mature economies). These questions may inspire further empirical work. The most challenging task is probably going to be related to the current scarce availability of data on the composition of construction investment in most developing countries.

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Appendix

List of countries in the sample and Economic Development Index (EDI) ranking

Rank		EDI	Rank		EDI	Rank		EDI
1	Norway	99.4	44	Malaysia	90.6	87	Pakistan	75.9
2	Switzerland	99.1	45	Peru	90.2	88	Bangladesh	75.8
3	Sweden	98.6	46	Venezuela	90.0	89	Sao Tome	75.5
4	Australia	98.6	47	Belarus	89.9	90	Ghana	72.9
5	Japan	98.5	48	Russia	89.3	91	Yemen	72.6
6	Netherlands	98.4	49	Macedonia	89.1	92	Congo, Rep. of	72.2
7	Canada	98.4	50	Turkey	88.9	93	Nepal	72.0
8	France	97.9	51	Serbia	88.6	94	Cambodia	72.0
9	United States	97.9	52	Iran	88.5	95	Benin	71.0
10	United Kingdom	97.9	53	Bosnia	88.5	96	Papua New Guinea	70.5
11	Belgium	97.9	54	Brazil	88.4	97	Lao P.D.R.	70.1
12	Austria	97.8	55	Jordan	88.4	98	Madagascar	69.7
13	Germany	97.8	56	Tunisia	88.3	99	Swaziland	69.4
14	Israel	97.7	57	Romania	87.6	100	Mauritania	69.3
15	Italy	97.6	58	Colombia	87.5	101	Togo	69.1
16	Brunei Darussalam	97.5	59	Algeria	86.1	102	Gambia	68.9
17	Finland	97.3	60	Ecuador	86.1	103	Sudan	68.4
18	Denmark	97.3	61	Ukraine	86.0	104	Senegal	68.2
19	Malta	96.6	62	Kazakhstan	85.2	105	Uganda	67.5
20	Cyprus	96.4	63	Thailand	85.0	106	Kenya	67.4
21	New Zealand	96.3	64	Sri Lanka	84.9	107	Côte d'Ivoire	67.3
22	Korea, south	96.3	65	Egypt	84.6	108	Ethiopia	66.3
23	Kuwait	96.0	66	Cape Verde	84.5	109	Tanzania	66.1
24	Greece	95.7	67	Paraguay	84.4	110	Rwanda	66.1
25	Slovenia	95.6	68	China	84.3	111	Burkina Faso	65.9
26	Czech Republic	95.5	69	Armenia	83.3	112	Nigeria	65.7
27	Portugal	94.5	70	Guyana	82.6	113	Cameroon	64.9
28	Slovak Republic	93.9	71	Gabon	82.6	114	Niger	64.5
29	Estonia	93.4	72	Morocco	81.8	115	Mali	64.4
30	Saudi Arabia	93.3	73	Moldova	81.4	116	Liberia	63.5
31	Oman	93.1	74	Georgia	81.4	117	Guinea	63.1
32	Chile	93.0	75	Philippines	80.9	118	Mozambique	62.8
33	Hungary	92.8	76	Uzbekistan	80.7	119	Malawi	62.3
34	Argentina	92.5	77	Mongolia	80.6	120	Zimbabwe	61.4
35	Poland	92.3	78	Turkmenistan	80.2	121	Sierra Leone	59.6
36	Croatia	92.2	79	Kyrgyz Rep.	79.9	122	Chad	58.2
37	Costa Rica	91.6	80	Botswana	79.6	123	Burundi	57.7
38	Lithuania	91.6	81	Bolivia	79.6	124	Central African Rep.	NA
39	Uruguay	91.4	82	South Africa	79.5	125	Djibouti	NA
40	Mexico	91.2	83	Indonesia	79.2	126	Lebanon	NA
41	Bulgaria	91.1	84	Namibia	77.4	127	Myanmar	NA
42	Latvia	91.0	85	Bhutan	76.7	128	Taiwan	NA
43	Montenegro	90.9	86	India	76.0			

TABLES

Table 1: Investment in construction by sector and macro-area in 2011 (Billion Euros)

	Residential		Non-residential		Infrastructures		Total	
	Investment	Share	Investment	Share	Investment	Share	Investment	Share
Asia	737	29.6%	819	32.8%	937	37.6%	2, 493	100%
Europe	667	42.4%	522	33.2%	386	24.5%	1, 575	100%
N.America	304	33.1%	329	35.9%	285	31.1%	918	100%
S.America	117	35.5%	87	26.3%	125	38.1%	329	100%
Africa	38	26.1%	35	24.0%	73	49.9%	145	100%
Oceania	43	26.9%	30	19.0%	86	54.1%	159	100%
World	1,906	33.9%	1,822	32.4%	1,897	33.7%	5,619	100%

Source: Cresme/Simco (2012)

Table 2: Average results of yearly cross-section analyses (2000-2011)

	lin-lin		**lin-log**		**log-log**	
	Parameters	P-Value	Parameters	P-Value	Parameters	P-Value
Constant	0.117	0.000	-0.460	0.124	-8.240	0.000
GDP	0.000	0.235	0.142	0.046	1.431	0.011
GDP^2	0.000	0.122	-0.008	0.052	-0.083	0.016
R^2	3.7%		6.9%		9.9%	

Notes: Dependent variable: share of construction in output; GDP = per-capita GDP

Table 3: Estimation of the CDC with GDP per capita as a proxy for development

a)Dep. variable: log(Investment in construction as a share of GDP)

	2000-2006		2007-2011	
	Coefficient	P-value	Coefficient	P-value
Constant	-2.61	0.12	**-5.44*****	0.003
log(GDP per capita)	**1.16*****	0.006	**1.90*****	$2.3*10^{-5}$
log(GDP per capita)^2	**-0.07*****	0.009	**-0.11*****	$2.8*10^{-5}$
Y_{max}	12.0%		14.1%	
X_{max}	6,509		4, 906	
Regression statistics	N = 128, F-Stat = 6.0, R^2 = 8.7%		N = 128, F-Stat = 9.8, R^2 = 13.6%	

b)Dep. variable: log(Construction's share of value added)

	2000-2006		2007-2011	
	Coefficient	P-value	Coefficient	P-value
Constant	-3.10*	0.07	**-4.51****	0.02
log(GDP per capita)	**1.07*****	0.01	**1.45*****	0.002
log(GDP per capita)^2	**-0.06****	0.02	**-0.08*****	0.004
Y_{max}	5.6%		6.4%	
X_{max}	7, 931		6, 501	
Regression statistics	N = 127, F-Stat = 6.6, R^2 = 9.6%		N = 127, F-Stat = 6.6, R^2 = 9.6%	

Table 4: Estimation of the CDC with alternative measures of economic development

Dep.variable: log(Investment in construction as a share of GDP)

Human Development Index (HDI)	2000-2006		2007-2011	
	Coefficient	P-value	Coefficient	P-value
Constant	**2.42*****	$8.2*10^{-37}$	**2.21*****	$3.0*10^{-39}$
log(HDI)	-0.16	0.73	**-1.47*****	0.005
log(HDI)^2	-0.41	0.25	**-1.44*****	0.001
Y_{max}	11.4%		13.4%	
X_{max}	0.82		0.60	
Regression statistics	N = 127, F-Stat = 5.7, R^2 = 8.3%		N = 127, F-Stat = 6.7, R^2 = 9.8%	

Economic Development Index (EDI)	2000-2006		2007-2011	
	Coefficient	P-value	Coefficient	P-value
Constant	**-110.5*****	0.003	**-179.7*****	$2.0*10^{-6}$
log(EDI)	**50.9*****	0.002	**83.0*****	$1.7*10^{-6}$
log(EDI)^2	**-5.73*****	0.003	**-9.43*****	$2.0*10^{-6}$
Y_{max}	12.1%		14.5%	
X_{max}	84.7		81.2	
Regression statistics	N = 123, F-Stat = 10, R^2 = 14.6%		N = 123, F-Stat = 15, R^2 = 20.2%	

Life Expectancy at birth	2000-2006		2007-2011	
	Coefficient	P-value	Coefficient	P-value
Constant	**-66.6*****	0.004	**-144.4*****	$9.1*10^{-7}$
log(Life Expectancy)	**32.7*****	0.004	**70.0*****	$8.0*10^{-7}$
log(Life Expectancy)^2	**-3.87*****	0.005	**-8.32*****	$1.0*10^{-6}$
Y_{max}	12.0%		14.4%	
X_{max}	68.5		66.8	
Regression statistics	N=127, F-Stat = 12.6, R^2 = 16.9%		N = 127, F-Stat = 19.8, R^2 = 24.2%	

Table 5: Estimation of the CDC with control variables

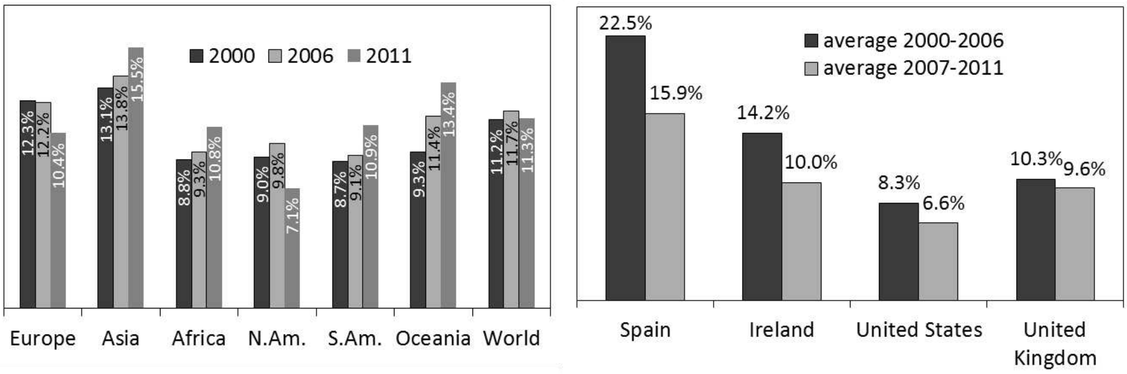
Dep.variable: log(Investment in construction as a share of GDP)

	2000-2006		2007-2011	
	Coefficient	P-value	Coefficient	P-value
Constant	**-116.0****	0.01	**-198.9*****	$8.9*10^{-6}$
log(EDI)	**53.3****	0.01	**92.0*****	$8.5*10^{-6}$
log(EDI)^2	**-6.0****	0.01	**-10.5*****	$1.0*10^{-5}$
Gini Index	-0.04	0.43	**-0.09****	0.04
Population	0.03	0.53	0.01	0.74
Surface	-0.05	0.25	-0.02	0.66
Population Density	0.07	0.64	-0.13	0.37
Population Growth	0.35	0.67	0.002	0.98
Credit/GDP	0.01	0.87	0.03	0.57
Regression statistics	N=119, F=3, R^2=18.2%, Adj.R^2=12.2%		N= 119, F=4, R^2 = 24.0%,Adj.R^2=18.4%	

Note: All variables except the EDI were standardized

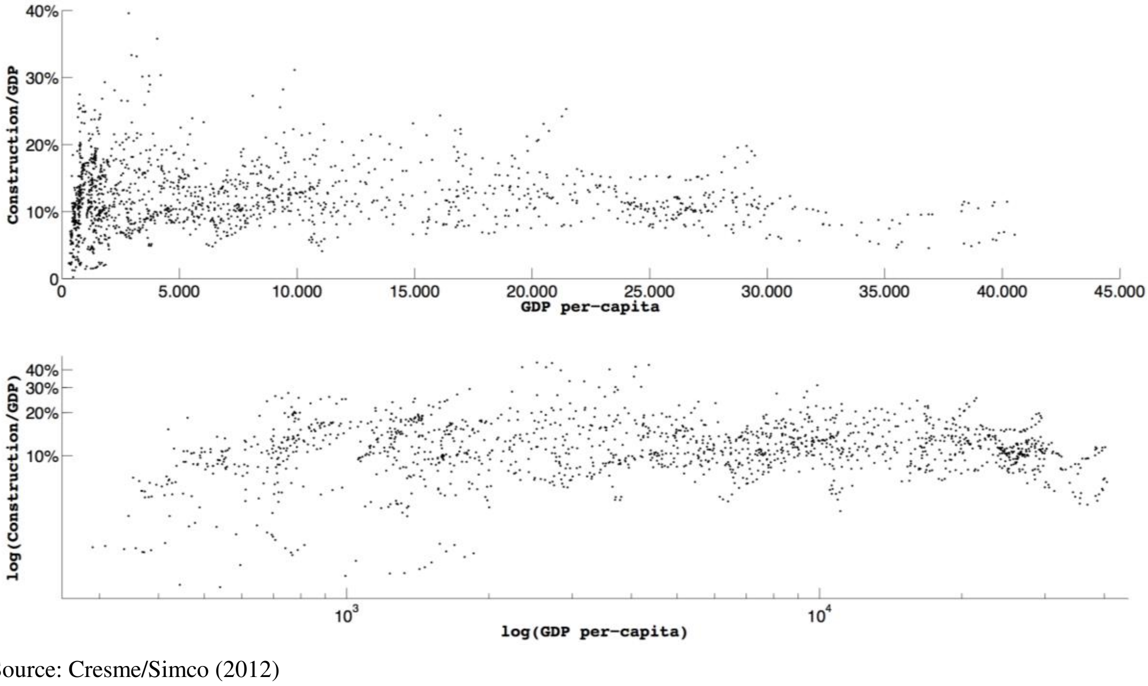
FIGURES

Figure 1: Investment in construction as a share of GDP



Source: CRESME/Simco (2012)

Figure 2: Country distribution with respect to GDP per capita and construction's share in output. Linear (top panel) and logarithmic (bottom panel) scale.



Source: Cresme/Simco (2012)

Figure 3: Structural break (estimated yearly coefficients and confidence intervals)

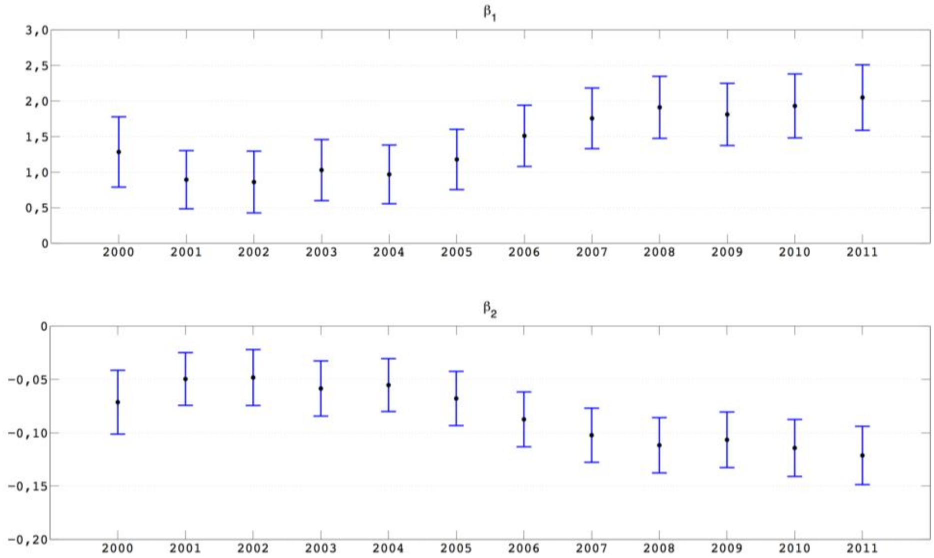


Figure 4: Construction-Development Curve with per capita GDP as a proxy for development (2007-2011)

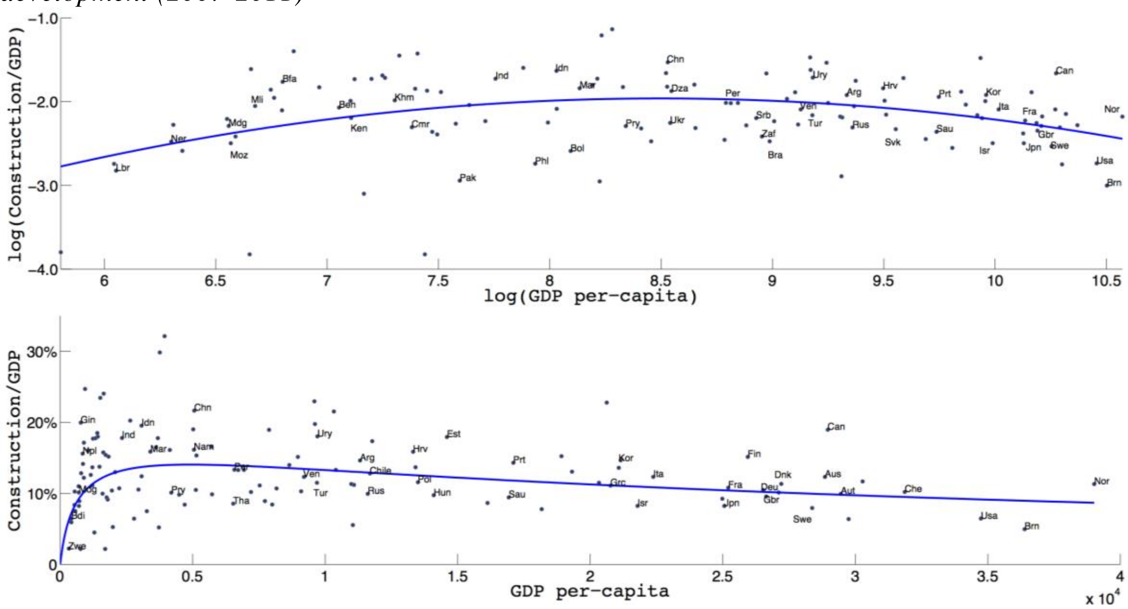


Figure 5: Construction-Development Curve with the EDI as a proxy for development (2007-2011)

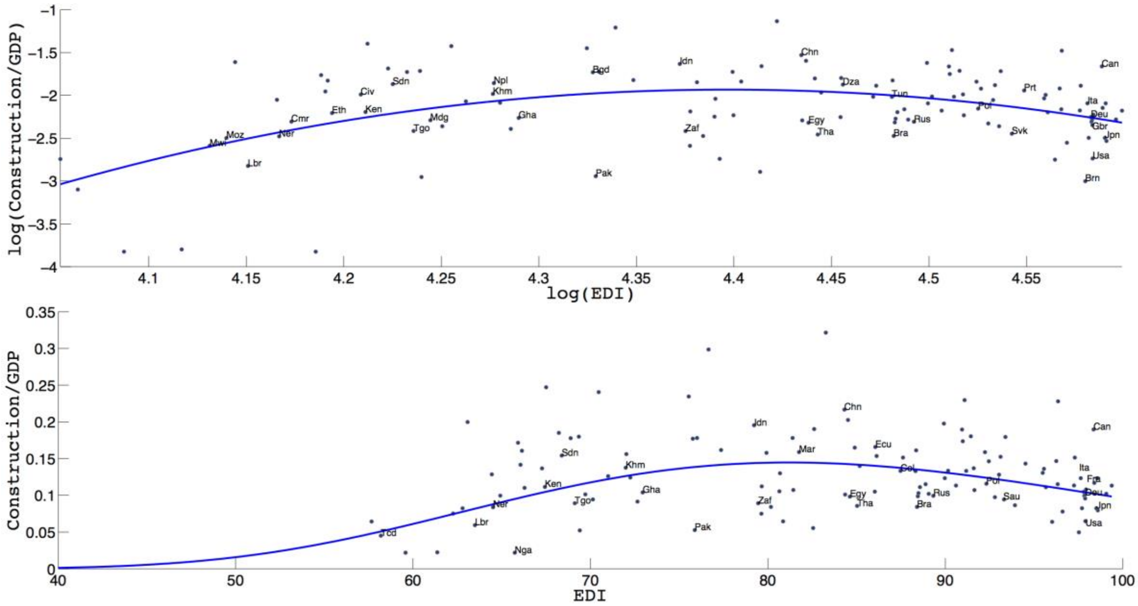


Figure 6: Construction-Development Curve with life expectancy as a proxy for development (2007-2011)