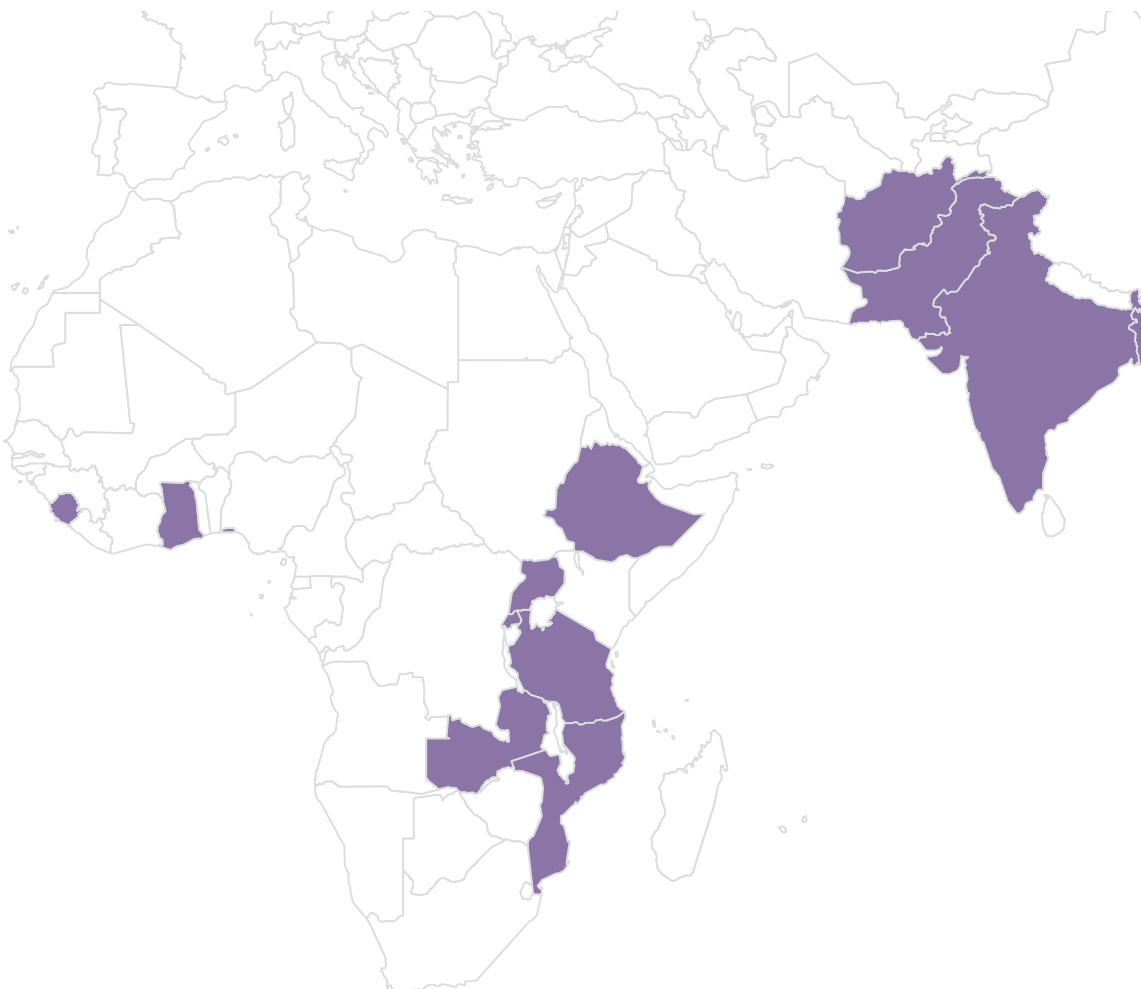


It's Tough at the Top: Assessing the complexities of projects at different tiers of government

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Daniel Rogger*

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Abstract

Empirical approaches to assessing decentralisation have typically compared a measure of output quality at different tiers of government. They have ignored the possibility that organisations at different tiers of government may be implementing projects that present different levels of technical challenge. By measuring and assessing the differing 'complexities' of projects, we show that higher tiers of government do indeed implement projects that are more complex. Taking this fact into account provides an explanation as to why higher tiers of government score lower on indicators of output quality. The highlighted concepts, measurement tools, and validity checks related to complexity can be used for a far wider range of analyses.

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[†]This document reports on an ongoing research project. A working paper has been produced only in response to an International Growth Centre deadline. Due to delays in the securing of the data, this analysis is still at a very early stage, and this work should be seen as incomplete and ongoing. This paper should not be quoted.

1 Introduction

The effectiveness of delegating the responsibility to provide public goods to decentralised tiers of government has recently found support in the economics literature.¹ Typically empirical work on decentralisation has compared a measure of output quality at different tiers of government. If it finds that decentralised tiers of government score better on this measure on average, it is argued that decentralisation is a successful means of improving service delivery.

However, this approach ignores the possibility that projects may be different across tiers. Organisations at different tiers of government may be implementing projects that present different levels of technical challenge. This paper aims to investigate that possibility.

These arguments are not new. Many authors have argued that more centralised tiers of government may have a comparative advantage in implementing large-scale, complex projects. An early analyst of decentralisation, Oates (1972) argued that more centralized governments are better equipped to deal with complexity. They have access to greater resources, skills, and international expertise.

Since these early arguments however, empirical assessments of decentralisation have abstracted from the impact of project complexity on project success. What we mean by complexity will be discussed below, but relates to the different types of implementation challenge faced in the undertaking of a project. If heterogeneity in the complexity of projects is correlated with project success, previous analysis ignores a potentially important source of heterogeneity. If complexity is correlated with some unobserved driver of decentralisation, standard estimators will be biased. Valid estimates of the impact of decentralisation require that project complexity is defined and measured.

Analyzing the extent to which success in public projects is due to the complexity of projects has been held back by a lack of data. This paper is therefore an exercise in definition and measurement. The associated research attempts to define indicators for the complexity of projects that reflects current thinking in the engineering and project management literatures. It then aims to collect data on these indicators that are internally consistent and test for their external validity. Sister papers (Rogger, 2011a and 2011b) investigate other issues in the analysis of decentralisation, namely how political considerations might determine the sorting of projects across tiers or how civil servants might sort themselves across tiers.

Once the validity of the data has been argued for, we investigate how different aspects of complexity vary across different tiers of government. We find that the most centralised tier of government does in fact implement projects that have a higher level of complexity, and that this might go some way in explaining lower rates of completion and quality.

There are many areas for further research on this topic. There are certainly many margins along which the indicators of complexity could be developed. There is also a need to integrate economic models into the study of complexity.

2 Complexity

What determines the degree to which different public projects constitute greater technical challenges than others? It feels intuitive that the building of a hospital would be more complex than the building of a village health centre, but what makes it so? Is it the difference in scale, the number of methodologies required, or the interdependencies between different components of the projects? Projects can differ in complexity along a number of margins, so how do we measure these?

Over the last 20 years, the analysis of complexity in projects has been widely discussed in the fields of engineering and project management.² In that time, this literature has moved from a basic view of complexity as arising from the physical elements of the project to one that encompasses broader notions of uncertainty, ambiguity, and power relations governing the project. The importance of political and

¹'Decentralisation' is defined here as the delegation of responsibility to provide public goods to tiers of government increasingly independent of the influence of centralised government. There are many other definitions of decentralisation relating to the capacity to generate revenues, the setting of laws, the determination of expenditures, and so on. These will be discussed below. The general principles of the arguments made here apply to all these settings.

²For a recent overview of the literature, see Geraldi, Maylor, and Williams (2011).

community dynamics on the implementation of projects is the focus of Rogger (2011a). I thus focus here on issues of complexity that relate directly to the physical implementation of the project.³

Baccarini (1996) reflects early notions that complexity was determined by “the number of physical elements of a project and their interdependencies”. In this view, as the number of inputs into the project rise, it becomes increasingly difficult to manage. Thus, a large project with few inputs (a dam made purely from earth for example) may be less complex than a complicated machine that is limited in scope (such as the drilling and installation of a hand pump water well). Similarly, the more interdependent the objects are, the more complex the project. If one part of the hand pump mechanism of a water well fails, the entire project fails.

Over time, this view was seen to be too basic. Projects with few physical elements or dependencies continued to confront project managers with complex challenges. Williams (2002) summarises how the literature introduced the concepts of time and uncertainty into the study of complexity. If a manager is unclear on what the requirements of the project will be in the future, this impedes efficient investment and planning. Uncertainty may arise in the planning process, in which the design of the project may be vulnerable to changes in the environment outside of the control of the project implementer. Uncertainty may also arise in implementation, where the implementation of the project is vulnerable to changes in the external environment.

Most recently (see for example Hass (2009) and Cicmil et al. (2009)) the literature has turned to the impact of ambiguity. Whereas uncertainty is quantifiable risk, ambiguity relates to those aspects of uncertainty that cannot be quantified. A project which might be said to face ambiguity in design or implementation is one where managers are unable to forecast technical risks and prepare for them. Returning to our example of a hand pump water well above, it may be unclear whether there is a water table available at a feasible drill depth in the recipient community.

The literature on decentralisation engages with this research by placing these observations into the broader framework of hierarchy. Higher tiers of government are typically assumed to have less local information than lower tiers (Bardhan and Mookherjee, 2003). However, they often have greater access to credit (Oates, 1972), are less risk-averse, and have greater access to technical skills. As will be discussed in greater detail below, these observations point to different tiers of government being better able to handle projects with different aspects of complexity. Those that require a high degree of local knowledge are likely to be better implemented by lower tiers of government. Projects that are highly uncertain may be better handled by higher tiers of government. Which tier is better placed to handle ambiguous projects will be determined by the preference structure of different tiers (how they will respond to ambiguity).

There is now wide agreement that “one concept of complexity only is not enough to explain our perceptions and interactions with this phenomenon” (Geraldi and Adlbrecht, 2007). Rather, identifying and measuring multiple aspects of complexity allows a richer picture of the phenomenon.

Defining measures of complexity takes the theoretical constructs above as a basis. However, there have only been a few attempts at defining measurable indicators or producing data on complexity. Remington and Pollack (2007) define a series of tools and indicators to measure complexity and provide qualitative accounts of their use in the field.

Geraldi and Adlbrecht (2007) study projects at a multi-national engineering company. Project managers were asked to evaluate the complexity of their current projects as high, medium, or low across categories like those discussed above. Different types of complexity were often highly correlated and for the projects they were studying there was a distinct hierarchy of complexities: interdependencies were more important than scale considerations, which dominated ambiguity.

Both of these sets of authors argued for improved indicators of complexity and studies of a broader sample of projects.

3 Data

To assess the impact of complexity on the success of different tiers of government in implementing public projects, I utilise data from Nigeria’s Federal Government. In 2006 and 2007, the Nigerian

³For discussions of the impact of power relations within the project community from this literature, see Morris and Hough (1987) and Maylor, Vidgen, and Carver (2008).

Government set up a system to track the fate of roughly 5% of its Federal Budget. The ‘Overview of Public Expenditure in NEEDS’ (OPEN) process “was adopted as the mechanism to monitor and evaluate public expenditure” (Federal Government of Nigeria, 2009). The ‘OPEN data set’ contains indicators of success for each of the projects it tracked.

To assess the complexity of the projects outlined in the OPEN data set, I worked with a number of engineers and project managers recognized in the field to construct relevant indicators. I then employed Nigerian and British engineers to evaluate the OPEN projects along these margins. To assess the internal validity of the data, I randomly repeated projects throughout the data set and compared their codings. To strengthen external validity, I had two separate Nigerian engineers assess the projects. To assess the external validity of the process, I had independent Nigerian and British engineers code random samples of the projects and compared the independent codings. I have also utilised other data on characteristics of project location that I argue should provide robustness checks on the complexity codings.

More information on each of these data sets is now provided.

3.1 The Overview of Public Expenditure in NEEDS (OPEN) data set

The OPEN data set reports on roughly US\$1.2billion of expenditures channeled through standard institutions and processes of the Nigerian government. The projects range across 10 sectors including health, power, and water. Table 1 describes the distribution of funds across sectors.

Table 1 shows that in most sectors, the average project is a small fraction of the overall sector budget. Of the order of a tenth of a percentage point. In a few sectors, Housing, Works and Women, the projects were a substantial proportion of the sectors budget. These are therefore typically dropped in analysis. More details on the OPEN data set can be found in Appendix 1.

Table 2 describes the sort of projects that are under analysis. Typically the projects are small-scale interventions that serve basic local needs such as the provision of a basic health centre, the improvement of local electrification infrastructure, or the drilling of a well to supply drinking water and irrigation for agriculture.

This focus on capital projects implies they are not representative of the entire budget, which includes much recurrent expenditure (salaries, materials and supplies, and so on). However, they are representative of small-scale social-sector projects. An analysis of how representative of the federal budgets the OPEN projects are is provided in Rogger (2011c). I argue there that the projects are broadly representative of the capital budgets of Nigeria’s social sector ministries.

The OPEN projects were implemented through organisations of differing levels of decentralisation. There are many ways to define ‘decentralisation’. These may relate to the regulations around generating revenues, the capacity to set laws, the power to determine expenditures, and so on. We focus on what is known as ‘bureaucratic’ decentralisation. This is decentralisation within the same political strata of government, and accedes power over bureaucratic responsibilities such as the definition of budget and the management of human resources.

The projects studied in this paper are all implemented by the Nigerian Federal Government. Whilst there are three ‘layers’ of government in Nigeria - federal, state, and local - none of these projects are implemented by state or local governments. By focusing on a single layer of government, we hope to limit the heterogeneity in institutional structure beyond that of interest. Other layers of government are distinct from federal institutions in numerous ways that institutions within the same layer are not. For example, they are governed by a different set of politicians, under a distinct set of electoral rules.⁴

Institutions (bodies such as a local river basin, or educational establishment) are grouped into strata (which I will call tiers) along the following lines. The central ministry is the central organising authority for the sector, with a direct line of responsibility to the President and the National Assembly. The next tier of government (although in much of what we will do we will group these two) are made up of subsidiaries of the main ministries. These are organisations with a separate budget line in the national budget and distinct institutional structure, but a direct line of responsibility to the central ministries.

⁴A model of different tiers of government is presented in Bardhan and Mookherjee (2006). Empirical assessment of this question would answer a distinct, but no less important, set of questions than addressed here. A next step is to expand the OPEN data set to different tiers of government and test their model.

Typically, central ministries will play a part in the day-to-day running of these institutions. Both of these types of organisation typically have to serve the nation as a whole.

The third, and most decentralised tier of Nigerian Federal Government are the regional bodies. These are separate organisations to the ministry whose day-to-day running is largely independent of the central authority. They have boards of governors that make decisions over policy and operation. They have a separate budget line to the central ministries and focus on a strict sub-set of the citizenry. They are thus prototypical examples of bureaucratically decentralised organisations: operationally and financially independent bodies.

Whilst each project is implemented by a single tier, ‘like’ projects are implemented by distinct tiers. For example, the Federal Ministry of Water Resources implements projects in districts throughout the areas covered by the (more decentralised) River Basin Development Authorities. In many districts, ‘like’ water projects will be implemented by distinct tiers. Similar arguments can be made for other sectors.

Table 3 describes how different types of project are distributed across different tiers. We see that for almost all the categories, each tier of government produces at least some projects. We can break down the analysis done below into project types, assessing whether our conclusions hold keeping project type constant.

3.2 Defining a project

Since the OPEN data set’s unit of observation is the project, it is important to be clear on what we mean by that. As the analysis of projects in economics, and quantitative work of this sort in engineering, is rare, there are limited guidelines as to how to define a project.

In many surveys, the individual is the natural unit of observation. There is therefore no requirement to defend this choice of observation. Programs of work, however, have numerous constituent parts, and thus what makes up a project and what doesn’t is sometimes not a clear cut decision. For example, whether the renovation of a hospital is one single project or many (including the supply of new equipment, the renovation of a ward, and the construction of a new generator house) is not clear cut.

The closest comparison from the household survey literature is ‘what makes up a household’. In that debate, definitions typically revolve around substantive interactions between individuals (the sharing of food or living space) or interdependencies (physical access to the household independent of other households or the intermingling of income or production).

A similar discussion has been had in the project management literature. The consensual definition of a project, from the Project Management Institute’s ‘Project Management Body of Literature’ (2008) is “a temporary endeavour undertaken to create a unique product, service or result”. They define ‘unique’ as “the product or service is different in some distinguishing way from all similar products or services”.

All projects in the OPEN data set are temporary, in the sense that they are to be completed within a year.⁵ Thus, the natural extension to defining a project in the OPEN data set is to isolate those endeavours that are unique in their interactions or dependencies in a temporal, geographic, or thematic sense.⁶ These are taken as independently excluding, so that all must be fulfilled for it to be the same project.

This is how the projects have been defined throughout the OPEN data set. The data started life organised around lines of the Federal Budget. Projects were placed together under these lines for numerous, often arbitrary, reasons. They may have been related to the same theme, were to be implemented by the same department, and so on. However, the number of projects under a single budget line item is relatively arbitrary. Some line items have a large number of projects contained in them, whilst others few. This skews both the weighting placed on a single project and wastes information, as we have data on individual projects, rather than simply line items. Whilst there is little argument for the projects to be analysed along these budgetary lines, for completeness I provide results clustering by ‘line item’ where relevant.

⁵OPEN projects were limited to those planned to be completed within the fiscal year.

⁶Note that a geographic unit differs throughout the data set. The project is defined by geography based on that geographic entity assigned to that project. Some projects are associated with a particular local government, others are state-wide programs (where the state is taken as the geographic unit) and others are national programs. The scale used to study a project can determine the definition of that project.

Given the arbitrary nature of the line item, we have split the line items into projects that better fit our definition of a project. Thus, a sensitisation project that happens at different times around the country is taken as a series of independent projects. A borehole drilling program that drills one borehole each in two different local governments is made up of two projects. A conference program that organises two conferences on different themes is made up of two projects. On the other hand, a sensitisation project made up of two briefings in which farmers in the same state must go through one briefing before they attend the next is taken as one project. Different components of a community water system are all taken as one project. A conference program that all relates to the passing of a national gender bill is taken as one project. When a line item contains two components which occur in the same theme, at the same time, in the same location, they are taken as a single project. Further information on the process that led to defining the OPEN projects is provided in Rogger (2011c).

A distinct way to have organised the data set would have been to take the bureaucratic system of organisation, where projects are determined by their ‘file’. If a file is opened on a project, it becomes a bureaucratic entity in its own right. It can then be delegated, ‘acted upon’ (for example, a request for permission to perform an action on the subject matter of the file can be made), and so on independently of other files. To quantify which projects were aggregated into files together would take knowledge of the implementing organisation’s bureaucratic running that does not exist in this data. Thus, as an approximation to such an indicator, the author has worked with bureaucrats from different sectors to define the filing arrangement that should have been utilised given the public service rules. I report results clustering by ‘file’ in what follows.

As expected, there is a lot of overlap amongst these three definitions. Table 4 describes how the 6808 projects defined by our definition are clustered in 4122 files funded under 3213 line items.

3.3 Data on complexity

Data on the complexity of government projects is not collected by the Nigerian Government nor is a part of the OPEN data set. We thus require a means of defining relevant indicators and producing data on them. In collaboration with a Nigerian engineer familiar with the OPEN projects and in consultation with many of the authors outlined in section 2, I developed a series of complexity indicators. These attempt to capture the main themes of complexity outlined above.⁷

Table 5 outlines the indicators and their features. As an organisational framework, they take the four perspectives on complexity suggested by Remington and Pollack (2007). Structural complexity stems from the scale of different interconnected tasks and activities. The indicators capture structural aspects such as project size and the number of inputs required for production. They capture issues in raw material and labour supply, and the ease with which any necessary specialised skills and equipment can be sourced. Temporally complex projects are those whose production involves uncertainties. There are thus indicators for uncertainties in design and implementation. Technically complex projects are those whose production have ambiguous risks i.e. their uncertainties are not well understood. So indicators capture ambiguities in design and implementation. Directional complexity refers to the potential for preferences over the project to diverge. The assessor is thus asked to rate the managerial complexities of the project. Finally, there is a subjective assessment as to the overall complexity of the project. This allows any unassessed aspects of complexity to be measured and provides a coherent picture of the complexity of the projects.⁸

A Nigerian engineer was then provided with project details and documents to assess each project along these margins.⁹ The engineer is familiar with the OPEN projects through his engagement by an international development partner to assess a sample of the projects in 2009. However, he had not worked on any of the projects directly and thus there are no concerns of conflict of interest. A number of checks on the validity of this data were undertaken, such as a second Nigerian engineer checking the data set,

⁷The literature on project complexity is dominantly concerned with ex-ante evaluation. They ask the question: How complex will this project be? We are concerned with ex-post evaluation: How complex were these projects to implement? This distinction brings up interesting methodological differences between the approach but much of the literature continues to apply.

⁸More information on how the indicators were interpreted is provided in the guidelines for coding which are available from the author on request.

⁹Both of the Nigerian engineers engaged for this project had competitive CVs with experience on a broad range of projects reflective of the OPEN projects. Both were members of relevant professional bodies such as the Nigerian Society of Engineers and the Council for the Regulation of Engineering.

a couple of comparison data sets being independently coded, and so on. These checks will be discussed in section 4.

Table 6 provides descriptive statistics for all complexity indicators. On average, the projects are small scale with an aggregate complexity in the lower quintile of the distribution. Figure 1 provides a plot of the distribution of the subjective assessment of the overall complexity of the projects. This is highly skewed to the left, with the median project having an aggregate complexity of only 20 out of 100.

Despite this however, even the average project is highly interdependent (an INTERDEP score of 3.5 out of 4) and exhibits a relatively high degree of uncertainty in design (a DESIGNUNC score of 2.69 out of 3) and ambiguity in implementation (a IMPAMB score of 2.01 out of 3). This suggests that issues of technical complexity may be important even in relatively small scale projects.

Another feature of interest is how different measures of complexity relate to one another. Table 7 provides correlations between the different measures of complexity. Starred numbers have an absolute value greater than 0.5, an arbitrary number but one that guides the eye.

An intuitive finding is that projects requiring a larger range of methods also require a greater number of inputs and increases the aggregate complexity of the project. Requiring specialised skills or equipment increases the challenge of securing required inputs and increases the ambiguities around design. A natural way to interpret the correlations on INTERDEP is that a larger number of project interdependencies leads to greater uncertainty and ambiguity in design.

Validating the discussion in the engineering and project management literatures that project size is only loosely related to project uncertainties and ambiguities, we find little correlation between project size and other measures of complexity. The recent focus of that literature on ambiguity also seems to fit the data, with positive correlations between both measures of ambiguity and aggregate complexity.

4 Validity of the data

A basic concern with these numbers is whether the coding reflects the realities of the OPEN projects. First we turn to internal consistency. Are like projects awarded similar scores? To assess this, the data set contained randomly chosen repeats of 200 of the projects. These projects were embedded in the data set under a different year but within the same sector. When asked post-coding, none of the engineers involved in the process said they had realised such repeats existed.

Since the project characteristics of the original and repeat projects are the same, we would expect that the codings of the two sets of projects would be similar. Table 8 reports simply the number of deviations in the complexity indicators from perfect replication. We see that 90% of the repeated projects deviated from the original codings in 4 indicators or less. When comparing projects with any other randomly selected OPEN project, the likelihood of deviation is much higher.

It is difficult to judge whether these deviations were significant without knowing the extent of the deviation. Table 9 therefore provides summary statistics on the distribution of deviations. These are typically small. On average, they are less than a tenth of a category difference for categorical variables or less than a percentage point difference for continuous variables. There are certainly some substantial differences at the tails of the distributions of each variable. These are, however, very rare. There seems evidence to support the internal consistency of the coding.

Now let us turn to external validity. One concern in the production of complexity data is the room for subjective bias. Any single engineer's opinion of the projects may be quite distinct from the opinion (and thus coding of indicators) of another. To try to minimize this I did three things.

First, once the first Nigerian engineer had delivered his initial draft of the data, I engaged a second engineer. This engineer was completely independent of (and had never worked with nor knew) the first engineer. He similarly had a broad range of experience in implementing projects and programs in Nigeria and had not worked on an OPEN project. He knew about the range of OPEN projects have been engaged in the past to monitor a sample of OPEN projects. He was asked to check the data and assess the extent to which he agreed with the chosen coding.

I had the second engineer code a sub-sample of projects before he saw the first engineer's efforts. This allows us to compare both estimates independent of each other. Thirdly, I also engaged a British engineer

with experience working in West Africa and across the developing world. This provides a check on the data from outside the Nigerian context. These checks provided very similar patterns to the one above. On average, the deviations were extremely small, albeit with the occasional large disagreement.¹⁰ Together, these indicate that there is some informational content in the complexity codings.

5 Results: Complexity and Decentralisation

The OPEN data set provides a snapshot of the efficiency of government in the developing world. Table 10 provides some descriptive statistics. Surprisingly, 81% of the OPEN projects commence, and of these 80% of the work is of fair or good quality. This implies that over 60% of government work in Nigeria is effective. However, only 38% of projects have completed 18 months after initiation. Thus, whilst the picture is not as bad as many stereotypes of federal expenditures in Nigeria would suggest, there is much room for improvement.

Now we turn to the assessment of decentralisation. We begin by describing unconditional averages for the tiers. Table 10 disaggregates the evaluation variables by tier. We see that our most robust evaluation variable, progress average, or the proportion of the project completed on inspection, is increasing linearly in decentralisation. This is also broadly true for proportion completed, although there seem to be some deviations from this rule in commencement and quality assessment. Compared to central ministries, regional bodies are more effective project implementers in this data.

As an aside, it is interesting to confront the often proposed hypothesis that whilst rates of implementation are higher in a decentralised context, there is also greater variation, with vulnerable communities losing out. The standard deviation of progress seems pretty constant across the three tiers, going against this proposition. Further analysis of how community characteristics and political power impact on project completion can be found in Rogger (2011a).

Turning now to how complexity varies by tier. Tables 11, 12, and 13 present averages of the complexity indicators for the centralised, central subsidiary, and the regional bodies respectively. Our summary statistic, AGGCOM, indicates that projects at the centralised tier are more complex than those at other tiers of governments (an aggregate complexity of 27.45 versus 19.27 and 22.87 respectively). This implies that the lower project completion rates at the centralised tiers of government might be explained by the differential in project complexity.

Looking at the analysis from the reverse perspective, we can ask whether complex features of a project make it more likely to be implemented by a decentralised tier. Table 14 describes the results of a probit regression on the likelihood of decentralisation. (Note, clustering by line item make almost no difference to the results.) We see that many aspects of complexity make a project less likely to be decentralised. Coefficients on NUMIMP, NUMMETH, RAMASUP1, LOCLAB, SPECSKILLS, and CONSEQUIP are all negative and significant at the 99% level.

In what ways are centralised projects more complex? Returning to tables 11, 12, and 13, we see that projects at the centralised tier are larger. They require more methods and inputs on average, are more likely to need local labour, and utilise more complicated equipment. The projects are also more ambiguous in design. These correlations fit with an interpretation that more centralised tiers of government have greater access to the capital and skills required to implement large projects, as well as being less averse to implementing projects beset by uncertainty and ambiguity.

6 Conclusions and further research

This paper presented the preliminary results of an ongoing research project into the definition and measurement of ‘complexity’ in public projects. The paper took a first look at how such complexity might explain the differences in quality indicators and completion rates in a series of public projects from the Nigerian Federal Government. It found that more centralised tiers of government do implement projects of a greater level of complexity. This complexity was along a range of margins including the uncertainty and ambiguity in the design and implementation of the projects.

¹⁰Further information on these robustness checks, and on ongoing assessments using other data on characteristics of project location that I argue should provide robustness checks on the complexity codings, is available from the author.

There is still much to do on this project and significant need for further work. The next step for this work is to link these preliminary results to more economic mechanisms. There is also a need to develop an understanding of how complexity, politics, and community participation combine in determining the outcome of a public project.

The paper also discussed important aspects of this type of research, such as the definition of a project, the definition of complexity indicators, and validity checks on the collection of complexity data. Getting better and more detailed data along each of these margins is an important avenue for research.

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Appendix 1: Further details on OPEN process

The OPEN data set is constructed from a series of sources. At the heart of the data set are the OPEN evaluation reports for 2006 and 2007 published by the OPEN office in 2009.¹¹ These describe the evaluation of over 6000 projects by independent engineers and civil society groups. Funded from debt relief gains, the evaluations were outsourced to the private sector to “provide an immediate evaluation mechanism independent of the executing ministries” (Federal Government of Nigeria, 2007a).

A set of national consultants sub-contracted evaluation to regional teams of engineers and civil society. Engineers evaluating the projects were not those working on the sites. They visited public projects over a two-week period during June 2007 (for projects funded in Budget 2006), and then again in June 2008 (for projects funded in Budget 2007). Thus, implementers were given 18 months to complete work and for it to be utilised by the community. The evaluation teams coded i) whether the project had started, ii) it’s level of completion, iii) the quality of the inputs and work, and iv) the awareness of the beneficiary community during and after project implementation. For full details of how the operational framework of the monitoring and evaluation mechanism worked, see Federal Government of Nigeria (2007b).

To ensure the representativeness of the reports, the OPEN office put in place a number of checks and balances. First, engineers were teamed with independent civil society groups, partly so that the groups would act as a check on each other. Second, evaluators were asked to provide material, photographic, or video evidence to support their reports. Third, the national consultants and the OPEN office performed random checks on evaluated sites (all of which were found to be consistent).

Financial details were taken from the 2006 and 2007 budgets published by the Nigerian Federal Ministry of Finance. Project characteristics were summarised from project documents made available by the office of the OPEN process. Locations were provided in full by the evaluation reports.

To highlight the unique nature of the OPEN data set, we review Banerjee et al. (2007)’s assessment of the challenges to research on public good provision. They state that “the most important problem is that public action is almost never directly observed.” Here we have observations of the actual implementation success of a wide range of projects - those that are fully implemented and those that are not - across a significant portion of the country.

Second, they argue that “public good quality varies enormously, but these quality differences are notoriously difficult to measure.” We have independent evaluation teams making relatively consistent assessments of completion and quality. We also have a sense of the varying complexity of the different projects. Finally, they state that “community characteristics may respond to the availability of public goods”. In our data we have a household survey implemented at the end of 2005, approximately at the baseline of our study. Thus, whilst it is important to keep in mind the limitations of the OPEN data set, it is a useful lens for investigating the internal workings of government in a developing country.

Further details on the OPEN data set can be found in Rogger (2011c).

Appendix 2: Figures and Tables

Notes for table 1: The local currency is the Naira. Converted to US\$ at a rate of US\$1:N150.

Notes for table 10: ‘Central ministry’ refers to the central organising authority for sector, ‘Central subsidiary’ to organisations with a separate budget line and institutional structure but day-to-day running of institution significantly influenced by central authority, and ‘Regional’ to organisations whose day-to-day running is largely independent of the central authority and focuses on serving a strict sub-set of the citizenry. The evaluation variables are not complete for all projects, with 100% of traced projects detailing proportions commenced and completed, 90% of projects detailing progress, and 52% of projects reporting quality.

Notes for table 14: * indicates significance at 95% level, ** indicates significance at 99% level. Dependant variable is defined as a dummy variable coded 0 if the project is implemented by a central tier of government or 1 if it is implemented by a subsidiary central or regional organisation.

¹¹These were in various formats, from narratives to tables, and were coded by the author according to a standardised convention to ensure consistency.

Table 1: **Distribution of OPEN projects across sectors**

SECTOR	OPEN funds		Project cost		
	Allocation, US\$	Proportion of sector budget	Average, US\$	As a proportion of sector budget	Standard deviation, US\$
Health	248,686,667	0.16	272,414	0.001	1,318,512
Water	220,262,667	0.19	130,122	0.001	552,344
Education	217,221,067	0.09	492,367	0.002	2,502,184
Power	184,000,384	0.15	162,771	0.001	187,940
Agriculture	162,666,700	0.35	231,811	0.001	1,498,934
Works	66,000,000	0.04	3,283,333	0.050	3,195,285
Housing	23,300,000	0.17	3,300,000	0.142	2,888,150
Women	13,659,889	0.42	392,157	0.029	462,561
Youth	13,266,667	0.05	112,935	0.009	329,181
Environment	10,000,000	0.14	187,611	0.019	284,571
TOTAL	1,159,064,006	0.13			

Table 2: **Characteristics of the OPEN projects**

Characteristic	Frequency
TOTAL	6808
New	6041
Rehab	767
Construction	5336
New	4607
Rehab	729
Rural electrification	1955
Water well	1573
Dams and dykes	642
Primary Health Centre	585
Procurement	1098
Training	1166
Advocacy	207
Grants or microfinance	834

Table 3: **Distribution of different types of project across tiers**

Project	Tier of organisation		
	Central	Subsidiary	Regional
New	2357	2019	1701
Rehab	296	236	199
Construction	1,938	1,657	1,741
Rural electrification	952	1,003	0
Water well	159	69	1,345
Dams and dykes	394	5	243
Primary Health Centre	4	581	0
Procurement	266	662	170
Training	515	631	20
Advocacy	145	25	37
Grants or microfinance	56	775	3

Table 4: **Nesting of definitions of project**

Definition	Frequency
Line item	3213
File	4122
Project	6808
Line item	
Average no. files	1.45
Standard deviation	4.73
Average no. projects	2.12
Standard deviation	10.4
File	
Average no. projects	1.64
Standard deviation	1.68

Table 5: **Complexity indicators**

VARIABLE	QUESTION	CODING
Structural complexity		
Physical size of project	What is the physical size of the project on a scale of 1 (smallest type of project in OPEN data set) to 4 (largest type of project)	Categorical; (1, 2, 3, 4)
Number of inputs	Roughly how many distinct components does the finished project contain?	Continuous; (1, 2, ...)
Number of disciplines, methods, or approaches	Roughly how many distinct disciplines, methods, or approaches are involved in implementing the project or program?	Continuous; (1, 2, ...)
Interdependence of activities	Are the activities involved in implementation interdependent?	Categorical; (1, 2, 3, 4)
Access to raw material supply	Rate the difficulty of accessing the raw materials required on a scale of 1 (no impediments at all) to 6 (must be obtained from an international supplier)	Categorical; (1, 2, ..., 6)
Raw material storage and transport	Would the raw inputs to the project be easily stored and transportable to the project site?	Binary; No=0; Yes=1
Local labour	Would the project have required local labour?	Categorical; (1, 2, 3)
Specialised skills	Rate the challenges associated with the involvement of a few key individuals whose specialised skills are critical for the successful completion of this project on a scale of 1 (no specialised skills required) to 3 (specialised skills required and difficult to obtain)	Continuous; (1, 2, 3)
Construction /Program equipment	Rate the difficulty of accessing construction/program equipment required for this project on a scale of 1 (no impediments at all) to 3 (very difficult to obtain)	Continuous; (1, 2, 3)
Temporally complex		
Design uncertainty	To what extent is the design of this project uncertain and vulnerable to changes in the environment outside of the control of the project implementer?	Continuous; (1, 2, 3)
Implementation uncertainty	To what extent is the implementation of this project uncertain and vulnerable to changes in the environment outside of the control of the project implementer?	Categorical; (1, 2, 3)
Technically complex		
Need for design review	To what extent is the project likely to have to be redesigned during implementation?	Continuous; (1, 2, 3)
Implementation ambiguity	To what extent would implementers be able to forecast technical risks and prepare for them?	Categorical; (1, 2, 3)
Directional complexity		
Managerial complexity	How difficult would such a project be to manage? Please note that we are interested in the physical implementation aspects of the project only	Categorical; (1, 2, 3, 4, 5)
Number of agencies involved	Roughly how many agencies, contractors, and sub-contractors are required to implement the project?	Continuous; (1, 2, ...)
Aggregate complexity		
Aggregate complexity	In the distribution of the difficulty of OPEN projects (with extremely easy projects at the bottom of the distribution, rated as 0 difficulty, and extremely difficult/impossible projects at the top of the distribution, rated as 100 difficulty), what percentile of difficulty would you rate this project at?	Continuous; (0, 1, 2, ..., 100)

Table 6: Complexity indicator descriptives

Variable	Mean	Std. Dev.	Min	Max
Physical size of project (PROJSIZE)	1.64	0.88	1	4
Number of inputs (NUMINP)	6.2	3.82	1	32
Number of disciplines, methods, or approaches (NUMMETH)	5.11	2.09	1	20
Interdependence of activities (INTERDEP)	3.51	0.87	1	4
Access to raw material supply (RAMASUP1)	2.95	1.01	1	5
Raw material storage and transport (RAMASUP2)	0.74	0.44	0	1
Is local labour required? (LOCLAB)	1.66	0.62	1	3
How critical are specialised skills? (SPECCKILLS)	2.45	0.66	1	3
How accessible is project equipment? (CONSEQUIP)	2.35	0.64	1	3
Design uncertainty (DESIGNUNC)	2.69	0.62	1	3
Implementation uncertainty (IMPUNC)	1.77	0.42	1	3
Need for design review (DESIGNAMB)	1.91	0.45	1	3
Implementation ambiguity (IMPAMB)	2.01	0.6	1	3
Managerial complexity (MANCOM)	2.96	1.25	1	5
Number of agencies involved (NUMAGE)	3.69	0.49	2	5
Aggregate complexity (AGGCOM)	23.46	17.94	0	100

Figure 1: Distribution of AGGCOM

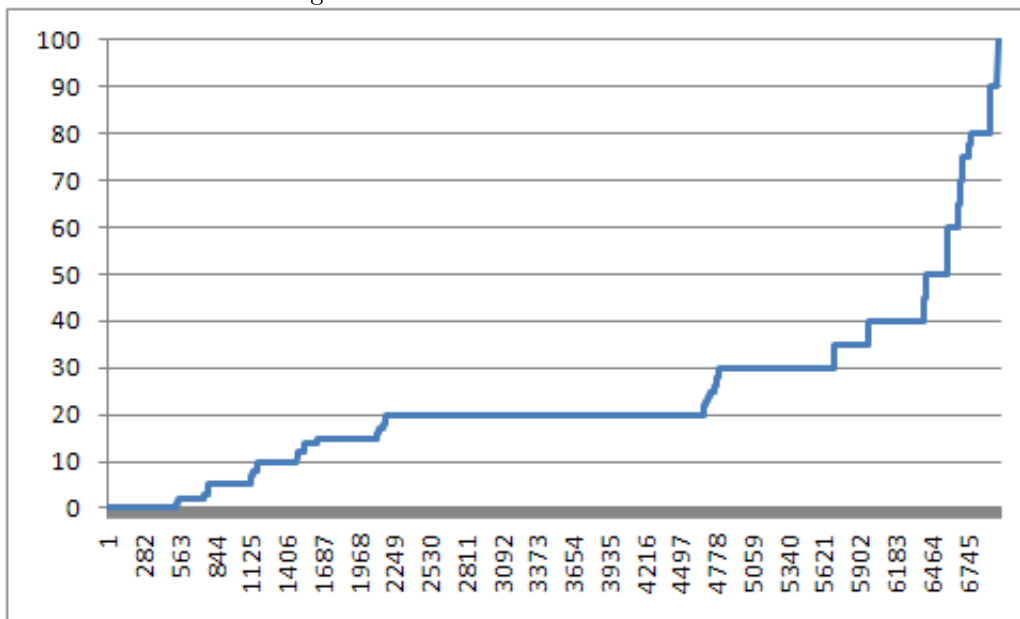


Table 7: Complexity indicators correlations

	PROJSIZE	NUMNP	NUMMETH	INTERDEP	RAMASUP1	LOCLAB	SPECSKILLS	CONSEQUIP	DESIGNUNC	DESIGNAMB	IMPAMB	MANCOM	NUMAGE	AGGCOM
PROJSIZE	1													
NUMNP	0.23	1												
NUMMETH	0.3	0.57*	1											
INTERDEP	0.22	-0.17	-0.14	1										
RAMASUP1	-0.07	-0.14	-0.4	0.34	1									
RAMASUP2														
LOCLAB	0.19	-0.27	0.39	-0.16	0.02	1								
SPECSKILLS	-0.23	-0.25	-0.59*	0.44	0.86*	-0.19	1							
CONSEQUIP	0.07	-0.43	-0.23	0.63*	0.78*	0.29	0.71*	1						
DESIGNUNC	0.19	-0.29	-0.21	0.82*	0.27	-0.06	0.38	0.57*	1					
IMPUNC														
DESIGNAMB	-0.17	-0.38	-0.13	0.52*	0.4	0.11	0.64*	0.62*	0.48	1				
IMPAMB	-0.15	-0.34	0.19	0.42	-0.02	0.14	0.18	0.33	0.43	0.83*	1			
MANCOM	-0.1	-0.29	0.13	0.2	0.48	0.39	0.45	0.64*	0.18	0.74*	0.63*	1		
NUMAGE	-0.1	0.15	-0.54*	-0.05	0.57*	-0.36	0.46	0.13	-0.12	-0.36	-0.71*	-0.3	1	
AGGCOM	0.32	0.19	0.65*	-0.05	-0.46	0.29	-0.5	-0.23	-0.11	0.12	0.38	0.22	-0.76*	1

Table 8: **Randomly repeated projects: deviations from perfect replication**

Deviations	Frequency	Percent	Cumulative
0	58	29	29
1	38	19	48
2	36	18	66
3	23	11.5	77.5
4	25	12.5	90
5	8	4	94
6	4	2	96
7	2	1	97
8	3	1.5	98.5
9	3	1.5	100
Total	200	100	

Table 9: **Randomly repeated projects: Scale of deviations**

Variable	Obs	Mean	Std. Dev.	Min	Max
PROJSIZE	16	0	1.59	-3	3
NUMINP	23	-0.13	4.08	-9	6
NUMMETH	16	0	4.16	-8	8
INTERDEP	13	-0.08	1.04	-1	1
RAMASUP1	24	0.42	1.67	-2	3
RAMASUP2	63	-0.08	1	-1	1
LOCLAB	39	0.26	1.23	-2	2
SPECSKILLS	8	-0.25	1.04	-1	1
CONSEQUIP	6	0.17	1.72	-2	2
DESIGNUNC	9	-0.11	1.36	-2	2
IMPUNC	10	-0.4	0.97	-1	1
DESIGNAMB	7	0.57	1.81	-2	2
IMPAMB	8	-0.75	2.25	-3	3
MANCOM	20	-0.15	1.73	-3	3
NUMAGE	63	-0.29	3.53	-5	5
AGGCOM	83	-0.31	10.2	-20	30

Table 10: **Descriptive statistics for OPEN evaluation variables**

	Proportion commenced	Proportion completed	Progress Average	Progress Std. Dev.	Proportion of fair or good quality
All tiers	0.81	0.38	0.64	0.41	0.79
Central ministry	0.75	0.33	0.54	0.43	0.68
Central subsidiary	0.86	0.29	0.60	0.38	0.86
Regional	0.79	0.53	0.68	0.43	0.77

Table 11: Complexity indicators: Centralised tier

Variable	Obs	Mean	Std. Dev.	Min	Max
PROJSIZE	2653	1.75	0.91	1	4
NUMINP	2653	5.41	3.72	1	30
NUMMETH	2653	5.54	2.24	1	17
INTERDEP	2653	3.56	0.70	1	4
RAMASUP1	2329	3.15	1.10	1	5
RAMASUP2	2653	0.81	0.39	0	1
LOCLAB	2653	1.88	0.66	1	3
SPECSKILLS	2653	2.35	0.74	1	3
CONSEQUIP	1771	2.68	0.53	1	3
DESIGNUNC	2510	2.53	0.76	1	3
IMPUNC	2653	1.70	0.46	1	3
DESIGNAMB	1727	2.15	0.41	1	3
IMPAMB	1722	2.37	0.52	1	3
MANCOM	2653	3.21	1.32	1	5
NUMAGE	2155	3.53	0.55	2	5
AGGCOM	2653	27.45	20.47	0	100

Table 12: Complexity indicators: Centralised subsidiary

Variable	Obs	Mean	Std. Dev.	Min	Max
PROJSIZE	2255	1.70	0.93	1	4
NUMINP	2255	5.87	3.31	1	32
NUMMETH	2255	5.23	1.72	1	20
INTERDEP	2255	3.24	1.15	1	4
RAMASUP1	1697	3.17	0.99	2	4
RAMASUP2	2255	0.92	0.27	0	1
LOCLAB	2255	1.79	0.48	1	3
SPECSKILLS	2255	2.39	0.58	1	3
CONSEQUIP	1673	2.43	0.77	1	3
DESIGNUNC	1776	2.77	0.49	1	3
IMPUNC	2255	1.75	0.43	1	2
DESIGNAMB	1671	1.60	0.49	1	2
IMPAMB	1672	1.60	0.49	1	2
MANCOM	2255	2.74	1.26	1	4
NUMAGE	2075	3.79	0.41	3	4
AGGCOM	2255	19.27	14.81	0	100

Table 13: Complexity indicators: Regional bodies

Variable	Obs	Mean	Std. Dev.	Min	Max
PROJSIZE	1900	1.39	0.73	1	4
NUMINP	1900	7.68	4.09	1	25
NUMMETH	1900	4.37	2.07	1	14
INTERDEP	1900	3.76	0.59	1	4
RAMASUP1	1730	2.45	0.66	1	4
RAMASUP2	1900	0.43	0.50	0	1
LOCLAB	1900	1.19	0.41	1	3
SPECSKILLS	1900	2.66	0.57	1	3
CONSEQUIP	1669	1.93	0.26	1	3
DESIGNUNC	1832	2.85	0.42	1	3
IMPUNC	1900	1.89	0.32	1	2
DESIGNAMB	1629	1.97	0.17	1	3
IMPAMB	1717	2.03	0.52	1	3
MANCOM	1900	2.87	1.08	1	5
NUMAGE	815	3.85	0.36	3	4
AGGCOM	1900	22.87	16.29	0	90

Table 14: Probit regression: Impact of complexity indicators on likelihood of decentralisation

Indicator	Impact on likelihood of decentralisation
PROJSIZE	-0.09* (0.04)
NUMINP	-2.27** (0.6)
NUMMETH	-1.34** (0.53)
INTERDEP	-0.89 (0.74)
RAMASUP1	-1.17** (0.2)
LOCLAB	-2.81** (0.54)
SPECSKILLS	-14.44** (1.38)
CONSEQUIP	-4.95** (1.33)
DESIGNUNC	6.73** (1.92)
DESIGNAMB	-0.47 (2.41)
IMPAMB	-1.58 (1.42)
MANCOM	1.84** (0.15)
AGGCOM	0.01 (0.01)