

Working paper

# Bricks-and- Mortar Institutions Matter

Project Delivery  
and Unfinished  
Infrastructure in  
Ghana's Local  
Governments

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Martin J. Williams

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BRICKS-AND-MORTAR INSTITUTIONS MATTER:  
PROJECT DELIVERY AND UNFINISHED INFRASTRUCTURE  
IN GHANA'S LOCAL GOVERNMENTS

Martin J. Williams  
Department of Government  
London School of Economics and Political Science

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**Abstract**

Many infrastructure projects in developing countries are started but never finished. Despite the vast resources invested in infrastructure and the obvious inefficiency of abandoning projects mid-construction, there is little research on this problem. I have collected, digitized, and coded administrative records of over 14,000 local government infrastructure projects in Ghana, covering multiple project types and delivery mechanisms. Approximately one-third are never completed, consuming one-fifth of total infrastructure expenditure. There is a bifurcation of outcomes: projects tend to be completed either promptly or not at all. There are large differences across districts in completion rates, but there is also significant variation *within* districts across different delivery mechanisms, each of which has varying degrees of involvement from local government, central government, and donors. These differences are extremely robust and remain statistically and economically significant even after controlling for project characteristics and district, community, and contractor fixed effects. I discuss issues of causality, and argue that it is implausible that endogenous project sorting can account for the magnitude of the observed differences. These results are consistent with generalized hold-up problems as a primary mechanism of non-completion, but are not well explained by common explanations for poor service delivery such as low bureaucratic capacity, technical complexity, political favoritism, or simple corruption. The findings complement micro-level experimental studies as well as macro-historical research on state capacity and abstract institutions, by providing rigorous observational evidence that the design and implementation of government institutions and delivery mechanisms can affect project outcomes in political and bureaucratic equilibrium. I discuss implications for theories of policy implementation, state capacity, and distributive politics.

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This project has benefited from advice, data, and discussions with individuals of numerous institutions, including the National Development Planning Commission, Ministry of Local Government and Rural Development, Local Government Service Secretariat, Ministry of Finance Fiscal Decentralization Unit, Office of the Head of Civil Service, District Assemblies Common Fund Administrator, Ghana Audit Service, the District Development Facility Technical Committee, Canadian International Development Agency, World Bank, Ministry of Education, GETFund Secretariat, and Ghana Road Fund Secretariat. Without their time and generous assistance this project would not have been possible. The analysis of this data has been conducted independently and the opinions expressed herein should not be attributed to any of these institutions. I am grateful for comments from Nana Agyekum-Dwamena, Stefano Caria, Douglas Gollin, Nahomi Ichino, Anisha Sharma, Joachim Wehner, and workshop participants at the Civil Service Training Centre (Ghana) and London School of Economics. This research was funded by the International Growth Centre grant I-VRG-VGHA-VXXXX-89105. Allan Kasapa and Joseph Napen provided excellent research assistance. Any remaining mistakes are my own.

## **Bricks-and-Mortar Institutions Matter: Project Delivery and Unfinished Infrastructure in Ghana's Local Governments**

Building infrastructure is one of the few uses of government resources that is as popular with economists and donors as with politicians and voters. Yet the actual process of construction is fraught with administrative and political challenges, and many infrastructure projects in developing countries are abandoned mid-construction and never finished. Despite the obvious inefficiency of spending scarce resources on unusable schools and half-built bridges – and anecdotal evidence that such outcomes are widespread<sup>1</sup> – there has been little systematic research about the extent, mechanisms, and causes of this problem, or how it is affected by the institutional structures and processes used to select, fund, and implement these projects.

The question of how the design of government policies and institutions affects their performance is a vexing one for researchers. There is an abundance of evidence that political economy factors and abstract institutions – rule of law, property rights, bureaucratic quality, political economy, social capital, trust – influence the quality of governance outcomes. Yet empirical efforts to understand how these abstract institutions manifest in the design and operation of the tangible, bricks-and-mortar institutions and organizations through which governments act is usually confounded by potential endogeneity and unobservable variation across contexts. On the other hand, a growing body of experimental and quasi-experimental studies has demonstrated that specific interventions and policy design features can improve outcomes (Reinikka and Svensson 2004, Olken 2007, Yanez-Pagans and Machicado-Salas 2014). These findings are convincing in the context of particular programs over relatively short time frames, but would these design features still matter outside of narrow and carefully controlled implementation settings, in bureaucratic and political equilibrium, or once scaled up to national level (Rodrik 2009, Deaton 2010, Olken and Pande 2012), or would the effect of policy and institutional design be swamped by that of abstract institutions, political economy, and other contextual factors?

To address these issues, I have collected, digitized, and coded administrative records of over 14,000 local government infrastructure projects in Ghana from 2011 to 2013. These are predominantly small, discrete, highly visible, and technically simple projects such as classroom blocks and latrines. The median project had a budget roughly equivalent to USD 36,000 and was scheduled to last five months, and 88.8 percent of projects were scheduled to be complete within one year. However, after one year less than half (45.8 percent) were finished, and even after three years over a third of projects (35.5 percent) remained unfinished and are unlikely ever to be completed.<sup>2</sup> Most projects have a substantial amount of work done on them – the median unfinished project is 60 percent complete – but there appears to be a bifurcation of outcomes: the average completed project is completed just one month behind schedule, but the average incomplete project is 200 percent past its due date.

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<sup>1</sup> Within Ghana, for example, unfinished projects are widely reported on by the media (e.g. Ghana News Agency 2014), and action against them has been pledged both by Parliament (Citi FM 2014) and

<sup>2</sup> As discussed later, calculating multi-year completion rates requires some assumptions about missing data and attrition, so I estimate them using three different methods. The figures reported here are from the middle of these three estimates; the corresponding three-year non-completion rates for the lower and upper estimate are 49.8 and 18.1 percent, respectively.

The likelihood of a project being finished decreases markedly over time, and nearly half of projects are never touched again after their first year. It is only a slight exaggeration to say that projects either get finished promptly or not at all. There is also dramatic variation across districts: average annual project completion rates range from 6.3 percent to 79.5 percent.<sup>3</sup> These descriptive findings represent the most comprehensive picture available to date of the scope and shape of the problem of unfinished infrastructure in any developing country.

To understand how project outcomes are affected by the institutions and mechanisms through which they are funded and delivered (“fund sources” henceforth), I take advantage of a unique feature of the dataset: the same types of projects are executed in the same districts and communities by the same pool of contractors through different fund sources, each with a different combination of local government, central government, and donor involvement. This allows me to estimate completion rates for observably identical projects (e.g. three-room schools) across these different fund sources, controlling for all observable and unobservable features of the district and community in which the project is located, as well as the contractor that implemented it. Even after controlling for all these factors, there is still a 15-25 percentage point difference in annual completion rates among projects from the three largest fund sources. This difference is statistically significant across a range of demanding specifications, and is also economically significant: a project from the top fund source in the 25<sup>th</sup>-percentile district has the same completion probability as an equivalent project from the worst of the three major funds in the 70<sup>th</sup>-percentile district.

While the differences across fund sources cannot necessarily be interpreted as causal impacts of their institutional design and operation, the demanding empirical specification greatly limits the range of alternative explanations. I examine the possibility of bias through endogenous sorting of projects into fund sources according to unobservable within-community factors; while these cannot be ruled out, it is empirically and theoretically implausible that these factors entirely explain the difference among fund sources. Likewise, the evidence does not support the hypothesis that differences across fund sources in political attribution of project outcomes are driving variation in completion rates. While cleaner identification could be achieved through an experimental study – and indeed these findings are strong evidence of the need for such studies – this would likely come at the cost of weaker external validity. Given these tradeoffs in research design and the paucity of existing research on infrastructure project completion in developing countries, these robust and nationally representative observational findings of stable programs fill an important gap in the literature.

This study is related to a variety of other non-experimental studies of development project outcomes. Rasul and Rogger (2014) is the only other study (to my knowledge) to examine the determinants of infrastructure project completion in a developing country setting, but they focus on the effect of management practices rather than institutional structures and delivery mechanisms, and do not track projects across multiple years. A number of studies examine the cross-country correlates of donor-funded project outcome assessments and find that they are influenced by recipient

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<sup>3</sup> These figures are three-year averages of annual completion rates for the 59 districts for which data is available for all three study years.

country characteristics as well as project design and donor practices (Isham, Kaufmann, and Pritchett 1997; Denizer, Kaufmann, and Kraay 2013; Honig 2014). Bold *et al* (2013) and Vivaldi (2015) show that implementing organizations matter for intervention outcomes by comparing NGO and government implementation of the same intervention; in contrast, this paper compares alternative delivery mechanisms within the same government. Khwaja (2009) studies maintenance of small infrastructure projects and uses within-community variation to argue that project design factors can mitigate the adverse consequences of being located in “bad” communities. A large literature examines the effects of decentralizing powers from central to local governments (e.g. Faguet 2004 & 2014) or vice versa (Malesky, Nguyen, and Tran 2014) through before-and-after comparisons; in contrast, this study investigates the simultaneous delivery of projects via institutions with varying degrees of local and central involvement. This paper also links to the rapidly growing literature on distributive politics in developing countries (Burgess *et al* 2013; Kramon and Posner 2013; Briggs 2014; Jablonski 2014; Harding 2015; Harris and Posner 2015). Whereas this literature examines the allocation of public goods, this paper examines their delivery conditional on their allocation. Finally, this study connects to the public financial management literature on budget institutions and fiscal federalism (Ferejohn and Krehbiel 1987; von Hagen and Harden 1995; Alesina, Hausmann, Hommes, and Stein 1999; Rodden, Eskeland, and Litvack 2003; Rodden 2006). Whereas these studies focus overwhelmingly on macro-fiscal outcomes to measure the performance of budget institutions, this study sheds light on the operational efficiency of public finance institutions and structures.

The remainder of this paper proceeds as follows. Section 1 discusses the unique challenges associated with infrastructure delivery and the role of government institutions in mitigating them. Section 2 introduces the project database and methodological issues involved in its creation. Section 3 presents descriptive evidence on the extent and dynamics of project non-completion, and argues that these are consistent with hold-up problems as a primary mechanism of non-completion. Section 4 analyzes differences in completion rates across fund sources, and addresses issues of causality and interpretation. Section 5 concludes by discussing implications for further research and policy.

## 1. INFRASTRUCTURE AND INSTITUTIONS

Perhaps due to the lack of empirical scrutiny devoted to the phenomenon of unfinished infrastructure, there is little dedicated theory to explain why so many politically popular, technically simple, and desperately needed projects are abandoned mid-construction.<sup>4</sup> Most existing research on infrastructure provision uses either input-based measures of spending and project allocation (Jablonski 2015, Harris and Posner 2015), or measures of access based on outputs or outcomes (Kramon and Posner 2013, Harding 2015).<sup>5</sup> Yet converting resources and plans into desired outputs and outcomes is the essence of service delivery and public management, which is precisely what is lacking in contexts of low state capacity and weak institutions. To

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<sup>4</sup> Other aspects of infrastructure provision in developing countries have been much better studied; see Estache and Fay (2007) and Briceño-Garmendia, Smits, and Foster (2008) for overviews of contemporary debates.

<sup>5</sup> Burgess *et al* (2013) use both a measure of expenditure and a measure of physical completion as dependent variables, but do not link the two.

the extent that the gap between inputs and outputs has been studied directly, it has been almost exclusively in highly controlled experimental settings and in the context of measuring corruption through “missing expenditures” that are presumed to have been embezzled (Olken 2007).<sup>6</sup> But while important, simple corruption is only one mechanism of implementation failure among many, and in the case of unfinished infrastructure projects there are theoretical and empirical reasons to think it is not the most important.

Infrastructure projects are a particularly interesting context for the study of policy implementation. Infrastructure delivery differs from other types of public services due to the multi-stage, sequential nature of the construction process and the large relationship-specific sunk costs incurred by governments as well as contractors.<sup>7</sup> This renders them uniquely vulnerable to a variety of economic and political hold-up problems, in addition to all the usual agency challenges associated with service delivery in developing countries. These hold-up problems arise from failures of credible commitment, which are precisely the sort of problems that governance institutions are designed to solve. When these institutions are weak, however, governments and contractors alike often find it easier and more rewarding to start projects than to finish them. This paper’s examination of the relationship between delivery mechanisms and infrastructure project completion therefore provides a unique setting in which to examine whether tangible, bricks-and-mortar institutions serve the same function at the micro level as abstract, society-wide institutions have been theorized to serve at the macro-historical level.

### **1.1 Starting and finishing infrastructure projects**

Figure 1 presents a stylized timeline of the construction of a typical small public infrastructure project.<sup>8</sup> After projects are selected, planned, and budgeted, the government goes through a procurement process and awards the contract to a private contractor who will actually carry out the physical implementation of the contract. After the contract is awarded the contractor begins work on the project, and after completing the first stage of the project the contractor requests partial payment from the government, who then inspects the work completed and, if satisfactory, makes payment.<sup>9</sup> This cycle then repeats itself: the contractor completes the project and requests full payment, and once the government has inspected the work and made full payment the project is handed over to the government and can be put into use. Importantly, the project’s value to users is zero until it is complete: schools without

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<sup>6</sup> Dabla-Norris *et al* (2011) construct a process-based index of public investment efficiency, but do not link it to outputs or outcomes.

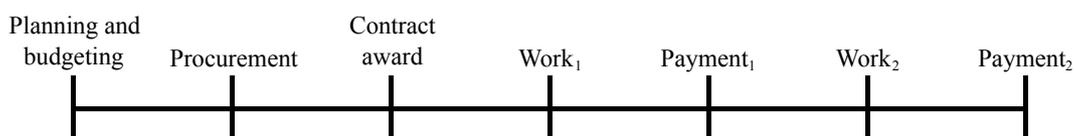
<sup>7</sup> Although this distinction is most obvious with physical infrastructure projects, it is also a general feature of the implementation of non-physical projects such as the drafting of policy and legislation; for example, it was reported to the Public Accounts Committee of Ghana’s Parliament that the preparation of a Land Bill and Land Use and Planning Bill had overrun its planned expenditure by 317 percent and, years later, still had not been submitted to Parliament (Daily Guide 2015).

<sup>8</sup> I focus on simple build-transfer projects, in which a private contractor is procured to build a government-designed project and the contractor’s involvement ends upon physical completion when it hands the project over to the government, since small infrastructure projects in Ghana are almost exclusively executed in this way. The large literature on public-private partnerships (PPPs), in contrast, focuses mainly on projects in which the private sector party also maintains a post-completion operational role.

<sup>9</sup> In some cases the government may make an up-front mobilization payment to the contractor prior to the start of work.

roofs are of little use.<sup>10</sup> In reality the construction process often involves more than two stages of work and can be considerably more complex, but for the small and simple projects this timeline is a reasonable approximation and captures the essential feature necessary for the theoretical discussion: the conceptual and temporal distinction between *starting* and *finishing* a project.

Figure 1: Stylized Timeline of an Infrastructure Project



The multi-stage nature of the construction process, together with the presence of large relationship-specific sunk costs, makes it susceptible to opportunistic behavior (Williamson 1975; Klein, Crawford, and Alchian 1978).<sup>11</sup> These hold-up problems run both ways, albeit at alternating points in the project's timeline. Contractors can delay work or demand to renegotiate the contract; the government is vulnerable to this since delay is politically costly and restarting the procurement process mid-project would entail additional costs in attention, staff time, the fixed costs associated with a new contractor relocating to the site, and inflation in price levels. Indeed, delayed implementation on some projects may be part of an optimal strategy for contractors who wish to minimize idle time of staff and machinery and thus obtain more contracts than they can simultaneously implement.<sup>12</sup> Governments, on the other hand, can delay or even refuse payment to contractors for work completed, entailing substantial interest costs and potential losses to the contractor. While procurement contracts typically include penalties for such behavior, these are of limited effectiveness in an environment where: 1) recourse to courts is slow, expensive, and uncertain; and 2) both governments and contractors are credit- and resource-constrained and subject to external shocks that are difficult to contract fully on, such as delayed disbursement of central government transfers (for governments) and unforeseen technical complexities or changes in the price of materials (for contractors).

Within government, bureaucrats and their political principals may also have stronger personal incentives to start projects than to finish them. One channel for this incentive

<sup>10</sup> This is a slight exaggeration, since projects nearing completion can sometimes be used without full functionality. For example, in site visits for this study the research team encountered instances of classes being held in a classroom block that had been roofed but construction had stalled prior to installation of windows, cladding of the building, and furnishing. Nonetheless, most infrastructure projects are characterized by a discontinuous relationship between implementation progress and use value, unlike many other types of service provision (e.g. teaching quality).

<sup>11</sup> In focusing on completion, this discussion abstracts from construction quality and corruption issues arising from information asymmetry, which have been the focus of other research on infrastructure delivery (e.g. Olken 2007). It also does not address the quality of supplementary services provided using the project (e.g. assignment of teachers to a school, teaching quality), maintenance after a project has been physically completed, or the appropriate allocation of resources among these dimensions of public service delivery.

<sup>12</sup> I am grateful to Douglas Gollin for this point. District governments often attribute unfinished projects to hold-up activities on the part of contractors (e.g. Freiku 2013).

is through corruption in the procurement process, which is typically associated with the start of the project rather than its completion. This incentive could manifest itself purely by the identity of the contractor to whom the contract is awarded, although in itself this is not inconsistent with the project being finished. More perniciously, corruption could manifest in the value of the contract: the project cost could be estimated unrealistically low by a preferred contractor to win the bid (“low-balled”), under the shared understanding that the project would either be left incomplete or the contract renegotiated, and thus still be profitable; or the project cost could be unrealistically high, as a rent transfer to a preferred client. Contract sums that are too low to complete the project or so high that they strain governments’ resources are obvious threats to project completion. However, unrealistic contract values and bureaucratic incentives to start projects also exist even in the absence of any corrupt activity: Flyvbjerg (2013) shows that planners have personal career incentives to underestimate costs and overestimate benefits of infrastructure projects, and Engel et al (2013) show that politicians and contractors collude to low-ball public-private partnership (PPP) concessions in Chile as an accounting gimmick to evade spending limits. More generally, low or high contract values can arise due to a lack of competition, poor technical quality of project designs, or low contractor capacity.

Finally, political economy factors can also incentivize starting projects over finishing projects, despite evidence that voters reward politicians for success in delivering infrastructure and other development projects (Briggs [2014], Weghorst and Lindberg [2013], and Harding [2015] demonstrate this in the Ghana case). Non-completion of infrastructure projects is not well explained by standard distributive politics models of “pork-barrel” spending (Dixit and Londregan 1996), because it is unclear why politicians would choose to expend scarce resources to half-build a project rather than using those funds to deliver a complete project to either core or swing voters, but is more consistent with the literature that emphasizes the credible commitment problems inherent in clientelism (Alesina 1988, Keefer 2007, Keefer and Vlaicu 2008, Robinson and Verdier 2013). Because politicians often have *ex post* incentives to deviate from their *ex ante* policy promises, unfinished infrastructure projects can be seen as a physical manifestation of dynamic inconsistency in policymaking. Politicians may start projects as a way to signal affiliation or the promise of completion, and unfinished projects may be those whose completion was not *ex post* incentive compatible for the politician.<sup>13</sup> However since these theories focus on the distributive aspect of policy rather than its implementation, it is not clear what factors – other than electoral cycle effects, which are shown below to not be empirically important in this case – would differentiate starting and finishing projects in this

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<sup>13</sup> Robinson and Torvik (2005) suggest that politicians might deliberately support inefficient projects – “white elephants” – as a form of credible commitment to redistribution to their clients. However, this seems implausible as a general explanation for unfinished projects in the Ghana context, since: 1) most of these projects are social infrastructure rather than projects that generate fiscal returns, on which Robinson and Torvik’s model focuses; and 2) there is a near-universal deficit of such social infrastructure in Ghana, so nearly all these projects potentially create positive social surplus (or at least a positive-return project of equivalent cost in the same community could have been identified). Whereas “white elephant” theories ask why bad projects get undertaken, this paper’s question is why (potentially) good projects get started but not finished. It is equally implausible that unfinished projects are simply used by politicians as a way to direct private transfers to communities (as opposed to contractors) in the form of labor income; not only is labor a relatively small share of most capital projects, but a politician could still achieve this aim by seeing a project through to completion and also reap the additional political benefits of having provided a club or public good.

account.<sup>14</sup> Another potential political mechanism is the differential attributability of project starts and project completion to politicians by voters: whereas a politician can easily claim credit for the distributive decision to start building a project in a community, the subsequent failure to complete it can be blamed on contractors, bureaucrats, revenue shortfalls, or other external shocks.<sup>15</sup>

In addition, interruptions or delays in construction are likely to increase the project's cost and thus decrease the likelihood of its completion, independent of the cause of the delay. On the economic side, this is due to contractors' financing and relocation costs, decay in partially completed work, general price inflation, and recontracting costs. For a sample of OECD transportation projects, Flyvbjerg, Holm, and Buhl (2004) estimate that each year of delay is associated with a 4.6 percent cost increase; in developing countries with higher inflation and interest rates and weaker legal systems, this figure would presumably be even larger. Finally, interruptions may also weaken political commitment to a project due to attention economies or competing distributive claims from other communities.

The effect of these cost increases is compounded by nominal rigidities inherent in budgeting, policymaking, and procurement processes, which require renewed political and bureaucratic approval of nominal contract adjustments even if the real cost of the project does not increase. These rigidities could help explain the striking difference in outcomes between the small infrastructure projects studied in this paper, and the (largely OECD-focused) literature on mega-projects: whereas 90 percent of OECD mega-projects exhibit cost overruns (Flyvbjerg 2014), only 2.4 of completed projects in this paper's Ghana sample have overruns greater than 10 percent (see Section 3.3, below). If nominal rigidities make it difficult to adjust contract amounts mid-project, then projects that are destined to overrun their initial cost could be abandoned mid-construction rather than completed at an increased cost.

## 1.2 Delivery institutions

Project delivery institutions can be viewed as bundles of structures and processes designed to solve these numerous and overlapping agency and commitment problems. These “bricks-and-mortar” institutions are distinct from abstract institutions, such as the rule of law or social capital, in that they are embodied in organizations and the links between them. Delivery institutions are designed to monitor the performance of contractors as well as their own staff, with different levels of effectiveness; they pursue breach of contract claims in court, requiring technical, legal, and financial capacity; they ameliorate credible commitment problems by tying politicians' hands through the separation of policymaking and implementation; and they deliver funds predictably and promptly to minimize delays and interruptions in construction. While these functions are relevant for all types of public service delivery, they are *prima*

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<sup>14</sup> Another attribution-based mechanism for explaining incomplete projects focuses on the role of political turnover and new governments' refusal to complete the projects of previous governments; while there is substantial anecdotal evidence of this occurring, including in Ghana, I do not discuss it here since the same party was in power throughout the study period.

<sup>15</sup> I am again grateful to Douglas Gollin for this point. This attribution argument is distinct from that made by Harding (2015) and Harding and Stasavage (2013), which relies on differential visibility of different types of public goods (Mani and Mukand 2007) and thus is not applicable to this study's context, since all the types of infrastructure projects under discussion are highly visible.

*facie* even more important for infrastructure projects given their unique vulnerability to hold-up problems.

In reality, however, not all institutions are effective at solving these agency and credible commitment problems – state capacity is a phenomenon to be explained, not the default state of affairs (Besley and Persson 2009). In contrast to the bulk of the literature that focuses on institutional development in an abstract, society- or government-wide sense (Acemoglu, Johnson, and Robinson 2005), the empirical analysis in this paper examines differences in the effectiveness of specific bricks-and-mortar institutions in solving agency and credible commitment problems in infrastructure project delivery. There is a surprising lack of robust evidence about how infrastructure project delivery is affected by the institutions, processes, and practices through which it is implemented. While the effect of specific procurement practices on project outcomes has been the subject of a number of studies in the management literature (Estache and Iimi 2012, Budzier and Flyvbjerg 2013), these are subject to econometric concerns about representativeness and potential endogeneity. On the other hand, the rapidly growing experimental and quasi-experimental literature on program evaluation has succeeded in cleanly identifying causal effects of specific interventions (e.g. Olken 2007) on infrastructure project outcomes, but the effectiveness of these practices could differ in non-experimental settings or be reduced over time as actors adjust their behavior into a new equilibrium. Likewise, the narrow nature of randomized trials typically permits inference about one or two dimensions of the project design, whereas the design and implementation of government policies and institutions is highly multi-dimensional (Hausmann 2008).

### **1.3 Implications for empirical analysis**

The above discussion has presented a loose framework for thinking about the distinction between starting and finishing infrastructure projects, and how project delivery mechanisms – bricks-and-mortar institutions – can increase project completion rates. The purpose of this synthetic discussion has been to focus attention on this understudied issue and potential theoretical perspectives on it, rather than proposing a single cause or mechanism to be tested empirically. This paper’s empirical analysis instead attempts to provide empirical evidence in key two areas to inform the development of specific theoretical mechanisms and hypotheses for testing.

First, I first examine the data descriptively to examine the extent and dynamics of project completion and non-completion. I also show that the particular pattern revealed by this descriptive analysis is consistent with theoretical mechanisms emphasizing generalized hold-up problems. Second, I investigate whether different project delivery mechanisms are associated with different completion rates, while holding constant numerous other factors associated with the quality of public service delivery, including: bureaucrat quality and management; political leadership; the quality of legal institutions; the socioeconomic, ethnic, geographic, and political characteristics of the communities in which projects are located; and the identity of the contractor executing the project. While the resulting differences do not in themselves reveal the underlying mechanisms, they are nonetheless a revealing and novel finding with significant implications for existing theories of public service

delivery. The subsequent discussion suggests promising areas for future theoretical and empirical work.

## 2. DIGITIZATION METHODOLOGY AND DATA

The infrastructure project data used in this study is compiled from the Annual Progress Reports (APRs) of local governments in Ghana, which each district<sup>16</sup> is required to submit annually to three supervisory institutions: the National Development Planning Commission (NDPC), the Ministry of Local Government and Rural Development (MLGRD), and one of the ten Regional Coordinating Councils (RCCs). However, in practice some districts fail to report in some years, and most districts forward their APRs to the NDPC and/or their RCC but not to MLGRD. To collect the APRs, study team members first worked with staff of the NDPC to locate all the soft and hard copy reports that were available centrally at the NDPC. With support from the NDPC, team members then travelled to all ten regional capitals and worked with the RCCs to collect APRs that were not available centrally. Those reports that were only available in hard copy were then scanned to create a complete digital archive of extant APRs. APRs typically follow a semi-standard format, which includes a table of infrastructure projects that were underway in the district during that calendar year. Once digitized, the columns of this table were coded and combined into a database using manual double entry with reconciliation of all errors. A sample page of an APR project table is shown in Appendix 1.<sup>17</sup>

Altogether it was possible to locate 479 out of a potential 602 APRs (79.6 percent), of which 407 (67.6 percent) had sufficient information to be entered into the database. While this level of coverage is perhaps surprisingly high for a previously unused source of administrative data, it nonetheless raises concerns that reporting completeness may be correlated with project completion. This does not appear to be the case, however, as project completion rates are balanced across districts' reporting completeness, as are a wide range of district characteristics. These balancing tests are presented in Appendix 2.

All variables were coded algorithmically from text strings by defining a set of word or phrases corresponding to values. For the variables *ProjectType* and *ProjectCompletion*, the algorithmic coding was supplemented with manual disambiguation for projects that could not be uniquely assigned a value. For example, an observation whose project title contained the words "CLASSROOM BLOCK",

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<sup>16</sup> Ghana's local governments are classified as either Metropolitan, Municipal, or District Assemblies (MMDAs, collectively), depending on their size. However they are often referred to generically as "districts" for convenience, a convention which I follow in this study.

<sup>17</sup> A similar digitization exercise was carried out on District Medium-Term Development Plans (DMTDPs), three-year development plans compiled by districts in 2010 that contain lists of planned infrastructure projects to be undertaken through 2013. For the sub-sample of districts with three years of APR data, these planned projects were linked to actually undertaken projects in the APRs. The correspondence between the planned and actual projects is extremely low: only 2.8 percent of projects in the APR database could be linked to a planned project in the DMTDP database. The maximum percentage of projects linked in a district was 23.3 percent. While this may reflect differences in data structure, project naming, and manual linking between the two databases, it may also be partially attributable to a low correspondence between planned and realized development projects at district level. This was likely accentuated by district elections that took place in December 2010, meaning that DMTDPs were effectively prepared under a district assembly whose composition could have changed significantly and may have had different priorities.

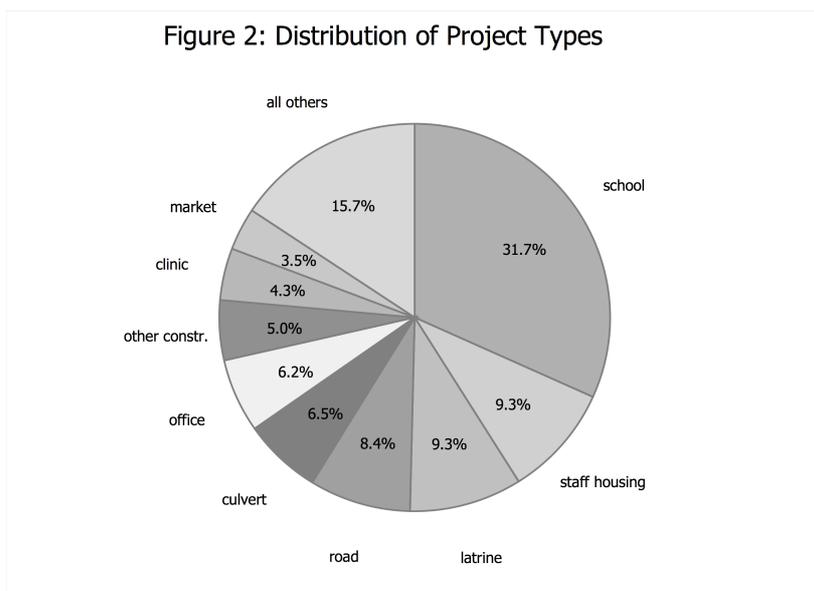
“SCHOOL”, or “CRB” (or eleven other keywords) was labeled a school. If the project title also contained the phrase “LATRINE” and was therefore also classified as a latrine, the observation was manually inspected and disambiguated if possible; if the project genuinely straddled two types, it was coded as “multiple”. Project completion was coded as a binary variable by combining information from three variables of which one or two are typically reported in APRs: *ProjectStatus* (e.g. “COMPLETED”, “INSTALLED AND IN USE,” “100 WORK DONE”), *Remarks* (similar), and *PercentWork* (on the scale 0-100; 100 coded as complete). This yielded a unique value for 91.6 percent of observations; the remainder were disambiguated by visual inspection if possible, and giving a missing value if it was impossible to determine the project’s status conclusively. The interpretation and accuracy of this completion measure is discussed below. Further details of variable coding are available in Appendix 3.

Table 1: Coverage of Key Variables in Dataset

Variable name	Non-missing		Variable name	Non-missing	
	Obs.	Pct.		Obs.	Pct.
Project title	14,246	100.0%	Contract sum	9,869	69.3%
Completion status	13,339	93.6%	Commencement date	5,518	38.7%
Fund source	11,226	78.8%	Completion date - expected	5,061	35.5%
Location	11,326	79.5%	Completion date - actual	1,424	10.0%
Contractor	9,319	65.4%	Expenditure to date	6,224	43.7%

Note: See Appendix 3 for full variable descriptions. Percentages are as percent of total core sample (n=14,246).

Because very few districts assign unique tracking numbers to projects, linking projects across years had to be done manually. For each district for which all three years of data were available, records of projects coded as being in the same location (e.g. village, neighborhood) in different years were visually inspected according to their project title, fund source, completion status, contract sum, and other potentially identifying information, and linked if they were obviously the same project. Conditional on being incomplete in 2011 or 2012, only 33.8 percent of projects could be identified in the following year, indicating a high degree of attrition in reporting. Attrition is likely to be correlated with project completion (if bureaucrats stop reporting unfinished projects that have been abandoned) and thus poses a challenge for estimating the overall completion rate, which I discuss in more depth later. It also varies across districts, and it is possible that districts interpret the reporting mandate in slightly different ways: some may report all projects that were underway in the district, whether or not they were active during the year, while others may only report projects that were active or included in annual budgets. While this could potentially bias cross-district comparisons and has implications for the overall project completion rates and dynamics discussed in Section 3, these district-level differences in reporting do not affect the within-district fund source estimates in Section 4. Appendix 4 demonstrates that attrition probability is uncorrelated with project fund source for the main fund sources on which my analysis focuses.



Of the total of 21,760 projects, 15,959 are infrastructure projects and 5,801 are other activities undertaken by the district, such as procurement, furnishing of completed structures, awareness raising, etc. These non-infrastructure activities were not reported evenly across districts and differ in their implementation characteristics, so were dropped from the dataset. Removing 1,713 repeat reports of projects that had been completed in previous years leaves a database of 14,246 projects, which is the core dataset used in this study’s analysis.<sup>18</sup> Figure 2 shows the distribution of these projects across the largest type groups. Seventeen different basic types were defined; for the parametric analysis in Section 4, the category “schools” was broken down into five sub-categories according to the number of units in each school block, leaving a total of 22 project type categories. The database also includes some projects which constituted the maintenance, repair, rehabilitation, or renovation of existing projects; these comprise 12.1 percent of projects, while greenfield construction comprises 75.9 percent, and the remaining 12.0 percent cannot be classified.<sup>19</sup> While detailed engineering assessments of each project are not available, from an engineering perspective nearly all of these projects are small, commonly executed, simple, and low-risk. It is thus not plausible that unobserved project complexity or mid-project engineering “shocks” are a significant feature of project implementation for the vast

<sup>18</sup> Repeat reports were identified either as 1) projects that were reported to have been completed in a previous calendar year, for projects with non-missing completion dates; or 2) projects that were manually linked to a project in the previous year’s report, for projects in districts for which all three years of data were available. This lowers the overall annual completion rate by 3.6 percentage points. Since identifying repeat reports of completed projects through manual linking is not possible for observations in 2011, it is likely that the 2011 completion rate is biased slightly upwards; projecting the size of this bias based on the number of manually traced repeat reports of completed projects from 2012 and 2013 suggests that this bias is fairly small, in the range of 1.1 to 1.5 percentage points.

<sup>19</sup> Construction type was defined by the existence of text string prefaces in the project title, with strings such as “CONSTRUCTION OF” or “COMPLETION OF” indicating greenfield construction projects and strings such as “RENOVATION OF” or “REPAIR OF” indicating maintenance/repair/renovation projects. Project titles that simply named the project type (e.g. “3-UNIT CLASSROOM BLOCK”) were unclassified. All empirical results hold if maintenance/repair/renovation and unclassified projects are dropped from the sample.

majority of these projects, although these are often a significant challenge for larger and more unique projects.<sup>20</sup>

The information in the project database is based on the self-reports of the local governments themselves and is thus subject to some concern about accuracy, either due to poor reporting quality or deliberate misrepresentation.<sup>21</sup> This study has therefore taken multiple approaches to probing the accuracy of the APR data. First, it should be noted that districts have had little incentive to deliberately misreport any data in the APR, because these reports were submitted in hard copy and subject to only cursory scrutiny by supervisory institutions, so careful and systematic analysis of them was not possible.<sup>22</sup> Second, for one of the project fund sources the government maintains its own monitoring database which is compiled and maintained independently of the APR reporting system, and reports from the independent Ghana Audit Service are also available. While this database differs somewhat in structure, format, and scope from the APR database, the estimates of project completion rates are similar in magnitude.<sup>23</sup> Finally, the research team conducted physical site visits to a small (not nationally representative) sub-sample of projects that had been reported as complete in 2013, spread across four randomly selected districts in two regions. The physical evidence from this limited sample suggests that while construction quality and maintenance may be issues with projects reported as complete, there is little evidence that districts reports of completion status are systematically biased.<sup>24</sup>

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<sup>20</sup> It is possible that engineering complexity is a factor for some larger projects, particularly in urban areas; however the findings below are robust to excluding projects with large contract sums, and the consistency of results across project types suggests that engineering considerations are not driving project non-completion.

<sup>21</sup> Note however that if district APRs are deliberately misreporting completion rates to exaggerate their achievements the completion rate would be biased upward, meaning that unfinished projects are even more prevalent than estimated here. For the fund source-level estimates presented in Section 4, misreporting bias would only be a problem if it were differential across fund sources. District officials would have no incentive to do so, however, since the APRs are not submitted directly to any of the funding institutions and were not being used by these institutions for monitoring purposes.

<sup>22</sup> Interviews with officers at these institutions have confirmed this, and have not yielded any anecdotal evidence of district-level officers being subject to any form of sanction or reproach due to information contained in the APRs. There were no concerns on the part of any of these officers that completion data on the APRs was being deliberately exaggerated, although some acknowledged that some of the finer details (such as the percentage of work completed) may be somewhat rough. Scrutiny of district operations is somewhat more intense in terms of financial management due to the Ghana Audit Service's annual audits, but these are not based on the APRs and if anything provide an incentive for district-level officers *not* to misreport the financial status of projects on APRs.

<sup>23</sup> The Ministry of Education's internal monitoring database of 1,146 GETFund projects reports that of 6-unit classrooms and dormitories started between 2009 and 2013 nationwide, only 36.6 percent had been completed. (The GETFund is described in more detail in Section 4.1). Unfortunately it is not possible to disaggregate this by year of project commencement, and the date of reporting is not indicated (these figures are based on a database provided by the Ministry of Education in January 2015). In addition, the Ghana Audit Service reports that a June 2013 monitoring effort of 179 school projects in seven regions started in 2010 and 2011 found that 27 percent were complete, despite scheduled completion times of six to twelve months – a similar length to most GETFund projects in the APR database (Ghana Audit Service 2014, 290). While these estimates differ slightly in timespan and project coverage, they are in the same range as APR database estimates that GETFund projects have one-year completion rates of 24.0-25.4 percent and three-year completion rates of 32.0-56.1 percent. Likewise, the June 2013 monitoring report found that 61 percent of the contract value of these incomplete projects had been disbursed; the equivalent figure in the APR database is 48.4 percent.

<sup>24</sup> Resource constraints made it impossible to conduct physical site visits on a nationally representative scale. Seventeen of the twenty projects were fully complete, while the remainder were functionally complete but with minor areas of incompleteness (e.g. no windows, untiled floors, holes in roof, some

### 3. UNFINISHED PROJECTS

Anecdotes about unfinished infrastructure projects in Ghana and other developing countries are widespread, but data on the extent and dynamics of the problem are almost non-existent. For scholars of public good provision, measuring what percentage of government projects get finished is as fundamental a task as measuring poverty headcounts is for studies of poverty reduction, so this ignorance is worrying. What little data there is, however, confirms the severity of the problem: in the only such large-N dataset available for a developing country (to my knowledge), Rasul and Rogger (2014) estimate that only 31 percent of small government infrastructure projects are fully completed within the budget year. However, it is unclear whether such projects are simply delayed or have been completely abandoned. This dynamic aspect of project completion also has important implications: if unfinished infrastructure is primarily a matter of slow but steady and even progress across all projects, the nature of the underlying problems is likely to be different than if we observe important discontinuities.

This section digs into the data to determine the *extent* and *dynamics* of unfinished infrastructure as a problem. It finds that less than half of projects are finished within a year and a substantial percentage of projects remain unfinished after three years. Project completion rates decrease significantly over time, and almost half of all projects that are not completed in their first year are never worked on again. Surprisingly, however, the vast majority of completed projects were finished within one year and most completed projects are delayed only slightly if at all. Yet even incomplete projects have had a substantial amount of work done on them – the median incomplete project is 60 percent finished. The picture of infrastructure development seems to be one of rapid progress on the initial stages of projects, followed by a bifurcation of outcomes: some projects go on to be finished promptly, while others languish and are often abandoned entirely. This supports this study's theoretical emphasis on economic, administrative, and political credible commitment problems combined with the multi-stage nature of infrastructure projects as a key explanation of unfinished projects.

#### 3.1 Measuring project completion

Due to attrition and the lack of unique project identifiers in the dataset, calculating project completion rates requires making some assumptions about the form of attrition and missing data. I therefore estimate three different sets of completion rates, which are almost identical for projects' first year but diverge thereafter:

- Upper bound. Projects are classified into years (1-3) according to their reported year of commencement (e.g. a 2012 observation of a project that started in 2011 is in its second year). No correction is made for attrition. Sample is all projects with non-missing commencement year.

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roofing remaining to be done). Sixteen of the projects were in full use; of the remaining four, one was in partial use, one was out of use because of cracks and accessibility issues, and one had not been commissioned yet. The site visits were conducted in October 2014, ten months after the project had been reported as complete; in only one case did people present at the project site report that the project had actually been finished in 2014 rather than 2013.

- Middle estimate. Projects are classified into years according to manual linking (see previous section). Incomplete projects that cannot be traced to the subsequent year are treated as missing in the subsequent year (i.e. no correction is made for attrition). Projects that have not been linked to an observation from previous year are assumed to be in their first year. Sample is all projects from districts for which all three years of data are available.
- Lower bound. Same as middle estimate, but incomplete projects that cannot be traced to the subsequent year are assumed *not* to have been finished (i.e. attriting observations are treated as incomplete).

The upper bound estimate will be biased upward if unfinished/abandoned projects are more likely to attrite from the dataset than completed projects, which is probable. Likewise, the lower bound estimate will be biased downward if untraceable projects are actually completed in the subsequent year but not reported, or if the projects were completed and reported but not linked by the manual tracing methodology. The middle estimate is situated between these two but may also be biased, although the direction of this bias is unclear *a priori*. To the extent that the middle and lower estimates incorrectly group projects that are in their second or subsequent years but are appearing in the dataset for the first time as first-year projects, the first-year completion rates may be biased; in practice however this bias appears to be small, as the first-year completion rates are very similar under all three estimates.

### 3.2 Overall completion rates and dynamics

Figure 3 graphs these three completion estimates over the first three years of project life, with cumulative completion rates in the top panel (3a) and annual completion hazard rates in the bottom panel (3b). An estimated 43.4 – 45.8 percent of projects are finished in their first calendar year. The estimates diverge sharply in the second and third years of projects, however, with three-year cumulative completion rates estimated at 50.2, 64.5, and 81.9 percent for the lower, middle, and upper estimates, respectively. Figure 3b shows that the completion hazard rates decrease monotonically over the years of a project, gradually for the upper bound estimate but drastically for the lower and middle estimates.<sup>25</sup> While the divergence between the three estimation methods is frustratingly large for the second and third years of projects, they yield qualitatively similar findings: a significant fraction of projects are not finished even after three years of their commencement, and projects' probability of completion decreases after the first year.

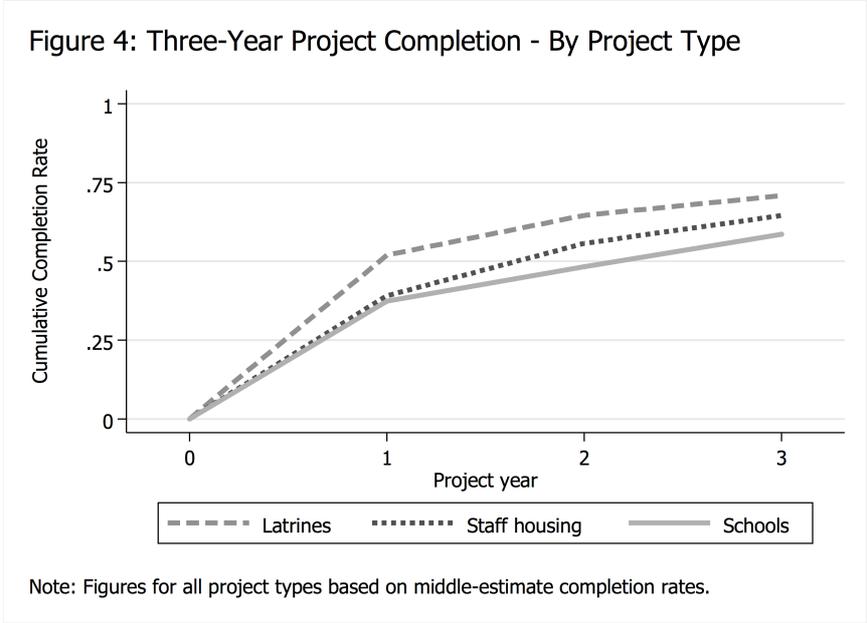
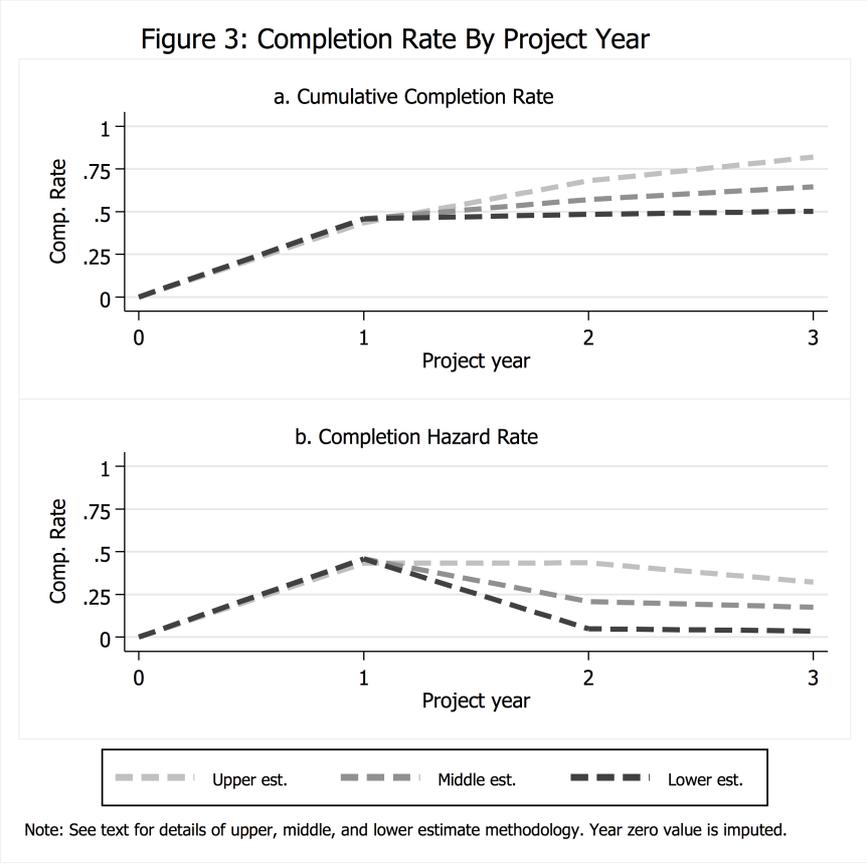
These findings both hold across project types, as Figure 4 shows for the three most common types of projects (schools, latrines, and housing for local government staff).<sup>26</sup> Completion rates remain broadly consistent across years, indicating that the phenomenon of unfinished projects is not primarily explained by political dynamics relating to Ghana's December 2012 election.<sup>27</sup>

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<sup>25</sup> The second year completion rate for the upper bound estimate is actually 0.15 percentage points higher than in the first year, but this difference is minute and would almost certainly disappear after correcting for attrition.

<sup>26</sup> It is noteworthy that project incompleteness is an issue even for types of projects, such as staff housing and office buildings, for which the staff of the districts are themselves the direct beneficiaries.

<sup>27</sup> Annual projection completion rates were 48.6 percent for 2011, 40.7 percent for 2012, and 44.7 percent for 2013. While this does not rule out the presence of any political economy effects in project completion, it nonetheless makes it clear that the findings are being driven by within-year variation, not

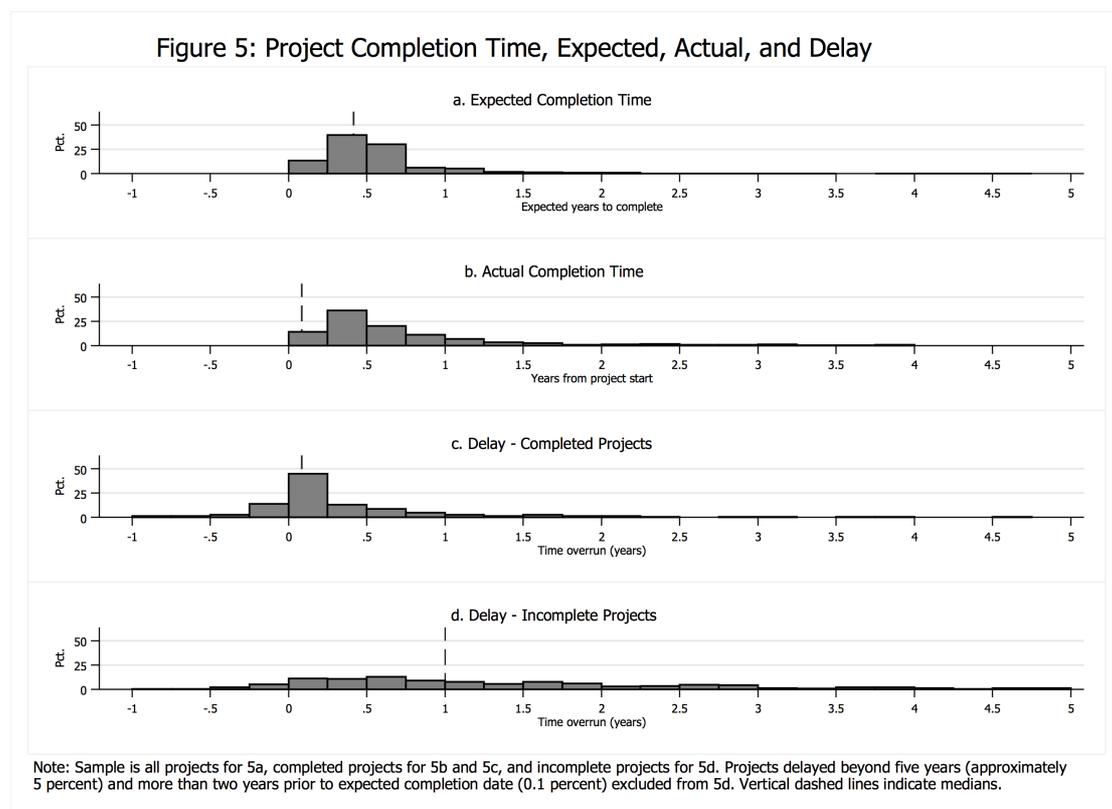


It is possible that these findings could emerge normally if many projects were scheduled to last longer than three years, but Figure 5 demonstrates that this is not the

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primarily by simple pre- or post-election dynamics (i.e. politicians starting or finishing projects *en masse* just before or after an election). These elections were won by the incumbent party, however, so completion rates for 2013 may have differed if they had been won by the opposition.

case. It plots the expected time to completion for all projects (5a), actual time to completion for complete projects (5b), and time overruns both for completed (5c) and incomplete (5d) projects. Most projects are intended to be brief: five months for the median, and 88.8 percent less than twelve months. And indeed, projects that get finished do tend to be prompt: the median delay is just one month, 81.0 percent are finished in less than twelve months, and just 10.7 percent are delayed by a year or more. The median incomplete project, however, is twelve months past its expected completion date – a delay of 200 percent – and there is a long tail of over a quarter of incomplete projects that are more than two years late. While it is impossible to conclusively say that these projects will never be completed, just 5.3 percent of completed projects were finished two or more years past their due date, so it is empirically improbable. These figures likely *understate* the extent of the problem, since many incomplete projects attrite out of the dataset.

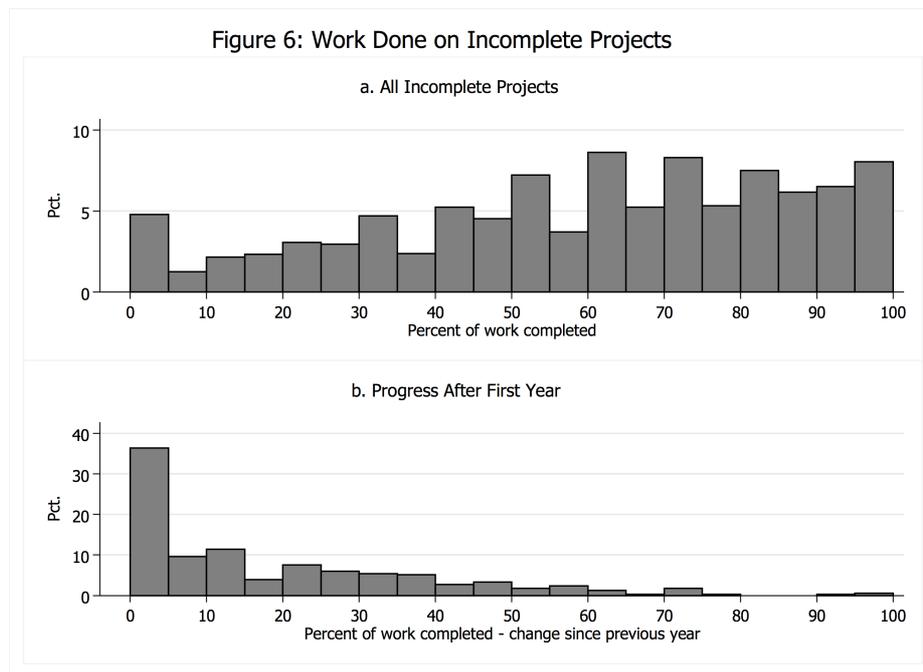


### 3.3 Physical progress and financial expenditure on unfinished projects

Figure 6 examines the level of work completed on unfinished projects. The top panel (6a) shows that most incomplete projects have had a significant amount of work done on them – 60 percent, for the median. While this could be a sign that construction is proceeding slowly but steadily on these projects, the lower panel (6b) shows that nearly half of projects are not touched after their first year.<sup>28</sup> This bifurcation of outcomes is consistent with the view that unfinished projects are due largely to inter-temporal consistency problems combined with the multi-stage nature of the

<sup>28</sup> Reported progress is precisely zero for 32.7 percent of projects, but is 10 percent or less for 55.0 percent. Given that the percent of work complete variable may be reported somewhat imprecisely, reported progress in this range is more likely to be due to measurement error than genuine work completed.

construction process, rather than a “smoother” underlying completion function that might be more suggestive of low capacity and resource constraints as driving factors.



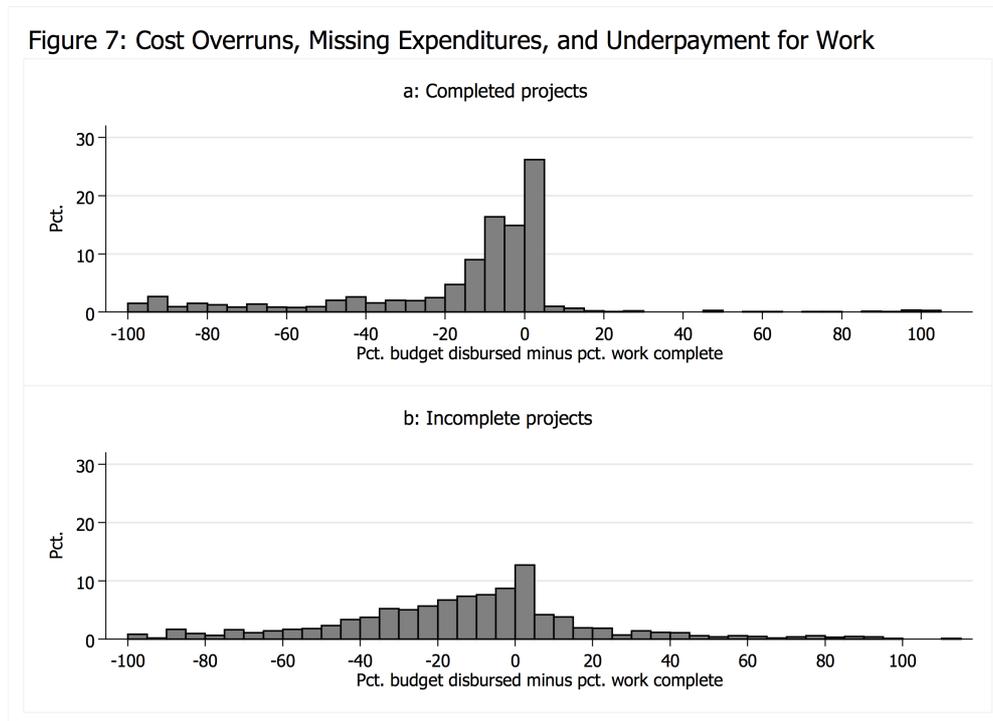
To examine whether simple theft of resources is a primary cause of project non-completion, Figure 7 constructs an analog of Olken’s (2007) “missing expenditures” measure by subtracting the percentage of physical work complete on a project from the percentage of its budget that has been disbursed relative to the original contract value.<sup>29</sup> Unlike Olken’s measure, however, this measure is two-sided: contractors can be either overpaid or underpaid relative to the work they have done. For complete projects (7a), positive values thus represent cost overruns, while for incomplete projects (7b) they represent “missing expenditures”.<sup>30</sup> In both cases, negative values represent delayed payment or non-payment for work done. While this is only an indicative measure<sup>31</sup>, it is nonetheless revealing. If simple corruption were the cause of unfinished projects, we would expect to observe positive values: a 60 percent

<sup>29</sup> This measure is an analog to Olken’s missing expenditures measure, not an exact replication. Whereas Olken’s measure focuses on embezzled funds by measuring sub-standard material quality in completed roads, this paper’s measure focuses exclusively on percentage physical completion (regardless of quality). These measures are not mutually exclusive, and both could be occurring simultaneously.

<sup>30</sup> Cost overruns could arise for multiple reasons: mid-project scope of work changes (e.g. building a larger project than was planned); legitimate cost increases without scope of work changes; or deliberate overpayment, likely due to corruption. While these are all sub-optimal outcomes, not all are illegal or illegitimate. Unfortunately, it is not possible to disentangle these in the absence of more detailed procurement and physical completion data.

<sup>31</sup> This measure is based on the assumption that there is a correspondence between a project’s physical completion percentage and the fraction of the budget to be paid out according to the contract’s payment schedule. In reality this correspondence is unlikely to be exact, although one would expect a strong positive correlation (and indeed this is empirically the case). For complete projects, however, both numbers should be 100 percent, giving a difference of zero; the fact that this is not observed suggests that the measure is not being driven by the contractual details of work and payment schedules.

complete project with 100 percent of its budget disbursed, for example, might suggest that the remaining 40 percent had been embezzled by one party to the transaction.<sup>32</sup>



Instead, the opposite appears to be the case. Defining overpayment as projects with values greater than 10 percent and underpayment as values less than 10 percent, underpayment is almost five times more common (44.2 percent of projects) than overpayment (8.1 percent). Overpayment (“missing expenditures”) is slightly more common on incomplete projects than completed ones (15.8 percent, compared to 2.4 percent), but underpayment is still several times more frequent (50.9 percent of incomplete projects, 39.2 percent of complete projects). These figures are approximate and should be interpreted with care, but the observed differences between over- and underpayment are dramatic and far too great to be explained by normal time lags in processing payment.<sup>33</sup>

These results are consistent with issues related to public financial management being far more prevalent than simple corruption in infrastructure delivery, although these figures alone do not demonstrate a causal relationship. From the perspective of contractors, delayed or non-payment for work done is a quintessential hold-up problem: having completed the work, if the government does not pay them they have

<sup>32</sup> As Olken (2007, 203) emphasizes, “missing expenditures” can arise for reasons other than simple theft, even if they are highly suggestive of some form of either corruption or extremely poor contract management.

<sup>33</sup> Governments usually have a contractual period of a few weeks or months after contractors have submitted payment requests in which to inspect work and make payment. However, this does not seem to be driving variation, as there is no correlation between the over/underpayment measure and the month of project completion (not shown) – since both financial and physical status is reported in the APRs at the end of the year, this correlation would be positive if underpayment was primarily a short-term phenomenon. Thus, negative values of “missing expenditure” really do seem to be measuring severely delayed payment or non-payment rather than normal lags in processing payment.

little recourse other than to wait or resort to a costly and slow legal system.<sup>34</sup> This not only affects the completion probability of the project in question (especially if the delay increases the nominal or real cost of finishing the project), but also can reduce the completion probability of other projects by reducing contractors' financial capacity, increasing the cost of tender bids as contractors build the interest costs of delayed payment into their estimates, and increasing the likelihood that contractors themselves will engage in hold-up activities.

The full cost of leaving projects unfinished is difficult to calculate exactly, especially if the social costs of non-access are taken into account, but even a rough calculation of direct fiscal expenditure shows that it is substantial. Using the middle-estimate of completion, 35.5 percent of projects are unfinished after three years, and expenditure on these averages 55.5 of the contract value, so 19.6 percent of total expenditure – roughly one-fifth – is on projects which are almost certain never to be finished. To give a sense of magnitude, scaling this figure by the total capital expenditure by Ghana's local governments in 2013 of USD 135 million implies that annual spending on projects abandoned mid-construction is approximately USD 26.6 million.<sup>35</sup> In addition, the average physical completion percentage of projects that are unfinished after their third year is 64.9 percent, or 9.4 percentage points greater than the percent of the budget disbursed. Assuming that these costs are borne directly by the contractor implies an additional annual societal cost of USD 6.7 million beyond the direct fiscal cost.

### **3.4 Variation across districts**

Finally, it is noteworthy that project completion rates vary substantially across districts. Figure 8 illustrates this by showing the average annual completion rates of the 59 districts for which all three years of data are available. Average annual project completion rates range from 6.3 to 79.5 percent, with an unweighted district mean of 38.8 percent. Explaining this variation across districts would be a useful exercise, but since the determinants of public service delivery across local government units have been widely studied already, this study instead turns to analyzing *within*-district variation across different fund sources, while holding constant the determinants of cross-district variation.

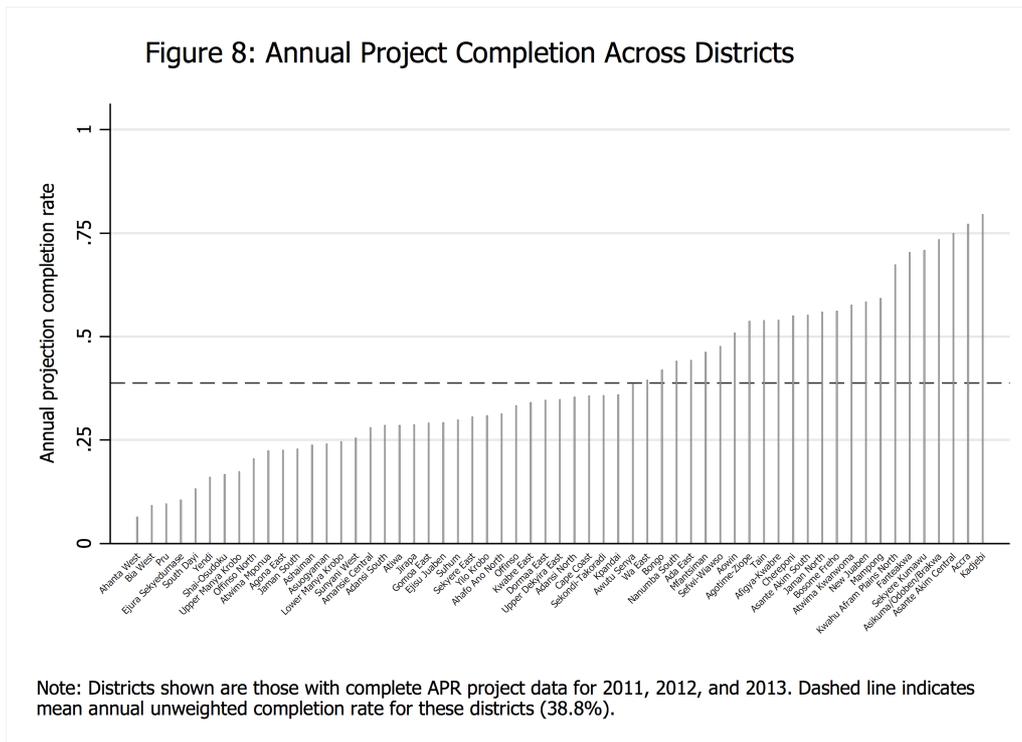
## **4. BRICKS AND MORTAR INSTITUTIONS**

To investigate how bricks-and-mortar institutions affect project outcomes, this section takes advantage of the overlap between fund sources and project types in Ghana's local governments. Since the same types of projects are funded and delivered through different mechanisms with the same districts and narrowly defined geographic communities, and sometimes even by the same contractors, it is possible to control for

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<sup>34</sup> Contractors in Ghana frequently complain about delayed payment and non-payment for work by Government; there are reports of contractors going unpaid for periods of a year or more for work done (Abotsi 2013).

<sup>35</sup> Calculations based on an exchange rate of USD 1 = GHS 2.35, as at 31 December, 2013. These figures are indicative, since the expenditure on these projects would have spanned the period 2011-13 and thus could have been somewhat higher or lower depending on exchange rates fluctuations, the temporal incidence of expenditures, and changes in aggregate spending. Likewise, the set of project fund sources included in the overall local government capital expenditure figures is slightly different than the set of fund sources included in the APR database, but it is not possible to disaggregate them by fund source to arrive at a more precise estimate.



a broad range of observable and unobservable factors that can influence project completion. The remaining difference in completion rates between fund sources is difficult to attribute to anything but the effect of the fund sources and delivery mechanisms themselves. Nevertheless the data is observational and the processes involved are complex, so in the absence of convincing instruments it is impossible to prove a causal link. I discuss potential alternative explanations and argue that while they cannot be ruled out entirely, they are unlikely to account for the observed difference between fund sources. This robust observational evidence is a useful complement to the proliferation of experimental research, the internal neatness of which stands in stark contrast to the untidy realm of real-world policy implementation.

#### 4.1 Institutional context

Since the 1990s, Ghana has progressively decentralized responsibility for delivering a variety of public goods and services to its districts.<sup>36</sup> In the realm of infrastructure, this includes facilities for basic (but not secondary or tertiary) education, sanitation, construction and maintenance of non-trunk roads, primary care clinics, local economic infrastructure (e.g. markets), and the provision of housing and offices for local government staff. While the central government has retained responsibility for undertaking most large infrastructure projects and thus accounts for the majority of public infrastructure investment, local governments nevertheless spend a substantial amount of the revenue on capital investment: GH 317 million (equivalent to just over US \$135 million) in 2013, or 42.5% of their total revenue.

<sup>36</sup> The list of decentralized functions varies slightly across local government unit classification, so that Metropolitan and Municipal Assemblies have greater responsibilities and occasionally slightly different financial management and procurement rules than District Assemblies. These distinctions do not affect this study's analysis, however, since the focus is variation within rather than across districts, and project type is controlled for throughout.

Despite this decentralization program, the central government has continued to be actively involved in infrastructure development in the districts, either by implementing projects directly, by statutory revenue transfers, or by other funding mechanisms whose operations involve a mix of local and central participation. Likewise, donors play an important role in the funding and implementation of infrastructure projects in decentralized domains, also through various channels: direct implementation, revenue transfers via the central government, or other forms of collaboration with district administrations.

Table 2 summarizes this diversity of mechanisms for funding and executing infrastructure projects in Ghana's local governments. There are three main fund sources that jointly account for half of all projects:

- The District Assemblies Common Fund (DACF) is a central government lump sum transfer to districts. The DACF was established by the 1992 Constitution and funded by 7.5 percent of total central government revenue, of which roughly one half is transferred as a lump sum to districts on a quarterly basis according to a formula that is approved annually by Parliament.<sup>37</sup> Project selection, procurement, and implementation are left in the hands of the district, subject only to annual financial reporting to the DACF Administrator (a small secretariat in Accra) and an annual financial audit by the Ghana Audit Service. Due to aggregate fiscal constraints, the Ministry of Finance is often delayed in disbursing DACF funds by six months or more; for example, the third quarter 2013 funds were actually disbursed in the second quarter of 2014 (Kunateh 2014).<sup>38</sup>
- The District Development Facility (DDF), created in 2008/09, is also a lump sum transfer to districts, but it is primarily financed by donors (with the central government contributing some co-financing). Disbursements are made once or twice annually, and are not subject to delays (in contrast to most other fund sources). As with the DACF, districts themselves are responsible for project selection, procurement, and implementation. Allocations are made on the basis of a pre-defined formula and the results of an annual assessment of compliance with statutory regulations and administrative processes. Districts that perform better receive incrementally higher allocations, while districts that do not meet the minimum requirements do not receive funds for investment in that year's allocation. The grant is administered by a dedicated secretariat in Accra at the Ministry of Local Government and Rural Government, with periodic oversight from joint donor and government technical and steering committees; financial auditing is conducted by the

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<sup>37</sup> Substantial "at source" deductions are made for goods procured on behalf of districts (such as bulk purchases of equipment) or nationwide programs being implemented in districts, such as the National Youth Employment Programme and School Feeding Programme (DACF 2014); there are also smaller deductions for other bodies. The amount directly disbursed to districts varies by district and year, but this is announced in advance and thus can be anticipated by districts, and is exogenous to district performance. Banful (2011) presents evidence that the allocation formula itself was manipulated over the period 1994-2005 in order to target more resources to swing districts. However, such targeting should decrease the *number* of completed projects but not necessarily the completion *rates*, since the manipulation occurs prior to budgeting and can thus be anticipated by districts. The effects she estimates are in any case relatively small in magnitude.

<sup>38</sup> Funds are disbursed to all districts simultaneously so these delays affect all districts equally, and there is no evidence of any differential delay in releases or manipulation thereof.

Ghana Audit Service as part of its audit of DACF funds.<sup>39</sup> There are also site visits to a small number of projects as part of the annual compliance assessment exercise.

- The Ghana Education Trust Fund (GETFund), established in 2000, provides funds for basic, secondary, and tertiary educational infrastructure, and is funded by 2.5 percent of value-added tax collections. Districts submit a list of proposed projects to the Ministry of Education, which selects a number of these to fund (in conjunction with the dedicated GETFund Administrator's office). As with the DACF, releases from the Ministry of Finance into the GETFund are often subject to significant delays; unlike the DACF, GETFund resources are not transferred to districts but are used centrally to pay contractors directly for work done in the districts. Procurement is conducted at district level for some GETFund projects and centrally for others.

From an institutional design perspective, the DACF, DDF, and GETFund are comparable in that they are alternative mechanisms through which non-local actors – the central government and donors – can channel resources to realize infrastructure projects in districts. By an act of Parliament, for example, the central government could redirect funds from the DACF to increase its co-financing of the DDF; alternatively donors could choose to redirect their funds from DDF contributions to a direct contribution to the DACF.<sup>40</sup> Since there is substantial overlap in the types of projects they fund, they can legitimately be viewed as institutional alternatives. However, moving the level of analysis down from the problem of aggregate resource allocation to the comparison of particular institutional features is more difficult because the dimensionality of institutional design is greater than the number of institutions, so attempts to attribute overall performance to particular features are overidentified.

One way to reduce the dimensionality of the problem is by making bilateral comparisons. The DDF is most directly comparable to the DACF, in that both are lump-sum transfers for which districts themselves are responsible for project selection, procurement, and execution. The differences between them are: 1) the DDF is subject to a higher degree of *ex ante* scrutiny of budgets, making it more effective in insisting that districts budget to complete existing projects before starting new ones; 2) the DDF is subject to a slightly higher degree of *ex post* monitoring of projects, and the involvement of donors may make the threat of sanctions more credible; and 3) the DDF fund releases are reliable, while those of the DACF are

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<sup>39</sup> While the performance-linked nature of the allocation formula raises concerns about bias in estimated fund source effects, in practice the potential for this is minimal. First, as with the DACF, reduced allocations are known in advance and should thus affect the number of completed projects rather than the completion rate. Second, there is a two year lag between the assessment year on which the allocation is based and the allocation itself: for example, the allocation for the 2013 DDF disbursement was made based on an assessment conducted in 2012 of administrative records from 2011. Third, since the first year of the assessment the vast majority of districts have passed the assessment and thus receive the investment grant. Whether this reflects improved compliance or falsification of records, it means that there is comparatively little variation in allocations. Finally, if failing the assessment were leading to projects not being finished due to shortfalls in funds, this would result in a downward bias on the estimated coefficient for DDG projects, suggesting that the estimates actually understate the true degree of variation among fund sources.

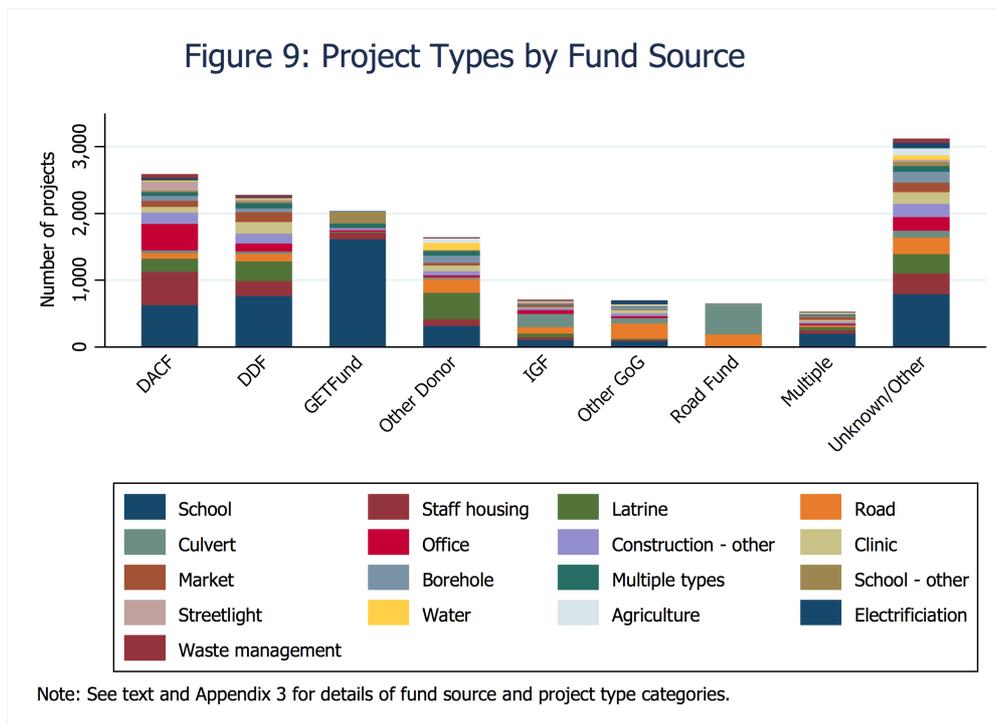
<sup>40</sup> The Constitution mandates that the DACF transfer be at least 5 percent of government revenue, but since 2007 Parliament has devoted 7.5 percent of revenue to the DACF. In the long run, of course, even such constitutional provisions are questions of institutional design.

Table 2: Fund Sources and Their Characteristics

Fund source	Fund source characteristics				Implementation responsibility			
	Allocation to districts	Project types	Funding	Resource predictability	Project selection	Procurement	Monitoring	Payment
<i>Major fund sources</i>								
District Assemblies Common Fund ( <i>DACF</i> )	Formula	Any	Central transfer	Low	Local	Local	Local	Local
District Development Facility/ Urban Development Grant ( <i>DDF/UDG</i> )	Formula	Any	Donor transfer	High	Local	Local	Local/ Central/ Donor	Local
Ghana Education Trust Fund ( <i>GETFund</i> )	Central committee	Educational facilities	Central	Low	Central/ Local	Central/ Local	Central/ Local	Central
<i>Minor fund sources</i>								
Assembly Internally Generated Funds ( <i>IGF</i> )	-	Any	Local	Medium	Local	Local	Local	Local
Ghana Road Fund ( <i>Road Fund</i> )	Central committee	Roads/ Culverts/ Drains	Central (% taxes and tolls)	High	Local	Central	Central/ Local	Central
Other donor ( <i>Other donor</i> )	Donors	Varies	Donor	Varies	Donor/ Local	Donor/ Local	Donor/ Local	Donor/ Local
Other government ( <i>Other GoG</i> )	Central ministries	Varies	Central	Low/ Medium	Central	Central	Central/ Local	Central
Multiple	-	-	-	-	-	-	-	-
Unknown/ Other	-	-	-	-	-	-	-	-

Source: Author's synthesis from interviews and various fund source documentation. Cells with two government levels indicated (e.g. Central/ Local) are listed in rough order of importance.

subject to frequent delays of unpredictable length. On other dimensions, however, the DACF is more comparable to the GETFund, in that both are funded by the central government rather than donors, both are subject to significant unpredictability in resource availability, and physical monitoring of projects from the central level is significantly looser than for the DDF. The key differences between the DACF and the GETFund are: 1) DACF project selection is undertaken entirely at district level, whereas GETFund projects are proposed by districts but selected at the central level; 2) project procurement is always undertaken at district level for DACF, but is usually conducted by the Ministry of Education for GETFund projects; and 3) DACF funds are transferred to districts to pay contractors directly, while contractors on GETFund projects are paid by the Ministry of Education, even if procurement was done at district level.



In addition to these three major fund sources for district infrastructure projects, the APR database also contains details of projects undertaken by a variety of other fund sources:

- Districts can execute projects with their own internally generated funds (IGF), collected using their statutory powers. Districts have complete discretion over these funds, but these revenues are relatively small for most districts and as a result IGF projects are heavily concentrated in Accra and its suburbs and Kumasi (the second city).<sup>41</sup>

<sup>41</sup> In analyzing project completion I abstract from district revenue collection considerations. This does not pose a threat of bias, because only a few districts have enough IGF to use for capital projects and these levels are highly persistent across time, and are thus controlled for using district and district-year fixed effects. Mogues and Benin (2012) find that central government revenue transfers in Ghana reduce districts' own revenue collection, but this should not affect the analysis of project completion *rates* (as opposed to numbers) due to the use of fixed effects and the easily anticipated nature of these funding flows. I also abstract from issues of debt and other inter-temporal resource transfers, since districts

- The Ghana Road Fund is primarily responsible for maintenance of roads, but also executes some new works (especially culverts and drainage). Non-trunk road construction in Ghana has only been partially decentralized, so projects are selected and prioritized by districts but procured and executed by the deconcentrated but still centrally managed Department of Urban Roads and Department of Feeder Roads.<sup>42</sup>
- In addition to the DDF, numerous other donor programs support district infrastructure development, under various institutional arrangements. For the purposes of this study, these are grouped together in the “Other donor” category.<sup>43</sup>
- Central ministries can execute projects directly in districts, mainly but not exclusively in non-decentralized domains (e.g. secondary education). While these are funded and executed centrally, in some cases the district administrations may also play a role. However, this cannot be determined from the database.<sup>44</sup>

Making inferences about institutional effectiveness is more difficult for these minor funds, so the analysis below reports but does not dwell on differences across them. Only a handful of projects (3.7 percent) are funded by more than one of these fund sources.

District administrations themselves are composed of a core of professional public servants, including dedicated staff for planning, engineering, and finance. At the political level, districts are headed by a District Chief Executive (DCE) who is appointed by the President but must be confirmed by a formally non-partisan district assembly composed 70 percent of members elected from geographically defined electoral areas and 30 percent of members appointed by the President.<sup>45</sup> While DCEs and assembly members collaborate on the planning and budgeting of projects, within the year DCEs have a significant amount of operational and financial discretion, and are thus the most important actors for project execution.

## 4.2 Project completion across fund sources

Figure 10 shows the three-year completion rates of projects for the main three fund sources, both for all projects (10a) and for school buildings only (10b) for comparability, using the middle estimate methodology described in section 3. The differences across fund sources are substantial: after three years 78.5 percent of DDF

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have extremely limited credit capacity and are required to spend disbursed funds within the budget year.

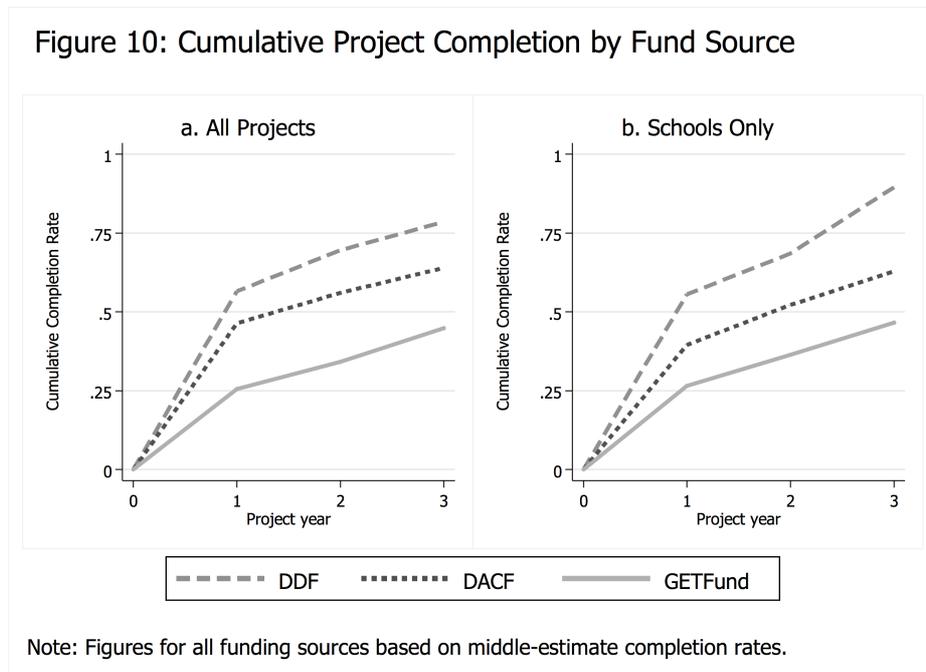
<sup>42</sup> The maintenance activities of the Road Fund appear to be included in some district APRs but not others.

<sup>43</sup> This category includes the Urban Development Grant (UDG), which was consciously modeled on the DDF and shares many features but targets only urban districts (Metropolitan and Municipal Assemblies), was only introduced in 2012, and has slightly different oversight mechanisms and qualification rules. Including UDG projects with the DDF does not materially change the analysis.

<sup>44</sup> It also seems likely that the reporting of central government projects is incomplete and potentially variable across districts.

<sup>45</sup> For convenience and clarity I refer generically to DCEs, but in Municipal Assemblies this position is known as Municipal Chief Executive, and likewise Metropolitan Chief Executives in Metropolitan Assemblies. Assembly members were elected in nationwide elections in 2010, and there are no differences across districts in their tenure. DCEs do not have a fixed term and so would expect to serve at least until the next presidential election unless they are removed; most importantly for the purpose of this paper, there are no differences in the structure or timing of their terms across districts.

projects are completed, compared to just 64.0 percent of DACF projects and 44.8 percent of GETFund projects. The same pattern emerges even when restricting the sample to school buildings only. The differences between DDF and DACF projects are particularly striking, since these projects are planned, procured, and executed by the exact same district-level bureaucrats and politicians, thus controlling for the quality, composition, and management of politicians and bureaucrats. Figure 11 confirms that the differences among fund sources are of similar magnitude regardless of which estimation methodology is used.



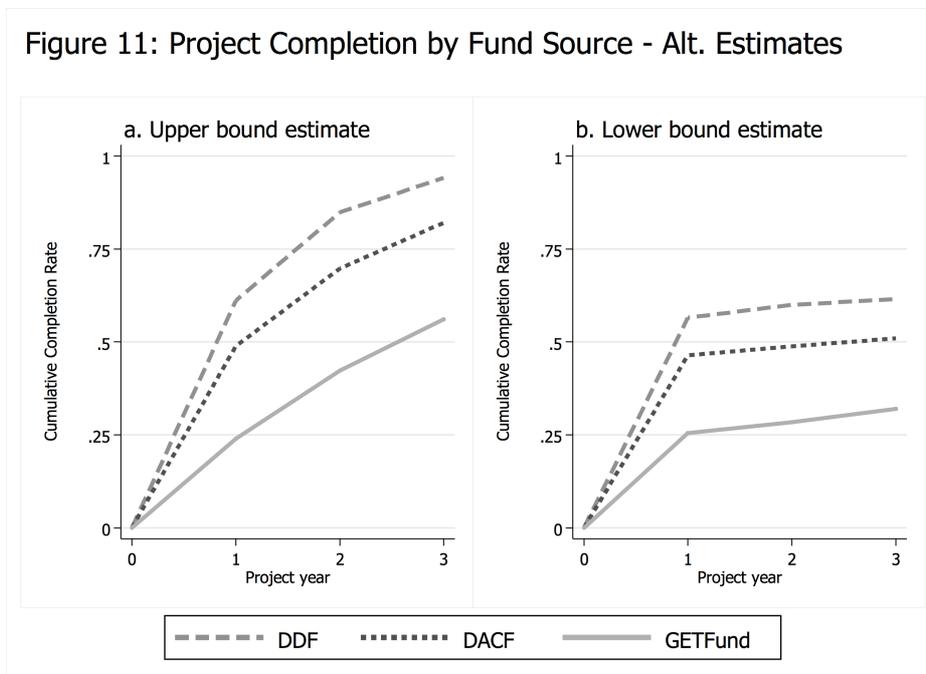
To estimate these differences parametrically while controlling for a broader range of other factors, I estimate a linear probability model of the following form:

$$(1) \quad y_{i,j,k,t} = \mathbf{F}_{i,j,k}\boldsymbol{\beta} + \mathbf{P}_{i,j,k}\boldsymbol{\gamma} + \lambda_j + \delta_k + v_t + \epsilon_{i,j,k,t}$$

where  $y_{i,j,k,t}$  represents the completion status of project  $i$  in district  $j$  of type  $k$  in year  $t$ ,<sup>46</sup>  $\mathbf{F}_{i,j,k}$  is a vector of fund source indicator variables,  $\mathbf{P}_{i,j,k}$  is a vector of project characteristics including construction type (i.e. greenfield projects vs.

<sup>46</sup> Using the annual completion status of a project does not take into account whether the project is a first or subsequent year project (although I control for this using indicator variables in most specifications). The annual completion status has the disadvantage of differing from the eventual cumulative completion status of a project, and is potentially vulnerable to cross-district bias if attrition differs systematically across districts. However, using three-year completion rates for full sample estimation and cross-district comparisons is not feasible since these cannot be calculated for districts with missing report years or that do not report project commencement dates, or for projects that started in 2012 or 2013. Where it is possible to calculate both, annual completion rates are highly correlated with three-year completion rates across project types and fund sources, and there are no observed instances for any major sub-group (such as fund source or project type) of one sub-group having a higher annual completion rate but lower three-year completion rate than another sub-group. The annual completion rate is thus a robust measure to use both for within- and across-district comparisons.

maintenance/repair) and project year (first, second, or third)<sup>47</sup>,  $\lambda_j$  is a vector of district fixed effects,  $\delta_k$  is a vector of project type fixed effects<sup>48</sup>,  $\nu_t$  is a vector of year fixed effects,  $\epsilon_{i,j,k,t}$  is an error term, and  $\beta$  and  $\gamma$  are vectors of parameters to be estimated. The coefficients  $\beta$  - specifically, the differences between them – are the parameters of primary analytical interest.<sup>49</sup>



The results are presented in Table 3. Column 1 shows simple mean annual completion rates of the three major fund sources, with the constant term being the completion rate of projects from the minor or unknown fund sources. Column 2 adds district and year fixed effects, and Column 3 further adds project type fixed effects and characteristics. The bilateral differences between the three coefficients of interest are highly statistically significant in each case, and also economically significant: the DDF annual completion rate is in the range of 10-12 percentage points greater than that of the DACF, which is in turn 15-20 percentage points greater than that of the GETFund.

<sup>47</sup> Project year is coded using the manual linking process; all projects that were not identified as continuations of a previous year's project are coded as year one. This coding scheme was chosen to make use of the entire sample while taking account, where possible, of whether a project was in its first or subsequent year. While there are theoretical concerns about this variable's endogeneity to project completion and potential bias from differential reporting quality or attrition across districts, in practice the inclusion of these variables has little effect on the coefficients of interest or the model as a whole, any cross-district bias would be cancelled out by the district fixed-effects, and attrition is independent of fund source.

<sup>48</sup> Project type is disaggregated into seventeen categories, with schools further disaggregated into 6 categories according to the number of rooms in the school block (with a residual category for schools with an unknown number of rooms), for a total of 22 categories. See Appendix 3 for more details.

<sup>49</sup> I use the linear probability model (LPM) due to the large number of fixed effects variables used (thousands, when adding location or contractor fixed effects) which make estimation by logit or probit computationally difficult and potentially biased. Where possible, however, estimating the model as a logit or probit produces similar results. Estimating a Cox proportional hazards model is problematic due to the short time frame and resulting truncation of the data, and the difficulties in linking project observations across years discussed in the previous section. Nevertheless, using this estimator generates similar differences across fund sources.

The model presented in Column 4 is identical to the baseline model in Column 3 but with the full range of fund source indicator variables. This shifts the point estimates of the DACF, DDF, and GETFund coefficients by changing the composition of the base comparison category, but does not affect the difference between them. While the point estimates on the minor fund source categories are not a primary analytical focus, they are nonetheless interesting to note. Projects funded by districts' own funds (IGF) have even higher completion rates than DDF projects, and the "Other donor" category also has an above average completion rate. The completion rate of Road Fund projects is extremely high, nearly 30 percentage points above that of the DDF; while it seems likely that this is at least partly skewed by reporting considerations (see previous sub-section) and should thus be taken with a grain of salt, it is nonetheless surprising. Projects executed directly by the central government (Other GoG) have relatively low completion rates, similar to those of the GETFund, while projects funded by multiple sources have middling completion rates, roughly on par with DACF projects.

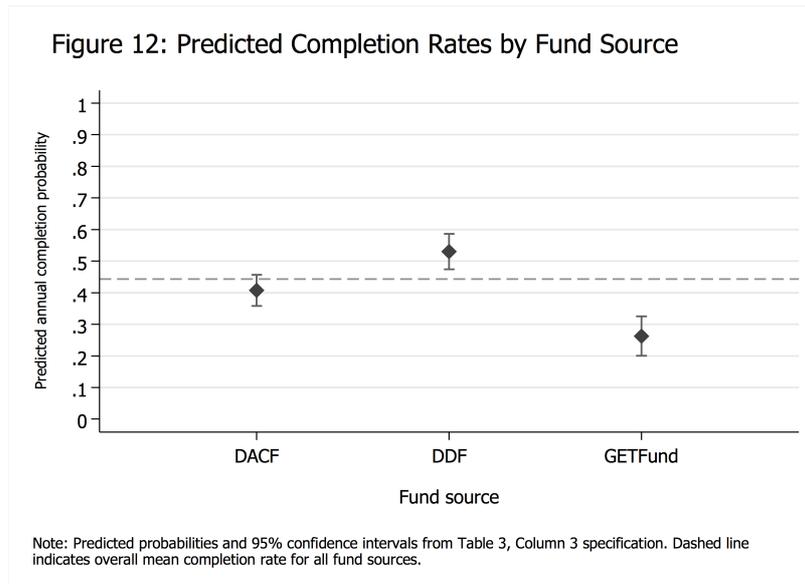
Table 3: Project Fund Source and Completion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All	All	All	All	All	Schools	All
	projects	projects	projects	projects	projects	only	projects
Project fund source							
<i>(Payment decisions - Primary source of funds)</i>							
DACF	-0.019	-0.004	-0.001	0.043	-0.022	-0.019	-0.089
<i>(Local - Central transfer)</i>	(0.041)	(0.024)	(0.025)	(0.038)	(0.031)	(0.040)	(0.036)*
DDF	0.091	0.120	0.122	0.165	0.095	0.112	-0.014
<i>(Local - Donor transfer)</i>	(0.061)	(0.028)**	(0.029)**	(0.042)**	(0.030)**	(0.049)*	(0.035)
GETFund	-0.218	-0.201	-0.146	-0.105	-0.112	-0.120	-0.181
<i>(Central - Central direct)</i>	(0.069)**	(0.036)**	(0.032)**	(0.044)*	(0.032)**	(0.040)**	(0.041)**
IGF				0.184			
<i>(Local - Local)</i>				(0.071)**			
Other donor				0.099			
<i>(Donor - Donor)</i>				(0.046)*			
Other GoG				-0.097			
<i>(Central - Central direct)</i>				(0.056)			
Road Fund				0.444			
<i>(Central - Central direct)</i>				(0.073)**			
Multiple				0.032			
				(0.072)			
Constant	0.464	0.515	0.408	0.339	0.611	0.302	0.823
	(0.059)**	(0.021)**	(0.060)**	(0.071)**	(0.105)**	(0.074)**	(0.134)**
<i>Coeff. equality tests (prob &gt; F)</i>							
DACF = DDF	0.005	0.000	0.000	0.000	0.001	0.001	0.084
DACF = GETFund	0.000	0.000	0.000	0.000	0.009	0.016	0.064
DDF = GETFund	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Observations	13339	13339	13339	13339	10420	4204	8801
R-squared	0.03	0.04	0.07	0.09	0.11	0.04	0.19
<i>Fixed effects</i>							
District		Yes	Yes	Yes		Yes	Yes
Year		Yes	Yes	Yes	Yes	Yes	Yes
Project type			Yes	Yes	Yes	Yes	Yes
Location					Yes		
Contractor							Yes
Project characteristics			Yes	Yes	Yes	Yes	Yes

\* significant at 5%; \*\* significant at 1%

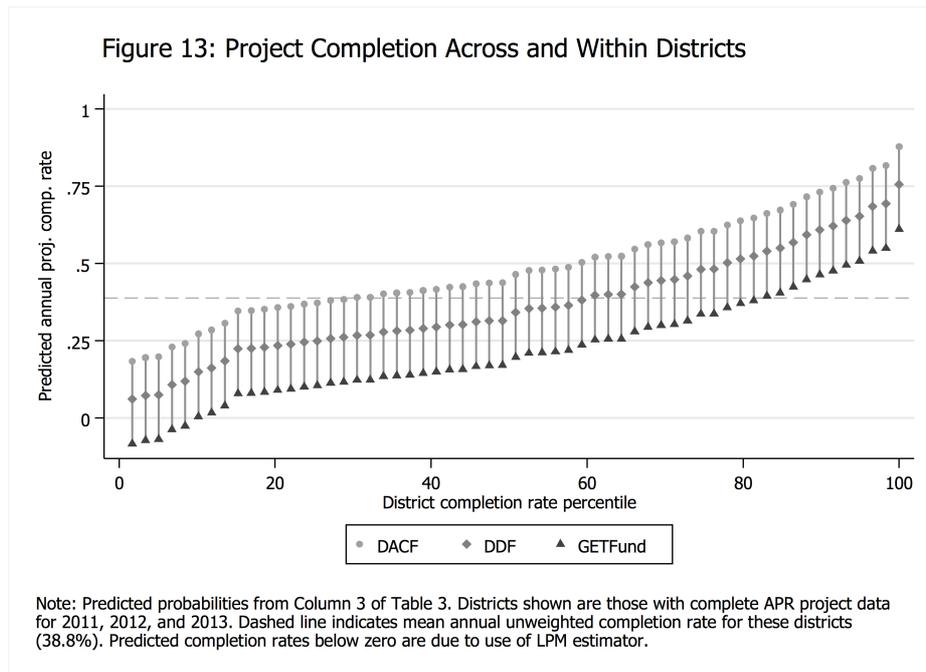
Note: Dependent variable is project completion. Other/unknown is omitted fund source category. Project characteristics are construction type (construction/maintenance) and project year indicators (based on manual linking). Huber-White robust standard errors clustered at district level. Payment decisions and primary source of funds are indicated for convenience, and are based on Table 2.

The specifications of Columns 3 and 4 are already demanding, but Columns 5-7 show that the key findings are robust to even narrower comparisons. Column 5 includes fixed effects for the location of projects – the 5,248 unique villages and neighborhoods in which the projects are located – in order to address concerns that projects might be sorted into fund sources according to unobserved within-district heterogeneity across locations. Even after controlling for all the observed and unobserved features of these narrowly defined locations, there is still a gap of 11.7 percentage points between the completion probability of DDF and DACF projects, and another 9.0 percentage points between DACF and GETFund projects.



Column 6 restricts the sample to the construction of school buildings only (with number of units in the classroom block controlled for within the project type fixed effects). This changes the point estimates slightly, but the differences remain highly significant. Column 7 estimates the model with fixed effects for the 4,546 unique contractors that executed the projects – the fund source coefficients are thus effectively estimated within the 15.9 percent of contractors that executed projects from more than one fund source.<sup>50</sup> Even with this extremely demanding specification, the differences between the DDF-DACF and DACF-GETFund coefficients are still 7.4 and 9.2 percentage points, respectively, and both are statistically significant at the ten percent level. It is all the more remarkable that these results hold in this specification since the choice of contractor is endogenous to the procurement process, and the selection of qualified contractors (as opposed to politically connected or bribe-paying firms) is itself one of the main channels thought to influence the quality of implementation.

<sup>50</sup> A total of 5,113 unique contractors appear in the APR dataset, as detailed in Appendix 3, but the number used to estimate Column 10 of Table 3 is slightly smaller since some contractors implemented only non-infrastructure projects (which are excluded from this paper’s analysis) and some projects are missing completion data.



In addition to being highly statistically significant, the differences in completion rates across fund sources are also economically significant. In the baseline model in Column 3, DDF project completion rates are estimated to be 12.3 percent points higher than DACF projects, and 26.7 percentage points higher than GETFund projects. Since the overall annual completion rate of all projects is 44.4 percent, these differences are substantial. They are also large even when compared to the cross-district variation in project completion rates. Figure 13 plots predicted annual completion rates for the three main fund sources for the 59 districts for which all three years of APR data are available, using the baseline model from Column 3 of Table 3. The gap between DDF projects and GETFund projects in this estimate is 26.7 percentage points, whereas the standard deviation of annual completion rates across districts is 18.8 percentage points. This means that a DDF project in the 25<sup>th</sup>-percentile district has approximately the same likelihood of completion as an equivalent GETFund project in the 70<sup>th</sup>-percentile district. Given that the cross-district differences include all the measurable and unobserved effects of leadership, district socioeconomic characteristics, political affiliation, and other variables, the magnitude of the estimated within-district differences across fund sources is remarkable.

Table 4 shows that the results are robust to the inclusion of a further set of controls. Column 1 re-estimates the baseline model, but with district-year fixed effects to capture district-specific time trends or shocks in particular years, such as leadership changes and economic or climatic shocks, with little change in the coefficients of interest. Columns 2-6 investigate the potential for systematic within-type differences in projects' engineering characteristics across fund sources. Column 2 restricts the sample to greenfield projects. Column 3 includes control variables indicating whether the classroom block is being constructed together with various types of additional facilities, such as latrines or offices.<sup>51</sup> Column 4 includes a control variable for the expected length of the project in years, as reported by the district (although this is

<sup>51</sup> Appendix 3 contains details of the definition and coding of these additional facilities variables.

plausibly endogenous to fund source, if bureaucrats factor in a project's fund source when making these estimates). This variable is only reported for 3,079 projects. This actually increases the difference between the DACF and DDF coefficients (relative to the baseline model), but the difference between DACF and GETFund decreases to 4.2 percentage points and loses statistical significance. However, Column 5 shows that these effects are largely due to the changing sample composition (since most projects do not report an estimated completion date) rather than the inclusion of the control variable itself. Finally, Column 6 shows that the estimated effects remain substantial even when restricting the sample to district administration offices and housing for district staff, both types of projects for which bureaucrats themselves are the primary beneficiaries, although the DACF-DDF and DACF-GETFund coefficient differences are statistically significant only at the ten percent level. As discussed below, the continued significance of fund source differences even for these non-patronage project types suggests that they do not merely reflect some type of endogenous sorting of projects into fund sources based on considerations of political economy or clientelism.

Table 4: Robustness of Results

	(1)	(2)	(3)	(4)	(5)	(6)
	All projects	Greenfield only	Schools only	All projects	Column (3) sample	Offices & staff housing
<i>Project fund source</i>						
<i>(Payment decisions - Primary source of funds)</i>						
DACF	-0.016	0.028	-0.024	-0.136	-0.132	-0.063
<i>(Local - Central transfer)</i>	(0.025)	(0.038)	(0.041)	(0.050)**	(0.050)**	(0.043)
DDF	0.103	0.176	0.111	0.056	0.063	0.017
<i>(Local - Donor transfer)</i>	(0.028)**	(0.042)**	(0.049)*	(0.064)	(0.064)	(0.056)
GETFund	-0.163	-0.079	-0.108	-0.178	-0.178	-0.163
<i>(Central - Central direct)</i>	(0.031)**	(0.043)	(0.041)**	(0.056)**	(0.056)**	(0.067)*
Constant	0.369	0.525	0.310	0.934	0.909	0.594
	(0.054)**	(0.095)**	(0.076)**	(0.070)**	(0.066)**	(0.045)**
<i>Classroom block additional facilities</i>						
"Ancillary facilities"			-0.063			
			(0.025)*			
Latrine			-0.020			
			(0.059)			
Office/ Store/ Library			0.025			
			(0.026)			
Expected years to complete				-0.040		
				(0.028)		
<i>Coeff. equality tests (prob &gt; F)</i>						
DACF = DDF	0.000	0.000	0.001	0.000	0.000	0.086
DACF = GETFund	0.000	0.000	0.045	0.355	0.310	0.093
DDF = GETFund	0.000	0.000	0.000	0.000	0.000	0.010
Observations	13339	10142	4204	3079	3079	2066
R-squared	0.07	0.09	0.05	0.11	0.11	0.05
<i>Fixed effects</i>						
District		Yes	Yes	Yes	Yes	Yes
Year		Yes	Yes	Yes	Yes	Yes
Project type	Yes	Yes	Yes	Yes	Yes	Yes
District-year	Yes					
Project characteristics	Yes	Yes	Yes	Yes	Yes	Yes

\* significant at 5%; \*\* significant at 1%

Note: Dependent variable is project completion. Other/unknown is omitted fund source category. Project characteristics are construction type (construction/maintenance) and project year indicators (based on manual linking). Huber-White robust standard errors clustered at district level. Payment decisions and primary source of funds are indicated for convenience, and are based on Table 2. See Appendix 3 for details of classroom block additional facilities coding; omitted category is schools for which no additional facilities were reported.

### 4.3 Interpretation and endogeneity

The results presented in Tables 3 and 4 are extremely robust evidence of a significant association between project fund source and project completion, and the extensive array of controls accounts for nearly every hypothesis on the determinants of public good provision that has been put forth by the literature. Nonetheless, in the absence of experimental variation or convincing instrumental variables, these associations cannot be conclusively identified as causal. This section therefore considers possible alternative interpretations of the results.

The most plausible possibility is that there could be some type of unobservable *within-location* variation in community attributes that are correlated with completion probability and according to which projects are endogenously sorted into fund sources. Local ethnic or partisan composition (Besley *et al* 2004; Ichino and Nathan 2013; Nathan 2015) could be one such source of unobserved heterogeneity: politicians might care more about delivering projects to residents in one part of the location and therefore allocate projects for that area into a fund source with a higher completion rate. Part of the estimated difference among fund sources would then be due to these unobservable factors rather than any causal effect of the fund source itself. (Although this potential source of bias assumes that the rationale for project sorting is that some fund sources have higher completion rates to begin with, so it would imply that the estimated differences between fund source coefficients would be biased upwards but not non-existent.) While this is theoretically possible, there are three reasons to think it implausible that this accounts for more than a fraction of the observed variation across fund sources. First, switching from district fixed effects in Column 3 of Table 3 to location fixed effects in Column 5 only reduces the overall difference between the DACF and DDF coefficients by 0.6 percentage points, or less than five percent of the estimated effect.<sup>52</sup> For within-location heterogeneity to account for the entire observed difference among completion rates of these two fund sources, the sorting effect of *within-location* heterogeneity would have to be *twenty times larger* than the combined effect of *across-location* heterogeneity. Although this informal logic relies on some fairly strong econometric assumptions (Altonji, Elder, and Taber 2005; Oster 2014) and should therefore be treated as indicative only, it nonetheless emphasizes that the within-location targeting and sorting effect would have to be extremely strong to explain the observed differences among fund sources.

Second, the within-location heterogeneity hypothesis relies on localities being sufficiently large that projects can be *club goods* accessible only to favored clients rather than *public goods* accessible to all residents of the location. Since the most common location definitions are village names (for rural areas) and neighborhood names (for urban areas), however, it is unlikely that many of them are larger than the catchment area of a school (for example), especially in contexts where existing service access and provision is low. While it is not presently possible to link project location to demographic information at the sub-district level, a very rough calculation suggests an upper bound on the mean population of these locations of 3,000 to

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<sup>52</sup> The reduction in the difference between DDF and GETFund coefficients is slightly greater, about one-fifth, but this still implies that within-location heterogeneity would have to have a very strong effect to account for the observed difference. For examining the potential role of project targeting, however, the DACF-DDF difference is the most relevant since these are the fund sources over which districts have complete control both of project selection and payment.

5,000.<sup>53</sup> While the possibility that infrastructure projects are locally excludable even within these relatively narrow geographic areas cannot be ruled out, it nonetheless seems implausible that sorting of projects into fund sources in order to engage in within-location targeting of projects could lead to differential completion rates across fund sources of the magnitude observed.

Finally, large differences in completion rates are observed even for types of projects that are not normally associated with patronage because the district administration itself is the main beneficiary, as Column 6 of Table 4 shows. While this does not exclude the possibility that other project types are subject to highly localized targeting, it nonetheless suggests that this effect is not driving the results.

Another potential interpretation of the results is that fund source-level completion rates are driven not by the institutional mechanisms through which they implement policy, but by politicians anticipating differences in voters' attribution of projects from different fund sources. For example, politicians might care more about completing projects for which voters think politicians are directly responsible, and therefore put more effort into completing those projects. If this were driving variation across fund sources, however, one would not expect the donor-supported DDF to have a higher completion rate than the DACF, which is entirely funded and implemented by the government. More generally, attribution and accountability considerations can be thought of as important elements of institutional design for service delivery; to the extent that attribution effects account for variation in completion across fund sources, then, this is a point about the *mechanism* through which projects' fund source affects completion, not about *whether* the institutional design of this fund source affects completion.

However, even assuming that the estimated fund source effects are entirely causal, the marginal effect of shifting a project from (for example) DACF to DDF could be smaller than these estimates if it induced actors to change their behavior along other margins. For example, if corruption were more prevalent in DACF projects than DDF projects due to stricter monitoring, shifting a DACF project to the DDF might lead politicians, bureaucrats, or contractors to substitute corrupt behavior towards other DACF projects or non-infrastructure activities. Thus the marginal effect could be to increase the completion probability of the project in question but reduce that of other DACF projects, although the net marginal effect would still be positive (assuming that the demand curve for corruption is downward sloping).<sup>54</sup>

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<sup>53</sup> For the 56 districts that reported at least some project locations and for which three years of APR data are available, the average number of locations is 46.1, giving a mean population per location of 3,350 (based on the 2010 Census). The number of projects (mean population per project) for Metropolitan Assemblies (the most urbanized) in this sub-set is 160.0 (4,610), for Municipal Assemblies is 53.9 (3,031), and for District Assemblies (the most rural) is 38.4 (3,380). However since some locations presumably did not have projects in the period 2011-13 and thus do not appear in the dataset, the actual number of locations per district (and thus population per location) is likely to be even higher (lower) than this.

<sup>54</sup> A related but distinct concern is that the effect of shifting projects to more effective fund sources may diminish over time, as Olken and Pande (2012) document often occurs over time in response to anti-corruption interventions. This concern may be slightly smaller in this case, since the programs under study are well established and thus the effects are already estimated in bureaucratic and political equilibrium.

## 5. CONCLUSION

This study has sought to make two contributions to the empirical literature on public good delivery in developing countries. First, it has provided the most comprehensive evidence to date on the problem of delays and non-completion of infrastructure projects. While this study has shed light on the extent and shape of the problem in Ghana's local governments, more data gathering efforts are needed in different countries to gain a better sense of how the phenomenon varies across countries and bureaucratic and political contexts. Given the vast resources poured into infrastructure investments by governments and donors alike, it is striking how little is known about whether these projects are even being realized. More such research is crucial to inform institutional design and resource allocation decisions.

Second, this study has provided robust observational evidence that the institutional structures and processes used to deliver public goods matter, even when the same types of projects are being delivered by (in many cases) the same bureaucrats working under the same politicians, in the same communities, and by the same contractors. Further analysis is needed to specify the exact mechanisms through which this effect occurs, although these mechanisms are likely to vary across countries and sets of institutions due to the high dimensionality of policy and institutional design and the importance of context. Nonetheless, this study's findings on the empirical importance of the bricks-and-mortar institutions provides an important counterpoint to the recent literature's overwhelming emphasis on abstract institutions and political economy factors as the fundamental determinants of government performance. While these factors surely matter, so do the details of how these intangible forces manifest themselves in tangible institutions, organizations, and bureaucratic processes. In making this point, the study complements the explosion of micro-level experimental evidence on policy design and implementation by showing that these details can matter even at large scale, in political and bureaucratic equilibrium, and outside of carefully controlled experimental contexts.

This study has also attempted to take the first steps towards a theory of infrastructure project delivery. Doing so will require reuniting two branches of transaction cost economics that have been separately influential in studies of service delivery: contract theory and organizational economics on the one hand, and studies of distributive politics and clientelism on the other. The macro-historical literature on institutional development has long recognized that considerations of distribution and efficiency are not separable (Acemoglu, Johnson, and Robinson 2005). Translating this insight into specific contexts of service delivery is at the intersection of exciting research frontiers in public service delivery, distributive politics, and public administration.

These findings have immediate policy implications for government and donors in Ghana and elsewhere. The prevalence of unfinished projects, consuming roughly one-fifth of all capital expenditure, suggests that stricter monitoring efforts could easily pay for themselves by reducing wasteful expenditure on incomplete projects. Likewise, the variation in completion rates among fund sources suggests that better project delivery mechanisms can successfully improve project completion; government can thus take action to reform poorly performing fund sources, as well as reallocate funds into delivery mechanisms with higher completion rates. Given the role that delays and interruptions play in causing projects to be abandoned, action by

the central government to force districts to complete existing projects before starting new ones may also prove effective, if properly monitored and enforced.<sup>55</sup> This should be paired with improved predictability in the release of allocated funds to districts, to minimize delays in implementation.

Finally, the findings suggest that donor involvement in project delivery may be beneficial not only by contributing funds, but also by strengthening government delivery institutions. This is especially true of monitoring and enforcement mechanisms, since it may be easier for donors to credibly commit to enforcing rules than the government. In this respect, donors could potentially serve a similar role to that played by other independent state institutions such as audit commissions, ombudsmen, and independent budget offices. This role could continue to be important even once the funding role of donors decreases as countries grow and become less reliant on donor support (although donors' effectiveness at enforcing rules may also depend on the extent of their financial contribution). This is a largely unexplored area for research and creative policy design, and this paper's findings on the significant role of bricks-and-mortar institutions in successful policy implementation emphasize its importance.

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# APPENDIX 1: ANNUAL PROGRESS REPORTS

Figure A1: Annual Progress Report Sample Page

ADANSI SOUTH														
No	Project detail	Location	Funding source	Contractor	Original contract amount	Revised contract amount	Amount committed	Date awarded	Date committed	Date expected completion	Date actual completion	Status	Remarks	
ADS0001	construction of 6 unit classroom block	AWOROSO	Get Fund	ESSIL CONSTRUCTION	156,969.67	149,900.00		05-Aug-10	25-Aug-10	12-May-11		20	On-going	
ADS0002	construction of 6 unit classroom block	KOJO MANKRONG	Get Fund	FESAGE ENTERPRISE	157,575.83	149,900.00		05-Aug-10	26-Aug-10	19-May-11		20	On-going	
ADS0003	construction of 6 unit classroom block	EDWINASE	Get Fund	SUE ENGINEERING	158,250.95	149,900.00		05-Aug-10	25-Aug-10	26-May-11		20	On-going	
ADS0004	construction of 3 unit classroom block ( JHS)	SUBRISO	DDF	V FORGHAN LTD	59,947.36		59,947.36	18-Nov-10	29-Nov-10	19-May-11	18-Nov-11	100	completed	
ADS0005	construction of 20 seater vault toilet chamber	WURIYE	DDF	FAUSBON CONSTRUCTION WORKS	52,847.95		52,035.46	18-Nov-10	23-Nov-10	17-May-11	18-Nov-11	100	completed	
ADS0006	construction of 3 unit classroom block	NKORANSA	DDF	HAFI-WELL WORKS	60,077.05		60,077.49	18-Nov-10	30-Nov-10	24-May-11	18-Nov-11	100	completed	
ADS0007	construction of 3 unit classroom block	ODUMASSE	DDF	ADJOPY CONSTRUCTION & SUPPLY LTD	61,985.00		61,985.00	18-Nov-10	29-Nov-10	18-May-11	18-Nov-11	100	completed	

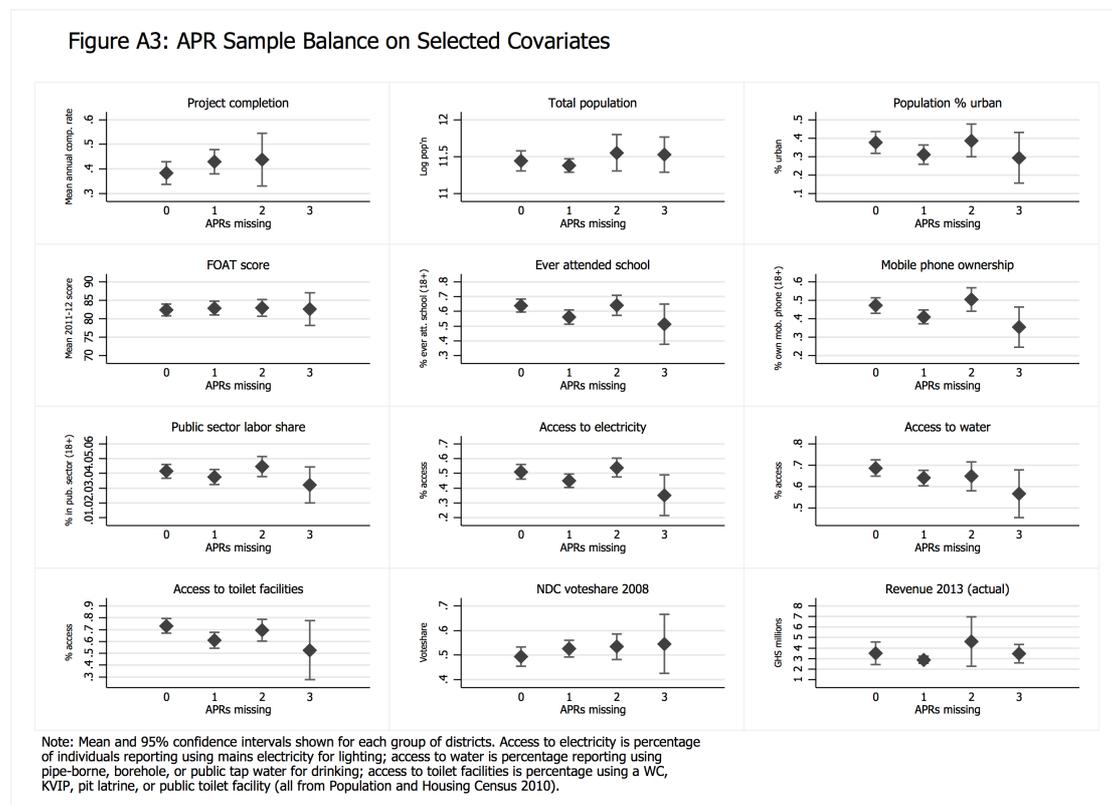
Figure A2: Storage of APRs in National Development Planning Commission Library



## APPENDIX 2: APR SAMPLE BALANCE

The coverage of the Annual Progress Report (APR) database is remarkably high, given that most had to be located in hard copy in the offices of the National Development Planning Commission (NDPC) in Accra or of the Regional Coordinating Councils (RCCs) in the ten regional capitals. Altogether 479 APRs were located. The maximum notional number of APRs for the period 2011-13 would be 602: 170 for 2011, 216 each for 2012 and 2013. Of these, 407 APRs contained project tables with sufficient information to be entered into the database. The final database thus covers 67.6 percent of possible district-year observations. Nevertheless, there are concerns that reporting could be correlated with other variables of interest, such as project completion rates.

As this Appendix shows, however, there is little evidence that reporting completeness is correlated with district characteristics. Figure A3 below plots the unweighted means and 95 percent confidence intervals of a wide range of variables, by the number of APRs that are missing for each district. The most important balancing test is for average annual project completion, this study's main dependent variable. Although it is not possible to calculate this for districts with all three APRs missing, there is no statistically significant difference in average completion rates across districts with different levels of reporting completeness; indeed districts with more incomplete reporting have, if anything, slightly higher completion rates, although this difference is not statistically significant. This alleviates the concern that estimated national project completion rates may be biased upwards due to reporting incompleteness.



The sample also appears to be balanced across the other variables reported in Figure A3. In addition to a wide range of demographic, social, and economic variables drawn from the 2010 Population and Housing Census, this includes: districts' scores on the Functional and Organizational Assessment Tool (FOAT) evaluation undertaken to assess districts' compliance with a set of procedural requirements as part of the allocation and disbursement procedure for DDF funds; the vote share in the district of the National Democratic Congress (NDC), which was the ruling party during the sample period, from the 2008 presidential elections; and budget size, as measured by the total revenue of the district in 2013. There are no apparent patterns across reporting completeness in any of the variables examined, so there is no evidence that the sample coverage of the APR database is biased.

### APPENDIX 3: VARIABLE CONSTRUCTION AND CODING

All APR database variables were coded algorithmically from text strings by defining a set of word or phrases corresponding to values; the particularities of this process for each variable, along with other relevant data and coding notes, are detailed below. Project numbers and statistics in this appendix are given at the point of coding, and thus may differ from those in the final database from which repeat observations and non-infrastructure projects have been excluded.

#### *FundSource*

Project fund source was constructed from APR entries for project's fund source for nearly all observations, although in a small number of cases (178, or 1.1 percent) there was no dedicated entry for fund source but fund sources were named in the project title. These were combined, and then coded into fund source categories according to a set of text strings commonly occurring in the data – e.g. for DACF, these were “DACF”, “COMMON FUND”, “D A C F”, and “CF”. All projects where the fund source was listed as the district itself were coded as using internally generated funds (IGF), together with those where IGF was directly identified as the fund source. The “Other donor” category comprises 51 sources, each of which accounts for only a small fraction of the total. Some of these are clearly identifiable – e.g. “USAID”, “EU”, “WORLD VISION” – while others are vague – e.g. “DONOR”, “NGO”, “CHINESE GRANT”. “Other GoG” includes all fund sources associated with central government other than the GETFund and Road Fund: e.g. “MOE” (Ministry of Education), “GOG” (Government of Ghana – typically used to mean central government in the Ghanaian context), “SECTOR MINISTRY”. The “Other/Unknown” category includes all projects for which no fund source was reported, as well as projects that could not be assigned to one of the other categories – most notably a small number of projects (143) funded by the local Member of Parliament (MP) using the minor allocation of the DACF which is disbursed to them as a constituency development fund, and 70 projects for which the “community” was listed as a fund source. All projects with more than one identifiable fund source (about 3 percent) were coded as “Multiple”.

#### *ProjectType*

Project type was constructed using sets of commonly used text strings in the project title to first group projects into sixteen types of infrastructure projects:

- *Agriculture*: dams, irrigation, dug-outs;
- *Borehole*: boreholes, wells;
- *Clinic*: clinics, health centres, hospitals, wards;
- *Construction – other*: abattoirs, computer centers, libraries, taxi ranks, lorry parks, community centers, sports stadiums, light industrial areas, warehouses;
- *Culvert*: culverts, drains, ditches, gutters;
- *Electricity*: electrification, substations;
- *Latrine*: latrines, Kumasi ventilated improved pits (KVIPs), toilets, water closets;
- *Market*: market stalls, stores, sheds, meat shops;
- *Office*: administration blocks, assembly/town/council halls, courts, police stations, fire stations;

- *Road*: roads (paved, graveled, or dirt), bridges, spot improvements, speed humps, paving works;
- *School*: classroom blocks, kindergartens, nurseries, early childhood development centres;
- *School – other*: dormitories, dining halls, hostels, school feeding kitchens;
- *Staff housing*: bungalows, guest houses, accommodation blocks, residences, quarters;
- *Streetlights*
- *Waste management*: refuse dumps, rubbish storage; and
- *Water*: water systems, water harvesting, water supply, reservoirs and storage, pipe-borne water works, water distribution.

In addition, two categories of non-infrastructure projects were constructed but not included in the analysis:

- *Procurement*: purchase, supply, distribution, and furnishing (e.g. tractors, desks, computers), acquiring land for projects, equipment of facilities; and
- *Services*: a wide variety of activities related to service-provision and other non-infrastructure activities, e.g. training, vaccination campaigns, capacity building, tax collection, celebrations, monitoring, public education, sponsoring.

The guiding principle in distinguishing between infrastructure and non-infrastructure projects was that projects involving physical transformation were coded as infrastructure (e.g. building a classroom block), whereas projects consisting only of related activities that did not themselves involve physical transformation (e.g. acquiring land to build a classroom block, supplying a classroom block with textbooks) were coded as non-infrastructure.

This algorithmic coding resulted in unique project types for 74.4 percent of projects, while 12.8 percent were not assigned a type and another 12.8 percent were assigned two or more types. These 5,569 projects were manually inspected and disambiguated if possible, or if the project genuinely straddled two types it was coded as “multiple”.

Finally, the category “school” was sub-divided into six categories according to the size of the classroom block: five categories for 2-, 3-, 4-, 6-, and 12-unit classroom blocks, and a sixth residual category for classroom blocks of indeterminate size, or reported projects which actually involved more than one discrete structure (e.g. construction of two 3-unit classroom blocks). Number of units was coded algorithmically by defining a set of 41 common text string permutations used to denote construction of a single classroom block (e.g. “1NO 3-UNIT [CLASSROOM BLOCK]”, “[CONSTRUCTION] OF 3-UNIT [CLASSROOM BLOCK]”).

Prior to analysis, projects with missing type or coded as “services”, “procurement” were dropped. The project categories used in the analysis therefore comprise the fifteen non-school infrastructure types listed above; six types of schools (five according to classroom block size, and one residual category); and the type “multiple” comprising all projects that could not be manually coded into a unique type.

### *ConstructionType*

Project titles often include a phrase that identifies whether the project constitutes new (greenfield) construction, or repair, maintenance, renovation, or rehabilitation of an existing project that had been completed previously. The former category was coded as projects including the general text string “CONSTRUCTION OF” and abbreviations or misspellings of this; project type-specific construction verbs such as “DRILLING OF”, “PAVING”, and “SPOT IMPROVEMENT”; and strings indicating that the project is a greenfield project in its second or subsequent year, such as “COMPLETION OF”, “CONTINUE”, and “CLADDING”. (The APRs are inconsistent in the extent to which they alter these prefaces for a given project across years (i.e. whether they change “CONSTRUCTION OF” in the first year of a project to “COMPLETION OF” in its second year), so these were coded together as greenfield projects.) Project titles containing general phrases such as “MAINTENANCE”, “REPAIR”, “RENOVATION”, and “REHABILITATION”, or project type-specific phrases such as “DESILTING”, “RE-ROOFING”, “RESURFACING”, and “RESHAPING” were coded as maintenance/repair/renovation projects. Altogether 76.4 percent of projects were coded as greenfield construction, 11.9 percent as maintenance/repair/renovation, and the remaining 11.6 percent could not be uniquely identified as either type.

### *ProjectCompletion*

Project completion was coded as a binary variable by combining information from three raw variables, of which one or two are typically reported in each APR: *ProjectStatus* (e.g. “COMPLETED”, “INSTALLED AND IN USE,” “100 WORK DONE”), *Remarks* (similar), and *PercentWork* (on the scale 0-100; 100 coded as complete). Projects were coded as complete if they were at a stage where physical construction work had been completed, regardless of whether they had been formally handed over, furnished, commissioned, and put into use – for example “COMPLETED YET TO BE FURNISHED AND COMMISSIONED” was coded as complete. This yielded a unique completion coding for 91.6 percent of observations; the remainder were disambiguated by visual inspection if possible, and given a missing value if it was impossible to determine the project’s status conclusively.

Although the gap between physical completion and putting the facility into use is of potential interest, physical completion was chosen as a cutoff point for the purposes of the APR database because: 1) the status of post-construction activities like furnishing, commissioning, and use are reported inconsistently in the APRs; and 2) the analytical focus of this paper is on infrastructure project construction, not subsequent service provision using those facilities.

### *Contractor*

A total of 6,798 unique contractor names are listed in the APR database for 10,701 infrastructure projects. However, many of these are clearly the same contractor but with different spellings (e.g. “WRKS” for “WORKS”), abbreviations (e.g. “LTD.” for “LIMITED”), or omissions (e.g. dropping “LIMITED” or “INC.”). In order to combine these, contractor names were stripped of these and other generic elements of company names (e.g. “ENTERPRISE”, “TRADING”, “MESSRS.”, “M/S”, “COMPANY”), as well as punctuation marks and spaces. This reduced the number of unique contractor names from 6,798 to 5,113. Using these corrected contractor names rather than the raw names slightly changes the point estimates on fund source

regression coefficients, but not the differences between these coefficients, which are the quantities of interest.

#### *District*

In mid-2012, 45 of Ghana's 170 districts were split to create 46 new districts (one district was split into three), leaving a total of 216 districts. The 46 new districts were all entirely contained within a single parent district, so there was no realignment of borders between districts. The 2011 and 2013 APRs thus reflect the 170 and 216 districts, respectively. For 2012 districts reported according to the new (216) district names, although many of the newly created districts did not report as they had only been in existence for approximately six months and were still waiting offices, personnel, etc. This creates some concern about duplications or omissions in the reporting of projects in split districts that started prior to the split, and it is unclear how consistently these matters were handled across districts. However, restricting the sample to districts that did not split in 2012 does not affect any of the results presented above, and the regression results are robust to the inclusion of district-year fixed effects that would capture any disruption caused by these administrative splits, so the potential data concerns created by the district splits do not appear to affect the analysis.

For purposes of project linking and fixed effects, the post-split "parent" district (the one that maintained the existing district capital, political leadership, and the majority of its administrative staff) is treated as the same district as the pre-split combined district, regardless of whether it changed its name, while the new "child" district is treated as a new district.

The other secondary data sources drawn on by this paper differ in whether they report the old 170 or new 216 districts for 2012. This means that in some cases (e.g. with budget data) APR data from a post-split 2012 district is matched to other secondary data from a pre-split 2012 combined district. Of data sources that are time invariant over 2011-13, the District Medium Term Development Plans (DMTDPs) and pre-2012 electoral data both use the 170 districts, while the 2010 Population and Housing Census initially used the 170 districts but has been recoded to correctly reflect the new 216 districts.

#### *Classroom Block Additional Facilities*

For all classroom blocks for which it was possible to identify the number of units (2, 3, 4, 6, or 12), three indicator variables representing additional facilities included in the project were defined: latrines and toilets (project titles including the strings "LATRINE", "TOILET", "KVIP", etc.); offices/stores/libraries ("OFFICE", "STORE", "COMMON ROOM", "LIBRARY"); and general ancillary facilities (various spellings and abbreviations of "ANCILLARY"). These variables were not coded as mutually exclusive, although it is not common for one project to combine multiple types of ancillary facilities. A residual variable was defined for the 38.0 percent of projects that do not appear to include any of these ancillary facilities.

## APPENDIX 4: ATTRITION IN PROJECT LINKING

Conditional on being incomplete in 2011 or 2012, only 33.8 percent of projects could be identified in the following year, indicating a high degree of attrition in reporting and linking. Attrition is likely to be correlated with project completion (if bureaucrats stop reporting unfinished projects that have been abandoned) and thus poses a challenge for estimating the overall completion rate, which is discussed in depth in Section 2. The concern of this Appendix, however, is that differential attrition rates across fund sources could bias the within-district estimates of fund sources completion rates in Section 4.

To investigate this possibility, I construct an attrition indicator variable equal to one if a project that is incomplete in 2011 or 2012 can be linked to the same project's record in the following year (2012 or 2013, respectively), and zero otherwise. This variable is defined only for projects in districts that have three years of APR data. I then use this as the dependent variable in an attrition probability model, estimated as a linear probability model, where the key variables of interest are fund source indicator variables.

The results are presented in Table A1. Column 1 estimates the model with no controls and indicator variables only for the three major fund sources; Column 2 adds the baseline set of district, year, and project type fixed effects, plus project characteristics; Column 3 adds indicator variables for the remaining minor fund sources; and Column 4 estimates the model for school buildings only. The differences among the coefficients on the three major fund sources are small and are not statistically significant in any of the specifications. Among the minor fund sources, projects funded by districts' own Internally Generated Funds (IGF) have the highest attrition rates, together with those with multiple fund sources. There is slightly more variation across coefficients in the schools only specification in Column 4, but with a reduced sample size that creates a great deal of statistical uncertainty about the parameter values. Overall, none of these results create cause for concern that this paper's main results are driven by differential reporting attrition rates across project fund sources.

Table A1: Project Attrition by Fund Source

	(1)	(2)	(3)	(4)
	All projects	All projects	All projects	Schools only
<i>Project fund source</i>				
DACF	-0.137 (0.030)**	-0.004 (0.044)	0.007 (0.065)	-0.016 (0.119)
DDF/UDG	-0.107 (0.034)**	0.008 (0.066)	0.018 (0.079)	0.061 (0.123)
GETFund	-0.086 (0.028)**	-0.033 (0.067)	-0.015 (0.100)	-0.006 (0.142)
IGF			0.148 (0.113)	0.093 (0.160)
Other donor			0.004 (0.092)	0.105 (0.147)
Other GoG			-0.034 (0.083)	0.297 (0.208)
Road Fund			0.000 (0.000)	0.000 (0.000)
Multiple			0.132 (0.117)	0.019 (0.157)
Constant	0.712 (0.014)**	0.613 (0.142)**	0.595 (0.155)**	0.735 (0.275)*
<i>Coeff. equality tests (prob &gt; F)</i>				
DACF = DDF/UDG	0.457	0.823	0.847	0.369
DACF = GETFund	0.143	0.604	0.701	0.885
DDF/UDG = GETFund	0.585	0.581	0.668	0.424
Observations	2033	2033	2033	780
R-squared	0.01	0.02	0.02	0.02
<i>Fixed effects</i>				
District		Yes	Yes	Yes
Year		Yes	Yes	Yes
Project type		Yes	Yes	Yes
Project characteristics		Yes	Yes	Yes

\* significant at 5%; \*\* significant at 1%

Note: Dependent variable is project attrition - whether a project that is unfinished in a given year can be located in the following year's report, conditional on the report being contained in the APR database. Other/unknown is omitted fund source category. Project characteristics are construction type (construction/maintenance) and project year indicators (based on manual linking). Huber-White robust standard errors clustered at district level.

## APPENDIX 5: SAMPLE PROJECT PHOTOS

Figure A4: Incomplete Staff Bungalow



Figure A5: Unfinished Classroom Block



Figure A6: Unfinished Classroom Block



Figure A7: Borehole at a School – In Progress



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