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An international experience on the evolution of road costs during the project life cycle

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ABSTRACT

The Millennium Challenge Corporation (MCC) is a United States government development agency that promotes economic growth and poverty reduction in poor but well-governed countries. MCC is legislatively mandated to obligate total grant amounts at the start of a project and to implement within 5 years. As a result, MCC transport infrastructure projects are sensitive to cost variability. Existing quantitative literature on transport infrastructure costs in developing countries is sparse and concentrated on the construction phase. This study evaluated the cost variability for MCC road construction projects and identified mitigating strategies. The mean increase between funding authorization and final costs was 135%. Project cost estimates were most uncertain during the design phase, where the mean increase between funding authorization and engineer's estimates was 100%. Three policy strategies to manage variations between planned and actual costs are discussed: improving funding authorization estimates, improving contingency policies, and using economies of scale in procurement packaging.

1. Introduction

Variability between planned and actual costs in road construction can result in cancellations, reduced scopes, and diminished rates of return. The peer-reviewed literature on road cost overruns focuses primarily on developed countries in Europe and North America (Bordat et al., 2004; Cantarelli et al., 2012a, 2012b, 2012c; Flyvbjerg et al., 2002, 2003, 2004; Hinze and Selstead, 1991; Odeck, 2004, 2014; Shrestha et al., 2013; Skamris and Flyvbjerg, 1997; Salling and Leleur, 2015; Tittermary et al., 2000; VanLandingham et al., 1996; and Verweij et al., 2015). The small number of studies that have quantified cost overruns from the international development donor perspective cite three main causes. First, donors have to contend with unique risks such as currency fluctuation and transboundary political uncertainties that are hard to predict (Mansfield et al., 1994; Kaliba et al., 2009; Long et al., 2004). Second, contractors employ competitive bidding strategies to underbid to win contracts (Vickerman, 2007 and Iimi, 2013). Third, projects that are packaged into smaller contracts are unable to take advantage of economies of scale, which can increase cost variability (Iimi and Benamghar, 2012). International donor agencies, such as the Millennium Challenge Corporation (MCC), must accurately assess and fund projects in the face of increased operational uncertainties. The purpose of this study is to quantify cost evolution in MCC road construction, analyze causes of cost evolution, and identify targeted interventions to minimize variability in international development donor road projects.

MCC is an independent U.S. development assistance agency with a mandate to reduce poverty and promote economic growth by providing large scale grants to poor but well-governed countries that are selected on a competitive basis (MCC, 2014). In particular, MCC selects countries based on third party indicators that measure a country's commitment to good governance, economic freedom, and citizen investment (MCC, 2014). Once partner countries are selected, project selection and implementation is led by the recipient country with MCC oversight (MCC, 2014). MCC's project lifecycle includes country selection, compact development (which defines the scope and budget), implementation, and closeout. Compact development typically lasts 2.5–3 years but only a portion of which is spent on technical feasibility studies for project activities. Implementation of MCC project funds is limited to a maximum of 5 years and funds are fully obligated at the start of this timeframe. The timeframe often results in establishing rigid funding envelopes prior to the completion of final designs. In addition, all MCC projects are subjected to independent ex ante and ex poste cost-benefit analysis. Consequently, cost changes can have a large and public impact at MCC. Hence, it is especially important that the drivers of MCC cost variations are well understood and managed. The rest of this paper describes this study's

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methodology (Section 2), presents MCC's cost variation results in the context of other studies in literature (Section 3), analyzes the causes of cost variation (Section 4), and discusses policy recommendations to improve cost variability (Section 5).

2. Methodology and data

This study evaluated costs from 13 completed MCC compacts: Burkina Faso, Cape Verde, El Salvador, Georgia, Ghana, Honduras, Mali, Mongolia, Mozambique, Nicaragua, Senegal, Tanzania, and Vanuatu. This dataset includes all of MCC's road construction projects that have been completed (where funds were authorized between 2005 and 2010). Road construction makes up 27% of MCC's investment portfolio, which is the largest share of all sectors. In all, MCC has funded the construction of 2450 km of roads. In the context of the US foreign development investments, MCC is the largest United States government donor in this sector, having disbursed $2 billion between 2004 and 2013 (OECD, 2015). Fig. 1 shows the countries analyzed in this study by chronological order of compact signing date.

Throughout the development and design of a road, several cost estimates can be made. A challenge in comparing cost variability across different studies is that there is no commonly accepted point of reference for initial estimates (Odeck, 2014). Some studies adopt a policy-centric approach and use the cost estimates that are approved at the time of decision to build (Flyvbjerg et al., 2002). Other studies evaluate cost overruns relative to the initial construction contract value (Bordat et al., 2004). Depending on the selection of an initial cost estimate reference point, cost estimate results can vary significantly.

To standardize the cost estimation phases in this study, a set of milestones defined by the Association for the Advancement of Cost Engineering were used to track costs for the entire lifecycle in this study (AACE, 2011). Project lifecycle costs were identified at the following four project stages (in chronological order): funding authorization (FA), engineer's estimate (EE), contract award (CA), and final cost (FC). FA estimates occur when the funding envelope is allocated based on feasibility and initial due diligence studies. EE costs occur after an independent engineer has completed a detailed design and evaluated construction costs. CA cost is the value of the initial works contract awarded for construction. FC is the total costs for construction, including variation orders and contributions from external funding agencies. For roads that are not completed within the 5 year implementation timeframe, external funding agencies (such as the recipient country's government or another international development institution) may pay to finish the projects. FA data were collected from investment documents approving the project. EE and CA data were collected from engineering design reports and works contract bid evaluation reports. FC data were collected from final reports. Because this study focused exclusively on cost variability in construction works only, other expenses (supervision, consulting, and design) were excluded. This methodological structure is comprehensive and allows the results to be accurately compared to other cost estimation studies, regardless of whether those studies use contract value (equivalent to CA in this study) or time of funding decision (equivalent to FA in this study) to define initial cost estimates.

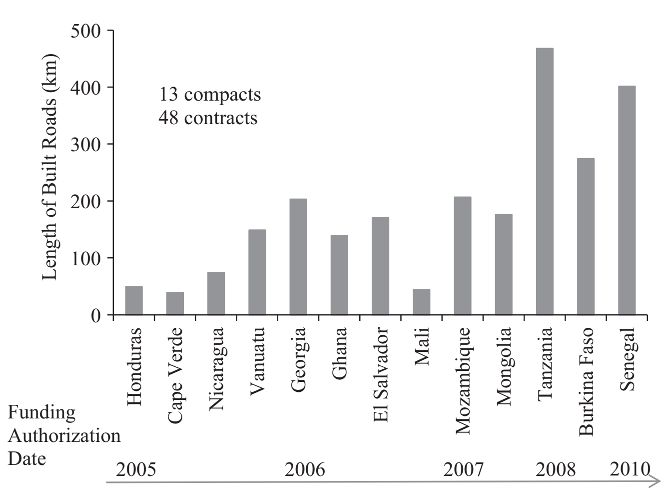

Fig. 1. Length and funding authorization date of all MCC compacts reviewed in this study.

This tracking method resulted in several data collection anomalies. First, there were instances of firms becoming insolvent or otherwise unable to complete construction due to MCC's strictly fixed budget envelopes. In such a case, where a new firm is hired to take over the remaining construction, the costs of both contracts were included in the final cost values. Second, there were scope changes throughout the project lifecycle (changes in the distance of road built). To eliminate these distortions, unit cost values were normalized by project size (per km per lane). Third, there was scope reapportionment in several projects. In some instances, road sections originally intended to be built through several contracts were combined or re-sectioned into larger contract segments. In such cases, subsequent costs were pro-rated by the newly segmented road size. Finally, several roads were not completed within MCC's 5 year time limit and other sources of funding paid for completion costs (recipient country government or other funding bodies). External donor contributions were included in the final cost values in order to reflect full construction costs.

3. Results

3.1. Cost variability from funding authorization to final costs

Variability was initially evaluated by comparing the final cost and funding authorization estimates in all projects. Fig. 2 shows that with the exception of 5 contracts, FC values were greater than FA estimates. FC was on average 2.35 times FA estimates (a 135% increase).

In addition to overall cost variations, de-scoping also affected project variability. On average, there was a 33% reduction in project size from initial planning at funding authorization to project completion. Scope reduction resulted from MCC's fixed budget and timeframe constraints. To evaluate the tendency for costs to increase and scopes to decrease, cost evolution was subsequently investigated by project phases.

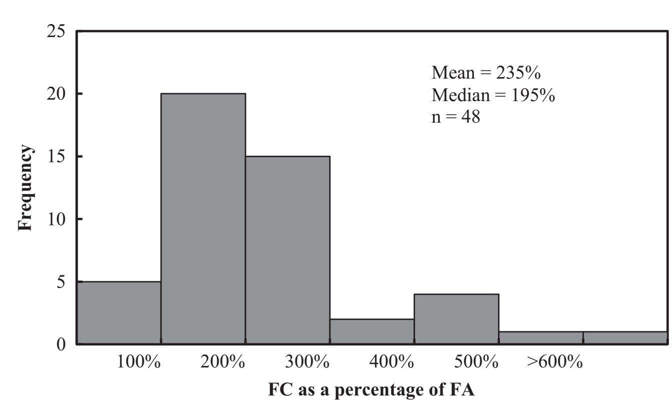

Fig. 2. Final cost as a percentage of funding authorization cost estimates.