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Infrastructure Project Prioritization in Theory and Practice

This paper is one of six commissioned as part of the workshop, *Economic Returns to Rural Infrastructure Investment*, organized by Farm Foundation and USDA's Economic Research Service (ERS). The workshop took place April 10–11, 2018, in Washington, D.C. A seventh paper, which had already been published, was also presented at the workshop because of its high relevance to the topic.

Authors Michael Bennon and Rajiv Sharma, Ph.D., both with the Global Projects Center at Stanford University, examine the use of benefit-cost analysis as a tool to evaluate and prioritize infrastructure projects. With the 2011 ban on earmarks for infrastructure projects, the responsibility for prioritizing federal infrastructure investments was transferred to the Executive Branch and increased the importance of how the federal government evaluates and selects infrastructure projects to receive federal funding.

To read the complete paper, or any of the other six papers, visit the Farm Foundation website, <https://farmfoundation.org>.

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Infrastructure Project Prioritization in Theory and Practice: Examples in Federal U.S. and International Programs

Michael Bennon is the managing director of the Global Projects Center at Stanford University in Stanford, CA.

Rajiv Sharma is a research director of the Global Projects Center at Stanford University in Stanford, CA.

Abstract

The 2011 congressional ban on earmarks for infrastructure projects formally transferred responsibility for prioritizing federal infrastructure investments to the executive branch, and has redoubled the importance of how, exactly, the federal government evaluates and selects infrastructure projects that will receive federal funding. The Benefit-Cost Analysis (BCA) study is one such method of evaluating and prioritizing infrastructure projects or other policy alternatives which has been widely studied in literature and largely adopted by U.S. federal agencies. Despite their renewed and significant impact on the selection of infrastructure projects, however, the use and applications of BCAs in the U.S. varies significantly between sectors, agencies and levels of government. In this paper, we review the BCA and other project prioritization policies in U.S. federal agencies and compare them with other, international programs in the comparable economies of Australia and Canada.

Keywords: infrastructure investment, benefit-cost analysis, infrastructure prioritization, infrastructure policy

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Introduction

The ban on congressional earmarks for infrastructure projects and other distributive federal spending, first passed by the U.S. House of Representatives in 2010 and U.S. the Senate in 2011, promised to usher in a new era of federal transparency and an end to the practice of “pork barrel politics” in determining where federal funds would be invested. By the time the ban was put in place, public perception of the federal earmark practice was at a low. This was exacerbated by several notable “bridge to nowhere” infrastructure projects that were won as earmarks by politically powerful members of Congress. The change had many implications, one of which was to formally transfer decision making around distributive federal investment from the legislative branch to the executive branch. Proponents of the earmark ban argued that the federal bureaucrats could more equitably allocate capital to infrastructure projects and select those projects with the greatest economic or other benefits, free from political conflicts of interest.

Among other implications of the change, the earmark ban naturally increased the importance of how, exactly, the executive branch prioritizes infrastructure projects. The methods used generally fall under the umbrella of the Benefit-Cost Analysis (BCA), forms of which are practiced by federal, state and local governments to select infrastructure projects, regulations or other forms of government spending. BCAs are also used internationally and by multilateral lenders, such as the World Bank, to assess potential projects, and the practice has been widely assessed in academic literature. Under a BCA, the total costs of an infrastructure project are compared with the total potential benefits (economic, social, environmental) to determine the relative value of the project in question. All of these costs and benefits are quantified and generally reported as a ratio of benefits to costs. The metric is useful in comparing virtually any set of public alternatives, but for infrastructure in particular it can compare projects across regions or within different sectors.

While BCAs are simple enough to describe in general, and are certainly useful as a “best practice” in selecting the most beneficial projects, they are also extremely complex to implement and driven by a wide range of ex-ante assumptions about an investment decision. This is especially the case for infrastructure projects, and in practice BCAs are often paired with other factors to assess projects. Large infrastructure projects are extremely complex undertakings, and the ability of governments, or investors for that matter, to forecast their outcomes ex-ante is demonstrably poor (Bain, 2009). There are many contributors to this problem, but one is certainly that large projects are complex and take years to develop. Their outcomes are naturally difficult to forecast. When more abstract elements are incorporated in a BCA, such as environmental or social benefits that are more difficult to quantify, the complexity of the assessment only increases. This assumption-heavy complexity lends an unfortunate amount of flexibility to the preparers of a particular BCA for an infrastructure project, which has raised concerns that the process in some cases could be driven by other factors or open to political influence, both in the United States and internationally (Perkins, 2005).

The opacity and complexity of the BCA process has thus caused some scholars to raise concerns that the formal ban on earmarks has not necessarily removed politics from the process of distributive federal investment, but rather made the process even more difficult to monitor. In the few years since

the earmark ban, there have been some studies of the practice of “lettermarking” and “phonemarking” in which members of Congress write or call the heads of executive branch agencies to request or demand that programmatic spending be directed towards their districts (Mills, Kalaf-Hughes, & Macdonald, 2015). The practice has increased dramatically since the earmark ban went into place, though some studies have questioned the practices’ effectiveness in actually influencing federal investment decisions (Gordon, 2016). Even if the earmark ban has partially removed the politics of congress from the distributive spending process, it could have also simply replaced it with the politics of the executive branch, and some studies since the ban have indicated that ideological alignment between the principals at executive bureaus and members of congress may influence the direction of federal investment decisions (Bertelli & Grose, 2009). Perhaps the most notable example of the executive flexibility inherent in BCAs in the United States came from the Clean Power Plan (CPP) implemented by the Obama administration in 2015, and later repealed by the Trump administration in 2017. When the Obama administration implemented the CPP by executive rulemaking, it prepared a program-wide BCA that concluded that the aggregate benefits of the program would outweigh the costs. When the Trump administration repealed it, the EPA produced a new BCA for the program, but which came to the opposite conclusion and thus justified the repeal (Shapiro, 2017).

Thus the technical methods used to prioritize infrastructure investments have increased in their importance significantly in recent years. In this paper, we review the policies of BCA development and other methods of prioritizing projects in several federal infrastructure agencies and the cross-sectoral guidance from the Office of Management and Budget (OMB), which prioritizes federal spending across the agencies. We also compare U.S. federal policies with practices used internationally. Here our main points of comparison are Canada and Australia, which like the United States are large landmass, federal, developed democracies and thus provide two interesting points of comparison for the problem of national distributed investment decision making across regions. We find that BCA policies and practices differ significantly between agencies and sectors in the United States, and that OMB policies to assess projects across sectors may significantly impact spending and investment decisions between them. We further find important differences in the balance between the political power of elected officials and the technical rigor of the bureaucracy between the U.S. and our international comparators.

In the following section, we briefly review some of the academic literature on BCAs as it pertains to federal infrastructure projects. In section three, we review sector based BCA policies in U.S. federal transportation and water agencies and cross-sectoral policies at the OMB, respectively. In section four, we review two international programs for prioritizing infrastructure projects in Canada and Australia. In the final section we describe our conclusions and relate them back briefly to the current debate over the Trump administration’s recently proposed infrastructure package.

BCAs in Academic Literature

Various forms of BCAs for large infrastructure projects have been studied widely in academic literature, and from a wide range of disciplines. Here we focus on general BCA literature with a focus on infrastructure investment as opposed to BCAs of regulatory actions or other public investment decisions, and not on studies of BCAs in practice, which we will include in the sector-based reviews below. Beyond these studies, BCAs are supported by a library of academic courses and textbooks that educate practitioners and policymakers on the practice and inform agency policies (Boardman, Greenberg, Vining, & Weimer, 2011).

To date a considerable focus of the academic literature on BCAs has focused on the discount rates used to convert future costs and benefits to the present. Some studies have supported a social discount rate in the range of 6% to 8% (Burgess & Zerbe, 2011), while others have argued that the public should use a relatively lower Social Time Preference (STP) rate (Moore, Boardman, & Vining, 2013) (Spackman, 2004). Other scholars have justified the use of a lower risk-free rate when considering public investment decisions (Arrow & Lind, 1970), while others have argued for more market-based rates of discounting (Lucas, 2014) (Schwartz, 1970). As the scope of factors included in BCAs expanded in practice, so too did the academic debate over discount rates for those factors, including proposals for a zero or declining discount rate of intergenerational factors, such as climate impacts (Arrow K. , 1995) (Arrow, et al., 2013). Other economists have proposed models that incorporate risk into the discount rate used for public investments (Jensen & Bailey, 1972).

These volumes of academic debate on the discount rates used in BCAs exist for good reason; this single assumption has significant ramifications for the outcomes of studies, and especially so for infrastructure projects and other major investments. Infrastructure projects naturally entail very large investments in the near term in exchange for a long tail of benefits in the future. The same could be said for many regulatory actions involving environmental costs and benefits. The rate by which those long-term benefits are discounted can completely change the outcome of an analysis. Beyond their singular importance, determining discount rates is often one of the most complex aspects of a BCA. The complexity of the models needed to calculate appropriate discount rates only increases as the scope of a BCA expands to environmental or social factors that are difficult to quantify and broader economic outcomes, such as job creation and destruction. Discount rates have been the focus of academia precisely because they are so esoteric yet critically important in driving the outcomes of studies.

Other studies have focused on the scope and inputs selected for incorporation in BCAs for large infrastructure projects, and their complexity. Flyvbjerg has produced a body of research comparing the forecasted and actual outcomes of large transport and other infrastructure projects, with many relevant policy implications. One notable finding from their database studies is that as the project in question increases in size, scale and its network effects (thus increasing the complexity of its associated BCA), the potential for inaccurate forecasts both in costs and economic impacts increases as well (Flyvbjerg, Skamris Holm, & Buhl, 2004). Other studies have focused on the complexity of BCAs and the incorporation of wider economic impacts. These have highlighted the fact that increasing the “scope” of a BCA to incorporate broader network effects can be attractive to practitioners in that they often increase the potential economic benefits of the project in question for the BCA, but naturally increase

the complexity of analysis and thus the propensity for error (Vickerman, 2007). That study focused on the scale and spatial issues associated with BCAs for large infrastructure projects with wide spatial impacts, but also discussed the implications of a project's financing on how or whether a BCA is needed for projects in Europe and the United Kingdom that have involved public-private partnerships or other financing from the private sector. Other studies of public investment assessment that have accounted for the potential for private financing have also recommended that the public sector use similar investment appraisal methods as private-sector counterparties to evaluate projects (Brealey, Cooper, & Habib, 1997).

BCAs in Practice – U.S. Federal Examples within Sectors

The preceding discussion is by no means an exhaustive review of the academic literature on BCAs and their development, but rather a focused review on those studies and issues relevant to the assessment of large public infrastructure investment. Additional studies have reviewed the practices and policies of U.S. federal agencies responsible for infrastructure investment, which we discuss in the section below.

Federal Assessments in the Water Sector

The use of BCAs and feasibility studies by federal agencies in the water sector was a focus of our review primarily because the practice is significantly more developed and has a longer track record in that sector. This is primarily due to their history of use by the U.S. Army Corps of Engineers (USACE) and to a lesser extent by the Bureau of Reclamation for water resources infrastructure and by the Federal Emergency Management Agency (FEMA) for hazard mitigation and flood response projects. USACE practices for using BCAs to evaluate federal projects date back to the late 1800s but were first codified in the agency's Economic and Environmental Principles and Guidelines for Water and related Land Resources Implementations Studies (1983) and applied to projects in flood protection, water resources and inland waterway transportation. USACE policies for BCAs were governed under separate legislation from other water agencies for a number of years but were updated in 2014 when the Council of Environmental Quality (CEQ) published an overarching set of guidelines for BCAs that applied to all of the federal agencies in the water sector titled, "Principles, Requirements and Guidelines for Water and Related Land Resources Implementation Studies" (CEQ, 2014). Currently, however, Congress has stopped the implementation of those guidelines in practice through spending restrictions in appropriations bills.

The typical planning process for a federal water project under USACE is extremely robust. Most studies are initially developed at the request of a local public sponsor, which will also share part of the costs of the project, but requires federal assistance. At the request of local congressional representatives, the appropriate Public Works Committee authorizes a study. The Corps district office completes a study of the project and its alternatives that includes a BCA that must encompass both the local costs and benefits and the broader national benefits of the project. This is also formally reviewed publically through the National Environmental Protection Act (NEPA) process, which leads to either an Environmental Assessment (EA) or Environmental Impact Statement (EIS). Once complete, the study is reviewed by division and national office and also undergoes interagency review through the NEPA

process and finally the OMB. Once approved at all levels, a Chief of Engineer's report is sent to the appropriate public works committees in the House and Senate for eventual authorization for construction via the passage of a Water Resources Development Act (WRDA) (USACE, 2000). At the same time, a separate process for construction funding incorporates projects into the President's Budget, which is submitted to Congress and funded through annual appropriation bills. As this description implies, this process can take years to complete. Though USACE does not maintain a detailed track record, a 1999 review found that they averaged roughly between five and seven years (Moreau, et al., 1999). To address this, USACE is currently implementing a planning process governed by the 3x3x3 rule to limit scope creep on the agency's planning process. The program would require project assessments to be completed in three years, cost less than \$3 million, and undergo only three levels of concurrent review.

Methodologically, the USACE BCA process has benefitted from decades of study and considerable criticism since it was formalized in the 1980s, both programmatically and on individual project reports, and has thus evolved considerably over time. The initial guidance essentially rendered one of the four national accounts, National Economic Development, to be the only required account for inclusion in Corps studies. A 1994 review of the USACE BCA policies commissioned by the EPA (The Zilberman Review) highlighted several flaws in the USACE process, and further recommended that the other national accounts – Environmental Quality, Regional Economic Development, and Other Social Effects – should also be quantified and included in Corps BCAs (Zerbe & Cook, 2009). A 1999 study by the National Research Council made numerous recommendations. Some of these recommendations were designed to streamline USACE's long and costly evaluation processes. Others would naturally make those processes more complex, including updating practices to convert environmental costs and benefits into monetary values to incorporate in BCAs and incorporating risk and uncertainty in its analysis of benefits and costs for flood mitigation infrastructure (Moreau, et al., 1999).

During this time, the Corps developed more complex planning models to estimate project benefits through a Planning Models Improvement Program and, taking up the recommendations described above, implemented peer review process and developed independently verified economic models by academics and transportation experts (Lambert & Bray, 2012). Still, academic and oversight criticism of USACE BCAs continued to mount. In 2003 and 2004, an additional NRC study commissioned by the Corps highlighted many similar issues in the USACE Upper Mississippi River-Illinois Waterway Feasibility Study, including the need to increase the study of alternatives and to better compare tradeoffs between the economic benefits and environmental impacts of the project (NAS, 2004). Between 2003 and 2006, the Government Accountability Office (GAO) also published a series of reports critical of the USACE BCAs for several specific projects and which highlighted broader issues in the USACE planning process (GAO, 2006). The 2007 WRDA bill then required the Corps to develop updated guidance for the development of BCAs, which the Corps released the following year. The Obama administration also issued an Executive Order to establish parity in regulatory review of economic growth and the other environmental and social welfare accounts, and the CEQ issued its cross-agency guidance for BCAs, which was updated in 2014.

The evolution of the USACE BCA policies for water infrastructure projects, beyond process improvements for streamlining, followed several key themes. These included the broadening of economic models to include more of the externalities associated with projects, the quantification and inclusion of environmental factors in project BCAs and the incorporation of risk models in Corps infrastructure planning for flood protection projects. The need to update USACE economic models and incorporate more external review and modeling into the Corps' planning process was also a consistent theme. The need to include additional alternatives in Corps analysis was also consistently recommended, as well as the need to better integrate studies of economic costs and benefits with environmental or ecosystem factors, including the study of the interaction of the project in question with other programs or ecosystems regionally or within the watershed. While originating from different parties and for different purposes, all of these recommended and adopted changes shared a common thread in that they all increased the complexity, in size, scale and scope, of the USACE BCA process. The CEQ Interagency Guidelines applied some of the learnings of the public evolution of USACE's evaluation process more uniformly across federal agencies in the water sector.

If the BCA practices for federal water agencies have grown increasingly robust and complex over time in response to public review and criticism, this is likely driven by factors beyond the fact that USACE has the longest history of using BCAs of any federal agency. It may also be caused by the relative importance of the studies themselves. BCAs at USACE matter – they determine which projects and alternatives navigate the planning process to be authorized and eventually receive federal dollars, which are a significant component of the total funding for the projects the Corps delivers. The relative importance of BCAs at USACE may be part of the reason the practice has attracted relatively more debate from the public, academics and practitioners alike, and by both supporters and opponents of particular USACE projects.

Federal Assessments in the Transportation Sector

Benefit-Cost Analysis (BCA) has been widely used for decision making within the transport sector in a number of countries for many years. A key motivation for using BCA has been to measure the benefits that are difficult to capitalize in prices such as reduced journey times, and reduced accident costs. More recently economists have developed techniques for monetizing non-market impacts, and transportation agencies have used standardized values for travel time, crash damages and environmental impacts (Vickerman, 2007).

As identified by the Economics Committee of the Transportation Research Board (TRB), the types of projects in the transport sector that BCA has generally been utilized for, have had the following characteristics:

- The potential project expenditure is significant enough to justify spending resources on forecasting, measuring and evaluating the expected benefits and impacts.
- The project motivation is to improve the transportation system's efficiency at serving travel and access-related needs, rather than to meet some legal requirement or social goal.

- Environmental or social impacts that are outside of the transportation system efficiency measurement are either: (a) negligible in magnitude, or (b) measurable by CBA or another appropriate method.

There are certain circumstances where BCA has not been appropriate for adoption:

- Projects that are required to meet legal requirements — such as safety standards, handicapped access standards or environmental impact standards. Changes in population growth, urban development, travel patterns or legal regulations may necessitate new projects to upgrade existing transportation facilities and services, build new facilities or provide new services to meet current legally required standards.
- Projects motivated primarily by a need to address distributional equity concerns — i.e., legal, political or moral desires for fairness. This includes the provision of some minimum level of basic (road, transit, air or sea) access for isolated or ill-served regions, communities or neighborhoods.
- Projects motivated by specific economic development goals, i.e., enabling the attraction and creation of new jobs particularly in economically depressed areas. Decisions are based on the desire (and in some cases, the legal need) to avoid selection of projects and project designs that focus undue negative impact on socially vulnerable groups (such as low income, elderly, or minority groups).
- Projects that are merely maintaining, renovating or rehabilitating already-built transportation facilities, which are necessary to avoid losing the already-demonstrated benefits of those existing facilities (unless there are viable alternatives present).

The Economics Committee of the TRB goes on to mention that it is also inappropriate to rely solely on Benefit-Cost Analysis in situations where there are special concerns that must also be considered outside of that analysis. Certain concerns for a project might be missed when attempting to calculate and compare total benefits and total costs. As identified above, the appraisal of projects might need to be considered in terms of their effectiveness at reducing certain key objectives — such as air pollution reduction, creation of new jobs, or improving mobility for physically, economically and socially disadvantaged people. In such cases, cost-effectiveness analysis (which measures environmental or social benefits per dollar of transportation project spending) may be appropriate, either in addition to or instead of a BCA.

Use of BCA in Federal Transportation Programs

While BCA is just one of many tools that can be used in making decisions about infrastructure investments, the USDOT has stated that it provides a useful benchmark from which to evaluate and compare potential transportation investments for their contribution to national economic vitality. One of the primary benefits of conducting a BCA, according to the USDOT, is the rigor that it imposes on project sponsors to be able to justify why a particular investment should be made by carefully considering the impact that that investment will have on users and of the transportation system and society as a whole. The USDOT has encouraged states to incorporate the BCA methodology into any

relevant planning activities, regardless of whether the sponsor seeks Federal funding (US Department of Transportation, Office of the Secretary, 2017).

The USDOT has primarily used BCAs in appraising applications for grants through the Transportation Investment Generating Economic Recovery (TIGER) or Infrastructure for Rebuilding America (INFRA) discretionary grant programs. The DOT uses the BCA framework and evaluates applications in a manner consistent with Executive Order 12893 (Principles for Federal Infrastructure Investments, 59 FR 4233), the Office of Management and Budget (OMB) Circular A-94 (Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs), and OMB Circular A-4 (Regulatory Analysis), details of which are provided in this document.

In their guidelines for the use of BCA, the USDOT starts with the need for an analysis to have a well-defined baseline against which to measure the incremental benefits and costs of a proposed project. Such a baseline would be considered the “do-nothing base case” or “no build alternative.” Further details are provided on how demand forecasting should be carried out, adjustments should be made for inflation, discounting (usually at a 7% rate), and how the appropriate analysis period is defined (usually full development/construction period followed by at least 20 years after the construction period of the project).

The main benefits defined by the USDOT for BCAs in transportation projects (while not being completely exhaustive) include: Value of Travel Time Savings (and reliability), vehicle operating cost savings, safety benefits and emissions reduction benefits. Other issues in benefits estimation include: benefits to existing and additional users, modal diversion, work zone impacts (resilience, noise pollution, loss of emergency services, property value increases, quality of life). Costs are defined as the economic resources (capital, land, labor, and materials) needed to develop and maintain proposed projects over their lifecycle. These typically include: capital expenditures, operating and maintenance expenditures, residual value and remaining service life.

In their guidelines, the DOT also discuss the difference between BCA and economic impact analysis. The former measures the value of a project’s benefits and costs to society, while an economic impact analysis measures the impact of increased economic activity within a region. Economic impact analyses usually take a more positive view and do not examine how the resources used for a project might have benefitted alternative societal uses of the resources.

Despite the strong emphasis placed on BCA by the USDOT, research has shown that the outcome of the BCA was not a strong determining factor in whether a project received a grant from the federal government (Homan, Adams, & Marach, 2014), at least within the TIGER grant program. In fact, Homan et al. state that the single most important factor was whether a special Control and Calibration Team had forwarded a project to the Review Team, which was composed of senior policy members of the Department of Transportation. This suggests that policy considerations other than a comparison of benefits versus costs were the primary driver in project selection.

Notwithstanding the reasons for why BCAs in practice have not been a primary factor in grant allocation, there have been a number of challenges in using BCA's by a number of state DOTs, as well. It would appear that the uptake for states to use BCA is low, with it only being used for certain project types or for situations where a BCA is required for external funding. State DOTs have used several alternatives, notably asset management systems with a life-cycle cost component. There has also been a trend more recently toward the use of multi-factor scoring systems to facilitate prioritization, either within or across project categories (The Federal Highway Administration (FHWA), 2015)

State DOTs have faced a variety of challenges in incorporating BCA for decision making related to institutional, resource and technical issues. From a resource perspective, it has been found that a BCA and its associated data and modelling needs can strain agency budgets, staff time, and other resources. It also requires expertise that agencies may not possess. The BCA results may also be more difficult to interpret and explain to stakeholders. It would appear that state DOTs require additional technical assistance on BCA methodologies generally and on specific issues such as travel time reliability and the application of BCA to analytically challenging program areas, such as operations and maintenance (The Federal Highway Administration (FHWA), 2015).

BCAs in Practice – Cross-Sectoral OMB Policies

The infrastructure planning processes from various sectors and agencies come together through the budgeting process at the OMB. In developing the President's annual budget requests, the OMB prioritizes infrastructure projects across sectors and agencies using a BCA-driven evaluation. The process and evaluation metrics that the OMB uses are prescribed in OMB Circular A-94, which has been in place since 1992. The evaluation process was created precisely to compare projects across sectors given the federal government's limited funding capacity, and it follows some of the general principles of BCA development, including discounting future costs and benefits and risk-weighting future projections (OMB, 1992).

Much of the academic literature focused on the OMB's evaluation process is focused on the OMB's use of discount rates. Some of these reviews have highlighted that the OMB's current practice does not account for systemic risk (Hansen & Lipow, 2013) or fluctuate based on an assessment of a particular project's risk (Bazelon & Smetters, 1999). Beyond these methodological issues, a major concern with the OMB's current discount rate policy is simply that it differs significantly from the policies of other federal agencies evaluating projects, for infrastructure notably the Corps of Engineers.

To account for the risk associated with future benefits and costs, the OMB discounts them using a prescribed market-based discount rate which reflects the pretax rate of return in the private sector. Since the early 1990s a discount rate of 7% has been prescribed across projects. The discount rate used by USACE is governed by the 1974 WRDA, and is calculated based on the average yields of some long-term public securities. It is thus considerably lower than the rate used by OMB, and in 2015 was 3.375%. Thus, projects evaluated by USACE and the OMB effectively have two different BCAs using two different discount rates. For infrastructure projects, which commonly entail near term costs in exchange for long-term benefits, the higher discount rate used by the OMB will often drive down the benefit-cost ratio of

the project in question (Congressional Research Service, 2016). OMB policies also excludes certain benefit categories that are allowed by the Principles and Guidelines for project authorization. The two separate paths that USACE projects navigate (one for authorization, another for budgeting) likely further adds to the complexity of project prioritization for those projects.

OMB's role in reviewing projects and budgets in the transportation sector has historically differed from the more project-specific evaluations the agency completes as part of the USACE authorization process. While the OMB reviews USDOT's annual requests before incorporating them in the President's Budget, a significant portion of transportation funding is also passed through to the states via formula funds. This reduces OMB's direct role in prioritizing federal funding between various projects in the transportation sector.

International Comparable Programs

Here we compare the prioritization of federal infrastructure projects in the United States with similar programs internationally. We chose to review national programs in Australia and Canada primarily because they are also large landmass, developed democracies which face similar challenges to the United States in developing national infrastructure programs that prioritize projects across states or provinces. Here we note one key differentiator between the United States and our selected international comparators – in both of our examples, national spending, as a percentage of total infrastructure investment by all levels of government, is considerably lower than in the United States. In Australia the commonwealth gross capital formation has ranged between 4% and 24% of total gross capital formation in any given year over the last two decades, with an average of 13% (Australian Bureau of Statistics, 2017). In Canada, federal ownership of public capital stock has declined steadily since the mid-1950s, and in 2003 the federal capital investment was only 13% of the total, with the balance provided by provincial and local governments (Mackenzie, 2013). In the United States, total federal spending has averaged more than 27% of total infrastructure spending in water and transport infrastructure since 1975 (CBO, 2015).

National Infrastructure Prioritization in Australia

The Commonwealth government in Australia uses BCAs extensively for evaluating national infrastructure projects. The development of BCAs is the responsibility of Infrastructure Australia (IA) – an independent statutory body with a mandate to advise the national government on infrastructure projects and programs across all of the infrastructure sectors. Here the processes and policies for project evaluation are more centralized in Australia when compared with the United States, at least within national government. State, local and territory governments maintain their own project assessment programs, with IA consultation (Commonwealth of Australia, 2008).

Australia's current BCA policies were created along with IA in 2008 and have undergone several revisions since. In 2014 the policies were adjusted to require a business case analysis, including a BCA for any projects receiving national support greater than \$100mm. IA develops and maintains national Infrastructure Plans with a 15-year horizon, which are updated every five years. IA also maintains a

publicly available Infrastructure Priority List (IPL) which includes projects prioritized based on their Business Case Assessment across the infrastructure sectors. The IPL is a living document that is updated annually, and all of the projects on the list are required to have a BCA completed prior to their inclusion (Rural and Regional Affairs and Transport Legislation Committee, 2014).

IA publishes a regularly updated Assessment Framework which details its evaluation process and methods, and provides templates for state and local project sponsors to use when submitting potential projects for national support (Infrastructure Australia, 2018). While the requirement to incorporate BCAs in national projects is prescribed legislatively, IA is responsible for developing the specific methods it uses to evaluate projects. Methodologically, IA's Assessment Framework is similar to the policies used by U.S. federal agencies. Projects are evaluated based on three broad criteria – their strategic fit in national infrastructure plans, their deliverability, and their economic, social and environmental value. This includes the quantification of both economic and environmental/social factors. For the discount rates used in the analysis, IA requires local sponsors to use a range of rates in their BCAs and include a sensitivity analysis. The rates of 4%, 7% (base case) and 10% are required for inclusion (Infrastructure Australia, 2018). For economic costs and benefits, the Australian Transport and Infrastructure Council also maintains guidelines for estimating the wider economic impacts of projects (Australian Transport Assessment and Planning Steering Committee, 2016). The inclusion of strategic fit and deliverability evaluation criteria here are notable in that they ensure projects are evaluated on factors beyond the technical assessment of their costs and benefits. Strategic fit ensures that projects align with national government priorities for infrastructure, and deliverability ensures that projects can reasonably be implemented by their state and local sponsors if the national government provides support. These criteria align project evaluation with other factors crucial to successful infrastructure programs.

The application of IA's business case assessment is one area in which we find a marked difference between the assessment programs in Australia and comparable federal programs in the United States. While IA maintains the IPL and supports the projects on it with publicly available analyses, the projects that receive funding are in the end selected by elected officials. There is not an explicit requirement by the government to fund projects only based on IA's prioritization or to take all of IA's recommendations, but the analysis from IA does more than just support or guide national infrastructure decision making, it also helps inform public debate when the national government diverges from IA's recommendations (Terrill & Batrouney, 2016).

National Infrastructure Prioritization in Canada

BCAs have been adopted in Canada for a number of years primarily to support regulatory decisions. In November 1999, the Government of Canada instituted the policy that a cost-benefit analysis must be carried out for all significant regulatory proposals to assess their potential impacts on the environment, workers, businesses, consumers, and other sectors of society. (Editor's note: For clarity, this paper uses BCA though the term used in Canada is Cost-Benefit Analysis.) In April 2007, the Cabinet Directive on Streamlining Regulation replaced the 1999 Government of Canada Regulatory Policy. One of the key requirements of the new directive was that departments and agencies assess

regulatory and non-regulatory options to maximize net benefits to society as a whole (Treasury Board of Canada Secretariat, 2007).

When it comes to infrastructure prioritization, the use of BCA has varied from department to department and from province to province. Over the last 20 years, federal infrastructure policy has been mainly passive in relation to the adoption of BCA techniques. Other constitutional considerations such as the division of powers between federal and provincial levels of government have more often been deployed explicitly or implicitly as a reason for taking a passive role (Mulder, 2011). The Federal approach to infrastructure investment has focused decision making around funding to be made at the project level, without much regard for the wider strategic transportation/infrastructure/land-use context (Currie, 2016). For example, in the transport sector, projects under the various funding categories were often approved on the basis of “shovel-readiness” rather than on the basis of an economic BCA, or an identified link to national transportation or trade priorities (Canada, 2016). A key consideration was to ensure that funds were dispersed on a “fair share” basis across Canada (Canada, 2016). The bottom-up approach to project identification has left little room for the selection of projects to robustly take into account national scope and strategic importance (Currie, 2016).

The most recent *Investing in Canada* program represents a renewed commitment from the Government of Canada in 2015 to make new investments in infrastructure, more than doubling existing funding. The program is based on three key objectives: create long-term economic growth; support a low carbon, green economy; build inclusive communities. The federal government announced it would be investing more than \$180 billion over 12 years in five main infrastructure priorities: Public Transit; Green; Social; Trade and Transportation; Rural and Northern Communities.

Federal funding will be allocated to the five priority areas through specific funds within the areas, such as the Public Transit Infrastructure Fund (PTIF) and the Clean Water and Wastewater Fund. Bilateral agreements will be made between Infrastructure Canada (the federal arm tasked with implementing the Investing in Canada plan) and 14 provinces and territories of the country. The agreements will utilize an outcomes-based approach, giving provinces and territories, in consultation with municipalities, the flexibility to prioritize projects that meet their needs, including projects that may not have fit into eligible asset categories in previous programs. The provinces will have to attest that investments in municipal assets do not displace municipal spending in a certain asset class.

The bilateral agreements are made to ensure that federal investments help achieve national objectives while allowing the local governments to meet their infrastructure investment priorities. The provinces and territories are responsible for identifying projects, and are required to submit a project list to Infrastructure Canada for approval. All of the proposed projects are required to have basic information, eligible investment category, financial information, planned start and end dates as well as identification of outcomes the project will support. Eligible investments under the program are defined by Infrastructure Canada as per the fund that is being used for the investment. The definitions are designed to provide a description of the type of investment, without detailing the specific types of

projects that are prioritized over others. Generally speaking the investments are targeted at meeting public priorities that will strengthen communities and grow the economy.

In many ways, the Canadian system divulges responsibility from the federal level to the provinces, territories and municipalities to conduct their own BCA analysis on required investments. There is no obligation to utilize the BCA analysis but various commentators have noted that the incorporation of BCA in the Canadian system would be worthwhile (Currie, 2016) (Couture, 2016). As identified in the U.S. context, local governments are not incentivized to use BCA necessarily, particularly if the overall benefits are ambiguous. It is likely that the Canadian system will continue to use whatever has been working sufficiently and that satisfies the requirements for obtaining the funding source from the Federal government.

Conclusions and Recommendations

We find a wide variety of methods to prioritize national infrastructure investments, both between the United States and our international comparators and between U.S. federal agencies and sectors. The use of BCAs, generally, is fairly consistent across the programs we reviewed, but these vary significantly both in their precise methodology and in the actual use of the BCA in investment decision making. We find that while the general practice of using BCAs to prioritize infrastructure projects is certainly methodologically sound, its application in practice has literally no upper-bound of complexity, and is heavily weighted by ex-ante assumptions that for complex infrastructure projects are extremely difficult to forecast. This can create two problems in translating BCAs from theory to practice. First, as complexity increases transparency naturally decreases, which in turn creates the opportunity for other factors to influence the outcomes of BCAs for particular projects. This was presumably what congressional decisions like the earmark ban were intended to prevent. Second, additional national analysis naturally entails costs, both directly and in the form of delaying critical investments. This, too, must be accounted for in the design of programs to prioritize between infrastructure projects, nationally and otherwise.

In our review of the infrastructure sectors in which the federal government plays a significant role, we found that the water sector had the most robust or complex set of BCA guidelines. We also find that federal BCAs in the water sector have a relatively greater impact on federal investment decisions, at least in their authorization. Here, though, there are signs that the federal planning process in the water sector has diverged a bit from the actual appropriation of federal infrastructure dollars for water projects. This is perhaps best evidenced by the massive and growing “backlog” at USACE of authorized infrastructure projects. In 2011, the Corps estimated that it had a backlog of approximately \$60bn of infrastructure projects that were authorized but incomplete due to the fact that those projects had not received funding appropriations from Congress (NAS, 2011). In other words, those projects passed through the planning process described above to be authorized by Congress, but had not yet received federal funding. This backlog has likely only grown since 2011. Here the USACE project backlog is a bit of a barometer of the effectiveness of the most robust BCA-driven federal infrastructure planning process

in the nation, in that it is a measure of the projects that have been selected by that process but which have not yet received actual federal funding.

In addition to illustrating the divergence between the benefits assessed by the executive branch in the water sector and the funding priorities of congress, the USACE backlog may have other implications for the efficiency of federal infrastructure spending in the United States. The maintenance of a wide backlog may lead to Congress appropriating very small amounts annually for a large number of projects, instead of a more concentrated set of priorities. This may impact the efficiency of spending for those projects USACE is required to deliver. It is unclear whether a more consolidated and rank ordered priority list like that developed by Infrastructure Australia would lead to more concentrated spending by the legislature.

Issues such as these may be a contributor to proposals and practices to use other factors to supplement infrastructure BCAs in deciding what projects will receive federal funding. The program we reviewed in Australia leaves investment decision making with elected officials, but supports those decisions (or not) with the analytical rigor of executive agency review. Similarly, the current infrastructure program proposed by the Trump administration would use factors in addition to BCAs to select infrastructure projects for federal funding. At the time of this writing, the proposed program would use multiple weighted criteria, and the weighting of projected economic or social benefits would entail only 5% of a particular project's total score. Evidence that the project will secure non-federal revenue for construction and operations are meanwhile weighted at 50% and 20% of the project's score, respectively (White House, 2018). Metrics derived from state and local project advocates willingness to pay for some of the costs of the projects they are requesting federal support for may, in fact, be a useful signal of the benefits they hope to receive from the investment. If the program is implemented, it will certainly provide an interesting point of comparison with programs driven by agency economic analysis alone.

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