
# Too much and too fast? Public investment scaling-up and absorptive capacity

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**Abstract**

A recent trend in several low-income developing countries has been a rapid scaling-up of public investment. It is argued that in the presence of limited absorptive capacity countries are not able – in terms of skills, institutions, management – to translate additional public investment into sustained output growth. We test for the presence of absorptive capacity constraints using a large dataset of World Bank investment projects, approved between 1970 and 2007 in 80 countries. Our results indicate that projects undertaken in periods of public investment scaling-up are less likely to be successful, although this effect is relatively small, especially in poor and capital scarce countries. We also verify that this effect is unrelated to large aid flows and donor fragmentation.

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# 1 Introduction

Several low-income developing countries (LIDCs) have recently increased public investment, mainly driven by the need to fill their infrastructure and development gaps and to foster economic growth. Since 2007, public capital spending in LIDCs accounted for more than five percent of GDP and, in some countries, it increased substantially and is now above 10 percent of GDP. This sharp increase has been associated with the scaling-up of infrastructure investment, sometimes related to the exploitation of natural resources or reconstruction spending in the aftermath of natural disasters and conflicts. The studies on the relationship between public investment and output growth go back to the *big push* theory of development economics. Notwithstanding a few notable dissenting views (Easterly, 2001), the idea that a scaling-up of public investment could foster development is generally taken for granted by policymakers and is reflected in many policy recommendations. For instance, the influential Growth Report lists public investment as one of the most important policy ingredients of growth strategies, because "public investment [...] helps the economy to accumulate the infrastructure and skills it needs to growth quickly" (Commission on Growth and Development, 2008, p.34).

However, the empirical literature does not provide a consistent body of evidence supporting a positive association between the scaling-up of public investment and economic growth. In a seminal paper, Easterly and Rebelo (1993) show that public investment is positively correlated with output growth across countries; on the other hand, Devarajan, Swaroop and Heng-fu (1996) find that in developing countries, public capital expenditures are negatively associated with economic growth. More recently, Abiad, Furceri and Topalova (2015) use forecast errors to identify government investment shocks and find evidence of a positive effect of public investment on output in advanced economies. Eden and Kraay (2014) focus on a sample of 39 low-income countries and exploit the relevance of long-term disbursements of official creditor loans to isolate a predetermined source of variation in government investment (Kraay, 2012). Their estimates point to a significant and positive output effect. By contrast, when looking at large public investment boom episodes, Warner (2014) finds 'very little' evidence supporting the idea that public capital can promote growth.

One of the reasons that may explain the weak association between public investment accelerations and output growth is limited absorptive capacity (Horvat, 1958; Rosenstein-Rodan, 1961).[1] A first way to conceptualize absorptive capacity is in terms of declining marginal returns to public investment. In that sense, one could think that the output gains of additional public investment diminish as long as public capital is accumulated, so that the expected rate of return is declining with capital investment (Adler, 1965). Declining marginal returns could be due to constraints in the availability of institutional, human, and infrastructure capital.[2] However, as long as those factors can be adjusted, the conventional hypothesis of diminishing

[1] Berg and Berg (1983) provide an extensive review of the early literature on absorptive capacity, while the International Monetary Fund (2012) presents an overview of the concept of absorptive capacity.

[2] In addition, public investment above a certain threshold could create distortions in the private sector and the resulting crowding-out of private investment could have an adverse effect on GDP growth (Kelly, 1997; Fosu, Getachew and Ziesemer, 2012).

returns to public capital with other factors held constant is weakened.

A slightly different way to think about absorptive capacity is to relate supply bottlenecks with public investment dynamics. It has been argued that when the *pace* of investment (rather than the *level*) is above a certain threshold, countries do not have the capacity – in terms of skills, institutions, and management – to reap the benefit of additional public investment, as the implementation of several investment projects would require a varied set of technical and managerial resources which cannot be expanded in the short-run. In the words of Adler (1965, p.5), "absorptive capacity may [...] be defined as that amount of investment, or that rate of gross domestic investment expressed as a proportion of GNP, that can be made at an acceptable rate of return, with the supply of co-operant factors considered as given." This interpretation still embeds the notion of declining marginal returns, but stresses the role that binding supply bottlenecks can have on rates of return of public investment in the short-run. This idea reflects the limit on the ability to invest ('skill limit') embedded in the two-gap model of foreign aid (Chenery and Strout, 1966). Moreover, when the pace of public investment acceleration is sustained for a significant period, government officials may not have the capacity to select projects with high expected rates of return, so financing poor projects can lead to a reduction in the average return of public investment. Consistent with this line of argument, Shi (2013) finds a limit to the growth effect of infrastructure investment, which is associated with rising input costs.

For the purpose of this analysis, we limit the definition of absorptive capacity to the dynamic context, meaning that we focus on the consequences of rapid acceleration of public investment.[3] It is worth noting that the concept of absorptive capacity is also different from that of public investment efficiency, which measures the capacity to transform each dollar spent into actual public capital, irrespective of the amount and pace of public investment. The two concepts, however, are closely related and one could argue that when public investment is constrained by absorptive capacity, efficiency falls, given that project costs increase and the share of investment that translates into public capital declines.[4]

Consistent with the interpretation of absorptive capacity in terms of rapid acceleration of public investment, recent models highlight the key role of absorptive capacity constraints in determining the output effect of large public investment scaling-up episodes (van der Ploeg,

[3]In the literature, absorptive capacity in also defined in a static framework in which a country in unable to absorb public investment *tout court*, irrespective of the level and the pace of the scaling-up of investment. In other words, absorptive capacity is not necessarily related to the presence of supply bottlenecks but, more simply, it may depend on the lack of adequate institutional and economic resources required to plan and implement investment projects. Within this framework, Becker, Egger and von Ehrlich (2013) look at transfers within regions in the European Union and measure absorptive capacity by human capital endowments and the quality of regional government. Exploiting a regression discontinuity design, they find evidence that absorptive capacity matters, as sufficiently high levels of education and institutional quality in the recipient regions are necessary for European regional redistribution programs to translate into investment and GDP growth. Given that we are interested in the effect of large scaling-up of public investment, we do not consider this definition of absorptive capacity. However, the empirical analysis will take into account educational and institutional quality as factors that may affect the rate of success of public investment.

[4]For a discussion of investment efficiency and its measurement, see Berg et al. (2015) and International Monetary Fund (2015).

2012; Berg et al., 2013; Richmond, Yackovlev and Yang, 2015).[5]

Notwithstanding the importance of absorptive capacity for quantifying the growth dividend of public investment, empirical evidence on absorptive capacity constraints in developing countries is relatively limited. The main contribution of this paper is to shed some light on this issue by testing for the presence of absorptive capacity constraints in developing countries. We use a large dataset of World Bank projects approved between 1970 and 2007 in more than 100 countries, and we merge micro project-level data with macro country-level variables to test whether investment project outcomes worsen when public investment accelerates compared to historical patterns.

An alternative explanation for the presence of a negative association between investment scaling-up and project outcomes could be related to large aid inflows. The aid literature generally models the notion that the capacity to absorb foreign aid is impaired by various types of bottlenecks as a non-linearity, implying that there are diminishing returns to aid (Bourguignon and Sundberg, 2006; Clemens et al., 2012) or its effect is conditional on the quality of policies and institutions in recipient countries (see Rajan and Subramanian, 2008, for an extensive review). Other than the level of aid, donor proliferation could also weaken aid effectiveness, as multiple donors could create coordination problems, raise overall costs (e.g. because of transaction costs, unexploited returns to scale, and donor-specific procedures), foster corruption (e.g. increasing the negotiating power of recipient governments), and reduce the quality of the public sector bureaucracy (e.g. as interaction with donors are costly in terms of staff time and donors "poach" the most talented and qualified local employees) (Svensson, 2008; Knack and Rahman, 2007; Djankov, Montalvo and Reynal-Querol, 2009). Consistent with these arguments, it has been shown that donor fragmentation is correlated with lower levels of bureaucratic quality in recipient countries (Knack and Rahman, 2007) and weakens the effect of aid on economic growth (Djankov, Montalvo and Reynal-Querol, 2009).[6] Therefore, in the empirical analysis we also control for the level of foreign aid and for a measure of donor fragmentation, to differentiate between a 'pure' absorptive capacity constraint, due to investment acceleration, from a more general effect due to donor fragmentation and aid bonanza.

Our empirical approach builds on a strand of literature that investigates the potential determinants of World Bank project outcomes, measuring the extent to which cross-country differences in institutional quality, macroeconomic policies, and macroeconomic performance can

[5]Specifically, van der Ploeg (2012) models the presence of absorptive capacity constraints in terms of increasing internal costs of adjustment of public investment that occur when public investment is ramped up. Differently, Berg et al. (2013) calibrate a dynamic stochastic model to analyze the macroeconomic effects of investing resource revenues, modeling absorptive capacity constraints in terms of the relationship between public capital produced (i.e. effective investment) and actual investment expenditures. In the aid context, Carter (2014) introduces absorptive capacity constraints in a standard neoclassical growth model to show that the optimal aid allocation rule (which maximizes consumption in recipient countries) depends on the level of absorptive capacity in the recipient country, which is a function of aid intensity.

[6]In this vein, Feeny and de Silva (2012) develop a specific index of absorptive capacity, which builds on three main blocks: physical and human capital, governance quality and donor practices. They employ this index of absorptive capacity in a standard growth regression to assess the impact of aid on GDP growth and find some evidence supporting the hypothesis that the positive effect of aid on growth depends of the degree of absorptive capacity of recipient countries.

explain the variability of project outcomes (Kilby, 2000; Dollar and Levin, 2005; Guillaumont and Laajaj, 2006; Chauvet, Collier and Duponchel, 2010; The World Bank, 2010; Limodio, 2011; Blum, 2014; Bulman, Kolkma and Kraay, 2015; Kilby, 2015). In two seminal contributions, Isham, Kaufmann and Pritchett (1997) and Isham and Kaufmann (1999) find a strong positive association between civil liberties, good macroeconomic policies, and the performance of government investment projects financed by the World Bank. Interestingly, Isham and Kaufmann (1999) also show that the productivity of individual public investment projects increases with the share of public investment over GDP in the country, especially where the economic policy environment is relatively undistorted, but this positive correlation turns negative when the public investment-to-GDP ratio is larger than 10 percent. Recently, Denizer, Kaufmann and Kraay (2013) confirm that the quality of policies and institutions and GDP growth are strong predictors of projects' success, but they also underscore that a great part of the variation of project outcomes is within countries rather than between countries.[7]

We contribute to the literature by testing for the presence of absorptive capacity, focusing on the effect of public investment scaling-up on the performance of investment projects. Our results lend support to the presence of absorptive capacity constraints. The estimates indicate that projects undertaken in periods of public investment scaling-up are less likely to be successful, although this effect is relatively small, and the effect is relatively small in low-income and capital scarce countries. This result holds controlling for unobserved time-varying heterogeneity of project outcomes within sectors and country fixed effects. We also find that project outcomes depend on the quality of policies and institutions and on the overall aid flows to a country, while donor fragmentation is not robustly associated with project outcomes. We explore possible non-linearities, finding that the negative correlation between public investment accelerations and the success of investment projects is stronger in countries that are richer, have stronger policies and institutions, and have higher public capital stock-to-GDP ratio.

The paper proceeds as follow. After presenting the World Bank investment project dataset and some empirical regularities (Section 2), we turn to the regression analysis (Section 3), discussion of our results (Section 4), some robustness tests (Section 5), and our conclusions (Section 6).

## 2 World Bank projects data

### 2.1 Data

To address our main research question, we test for the presence of absorptive capacity constraints by looking at the correlation between the outcomes of individual investment projects and the scaling-up of the public investment-to-GDP ratio during the life of the project. We use the Independent Evaluation Group (IEG) World Bank Project Performance Ratings (PPR), a large database at the project level, with data on more than 10,000 projects financed by the

[7] This result is also emphasized by Blum (2014), where the best fit model predicts only 19 percent of the variation in the outcome ratings.

World Bank in 157 countries since 1960.[8] To the best of our knowledge, this data set is one of the broadest publicly available source about public investment outcomes in developing countries.[9] Other than information about the kind of project, its sector, length, and financing, a key feature of these data is that they include a measure of project evaluation, in terms of outcome ratings. Before 1995, projects were evaluated on a binary satisfactory/unsatisfactory scale on the grounds of the 'Implementation Completion Report' produced by the team leader and based on a subjective assessment of the degree to which the project met its targets. Since 1995, this sort of 'self-assessment' was subject to an additional layer of validation by the IEG, which introduced a six-point rating scale, ranging from highly satisfactory to highly unsatisfactory, according to the extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently; for additional details see Denizer, Kaufmann and Kraay (2013) and Kilby (2015).[10]

In our analysis, we consider exclusively investment projects, excluding development policy lending, which is typically intended for general budget support to help adjust to economic crises and to promote macroeconomic and structural reforms.[11] We also exclude a few projects started before 1960 and the ones which refer to regions, rather than countries, to be able to merge the micro-level data with the macroeconomic variables. We merge the investment project data from the World Bank PPR data set approved in the period 1970-2007 with a set of standard macroeconomic variables and some indicators that should capture limits on absorp-

[8] We use the November 2013 version of the data set, available on the World Bank website. In building many project-specific variables, we follow closely Denizer, Kaufmann and Kraay (2013).

[9] Recent papers use additional data from the Asian Development Bank (Bulman, Kolkma and Kraay, 2015) and from other eight agencies (Honig, 2015).

[10] More specifically, projects are evaluated according to this rating scale (see http://ieg.worldbankgroup.org/ratings):

- Highly Satisfactory: there were no shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.
- Satisfactory: there were minor shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.
- Moderately Satisfactory: there were moderate shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.
- Moderately Unsatisfactory: there were significant shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.
- Unsatisfactory: there were major shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.
- Highly Unsatisfactory: there were severe shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.

In addition to the overall evaluation, the IEG publishes an explicit evaluation of the borrower performance which is rated, again on a six-point rating scale, by assessing separately: (i) the government performance (central and/or local government as relevant), and (ii) the implementing agency or agencies performance. The ratings of the two separate dimensions are combined to produce an overall borrower performance rating. Where the government and implementing agency are indistinguishable, there is only an overall rating. For detailed information, see http://ieg.worldbankgroup.org/ratings. Finally, for a subset of projects (less than 4,000) the IEG releases the expected rate of return of the project, evaluated at appraisal and at completion. We do not use expected rate of returns as a measure of project outcome given that, because of sample size, the limited variability over time and across countries would prevent a sound identification of the correlation with country-level variables. On the limitations of the expected rate of returns data, see also Pritchett (2010).

[11] As stated on its website, the World Bank "has two basic types of lending instruments: investment loans and development policy loans. Investment loans have a long-term focus (5 to 10 years), and finance goods, works and services in support of economic and social development projects in a broad range of sectors. Development policy loans provide quick-disbursing external financing to support a government's policy and institutional reforms".

tive capacity. In particular, we take data on public investment and capital stocks from Gupta et al. (2014), who disaggregate total investment as published in the Penn World Table by applying public and private investment shares from IMF World Economic Outlook (WEO) database and then use the perpetual inventory method for estimating public capital stocks. The measure of human capital is drawn from the Penn World Table (version 8.0), while data on real GDP, total aid, World Bank lending, and the Country Policy and Institutional Assessment (CPIA) are taken from the World Development Indicators.[12] Finally, we build the measure of donor fragmentation using data on total official development assistance published in the International Development Statistics database by the OECD.

The list of all variables used in the analysis, their sources, and descriptive statistics are reported in Table 1. In the following, we present some descriptive evidence about the evolution of project outcomes. Then, we move to a multivariate regression framework to assess the correlation between the macroeconomic variables and investment project outcomes, taking into account observable and unobservable heterogeneity at the project level.

### 2.2 Stylized facts

At first, we analyze the pattern of individual investment projects, separating successful from unsuccessful projects. To do so, we follow Denizer, Kaufmann and Kraay (2013), Kilby (2015) and Bulman, Kolkma and Kraay (2015) and we do not exploit the granular distinction in the six-grade classification. Rather, we classify projects evaluated as "highly satisfactory," "satisfactory," and "moderately satisfactory" as successful projects; projects evaluated as "highly unsatisfactory," "unsatisfactory," and "moderately unsatisfactory" are coded as unsuccessful projects. We label the resulting dummy variable as $OUTCOME$.[13]

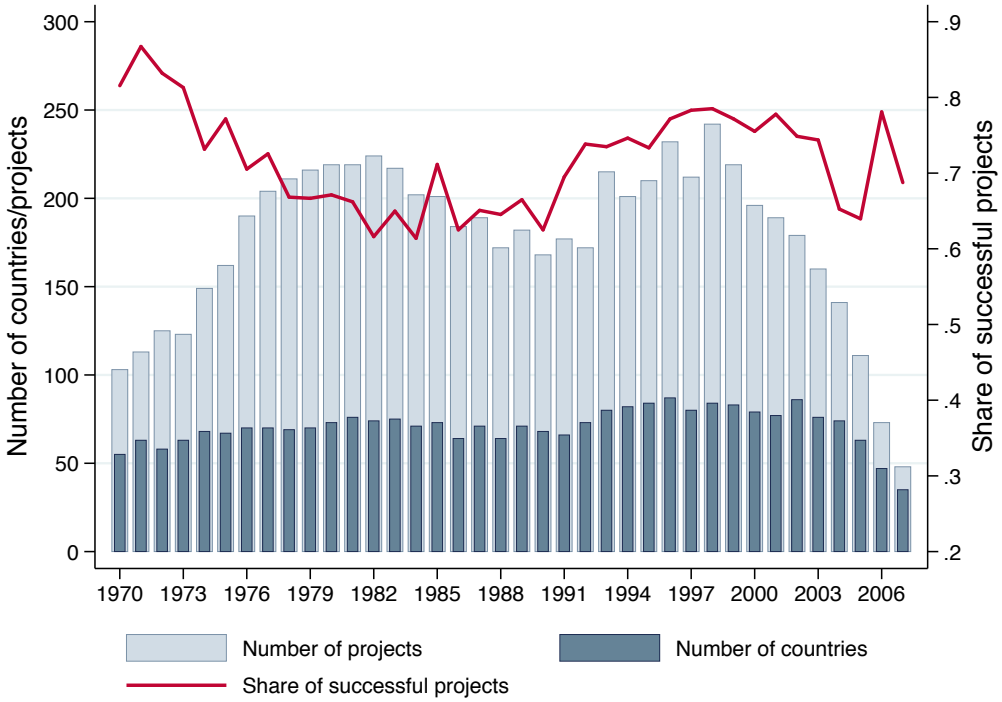
There are 7843 projects approved between 1970 and 2007, 6,980 of which are investment loans. After adding a standard set of project-level variables and dropping observations with missing values, we are left with 6750 investment project loans approved in 150 countries. This sample excludes recent years as there are a limited number of approved projects per year that have already been evaluated by end-2013. Figure 1 plots, for each approval year, the number of projects (and the corresponding countries in which they were undertaken) and the average share of successful projects. The number of projects included in the data set increased significantly in the 1970 and stabilized around 200 projects per year in the following two decades. Since 2000,though, the number of approved projects per year included in the data set decreased, given that an increasing number of them have not yet been evaluated. The number of countries covered per year is quite stable around 65 to 80 countries.

The share of successful projects fluctuates around 70 percent: this share decreased sub-

[12] Data on the CPIA prior to 2005 and for middle-income countries are confidential.

[13] Blum (2014) suggests that a meaningful threshold in the data is between "satisfactory" and "moderately satisfactory" projects, rather than between "moderately satisfactory" and "moderately unsatisfactory." This threshold effect may be due to the fact that a "satisfactory" assessment could be quite accurate, while a "moderately satisfactory" could be a *merciful* evaluation of projects that actually deserve an unsatisfactory assessment . However, given that we want to cover a long time span and the six-grade scale was introduced only in 1994, we use the standard satisfactory versus unsatisfactory classification which is consistent throughout the whole sample period.

Figure 1: Investment projects data, by approval year



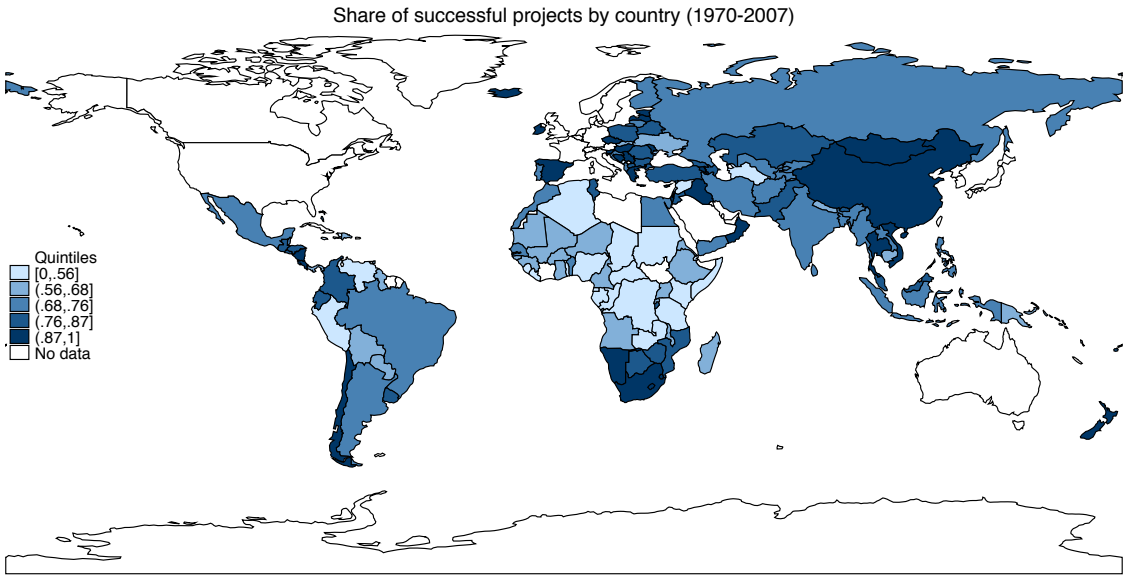

Note: Elaborations based on the IEG World Bank Project Performance Ratings data set (on a sample of 6750 investment projects).

stantially in the 1970s and was about 65 percent in the 1980s, and then increased to 74 percent in the remaining years. Figure 2 shows the distribution across countries of the average share of satisfactory projects approved between 1970 and 2007. The map clearly points out the relatively poorer performance in many sub-Saharan African countries compared to more successful countries in Eastern Europe and Asia.

## 3 The empirical setup

To inspect the relationship between macroeconomic conditions – and public capital accumulation in particular – and investment project outcomes, we turn to a standard multivariate regression framework. We focus the analysis on specific investment loans, excluding development policy loans. After merging the project data with country-specific variables, we are left with a sample of 3972 investment projects approved between 1977 and 2007 — and evaluated between 1980 and 2013 — in 80 countries (see Table A1), 3945 of which are actually used in the empirical models (27 observations are dropped as singletons, meaning that 27 fixed effects used in the analysis – see equation 1 below – contain only one observation). The average value of the dependent variable in this sample is 0.71 (s.d. = 0.46), almost identical to the average value in the larger sample of 6750 investment projects (0.71, s.d. = 0.46), and the distribution

Figure 2: Investment projects successful rates, by country




Notes: elaborations based on the IEG World Bank Project Performance Ratings data set (on a sample of 6,750 investment projects).

of projects by sectors is also very similar in the two samples (Table A2), suggesting that there is not a significant sample selection bias when restricting the sample to the projects for which we can merge macroeconomic variables.

On this sample of 3945 investment projects, we estimate a simple linear probability model in which the dependent variable is the IEG categorical evaluation of project outcomes, re-coded as the binary variable:

$$OUTCOME_{ijt} = \beta \mathbf{COUNTRY}_{jt} + \gamma \mathbf{PROJECT}_{ijt} + \epsilon_{ijt} \quad (1)$$

where $OUTCOME_{ijt}$ is a dummy equal to one if the investment project $i$ undertaken in country $j$ in year $t$ is evaluated as satisfactory and zero otherwise. The project outcome is a function of a set of country-specific variables ($\mathbf{COUNTRY}_{jt}$) and of a vector of project-specific characteristics ($\mathbf{PROJECT}_{ijt}$). The error term ($\epsilon_{ijt}$) follows the standard normal distribution. We cluster the standard errors at the country year-of-evaluation level to allow for the potential correlation of the residuals within these groups (Denizer, Kaufmann and Kraay, 2013).[14]

We take into account unobservable project-specific and time-varying heterogeneity saturating equation 1 with a set of sector × approval year and sector × evaluation year dummies, which would control for external (sector specific) aggregate shocks and unobservable changes in the evaluation standards over time. As the number of projects in some countries is rela-

[14]We also follow Denizer, Kaufmann and Kraay (2013) in estimating a simple linear probability model; this has the advantage of immediately showing the proportion of the variance of the dependent variable explained by project- and country-specific factors. Coefficients can also be easily interpreted as marginal effects, especially for the interaction terms. For robustness we also report the probit estimates, which are consistent with the findings discussed throughout the paper (see Tables A4-A6 in the Appendix).

tively small, we do not include country fixed effects jointly with macroeconomic variables in our baseline estimates, to allow for better identification of the country-specific variables. However, in Section 5 we show that results are robust to the inclusion of country fixed effects and can also be interpreted in the within-country dimension. The list, definitions and summary statistics of all variables are reported in Table 1.

### 3.1 Country-specific variables

To take into account the role of absorptive capacity constraints on the outcome of investment projects, we introduce a variable capturing the pace of public investment scaling-up (*SCALE UP*). This measure is obtained by calculating, for each year $t$, the difference between the actual public investment-to-GDP ratio of country $j$ and its average over the previous five-year period. Then, we take the average of this difference over the length of the project. The intuition is that a sharp deviation of public investment from the historical average could signal potential absorptive capacity bottlenecks. More formally, we calculate the measure of scaling-up as:

$$SCALE\,UP_{jt} = \frac{1}{ey - ay}\left[\sum_{t=ay}^{ey}\left(\frac{Public\ investment}{GDP}\right)_t - \frac{1}{5}\left(\sum_{t=ay-5}^{ay-1}\left(\frac{Public\ investment}{GDP}\right)_t\right)\right] \quad (2)$$

where $ay$ and $ey$ are, respectively, the year of the approval and end year of the project.[15]

The set of country-level controls includes other variables that could affect investment outcomes. First, we need to assess whether absorptive capacity constraints are related to overall public investment or to aid-driven investment. To take into account the possible confounding effect of foreign aid, we include two variables: 1) the ratio of total official development assistance (ODA) over GNI, and 2) a measure of donor fragmentation. The former controls for the possibility that supply bottlenecks could also bind during period of large foreign capital inflows, given that countries' may not have enough resources to manage public investment projects. The latter builds on the literature on donor fragmentation, according to which coordination failures, costly interactions with donors, and worsening bureaucratic quality could reduce the success of investment projects. While there is no clear consensus in the empirical literature on how to measure donor fragmentation, in our baseline analysis we follow Easterly (2007) and Djankov, Montalvo and Reynal-Querol (2009), and we construct the following index of donor fragmentation as one minus the Herfindahl-Hirschman index for shares of donors' ODA in recipient country total ODA:

$$FRAGMENTATION_{jt} = 1 - \sum_{d=1}^{N}\left(\frac{ODA_{djt}}{\sum_{d=1}^{N} ODA_{djt}}\right)^2 \quad (3)$$

where $ODA_{djt}$ is gross disbursements of ODA by donor $d$ to country $j$ at time $t$. This variable is then averaged over the length of the project. The sum of the squared aid shares measures the

[15] In the robustness test, we experiment with a number of alternative measures of public investment scaling-up.

probability that two randomly drawn aid dollars come from the same donor, while a higher value of the index indicates a higher degree of donor fragmentation. Then, as a robustness we also use the share of total ODA provided by the three largest donors as an alternative measure of donor concentration.[16]

We take into account the possibility that project outcomes are affected by the lack of adequate institutional and economic skills and by poor macroeconomic policies, irrespective of the level and the pace of public investment, including the overall Country Policy and Institutional Assessment ($CPIA$) score in the starting year of the project. This index is compiled by the World Bank and is widely used as a proxy of countries' policies and institutions.

Finally, we control for differences in the level of economic and social development and in the macroeconomic performance across countries adding the logarithm of real per capita GDP ($GDP$), an indicator of human capital ($HC$, which measures the average years of schooling, as calculated in the Penn World Tables on the basis of the Barro and Lee (2013) dataset), and the growth rate of real per capita GDP ($GROWTH$). All these variables are measured in the starting year of the project to mitigate endogeneity concerns (Kilby, 2015).[17]

### 3.2 Project-specific variables

The set of project-level variables includes a number of indicators that control for different projects characteristics. A first dimension which is likely to affect project outcomes is the degree of complexity. While complexity is difficult to measure precisely, we follow Denizer, Kaufmann and Kraay (2013) and we try to capture complexity using three variables. We use the size of the project, measured by the logarithm of the USD cost of the project ($SIZE$), under the assumption that larger project are more complex to undertake. Then, we exploit the information about the sectoral classification and we take the share of the largest share of the project assigned to a single sector ($SHARE\ 1^{st}\ SECTOR$) as a measure of low complexity, on the ground that projects that span across a number of different sectors are more complex to manage. Finally, we create a binary indicator that identifies 'repeated' projects as the ones which are follow-ups of previous projects ($REPEATED$), assuming that these projects will be less complex than brand new ones.

We have information on World Bank involvement in the overall project, which could be measured by the share of the project cost which has been financed by the World Bank ($SHARE\ WB\ FINANCING$) and we can also identify projects for which there has been an assessment of the expected rate of return, as they may systematically differ from other projects ($ERR$).

We also exploit the information about sectors and lending instruments. As the data set assigns a percentage of each project to up to five different sectors, we classify the projects on the basis of the largest sectoral assignment into 10 sectors: agriculture, energy and mining,

[16] In building the measures of donor fragmentation we consider all donors, bilateral and multilateral. Considering exclusively Development Assistance Committee (DAC) donor countries does not affect our main findings (results are available on request).

[17] Our findings do not change measuring those variables as averages over the length of the project, as in Denizer, Kaufmann and Kraay (2013); results are available on request.

industry and trade, transportation, water, education, finance, health and other social services, information and communication, and public administration. This classification allow us also to restrict projects to the ones which are targeted to infrastructure investment, considering only projects in the following five sectors: agriculture, energy and mining, industry and trade, transportation, and water.[18] Because investment loans are disbursed through six different instruments, we include a set of dummies to take into account unobservable differences across lending instruments. Other project-specific variables related to project length and evaluation are not included as they are potentially endogenous to the likelihood of project success. However, results do not change after including them (see Section 5).

# 4 Results

## 4.1 Main findings

The baseline regression results of the OLS estimation of equation 1 are reported in Table 2. Each specification controls for lending instrument, sector × approval year, and sector × evaluation year fixed effects. In the first column we estimate equation 1 on the whole sample of World Bank investment projects and we just include project-specific variables, to have a first assessment of their correlation with project outcomes and of the explanatory power of the model. In the second column, we augment the first specification by adding country fixed-effects to evaluate the relative contribution that country-specific characteristics can bring to the model.

The first regression shows that the model is able to explain about 18 percent of the variation in project outcomes. Adding country fixed effects increases the $R^2$ of the model to 25.3 percent (column 2). This result, while consistent with the finding that a large part of the variation in project outcomes still happens within countries across projects (Denizer, Kaufmann and Kraay, 2013; Bulman, Kolkma and Kraay, 2015), indicates that country-specific characteristics significantly contribute to the predictive power of the model (in relative terms, macroeconomic factors can account for one-fourth of the variance explained by the model).

### 4.1.1 Country-level variables

Given that we are interested in the effect of country-level variables on the likelihood that a project is successful, in column 3 we estimate our preferred specification of equation 1, adding the set of country-specific variables ($\mathbf{COUNTRY}_{jt}$) and dropping country fixed effects. Results indicate that the set of macro controls is indeed able to capture about 20 percent of the variability in the outcome variable, which is due to country-specific effects. The baseline specification (column 3) is estimated over the whole sample of investment projects, while in the remaining columns we estimate the model on different sub-samples, considering only infrastructure projects (column 4) and the ones evaluated after 1995, in order to focus exclusively on

[18] This classification of infrastructure projects is admittedly rough but the best available in the data set.

projects that have been reviewed by IEG, either by desk reviews or by a more detailed Project Performance Audit Report (column 5).

Moving to specific results, we find that the correlation between the measure of public investment scaling-up and the likelihood that a project is rated as satisfactory is negative and statistically significant across all model specifications. To quantify the economic magnitude of this correlation, our results indicate that a 3 percent increase in the public investment-to-GDP ratio with respect to its average in the previous five-year period is associated with a reduction of 3.9 percentage points in the probability of a successful outcome (column 3). This effect is relatively small but stable even when we restrict the sample to infrastructure projects and to the ones evaluated after 1995.

The coefficients on the aid-to-GNI ratio show that investment projects are less likely to be successful when aid is particularly large: a one standard deviation increase in foreign aid is associated with a 3.1 percentage point reduction in the probability that an investment project is rated as successful (column 3). This effect is larger (5.5 percentage points) for infrastructure projects, while no longer significant for projects evaluated after 1995.

Our results indicate that project outcomes do not depend exclusively on the scaling-up of public investment but also on institutional capacity (Denizer, Kaufmann and Kraay, 2013). There is a positive association between strong policies and institutions and project outcomes. A one standard deviation increase in the the institutional and policy indicator, which corresponds to around a 0.68 change in the CPIA ratings (somewhat larger than the change implied in the move from the CPIA threshold for weak policies to the threshold for strong policies in the IMF-World Bank debt sustainability analysis) is associated with an increase in the likelihood of project success of 1.8 percentage points.

We also find that projects are more likely to be successful when they are undertaken during periods in which the country is experiencing higher growth rates (Denizer, Kaufmann and Kraay, 2013; Kilby, 2015). Contrary to the presumption that better human capital endowment would improve project outcomes, the coefficient on the human capital index is imprecisely estimated. Finally, there is no difference in the likelihood that projects are assessed as satisfactory across country income level.

Our main results regarding the role of country-level variables in the success of individual projects point to the relevance of absorptive capacity constraints and are generally quite stable across different samples of projects. Therefore, we focus on the full sample of investment projects to preserve the largest sample size.[19]

#### 4.1.2 Project-level variables

Looking at the correlation between project-level variables and outcomes, we find, consistent with Denizer, Kaufmann and Kraay (2013), a mixed evidence on the correlation between our proxies for project complexity and outcomes: smaller projects are generally more likely to be

[19]Results for alternative sub-samples – and in particular for the infrastructure projects that are the ones more closely related to our research question about the likely growth effect of the ramping up of infrastructure spending in low-income developing countries – are available upon request.

successful than larger (i.e. more complex) ones (column 1), but these results are no longer significant once we control for country fixed effects (column 2) or add country-specific variables.[20] However, projects which are more concentrated in one sector – and therefore should be less complex to manage – are less likely to have a positive outcome than diversified ones. The dummies identifying projects that have been repeated and that have an expected rate of return are not robustly correlated with project outcomes, apart from the sub-sample of projects evaluated after 1995.

### 4.2 Additional financing and absorptive capacity

In light of the recent reliance on external borrowing to financing infrastructure spending in LIDCs, an interesting question is whether our results hold for the subset of investment accelerations that have been driven by a shift in aggregate savings, possibly due to an increase in capital inflows and/or grants. The evidence discussed so far shows that there is a negative association between individual project outcomes and public investment scaling-up, but it does not differentiate between episodes in which the increase in investment is due to a shift in aggregate savings and the ones driven by a shift in the public investment schedule. The former episodes are consistent with the hypothesis that additional financing could make absorptive capacity constraints binding, as governments will get closer to the 'skill limit' and will start to select poor projects as long as the overall project financing increases.

Thus, we isolate these episodes of investment scaling-up moving from the consideration that, in a simple savings-investment scheme, a greater supply of public savings (either due to aid, capital inflows, or domestic revenue mobilization) would result in lower real interest rates and higher investment. Thus, we look at the correlation between public investment and the real interest rate during World Bank financed investment projects. In particular, we build a measure of the change in the real interest rate for each $i$-th project undertaken in country $j$ over the period $ey - ay$ in the same way as calculated the $SCALE\ UP$ variable (see equation 2). First, we consider, for each country-year pair, the difference between the real interest rate and its country-specific average in the previous five-year period; second, we take the average of these differences over the length of the project. Finally, we split our sample between projects that have been executed during years when the real interest rate and aggregate public investment were positively correlated and the ones undertaken in periods when more public investment went hand-in-hand with lower real interest rates (*absorptive capacity constrained projects* (ACCP).

Table 3 reports the results for these two sub-samples. The estimates lend support to the hypothesis that the average effect we found in the baseline regressions is driven by the presence of absorptive capacity constraints in periods in which public investment accelerations have been associated with increasing savings (column 1). The coefficient on the $SCALE\ UP$ variable is significant only for ACCP, while it is much smaller (in absolute value) and not statistically significant for the other non absorptive capacity constrained projects. In particular, the point

[20] Interestingly, the coefficient on project size is positive and significant in column 1 when we do not control for country-level variables/fixed effects, suggesting that in this case, the size of the project would capture some country characteristic(s).

estimate is, in absolute value, larger than the one obtained on the whole sample (see Table 2, column 3), suggesting that the actual effect of absorptive capacity on project outcomes is larger that the average one estimated in the baseline regressions.[21]

### 4.3 Heterogeneity in the scaling-up of public investment

Our baseline results show that a rapid scaling-up of public investment seems to generate absorptive capacity bottlenecks, as it is associated with worse project outcomes. In this section we investigate whether this average result varies with some country-specific characteristics.

First, we interact $SCALE\ UP$ with the ratio of the stock of public capital to GDP in the year of project approval ($G/Y$) to test whether the negative correlation between scaling-up and project outcomes is stronger when the stock of public capital-to-GDP ratio is larger, under the assumption that an increase in investment is more likely to generate absorptive capacity constraints when the initial public capital stock is high. By contrast, a rapid acceleration of public investment in capital scarce countries could be less likely to generate problems, as infrastructure needs coupled with low capital stocks would imply the availability of a large number of potentially profitable investments. Results, shown in Table 4, indicate that the negative correlation between public investment scaling-up and project outcomes increases (in absolute terms) with the public capital stock-to-GDP ratio (column 2). The marginal effect of $SCALE\ UP$ on the probability of a satisfactory project evaluation is less than half (-0.0042) the average (-0.013, column 1) for countries whose public capital stock-to-GDP ratio is 50 percent (a value slightly larger than the first quartile of the sample distribution, 45 percent), but it increases (in absolute terms) to almost -0.021 for countries with a public capital stock-to-GDP ratio of 200 percent (a value close to the 90 percent of the sample distribution); for those countries, a scaling-up of public investment-to-GDP ratio of three percentage points translates into a six percentage point reduction in the likelihood that a process will be satisfactory.

Second, we allow for the possibility that the intensity of absorptive capacity constraints could change with the quality of policies and institutions and with GDP per capita. On the one hand, public investment scaling-up could be more likely to be successful in richer countries and in ones with sound policies in place, as those countries would be better equipped to manage a rapid increase in public investment. On the other hand, if the CPIA index and GDP per capita are proxies for the (unobservable) availability of high-return public investment opportunities, absorptive capacity would be less binding in countries that are poorer and have worse

[21] To further convince the reader of the validity of our findings, we exploit the fact that the World Bank PPR data set provides information not only on investment loans but also on development policy lending (DPL), including the structural adjustment loans extended in the 1980s and 1990s. These loans capture general budget support and are extended to promote countrywide macroeconomic and structural reforms so that their outcome could be less influenced by absorptive capacity constraints (however, the identification is not watertight, as a successful adjustment operation could also require significant government commitment and capacity). Thus, we run a sort of 'placebo test' replicating our baseline model on the sample of DPL projects (Table A3). Notwithstanding the small sample size (slightly more than 500 projects), we still find that some of the macroeconomic variables are significantly associated with DPL project outcomes, so that we can be confident that the model is well specified. However, we find that the coefficient on the scaling-up of public investment is close to zero and not statistically significant (but standard errors remain small), consistent with what to expect from a placebo regression.

policies and institutions. The estimated coefficient supports the second hypothesis, given that we find that the negative effect of the scaling-up on project outcomes increases (in absolute terms) with the level of the CPIA index (column 3) and GDP per capita (column 4). In particular, the coefficient on $SCALE\ UP$ is -0.015 when the CPIA index is 3.6 (the sample median), but it ranges from values close to zero (-0.005) for countries with weak policies and institutions ($CPIA = 3$) to -0.02 values for countries with good policies and institutions ($CPIA = 4$). The effect of GDP per capita is similar but slightly larger: the coefficient on $SCALE\ UP$ ranges from -0.006 for countries with an annual GDP per capita of about 400 USD (the first quartile of the sample distribution), to -0.024 for countries with a GDP per capita of almost 3000 USD (a value between the 75th and the 90th percentile of the sample distribution). Controlling jointly for the CPIA index and GDP per capita – as well as for the existing public capital stock – does not alter the main results, as all the three interaction terms remain statistically significant and the point estimates are similar to the ones reported in columns 2-4 (column 5). These results seem to suggest that absorptive capacity constraints are less likely to be binding for poorer countries, where there is a relative scarcity of public capital and policies and institutions are weaker than in other countries.

Third, to better differentiate between the 'pure' absorptive capacity hypothesis and the effect of aid bonanza and donor fragmentation we interact the $SCALE\ UP$ measure with the two aid-related variables (columns 6-7). A negative and significant interaction term would imply that absorptive capacity constraints are exacerbated for projects undertaken during periods of large aid flows or in countries that have to deal with a multitude of donors. Our results, by contrast, do not find any evidence for these effects, lending further support to the fact that our findings are solely related to investment scaling-up and not to foreign aid.

Finally, given that absorptive capacity constraints are often modeled assuming that internal adjustment costs are quadratic in the investment level (van der Ploeg, 2012), or considering a non-linear change in efficiency as investment exceeds a given threshold (Berg et al., 2013), in the last column we allow for a convex effect of the scaling-up. The inclusion of a squared term does not suggest the presence of any non-linearity. Because fitting a quadratic relationship is a simple way to test for non-linearity, in the robustness section we also experiment with measures of investment booms to capture some of the features of existing models.[22]

## 5 Robustness

We test the robustness of our findings along several dimensions. We start augmenting the model first with country fixed effects and with a set of additional project- and country-level variables. Then, we introduce several alternative definitions of public investment scaling-up. In the Appendix we also report the estimates obtained with a probit model (Tables A4-A6), which confirm the main results.

[22] Additional tests have been carried out to explore the presence of a non-linearity, including a spline specification, consistent with Berg et al. (2013), but there is no statistical support for the presence of a threshold effect.

### 5.1 Country fixed effects and additional controls

Table 5 replicates the baseline specification across the four different samples and the sample split between ACCP and other projects adding country fixed effects. In this way we exploit only the within-country variation in project outcomes, washing out all country-specific time invariant heterogeneity. Specifically, one could argue that differences in public investment efficiency may affect project outcomes, as suggested by some empirical evidence on the output effect of public investment (Abiad, Furceri and Topalova, 2015). If this were the case – and assuming that investment efficiency is time invariant[23] – country fixed effects should capture the role of efficiency and possibly wash out the significant effect of absorptive capacity. As expected, some of the country-specific variables are no longer significant once the model is augmented with country fixed effects. By contrast, the coefficient on the $SCALE\ UP$ variable in the whole sample of investment projects is similar in size to the one estimated without country fixed-effects, although it is imprecisely estimated when exclusively considering infrastructure projects and those evaluated after 1995. Moreover, the sample split between ACCP and other projects (columns 4-5) confirms the main results and lends support to the presence of absorptive capacity constraints during the scaling up of public investment. At the same time, these results suggest that absorptive capacity is not related with the *level* of investment efficiency, but it could affect *changes* in efficiency, as discussed in the introduction.

Having been assured that our findings are not driven by time-invariant country specific heterogeneity we control for the possible effect of other project-specific variables, which have been excluded from the baseline specification as they are likely to be endogenous. We consider two project evaluation characteristics: 1) the number of years that have passed between completion and evaluation ($TIME\ EVALUATION$), and 2) the specific kind of evaluation review ($TYPE\ EVALUATION$), so that we can distinguish among projects that have received the standard Implementation Completion Report (ICR) by the World Bank, the ones which received the desk review by the IEG (this evaluation replaced the ICR since 1995), and the ones for which the IEG performed a more detailed Project Performance Audit Report.[24]

The results reported in the first column on Table 6 control for the type of evaluation including two dummies and they indicate that the time lag between the end of the project and its evaluation is negatively associated with project outcomes. This result is consistent with a reverse causality interpretation, given that implementation problems are likely to cause delays in closing and evaluation.

The other four columns of Table 6 show some additional robustness tests on country-specific variables. We start by including the stock of public capita as a share of GDP. If there is a positive association between investment spending and capital accumulation, our results could capture a sort of level effect. However, we do not find that investment projects are less

[23] Pritchett, Woolcock and Andrews (2013) argue that many developing countries have made little progress in state implementation capacity, and that "short-term programmatic efforts to build administrative capability in these countries are thus unlikely to be able to demonstrate actual success." In practice, essentially all available measures of efficiency are time-invariant, see Berg et al. (2015) for a discussion.

[24] We are not able to estimate the correlation between the length of the project (measured by the number of years between the approval and the final fiscal year of the project) and project outcomes because of collinearity.

likely to be successful in countries with a large endowment of public capital, while the effect of the scaling-up is confirmed (column 2).

In column 3 we measure the aid-to-GNI ratio and the donor fragmentation variables in the starting year of the project, rather than averaging over the length of the project, to mitigate possible endogeneity concerns. We find again that larger aid flows are associated with a lower probability of success, while donor fragmentation is not significantly correlated with project outcomes. To further test this claim, in column 4 we employ an alternative measure of donor fragmentation, considering the share of total ODA provided to the recipient country by the three largest donors. Consistent with our previous results, this alternative variable does not point to any correlation between donor fragmentation and project outcomes.

Then, we replace the aid-to-GNI ratio with the ratio of International Bank for Reconstruction and Development (IBRD) credits and International Development Association (IDA) loans to GDP ($WB\ LENDING$) as a measure of the value of overall resources that the World Bank allocates the country during the length of the project. Given that we aim to explain the variability of World Bank project outcomes, one could argue that this indicator is more suitable for our purposes than a more general indicator of ODA (which does not include IBRD lending). While this measure has been taken as a possible proxy to signal the presence of limited absorptive capacity, a negative correlation between $WB\ LENDING$ and project outcomes, as indicated by the estimates reported in column 5, could also indicate limited management capacity of the World Bank (Guillaumont and Laajaj, 2006). Irrespective of the interpretation of this result, it is important to note that the coefficient on the $SCALE\ UP$ variable remains stable.

Finally, in the last column we control for dependence on natural resources by adding the value of total natural resource rents as a share of GDP, averaged over the length of the project (data from the World Development Indicators) to the set of explanatory variables. Natural resource rents are negatively associated with project success, and this effect washes out the one of the CPIA index, suggesting that dependence on natural resources could proxy for poor policies (in fact, the correlation between $RESOURCE\ RENT$ and $CPIA$ is $-0.25$).

### 5.2 Alternative definitions of the scaling-up of public investment

We recognize that the definition of public investment scaling-up used so far is arbitrary. Therefore, we test the robustness of our main result using a number of possible alternative definitions of investment scaling-up.

First, we assess the robustness of our findings to alternative definitions of the historical public investment-to-GDP ratio used to measure the intensity of the scaling-up. Hence, we calculate the $SCALE\ UP$ variable considering the difference between the actual public investment-to-GDP ratio and its average over the previous three or ten-year period and taking the average of these differences over the length of the project. Then, for each of the three proposed deviations of the public investment-to-GDP ratio from its historical average in the three, five and ten-year before project approval, we consider the value in the year of the project approval rather than averaging over the length of the project. In this way, we condition the

scaling-up to the information available before the start of the project. Third, we measure scaling-up considering public capital accumulation rather than looking at public investment data. Specifically, we consider the difference between the stock of public capital at the end of the project and in the first year of the project ($\Delta G/Y$).

Finally, to further explore the possibility of a nonlinear effect of scaling up, we also experimented by defining episodes of public investment booms as events when the public investment-to-GDP ratio is above a threshold (10 percent) and the deviation from its historical trend is above one standard deviation of the detrended investment-to-GDP series. We build two dichotomous indicators of investment booms: the first indicator is equal to one if there is at least one investment boom during the length of the project ($BOOM$, 36 percent of the projects are undertaken during a boom defined this way), while the second, more restrictive, indicator is equal to one if the year of project approval is also a starting year of an investment boom ($BOOM_{ay}$, 6 percent of the projects are undertaken during a boom defined in this way).

Results are presented in Table 7, where we report the coefficients on the alternative scaling-up variables and on other country-specific controls. The estimates consistently support the hypothesis that a sustained scaling-up of investment, compared to its historical average, is negatively correlated with the likelihood of a project being satisfactory. A similar effect is obtained when considering public capital accumulation over the length of the project ($\Delta G/Y$, column 6). By contrast, the coefficients on investment booms are not significant (columns 7-8). Read together, these additional findings would suggest that what matters more for absorptive capacity is the acceleration of investment with respect to previous years, rather than being above a specific common threshold, in line with the lack of any significant results when fitting a quadratic relationship (Table 4, column 8). In other words, thresholds above which public investment could generate absorptive capacity constraints are likely to be country specific.

The coefficients on other macroeconomic variables are mainly unchanged, and GDP growth and CPIA are positively correlated with the likelihood of success, while large aid flows are associated with a lower probability of project success.

## 6 Conclusions

Recent developments in modeling the output effects of scaling-up public investment have pointed out the critical role of investment efficiency and absorptive capacity constraints (van der Ploeg, 2012; van der Ploeg and Venables, 2013; Berg et al., 2013; Richmond, Yackovlev and Yang, 2015). This paper deals exclusively with the latter issue (see instead Berg et al. (2015) for a discussion about efficiency in developing countries) and provides new empirical evidence on the actual importance of absorptive capacity constraints in developing countries. Our results indicate that investment and infrastructure projects are less likely to be successful when they are undertaken during periods of higher than average public investment. We are also able to differentiate this effect from the effects due to foreign aid bonanza and donor fragmentation.

On the one hand, these findings are consistent with the presence of supply bottlenecks and

poor project selection and with the importance of sound policies and institutions for the selection and management of public investment projects. On the other hand, we confirm that a large part of the variability across project outcomes is due to project-level observable and non-observable characteristics rather than to macroeconomic effects, and the estimated magnitude of the effect of absorptive capacity on project outcomes is relatively small, especially in poor and capital scarce countries. With respect to the latter point, it is worth mentioning that our results could be a lower bound of absorptive capacity constraints. In fact, it is possible to argue that World Bank financing may pressure governments to prioritize the management of the selected projects, reducing the apparent impact of absorptive capacity constraints. In addition, given that money is fungible, if World Bank financing expands the government's budget constraint but the World Bank itself selects projects with high rates of return, the marginal projects financed by the government could be more affected by absorptive capacity constraints than the ones financed by the World Bank. However, one can also argue that our results overestimate absorptive capacity: if project selection by the World Bank lacks "borrower ownership," the government might be less engaged in World Bank projects than in other public investment projects, leading to a lower success rate (Johnson and Wasty, 1993).

Because our results are based on a sample of investment projects financed by one donor one may question their validity in a broader context. There are at least two arguments to support the view that results could have implication beyond World Bank financed projects. First, the World Bank is one of the largest donors, and its model for selecting, financing and assessing projects is the most common one across aid agencies (Denizer, Kaufmann and Kraay, 2013). Second, Bulman, Kolkma and Kraay (2015) show that the relationship between project- and country-specific variables and the outcome of projects financed by the World Bank and the Asian Development Bank are similar, suggesting that the main findings are not due to idiosyncratic factors of the two institutions, but are generalizable to aid projects.

With these *caveats* in mind, we believe that these results can provide some useful insights for policies in a period of public investment ramping up in LIDCs. While our findings do not imply that public spending in infrastructure needs to be curtailed, they speak to the importance of carefully assessing the design of public investment plans (i.e. how much spending is front loaded). This is an extremely relevant issue for many LIDCs experiencing windfall revenues due to commodity prices and, at the same time, have pressing needs to scale up infrastructure spending. In the presence of absorptive capacity constraints, scaling-up investment too much and too fast can reduce the success rate of individual projects, limiting the aggregate output effect of public investment; in this case, a gradual scaling-up is preferable.

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Table 1: Variable definition, sources and descriptive statistics

| Variable | Definition | Source | Mean | St. Dev. | Min | Max | Obs. |
|---|---|---|---|---|---|---|---|
| **Project-level variables** | | | | | | | |
| *OUTCOME* | Dummy equal to one if the project $i$ undertaken in country $j$ in year $t$ is evaluated as satisfactory and zero otherwise. See Section 2.1 for details. | IEG WB PPR | 0.707 | 0.455 | 0 | 1 | 3,945 |
| *SIZE* | Logarithm of the cost of the project, in constant USD. | IEG WB PPR | 17.674 | 1.367 | 13.816 | 22.547 | 3,945 |
| *SHARE WB FINANCING* | Share of World Bank financing in the total project cost. | IEG WB PPR | 0.795 | 0.279 | 0 | 1 | 3,945 |
| *SHARE* $1^{st}$ *SECTOR* | Share of the largest share of the project assigned to a single sector. | IEG WB PPR | 82.595 | 23.995 | 10 | 100 | 3,945 |
| *ERR* (0/1) | Dummy equal to one if teh project has received the expected rate of return at appraisal, and zero otherwise. | IEG WB PPR | 0.441 | 0.497 | 0 | 1 | 3,945 |
| *REPEATER* | Dummy equal to one for projects ones which are follow-ups of previous projects. We code projects as follow-up as they include in the name string roman numerals. | IEG WB PPR | 0.187 | 0.390 | 0 | 1 | 3,945 |
| *TIME EVALUATION* | Number of years between the evaluation and the end fiscal years of the project. | IEG WB PPR | 1.771 | 1.851 | 0 | 20 | 3,910 |
| *INFRASRUCTURE* (0/1) | Dummy equal to one if the project is undertaken, for the largest part, either in the agriculture, energy and mining, industry and trade, transportation, or water sectors, and zero otherwise. | IEG WB PPR | 0.620 | 0.485 | 0 | 1 | 3,945 |
| *SECTOR* | Categorical variable for the following 10 sectors: agriculture, energy and mining, industry and trade, transportation, water, education, finance, health and other social services, information and communication, and public administration. Each project is asigned one sector on the basis of the largest sectoral share. | IEG WB PPR | . | . | . | . | 3,945 |
| *LENDING INSTRUMENT* | Categorical variable for 11 lending instruments. | IEG WB PPR | . | . | . | . | 3,945 |
| *TYPE EVALUATION* | Categorical variable for the three type of project evaluations: the standard Implementation Completion Report (ICR) by the World Bank, the desk review by the IEG, and the more detailed Project Performance Audit Report (PPAR). | IEG WB PPR | . | . | . | . | 3,945 |
| **Country-level variables** | | | | | | | |
| *SCALE UP* | Difference between the actual public investment-to-GDP ratio and the average over the previous 5-year period, averaged over the length of the project. See Section 3.1 and eqaution 2 for details. | Author's calculation on Gupta et al. (2014) data | -0.418 | 1.623 | -14.127 | 8.751 | 3,945 |
| $SCALE\ UP^{3}$ | Difference between the actual public investment-to-GDP ratio and the average over the previous 3-year period, averaged over the length of the project. | Author's calculation on Gupta et al. (2014) data | -0.300 | 1.179 | -10.882 | 6.498 | 3,945 |
| $SCALE\ UP^{10}$ | Difference between the actual public investment-to-GDP ratio and the average over the previous 10-year period, averaged over the length of the project. | Author's calculation on Gupta et al. (2014) data | -0.595 | 2.400 | -18.473 | 16.508 | 3,945 |
| $SCALE\ UP^{3}_{ay}$ | Difference between the actual public investment-to-GDP ratio and the average over the previous 3-year period, in the year of project approval. | Author's calculation on Gupta et al. (2014) data | -0.217 | 2.560 | -15.894 | 19.628 | 3,600 |
| $SCALE\ UP^{5}_{ay}$ | Difference between the actual public investment-to-GDP ratio and the average over the previous 5-year period, in the year of project approval. | Author's calculation on Gupta et al. (2014) data | -0.265 | 2.906 | -15.619 | 19.141 | 3,600 |
| $SCALE\ UP^{10}_{ay}$ | Difference between the actual public investment-to-GDP ratio and the average over the previous 10-year period, in the year of project approval. | Author's calculation on Gupta et al. (2014) data | -0.323 | 3.564 | -25.567 | 23.751 | 3,600 |

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| Variable | Definition | Source | Mean | St. Dev. | Min | Max | Obs. |
|---|---|---|---|---|---|---|---|
| **Country-level variables** | | | | | | | |
| *BOOM* | Dummy equal to one if there is at least an investment boom (booms are defined as events when the public investment-to-GDP ratio is above a threshold (10%) and the deviation from its historical trend is above one standard deviation of the detrended investment-to-GDP series) during the length of the project. | Author's calculation on Gupta et al. (2014) data | 0.356 | 0.479 | 0 | 1 | 3,945 |
| $BOOM_{ay}$ | Dummy equal to one if the starting year of the project is also an investment boom year (booms are defined as events when the public investment-to-GDP ratio is above a threshold (10%) and the deviation from its historical trend is above one standard deviation of the detrended investment-to-GDP series). | Author's calculation on Gupta et al. (2014) data | 0.057 | 0.231 | 0 | 1 | 3,945 |
| *GROWTH* | Real GDP per capita growth (annual %), averaged over the length of the project. | WDI | 2.464 | 4.548 | -47.314 | 20.722 | 3,945 |
| *CPIA* | Country Policy and Institutional Assessment ratings, averaged over the length of the project. | World Bank | 3.653 | 0.677 | 1 | 6 | 3,945 |
| *GDP* | Logarithm of GDP per capita (in constant 2000 USD), averaged over the length of the project. | WDI | 6.909 | 1.048 | 4.963 | 9.719 | 3,945 |
| *HC* | Average years of schooling. See Feenstra, Inklaar and Timmer (2013) for additional details. The measure is averaged over the length of the project. | PWT 8.0 | 1.966 | 0.466 | 1.088 | 3.146 | 3,945 |
| *AID* | Total net official development assistance (% GNI), averaged over the length of the project. | WDI | 5.431 | 7.186 | -0.072 | 50.512 | 3,945 |
| $AID_{ay}$ | Total net official development assistance (% GNI), in the starting year of the project. | WDI | 5.789 | 8.310 | -0.475 | 94.946 | 3,923 |
| *FRAGMENTATION* | 1− Herfindahl index calculated on the share of gross disbursements of total ODA by individual donors, averaged over the length of the project. | OECD DAC (Table 2a) | 0.803 | 0.097 | 0.243 | 0.931 | 3,945 |
| $FRAGMENTATION_{ay}$ | 1− Herfindahl index calculated on the share of gross disbursements of total ODA by individual donors, in the starting year of the project. | OECD DAC (Table 2a) | 0.806 | 0.105 | 0.191 | 0.941 | 3,931 |
| *SHARE TOP3 DONORS* | Share of gross disbursements of total ODA by the top 3 individual donors, averaged over the length of the project. | OECD DAC (Table 2a) | 61.275 | 11.974 | 32.447 | 94.367 | 3,945 |
| $G/Y$ | Public capital stock over GDP, in the year of project approval. | Gupta et al. (2014) | 0.852 | 0.647 | 0.088 | 5.942 | 3,945 |
| $\Delta G/Y$ | Change in the public capital stock-to-GDP ratio over the length of the project. | Author's calculation on Gupta et al. (2014) data | 0.031 | 0.241 | -0.547 | 2.581 | 3,382 |
| *WB LENDING* | IBRD loans and IDA credits over GDP, averaged over the length of the project. | WDI | 0.106 | 0.119 | 0.000 | 0.923 | 3,830 |
| *RESOURCE RENT* | Value of total natural resources rents over GDP, averaged over the length of the project. | WDI | 7.307 | 7.272 | 0.003 | 66.713 | 3,923 |

*Notes*: IEG WB PPR: IEG World Bank Project Performance Ratings; WDI: World Development Indicators; and PWT 8.0: Penn World Tables, version 8.0.

Table 2: Baseline results

| Dep. Var.: *OUTCOME* | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Whole sample | | | Infra proj | post-1995 |
| Country-level variables | | | | | |
| *SCALE UP* | | | -0.013** | -0.013* | -0.014* |
| | | | (0.005) | (0.007) | (0.007) |
| *GROWTH* | | | 0.006*** | 0.006** | 0.009*** |
| | | | (0.002) | (0.002) | (0.002) |
| *CPIA* | | | 0.027* | 0.011 | 0.031* |
| | | | (0.015) | (0.019) | (0.018) |
| *GDP* | | | -0.002 | -0.005 | 0.044*** |
| | | | (0.013) | (0.016) | (0.014) |
| *HC* | | | 0.018 | 0.002 | -0.003 |
| | | | (0.027) | (0.034) | (0.029) |
| *AID* | | | -0.004*** | -0.008*** | -0.001 |
| | | | (0.002) | (0.002) | (0.002) |
| *FRAGMENTATION* | | | -0.033 | -0.109 | -0.069 |
| | | | (0.094) | (0.120) | (0.109) |
| Project-level variables | | | | | |
| *SIZE* | 0.018** | -0.013 | 0.000 | -0.017 | -0.000 |
| | (0.008) | (0.010) | (0.009) | (0.011) | (0.010) |
| *SHARE WB FINANCING* | 0.007 | 0.004 | 0.023 | 0.047 | 0.045 |
| | (0.038) | (0.039) | (0.039) | (0.050) | (0.039) |
| *SHARE* $1^{st}$ *SECTOR* | -0.001 | -0.001** | -0.001** | 0.000 | -0.001** |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) |
| *ERR* (0/1) | 0.007 | 0.006 | 0.006 | 0.003 | 0.060** |
| | (0.022) | (0.022) | (0.022) | (0.024) | (0.027) |
| *REPEATER* | 0.029 | 0.026 | 0.028 | 0.031 | 0.048* |
| | (0.021) | (0.020) | (0.021) | (0.025) | (0.028) |
| Observations | 3,945 | 3,945 | 3,945 | 2,447 | 2,737 |
| $R^2$ | 0.183 | 0.252 | 0.197 | 0.183 | 0.205 |
| Country FE | NO | YES | NO | NO | NO |
| Lending instrument FE | YES | YES | YES | YES | YES |
| Approval year × sector FE | YES | YES | YES | YES | YES |
| Evaluation year × sector FE | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. Infra: infrastructure. LICs: low-income countries. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: Additional test: absorptive capacity constrained (ACC) projects

| Dep. Var.: *OUTCOME* | (1)<br>ACC projects | (2)<br>Non-ACC projects |
|---|---|---|
| Country-level variables | | |
| *SCALE UP* | -0.015* | -0.001 |
| | (0.008) | (0.011) |
| *GROWTH* | 0.003 | 0.009** |
| | (0.003) | (0.004) |
| *CPIA* | 0.020 | 0.010 |
| | (0.025) | (0.026) |
| *GDP* | -0.005 | -0.002 |
| | (0.021) | (0.023) |
| *HC* | 0.007 | 0.078 |
| | (0.041) | (0.050) |
| *AID* | -0.006** | -0.002 |
| | (0.003) | (0.003) |
| *FRAGMENTATION* | -0.074 | -0.202 |
| | (0.159) | (0.159) |
| Project-level variables | | |
| *SIZE* | 0.018 | -0.016 |
| | (0.015) | (0.017) |
| *SHARE WB FINANCING* | 0.006 | -0.003 |
| | (0.065) | (0.076) |
| *SHARE* $1^{st}$ *SECTOR* | 0.000 | -0.002** |
| | (0.001) | (0.001) |
| *ERR* $(0/1)$ | 0.021 | 0.043 |
| | (0.038) | (0.044) |
| *REPEATER* | 0.022 | 0.078* |
| | (0.035) | (0.040) |
| Observations | 1,697 | 1,409 |
| $R^2$ | 0.306 | 0.405 |
| Country FE | NO | NO |
| Lending instrument FE | YES | YES |
| Approval year × sector FE | YES | YES |
| Evaluation year × sector FE | YES | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. ACC: absorptive capacity constrained. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Heterogeneities

| Dep. Var.: *OUTCOME* | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Country-level variables | | | | | | | | |
| *SCALE UP* | -0.013** | 0.001 | 0.043 | 0.048 | 0.121*** | -0.020** | -0.049 | -0.012** |
| | (0.005) | (0.009) | (0.027) | (0.035) | (0.042) | (0.008) | (0.041) | (0.006) |
| *SCALE UP* × *G/Y* | | -0.011* | | | -0.013** | | | |
| | | (0.006) | | | (0.006) | | | |
| *G/Y* | | -0.010 | | | -0.018 | | | |
| | | (0.014) | | | (0.016) | | | |
| *SCALE UP* × *CPIA* | | | -0.016** | | -0.017** | | | |
| | | | (0.007) | | (0.007) | | | |
| *SCALE UP* × *GDP* | | | | -0.009* | -0.008* | | | |
| | | | | (0.005) | (0.005) | | | |
| *SCALE UP* × *AID* | | | | | | 0.001 | | |
| | | | | | | (0.001) | | |
| *SCALE UP* × *FRAGMENTATION* | | | | | | | 0.045 | |
| | | | | | | | (0.051) | |
| $SCALE\ UP^2$ | | | | | | | | 0.000 |
| | | | | | | | | (0.001) |
| *GROWTH* | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.006*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| *CPIA* | 0.027* | 0.027* | 0.018 | 0.029* | 0.018 | 0.027* | 0.029* | 0.027* |
| | (0.015) | (0.015) | (0.016) | (0.015) | (0.016) | (0.015) | (0.015) | (0.015) |
| *GDP* | -0.002 | -0.002 | 0.001 | -0.005 | -0.002 | -0.001 | -0.002 | -0.002 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) |
| *HC* | 0.018 | 0.021 | 0.016 | 0.019 | 0.023 | 0.017 | 0.018 | 0.017 |
| | (0.027) | (0.028) | (0.027) | (0.027) | (0.028) | (0.027) | (0.027) | (0.027) |
| *AID* | -0.004*** | -0.004*** | -0.004** | -0.004*** | -0.004** | -0.004** | -0.004*** | -0.005*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| *FRAGMENTATION* | -0.033 | -0.034 | -0.046 | -0.028 | -0.046 | -0.022 | -0.005 | -0.031 |
| | (0.094) | (0.094) | (0.095) | (0.094) | (0.094) | (0.095) | (0.102) | (0.094) |
| Project-level variables | | | | | | | | |
| *SIZE* | 0.000 | 0.001 | -0.000 | 0.000 | 0.000 | -0.000 | -0.000 | 0.000 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| *SHARE WB FINANCING* | 0.023 | 0.021 | 0.023 | 0.020 | 0.019 | 0.023 | 0.023 | 0.023 |
| | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) |
| *SHARE* $1^{st}$ *SECTOR* | -0.001** | -0.001** | -0.001** | -0.001** | -0.001** | -0.001** | -0.001** | -0.001** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *ERR* (0/1) | 0.006 | 0.006 | 0.005 | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 |
| | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) |
| *REPEATER* | 0.028 | 0.029 | 0.028 | 0.029 | 0.030 | 0.028 | 0.029 | 0.028 |
| | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) |
| Observations | 3,945 | 3,945 | 3,945 | 3,945 | 3,945 | 3,945 | 3,945 | 3,945 |
| $R^2$ | 0.197 | 0.198 | 0.198 | 0.198 | 0.200 | 0.197 | 0.197 | 0.197 |
| Country FE | NO | NO | NO | NO | NO | NO | NO | NO |
| Lending instrument FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Approval year × sector FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Evaluation year × sector FE | YES | YES | YES | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: Adding country fixed effects

| Dep. Var.: *OUTCOME* | (1) All proj | (2) Infra proj | (3) post-1995 | (4) ACC proj | (5) Non-ACC projects |
|---|---|---|---|---|---|
| Country-level variables | | | | | |
| *SCALE UP* | -0.012* | -0.010 | -0.007 | -0.019* | 0.008 |
| | (0.007) | (0.008) | (0.010) | (0.011) | (0.014) |
| *GROWTH* | 0.002 | 0.002 | 0.002 | 0.002 | 0.003 |
| | (0.002) | (0.003) | (0.003) | (0.004) | (0.004) |
| *CPIA* | -0.013 | -0.047** | -0.008 | -0.026 | -0.016 |
| | (0.018) | (0.022) | (0.022) | (0.030) | (0.033) |
| *GDP* | -0.118** | -0.211*** | 0.013 | -0.219* | -0.089 |
| | (0.054) | (0.064) | (0.073) | (0.114) | (0.091) |
| *HC* | 0.399*** | 0.566*** | -0.437** | 0.003 | 0.219 |
| | (0.145) | (0.185) | (0.220) | (0.292) | (0.326) |
| *AID* | -0.001 | -0.001 | 0.000 | -0.010 | 0.005 |
| | (0.003) | (0.005) | (0.005) | (0.006) | (0.006) |
| *FRAGMENTATION* | 0.074 | -0.185 | 0.096 | 0.688** | -0.796** |
| | (0.164) | (0.237) | (0.227) | (0.328) | (0.326) |
| Project-level variables | | | | | |
| *SIZE* | -0.011 | -0.022* | -0.014 | 0.017 | -0.028 |
| | (0.010) | (0.012) | (0.011) | (0.017) | (0.021) |
| *SHARE WB FINANCING* | 0.011 | 0.060 | 0.028 | -0.036 | 0.012 |
| | (0.039) | (0.053) | (0.040) | (0.065) | (0.082) |
| *SHARE* $1^{st}$ *SECTOR* | -0.001** | 0.000 | -0.001** | 0.000 | -0.002** |
| | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) |
| *ERR* (0/1) | 0.004 | 0.006 | 0.049* | 0.002 | 0.057 |
| | (0.022) | (0.025) | (0.028) | (0.040) | (0.044) |
| *REPEATER* | 0.027 | 0.034 | 0.041 | 0.031 | 0.072* |
| | (0.020) | (0.025) | (0.028) | (0.035) | (0.039) |
| Observations | 3,945 | 2,446 | 2,736 | 1,693 | 1,407 |
| $R^2$ | 0.256 | 0.252 | 0.266 | 0.402 | 0.487 |
| Country FE | YES | YES | YES | YES | YES |
| Lending instrument FE | YES | YES | YES | YES | YES |
| Approval year × sector FE | YES | YES | YES | YES | YES |
| Evaluation year × sector FE | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. Infra: infrastructure; DPL: development policy lending; ACC: absorptive capacity constrained. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Adding project- and country-level controls

| Dep. Var.: *OUTCOME* | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Country-level variables | | | | | | |
| *SCALE UP* | -0.013** | -0.014** | -0.012** | -0.013** | -0.012** | -0.011** |
| | (0.005) | (0.006) | (0.005) | (0.006) | (0.005) | (0.005) |
| *GROWTH* | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.005** | 0.006*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| *CPIA* | 0.030* | 0.027* | 0.027* | 0.027* | 0.032** | 0.021 |
| | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) | (0.015) |
| *GDP* | -0.001 | -0.002 | -0.001 | -0.002 | -0.023* | 0.004 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) |
| *HC* | 0.015 | 0.020 | 0.027 | 0.018 | 0.010 | 0.001 |
| | (0.027) | (0.028) | (0.027) | (0.027) | (0.027) | (0.027) |
| *AID* | -0.004*** | -0.004** | | -0.004** | | -0.003** |
| | (0.002) | (0.002) | | (0.002) | | (0.002) |
| *FRAGMENTATION* | -0.022 | -0.034 | | | -0.025 | -0.110 |
| | (0.095) | (0.094) | | | (0.097) | (0.095) |
| *G/Y* | | -0.006 | | | | |
| | | (0.015) | | | | |
| $AID_{ay}$ | | | -0.003** | | | |
| | | | (0.001) | | | |
| $AID\ FRAGMENTATION_{ay}$ | | | -0.046 | | | |
| | | | (0.083) | | | |
| *SHARE TOP3 DONORS* | | | | 0.000 | | |
| | | | | (0.001) | | |
| *WB LENDING* | | | | | -0.540*** | |
| | | | | | (0.102) | |
| *RESOURCE RENT* | | | | | | -0.005*** |
| | | | | | | (0.001) |
| Project-level variables | | | | | | |
| *SIZE* | -0.001 | 0.000 | 0.003 | -0.000 | -0.002 | -0.001 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| *SHARE WB FINANCING* | 0.017 | 0.023 | 0.022 | 0.022 | 0.027 | 0.028 |
| | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) | (0.039) |
| *SHARE* $1^{st}$ *SECTOR* | -0.001** | -0.001** | -0.001** | -0.001** | -0.001** | -0.001** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *ERR* (0/1) | 0.006 | 0.006 | 0.001 | 0.006 | -0.001 | 0.010 |
| | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) |
| *REPEATER* | 0.026 | 0.028 | 0.028 | 0.028 | 0.034 | 0.022 |
| | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) | (0.021) |
| *TIME EVALUATION* | -0.016** | | | | | |
| | (0.008) | | | | | |
| Observations | 3,904 | 3,945 | 3,923 | 3,945 | 3,851 | 3,923 |
| $R^2$ | 0.197 | 0.197 | 0.199 | 0.197 | 0.207 | 0.203 |
| Country FE | NO | NO | NO | NO | NO | NO |
| Lending instrument FE | YES | NO | NO | NO | NO | NO |
| Type evaluation FE | YES | YES | YES | YES | YES | YES |
| Approval year × sector FE | YES | YES | YES | YES | YES | YES |
| Evaluation year × sector FE | YES | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7: Robustness: alternative definitions of public investment scaling-up

| Dep. Var.: *OUTCOME* | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Country-level variables | | | | | | | | |
| $SCALE\,UP^{3}$ | -0.015** | | | | | | | |
| | (0.007) | | | | | | | |
| $SCALE\,UP^{10}$ | | -0.007** | | | | | | |
| | | (0.004) | | | | | | |
| $SCALE\,UP^{3}_{ay}$ | | | -0.009** | | | | | |
| | | | (0.003) | | | | | |
| $SCALE\,UP^{5}_{ay}$ | | | | -0.007** | | | | |
| | | | | (0.003) | | | | |
| $SCALE\,UP^{10}_{ay}$ | | | | | -0.003 | | | |
| | | | | | (0.003) | | | |
| $\Delta G/Y$ | | | | | | -0.098** | | |
| | | | | | | (0.042) | | |
| $BOOM$ | | | | | | | -0.002 | |
| | | | | | | | (0.019) | |
| $BOOM_{ay}$ | | | | | | | | 0.020 |
| | | | | | | | | (0.033) |
| $GROWTH$ | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.006*** | 0.004** | 0.006*** | 0.006*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| $CPIA$ | 0.028* | 0.027* | 0.029* | 0.029* | 0.029* | 0.035** | 0.030** | 0.029** |
| | (0.015) | (0.015) | (0.016) | (0.016) | (0.016) | (0.015) | (0.015) | (0.015) |
| $GDP$ | -0.002 | -0.003 | 0.009 | 0.008 | 0.007 | -0.006 | -0.004 | -0.004 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.014) | (0.013) | (0.013) |
| $HC$ | 0.019 | 0.018 | -0.001 | -0.002 | -0.001 | 0.018 | 0.021 | 0.022 |
| | (0.027) | (0.027) | (0.028) | (0.028) | (0.029) | (0.030) | (0.027) | (0.027) |
| $AID$ | -0.004*** | -0.004*** | -0.004** | -0.004** | -0.004** | -0.006*** | -0.004** | -0.004** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| $FRAGMENTATION$ | -0.039 | -0.043 | -0.136 | -0.139 | -0.150 | -0.052 | -0.068 | -0.065 |
| | (0.094) | (0.094) | (0.095) | (0.095) | (0.095) | (0.096) | (0.093) | (0.092) |
| Observations | 3,939 | 3,939 | 3,584 | 3,584 | 3,584 | 3,354 | 3,939 | 3,939 |
| $R^2$ | 0.196 | 0.196 | 0.216 | 0.216 | 0.215 | 0.203 | 0.195 | 0.195 |
| Country FE | NO | NO | NO | NO | NO | NO | NO | NO |
| Lending instrument FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Approval year × sector FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Evaluation year × sector FE | YES | YES | YES | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. The group of project-level variables included in Table 2 and a constant are included. * significant at 10%; ** significant at 5%; *** significant at 1%.

# Appendix - intended for online publication only

## A-I Sample

Table A1: Number of investment projects by country

| Country | # projects | Country | # projects |
|---|---|---|---|
| Albania | 47 | Malawi | 63 |
| Argentina | 79 | Malaysia | 53 |
| Armenia | 31 | Maldives | 2 |
| Bangladesh | 125 | Mali | 50 |
| Barbados | 9 | Mauritania | 38 |
| Belize | 8 | Mauritius | 24 |
| Benin | 49 | Mexico | 129 |
| Bolivia | 60 | Moldova | 18 |
| Botswana | 15 | Mongolia | 16 |
| Brazil | 216 | Morocco | 69 |
| Burundi | 40 | Mozambique | 42 |
| Cambodia | 21 | Nepal | 62 |
| Cameroon | 49 | Niger | 38 |
| Central African Republic | 19 | Pakistan | 129 |
| Chile | 38 | Panama | 27 |
| China | 227 | Paraguay | 11 |
| Colombia | 99 | Peru | 56 |
| Congo, Rep. | 16 | Philippines | 86 |
| Costa Rica | 8 | Rwanda | 49 |
| Croatia | 24 | Senegal | 67 |
| Cyprus | 8 | Sierra Leone | 22 |
| Dominican Republic | 28 | South Africa | 5 |
| Ecuador | 52 | Sri Lanka | 78 |
| Egypt, Arab Rep. | 81 | Sudan | 19 |
| El Salvador | 17 | Swaziland | 2 |
| Fiji | 8 | Syrian Arab Republic | 6 |
| Gabon | 7 | Tajikistan | 15 |
| Gambia, The | 22 | Tanzania | 43 |
| Ghana | 84 | Thailand | 80 |
| Guatemala | 25 | Togo | 29 |
| Honduras | 47 | Trinidad and Tobago | 7 |
| India | 304 | Tunisia | 85 |
| Indonesia | 85 | Turkey | 97 |
| Iran, Islamic Rep. | 12 | Uganda | 58 |
| Jordan | 49 | Ukraine | 11 |
| Kazakhstan | 16 | Uruguay | 29 |
| Kenya | 88 | Venezuela, RB | 20 |
| Lao PDR | 21 | Vietnam | 39 |
| Lesotho | 32 | Yemen, Rep. | 36 |
| Liberia | 20 | Zambia | 49 |

*Notes*: The sample consists of 3,945 investment projects, excluding development policy lending and adjustment loans, used in the empirical analysis.

Table A2: Distribution of investment projects across sectors

| | Regression sample | | Full sample | |
|---|---|---|---|---|
| Sector | # projects | share | # projects | share |
| Agriculture | 819 | 20.76 | 1,517 | 22.47 |
| Education | 379 | 9.61 | 662 | 9.81 |
| Energy and mining | 474 | 12.02 | 781 | 11.57 |
| Finance | 205 | 5.2 | 388 | 5.75 |
| Health and other social services | 353 | 8.95 | 551 | 8.16 |
| Industry and trade | 232 | 5.88 | 387 | 5.73 |
| Information and communications | 56 | 1.42 | 134 | 1.99 |
| Public Administration | 505 | 12.8 | 752 | 11.14 |
| Transportation | 603 | 15.29 | 1,071 | 15.87 |
| Water | 319 | 8.09 | 507 | 7.51 |
| Total | 3,945 | 100 | 6,750 | 100 |

*Notes*: The regression sample consists of 3,945 investment projects (excluding development policy lending and adjustment loans), while the full sample consists of 6,750 investment projects. The difference in sample size is due to the merging with macroeconomic variables to run the empirical analysis.

# A-II Additional robustness exercises

Table A3: Additional test: placebo regression

| Dep. Var.: *OUTCOME* | DPLs |
|---|---|
| *SCALE UP* | -0.010 |
| | (0.013) |
| *GROWTH* | 0.010 |
| | (0.006) |
| *CPIA* | 0.055 |
| | (0.057) |
| *GDP* | 0.094*** |
| | (0.035) |
| *HC* | -0.081 |
| | (0.072) |
| *AID* | 0.005 |
| | (0.004) |
| *FRAGMENTATION* | 0.168 |
| | (0.236) |
| *SIZE* | -0.020 |
| | (0.025) |
| *SHARE* $1^{st}$ *SECTOR* | -0.001 |
| | (0.001) |
| *REPEATER* | -0.023 |
| | (0.056) |
| Observations | 488 |
| $R^2$ | 0.393 |
| Country FE | NO |
| Lending instruments FE | YES |
| Approval year $\times$ sector FE | YES |
| Evaluation year $\times$ sector FE | YES |

*Notes*: The table reports the regression coefficients of a linear probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. The sample includes only development policy loans (DPLs). Compared to the baseline model (Table 2, column 3), we do not include the variables *ERR* (which is not meaningful in the sample of DPLs) and *SHARE WB FINANCING* (which shows very little variation – it is 1 for about 90 percent of DPLs). The associated standard errors, clustered at the country year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A4: Baseline model: Probit estimates

| Dep. Var.: *OUTCOME* | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Whole sample | | | Infra proj | post-1995 |
| Country-level variables | | | | | |
| *SCALE UP* | | | -0.047*** | -0.047** | -0.054** |
| | | | (0.017) | (0.021) | (0.024) |
| *GROWTH* | | | 0.022*** | 0.022*** | 0.033*** |
| | | | (0.006) | (0.008) | (0.008) |
| *CPIA* | | | 0.094** | 0.037 | 0.112** |
| | | | (0.044) | (0.051) | (0.056) |
| *GDP* | | | -0.014 | -0.023 | 0.159*** |
| | | | (0.035) | (0.043) | (0.045) |
| *HC* | | | 0.076 | 0.015 | 0.018 |
| | | | (0.080) | (0.103) | (0.092) |
| *AID* | | | -0.013*** | -0.024*** | -0.002 |
| | | | (0.005) | (0.007) | (0.006) |
| *FRAGMENTATION* | | | -0.234 | -0.534 | -0.341 |
| | | | (0.314) | (0.403) | (0.389) |
| Project-level variables | | | | | |
| *SIZE* | 0.066*** | -0.042 | 0.012 | -0.059* | 0.007 |
| | (0.024) | (0.033) | (0.028) | (0.036) | (0.032) |
| *SHARE WB FINANCING* | 0.025 | -0.002 | 0.069 | 0.105 | 0.142 |
| | (0.129) | (0.142) | (0.132) | (0.185) | (0.136) |
| *SHARE* $1^{st}$ *SECTOR* | -0.002 | -0.004*** | -0.003** | 0.001 | -0.003** |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) |
| *ERR* (0/1) | 0.014 | 0.011 | 0.008 | 0.004 | 0.208** |
| | (0.068) | (0.073) | (0.069) | (0.080) | (0.086) |
| *REPEATER* | 0.128* | 0.119 | 0.132* | 0.114 | 0.212** |
| | (0.069) | (0.073) | (0.069) | (0.081) | (0.100) |
| Observations | 3,639 | 3,620 | 3,620 | 2,320 | 2,527 |
| Country FE | NO | YES | NO | NO | NO |
| Lending instrument FE | YES | YES | YES | YES | YES |
| Approval year × sector FE | NO | NO | NO | NO | NO |
| Evaluation year × sector FE | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. Infra: infrastructure. LICs: low-income countries. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A5: Absorptive capacity constrained (ACC) projects: Probit estimates

| Dep. Var.: *OUTCOME* | (1)<br>ACC projects | (2)<br>Non-ACC projects |
|---|---|---|
| Country-level variables | | |
| *SCALE UP* | -0.069** | 0.011 |
| | (0.031) | (0.041) |
| *GROWTH* | 0.018 | 0.043*** |
| | (0.011) | (0.016) |
| *CPIA* | 0.107 | 0.086 |
| | (0.083) | (0.110) |
| *GDP* | -0.025 | -0.111 |
| | (0.071) | (0.094) |
| *HC* | 0.018 | 0.641*** |
| | (0.147) | (0.201) |
| *AID* | -0.020** | -0.008 |
| | (0.010) | (0.011) |
| *FRAGMENTATION* | -0.292 | -1.118* |
| | (0.577) | (0.676) |
| Project-level variables | | |
| *SIZE* | 0.083 | -0.124* |
| | (0.051) | (0.067) |
| *SHARE WB FINANCING* | -0.021 | -0.049 |
| | (0.246) | (0.317) |
| *SHARE* $1^{st}$ *SECTOR* | 0.001 | -0.009*** |
| | (0.002) | (0.003) |
| *ERR* $(0/1)$ | 0.079 | 0.175 |
| | (0.131) | (0.159) |
| *REPEATER* | 0.213 | 0.446*** |
| | (0.135) | (0.156) |
| Observations | 1,312 | 947 |
| Country FE | NO | NO |
| Lending instrument FE | YES | YES |
| Approval year $\times$ sector FE | YES | YES |
| Evaluation year $\times$ sector FE | YES | YES |

*Notes*: The table reports the regression coefficients of a probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. ACC: absorptive capacity constrained. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A6: Heterogeneities: Probit estimates

| Dep. Var.: *OUTCOME* | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Country-level variables | | | | | | | | |
| *SCALE UP* | -0.047*** | 0.014 | 0.186** | 0.220* | 0.525*** | -0.078*** | -0.246* | -0.042** |
| | (0.017) | (0.031) | (0.085) | (0.118) | (0.146) | (0.026) | (0.146) | (0.019) |
| *SCALE UP* × *G/Y* | | -0.048** | | | -0.059*** | | | |
| | | (0.020) | | | (0.020) | | | |
| *G/Y* | | -0.033 | | | -0.057 | | | |
| | | (0.046) | | | (0.050) | | | |
| *SCALE UP* × *CPIA* | | | -0.066*** | | -0.070*** | | | |
| | | | (0.024) | | (0.024) | | | |
| *SCALE UP* × *GDP* | | | | -0.040** | -0.038** | | | |
| | | | | (0.018) | (0.018) | | | |
| *SCALE UP* × *AID* | | | | | | 0.003 | | |
| | | | | | | (0.002) | | |
| *SCALE UP* × *FRAGMENTATION* | | | | | | | 0.247 | |
| | | | | | | | (0.179) | |
| $SCALE\ UP^2$ | | | | | | | | 0.003 |
| | | | | | | | | (0.004) |
| *GROWTH* | 0.022*** | 0.023*** | 0.022*** | 0.022*** | 0.024*** | 0.021*** | 0.022*** | 0.022*** |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| *CPIA* | 0.096** | 0.097** | 0.057 | 0.102** | 0.061 | 0.097** | 0.103** | 0.096** |
| | (0.044) | (0.044) | (0.046) | (0.044) | (0.046) | (0.044) | (0.044) | (0.044) |
| *GDP* | -0.009 | -0.009 | 0.001 | -0.021 | -0.009 | -0.006 | -0.006 | -0.009 |
| | (0.035) | (0.035) | (0.036) | (0.036) | (0.036) | (0.035) | (0.035) | (0.035) |
| *HC* | 0.080 | 0.094 | 0.077 | 0.087 | 0.103 | 0.079 | 0.083 | 0.079 |
| | (0.080) | (0.082) | (0.080) | (0.080) | (0.082) | (0.080) | (0.080) | (0.080) |
| *AID* | -0.014*** | -0.013*** | -0.013*** | -0.014*** | -0.013** | -0.013*** | -0.013*** | -0.014*** |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| *FRAGMENTATION* | -0.207 | -0.198 | -0.263 | -0.189 | -0.249 | -0.160 | -0.066 | -0.193 |
| | (0.313) | (0.313) | (0.313) | (0.313) | (0.313) | (0.314) | (0.329) | (0.314) |
| Project-level variables | | | | | | | | |
| *SIZE* | 0.007 | 0.011 | 0.007 | 0.008 | 0.011 | 0.005 | 0.007 | 0.009 |
| | (0.027) | (0.027) | (0.027) | (0.027) | (0.028) | (0.027) | (0.027) | (0.027) |
| *SHARE WB FINANCING* | 0.062 | 0.060 | 0.064 | 0.053 | 0.051 | 0.059 | 0.060 | 0.062 |
| | (0.132) | (0.132) | (0.132) | (0.132) | (0.132) | (0.132) | (0.131) | (0.132) |
| *SHARE* $1^{st}$ *SECTOR* | -0.003** | -0.003** | -0.003** | -0.003** | -0.003** | -0.003** | -0.003** | -0.003** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| *ERR* (0/1) | 0.003 | 0.005 | 0.001 | 0.004 | 0.005 | 0.002 | 0.001 | 0.003 |
| | (0.069) | (0.069) | (0.069) | (0.069) | (0.070) | (0.069) | (0.069) | (0.069) |
| *REPEATER* | 0.128* | 0.135* | 0.126* | 0.131* | 0.137** | 0.129* | 0.131* | 0.127* |
| | (0.069) | (0.070) | (0.069) | (0.069) | (0.070) | (0.069) | (0.069) | (0.069) |
| Observations | 3,639 | 3,639 | 3,639 | 3,639 | 3,639 | 3,639 | 3,639 | 3,639 |
| Country FE | NO | NO | NO | NO | NO | NO | NO | NO |
| Lending instrument FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Approval year × sector FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Evaluation year × sector FE | YES | YES | YES | YES | YES | YES | YES | YES |

*Notes*: The table reports the regression coefficients of a probability model in which the dependent variable is a binary variable measuring the outcome of the project as satisfactory/unsatisfactory. The associated standard errors, clustered at the country evaluation-year level, are reported in brackets. A constant is included. * significant at 10%; ** significant at 5%; *** significant at 1%.