The Beacon Hill

The Impact of Tax Exempt Financing on Public-Private Partnerships: A Dynamic Analysis

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Executive Summary

A familiar refrain from both public officials and private citizens is the woeful state of infrastructure in the United States. Expert estimates on the dimensions of this challenge vary. For example, according to a recent study (InfrastructureReportCard, 2017), the United States needs to invest $870 billion on schools but has funded only $490 billion through 2025. On the campaign trail, President Trump proposed investing $500 billion to $1 trillion to upgrade the country's infrastructure. The President's plan endorses the use of Public-Private Partnerships (P3s) to help finance the new infrastructure projects. He contends that private partners under P3s can build projects quicker and cheaper than the government (Zanona, 2017).

In 2005, Congress enacted the "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users," enabling the use of private activity bonds (PABs) for transportation projects (IRS, 2005). PABs are debt instruments issued on behalf of a private entity (such as a P3 entity) for public projects, allowing a private project sponsor to benefit from the lower financing costs of tax-exempt municipal bonds (IRS, 2005). The Public Buildings Renewal Act (PBRA) of 2017 (H.R. 960, S. 326), now before Congress, would expand the list of projects that qualify for PABs to include public buildings (FederalHighwayAdministration, 2017). The PBRA would allow state and local governments to issue $5 billion in PABs to fund qualified projects and thus extend the use of P3s and provide the expected cost savings.

The Performance Based Building Coalition is leading an effort to have Congress enact the PBRA, which would remove barriers to P3s for public facilities. This effort is gaining broad bi-partisan support. The PBRA has 16 Democrat co-sponsors and 19 Republican co-sponsors across both chambers of Congress. Moreover, an increasing number of governors and mayors support the proposal.

P3s are arrangements under which a public entity partners with a private entity to build and maintain a public project. Evidence from U.S. and Canadian projects shows that P3s provide significant cost savings over traditional arrangements for public construction projects.

The Beacon Hill Institute[1] (BHI) recently undertook an in-depth analysis of how P3s impact both economic and fiscal policy toward infrastructure, particularly public buildings. BHI finds that P3s provide substantial cost savings, supporting the argument for the legislation. This report estimates those savings in order to calculate the economy-wide economic effects of expanding the use of P3s. Specifically, we provide estimates of the incremental effects of the PBRA on U.S. GDP and employment and on federal and state individual income tax revenues. We also provide estimates of the economic effects of a PBRA expanded to include all investment on projects of the kind it encompasses.

We estimate that, on average, P3s save 24.6% in project costs (design, construction, operation and maintenance). Using this estimate, we first determine the short and long-run effects of this cost saving on the assumption that building construction is limited to the $5 billion which would be authorized by the PBRA should it pass Congress. We next determine the short and long-run effects of extending the PBRA to cover all infrastructure investment on qualified projects as defined in the PBRA that could potentially benefit from PABs.

The cost savings afforded by the PBRA would add $591 million worth of public infrastructure within the $5 billion cap. The extension of P3s to 20% of all state and local infrastructure projects listed in the PBRA without the cap of $5 billion in PABs, would expand infrastructure investment by $2.796 billion in 2018 and then by larger amounts going forward.[2] Table 1 displays the economic effects of these changes.

We distinguish between short-run and long-run effects. Short-run effects consist of once-and-for all corrections in the economy that yield temporary increases in employment and production. These effects drop to zero once a construction project is completed. Long-run effects yield permanent increases in employment and production beyond the life of an individual construction project. New infrastructure increases productivity and thus increases employment and production for as long as the new infrastructure is maintained.

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[1] The Beacon Hill Institute (BHI) is a 501 (c) research organization, headquartered in Massachusetts. BHI applies economic and statistical methods to the analysis of current public policy issues. Established in 1991, BHI has contributed to the public policy debate by publishing dozens of research reports, by contributing to the academic literature and by testifying before Congress and several state legislatures.

[2] Not all projects listed in the PBRA would be built under P3s. The Canadian Council for Public-Private Partnerships estimates that P3s averaged about $12 billion over the past three years and total infrastructure investment in Canada averaged $40 billion per year over the same period, excluding municipal infrastructure projects. Thus, we conservatively estimate that 20% would be built under P3s.

We find that in the short-run, the PBRA would increase employment by 8,800 jobs, which would, in turn, increase real GDP by $1.654 billion. The increase in economic activity would boost federal tax collections by $118 million and state tax collections by $57 million. Were the PBRA expanded to 20% of all projects defined as qualified projects listed in the proposed legislation, as opposed to restricting the PABs allotment to $5 billion, the short-run effects would become much greater. Employment would increase by 43,200 jobs and real GDP by $8.285 billion. Federal tax collections would rise by $579 million and state tax collections by $281 million.

We find that, in the long-run, new public building construction would increase by $1.899 billion under the provisions of the PBRA. See Table 1. This additional construction would, in the first year of implementation, increase employment by 750 jobs and real GDP by $169 million. Federal income tax collections would rise by $14 million and state personal income tax collections by $3 million.

Table 1: Economic and Fiscal Effects of Expanding the Use of P3s

Short-run Incremental Effects	**PBRA**	**All Infrastructure**	
Investment Increase (2018 $, millions)	591	2,796	
Employment (jobs)	8,800	43,200	
Real GDP (2018 $, millions)	1,654	8,285	
Federal Income Tax (2018 $, million)	118	579	
State Income Tax (2018 $, million)	57	281	
Long-run Incremental Effects	**PBRA**	**All Infrastructure**	
	1st year	1st year	10th year
New Infrastructure (2018 $, million)	1,899	7,920	85,900
Employment (jobs)	750	3,100	32,400
Real GDP (2018 $, million)	169	1,766	8,060
Federal Income Tax (2018 $, million)	14	57	643
State Income Tax (2018 $, million)	3	13	146

The expansion of P3s to 20% of all qualified projects listed in the PBRA, as opposed to restricting the PAB allotment to $5 billion, would increase new public building construction by $7.92 billion in 2018. Employment would rise by 3,100 jobs and real GDP by $1.766 billion. The boost in real GDP would increase federal income tax collections by $57 million and state personal income tax collections by $13 million. In ten years, the expansion of P3 projects would increase public building construction by a cumulative $85.9 billion. The new buildings would create 32,400 jobs, increase real GDP by $8.06 billion and increase federal personal income tax collections by $643 billion and state personal income tax collections by $146 million.

Introduction

Public-Private Partnerships (P3s) are arrangements under which a public owner partners with a private entity to build and maintain a public project. The key difference between P3s and traditional procurement for public construction projects is that, under traditional procurements, the public entity assumes most or all of the risk connected with investing its funds in procurement of a facility, whereas under a P3, much of the risk is transferred to the private entity and is backed by fixed-price contracts and performance security to ensure that the public interests are protected.

Design, bid, build (DBB) is the most common type of traditional building procurement. Under DBB, the public owner retains an architectural firm to design a facility followed by putting the project documents out to competitive bid. In most cases, under these procurements, it is the public owner that bears the risk of completion delays, cost overruns, poor facility performance during the years of occupancy and deferred maintenance during the life-cycle of that structure, which is often 40+ years.

Under traditional DBB procurement, the public owner is responsible for maintaining the structure. Each part of the process is completed separately, usually without input or consideration from the point of view of the other project stakeholders, such as those responsible for facility maintenance. Construction cost is usually the driver, as budgets need to be met; all too often quality suffers to meet construction budgets. Further, because the public owner controls the process, it absorbs the procurement and performance risks of the project. In addition, when the public sector controls the interface between the various parties to the project design and construction, it retains the risk for cost overruns and delays resulting from slow decision making and "gaps" in the contractual documents.

While the proposed PBRA is targeted at removing barriers to enabling P3s at state and local government facilities, a good example of a recent federal project, demonstrates the need for P3s in building or renewing infrastructure. The construction of a new Veteran's Affairs (VA) hospital in Aurora Colorado demonstrates the problems that can arise under the DBB approach. The VA initially expected the new hospital to cost $590 million. Now the VA estimates that the project will cost $1.7

billion, and the project has dragged out for over seven years since the VA awarded the construction contract in 2010 .

Part of the delay resulted from disputes between the VA, the contractor and the design team. The contractor contended that the design could not be built within the project budget. The Civilian Board of Contract Appeals agreed and ruled in December 2014 that the VA had violated the contract by not giving the builders a design that could be built within budget (Elliot, 2017).

Investigators found that the VA did not "oversee the project closely enough…approved lavish design elements, failed to get the designers and builders to agree on the design and tried to use a complicated form of construction contract that agency executives did not fully understand" (Elliot, 2017).

This situation is not unique and provides strong support for P3 procurement, as the risk transfer inherent in a P3 procurement transfers those cost and time overruns to the private sector and holds both the public and private sectors accountable for performance. Table 2 shows a sampling of public construction projects built under traditional procurement methods and P3s. The traditional projects in the sample were consistently over budget and late, while the P3 projects were all built within budget and were mostly completed on time.

Many types of projects have been labeled as P3s, from full privatization of toll roads and bridges to building and operating college dormitories. Under the approach authorized by the PBRA, the private sector would have the ability to issue tax-exempt bonds to fund a state and/or local government PBRA-qualifying project. The public entity would then make payments to the private entity for a set period (typically 30 years), over which the private entity would retain responsibility for maintaining the project according to performance criteria stipulated in the contract between the two entities.[3] One of the key benefits of the P3 model is that it permits the government entity to shift both risk and responsibility to the private entity.

[3] Qualifying projects include elementary or secondary schools; a facility of a state college or university used for educational purposes; public libraries, courthouses, hospitals, health care facilities, laboratories, research facilities; public safety facilities (including police, fire, enhanced 911, emergency or disaster management and ambulance or emergency medical service facilities and jails and correctional facilities), offices for government employees.

Private Activity Bonds (PABs) are debt instruments issued by a private entity (such as a P3) for qualifying public projects, allowing a private project sponsor to benefit from the lower financing costs of tax-exempt municipal bonds (Federal Highway Administration, 2017). The public sector benefits because these projects are procured competitively and because competing private sector teams will pass the financing cost savings to the public sector in order to win the project.

Table 2: The Performance of a Sampling of P3 and Traditional Procurement Projects[4]

Traditional Procurement					
Project	**Location**	**Sector**	**Final cost ($ millions)**	**% Over Budget**	**Months Late**
VA	Las Vegas	Social	585	80	86
VA	Orlando	Social	616	143	61
VA	Denver	Social	1,730	188	50
VA	New Orleans	Social	1,035	66	14
UC	San Diego	Social	943	42	Unknown
Big Dig	Boston	Transport	15,000	150	Double Plan
520 Bridge	Seattle	Transport	4,250	10	>18
Highway 99 Bertha	Seattle	Transport	TBD	TBD	>27
P3					
Project	**Location**	**Sector**	**Final Cost ($ millions)**	**% Over Budget**	**Months Late**
Humber Hospital	Toronto	Social	1,750	0	0
CSEC	Ottawa	Social	867	0	0
Long Beach Courts	Long Beach CA	Social	339	0	0
Alberta Schools (2 Projects)	Alberta	Social	887	0	0
Durham Courts	Ontario	Social	355	0	0
MGCS Data Center	Ontario	Social	352	0	0
Toronto Detention Center	Toronto	Social	764	0	0
Windsor Parkway	Ontario	Transport	1,786	0	1*
Miami Tunnel	Miami FL	Transport	68/Year	0	2*

In 2005, Congress enacted the "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users," which enabled the use of PABs for transportation projects, but not buildings (Federal HighwayAdministration, 2017). The Public Buildings Renewal Act of 2017, now before Congress, would expand the list of projects that qualify for PABs to include public buildings (IRS,

[4] Note: While the Windsor Parkway and Miami Tunnel projects were late, all resulting costs, including financing costs, were borne by the private sector.

2005). The PBRA would allow state and local governments to issue $5 billion in PABs to fund qualified projects and thus extend P3s and their savings.

According to a recent study, the United States needs to invest $4.5 trillion to keep bridges, schools, ports and other public facilities up to date through 2025 . However, the United States has funded only $2.526 trillion for this purpose. Expert analyses vary on the dimensions of the funding challenge, but clearly there is a considerable unmet need (Infrastructure Report Card, 2017).

Local school districts share in the infrastructure deficit. More than half of school buildings were built to educate the "baby boomers" more than 50 years ago and are falling into disrepair. The *Infrastructure Report Card*, estimates that school facilities will require $870 billion in investment through 2025. While states and local school districts plan to fund $490 billion in school construction programs through 2025, a $380 billion shortfall persists (Infrastructure Report Card, 2017).

One obstacle to the task of closing this gap lies in the manner in which traditional contracting leaves public entities at risk for the project. When school districts build a new school or renovate an existing school, the project can run into delays, change orders and other developments that can cause costs to run over budget.

One solution is to adopt a P3 approach, under which a single, private entity assumes responsibility for the entire lifecycle of the structure, from design and construction to operation and maintenance. State and local governments find P3 projects attractive because (1) P3s transfer risk from the government to the private entity for the entire lifecycle of the project and (2) they can achieve significant cost savings over traditional financing and procurement methods and serve as a forum for design innovation.

Unfortunately, under current law, the state and local government entity cannot avail itself of the less expensive tax-exempt debt and must therefore forgo the savings it could achieve with the P3 procurement methods. So, the conundrum is: use public debt in a traditional DBB procurement and face significant price and performance risks, or use a P3 procurement approach to eliminate the price and performance risk, but pay a higher cost of financing using taxable debt. The PBRA aims to resolve this conundrum by allowing the public entity to both eliminate the price and performance risk and avail itself of less expensive debt. While the former approach (DBB with public debt) should theoretically be the least expensive alternative, invariably, the price and performance risks turn into reality and the public sector ends up having to finance these higher costs due to cost overruns and long-term performance issues. Therefore, while the financing should have been less expensive, it is actually more, due to the requirement to finance the cost over runs.

P3 Cost Savings in Canada and the United States

Governments in Canada have been using P3s to build infrastructure for two decades, since the opening of the Confederation Bridge in 1997. This 13-kilometer bridge connects Prince Edward Island to the mainland. Within a few years of the Confederation Bridge project, P3s became a widely accepted project delivery method, as over 200 P3 projects have been completed in Canada (PPPCouncil, 2016).

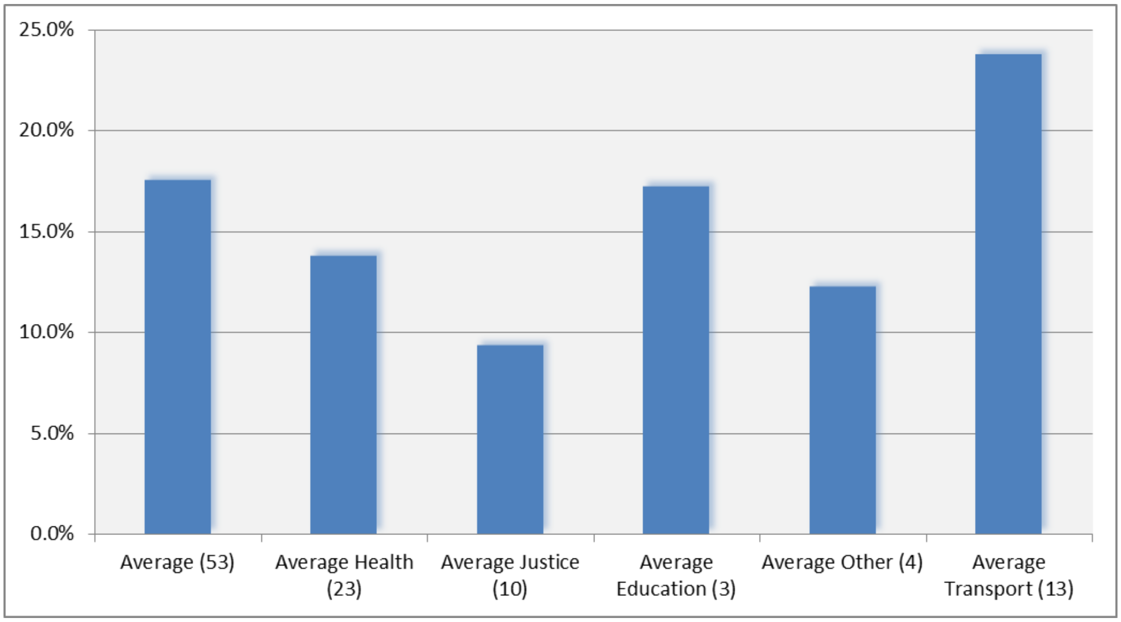
Canadian P3 projects typically undergo a Value-for-Money (VfM) analysis to assess whether a P3 is the best procurement option. VfM is a detailed analysis that compares the net present cost (NPC) of procuring an infrastructure project under a P3 with the NPC under traditional procurement methods. The difference between the two is the NPC of procuring the project under a P3 approach.

Under a P3, the private entity is responsible and retains most of the risk, for designing, bidding, building, operating and maintaining the infrastructure for an extended period, typically 30 years. Under traditional procurement, the public owner is responsible and retains the risks of designing, bidding, building and maintaining the piece of infrastructure. The VfM analysis quantifies this risk. If the VfM analysis finds the P3 to be less costly, typically the public entity would procure using the P3 procurement model as opposed to the DBB model.

A review of Canadian VfM analyses of 53 recent projects shows that using a P3 saved an average of 17.5%, or an aggregate of $6.777 billion, by transferring risk to the private sector. The projects consisted of 23 health care projects, with an average saving of 13.8%; ten justice projects with an average saving of 9.3%; three education projects with an average saving of 17.2 %; three housing projects and one data center with a combined average saving of 12.3%; and 13 transportation projects with an average saving of 23.8% (PPPCouncil, 2016). Figure 1 displays the results.

VfM analysis will not always find that a P3 will provide cost savings or be appropriate for particular infrastructure projects. BHI discussed VfM analysis with a practitioner from Partnerships B.C., the procurement agency for P3 projects in the province of British Columbia, Canada. He indicated that a VfM analysis would not favor P3 for a project in which the scope was not clear, such as a transit project in which the number of additional stations that would be needed in the future was unknown. He stated that a P3 would not be appropriate for a project in which the risk cannot be separated from a larger project. For example, when adding new turbines to an existing hydropower dam, the project risk of adding the new turbines cannot be separated from the risk of the whole dam.

Figure 1: Value for Money Savings for P3 Projects in Canada



BHI collected cost savings estimates for 13 P3 projects in the United States. On average, the project owners estimated the P3 would save 24.6% in project costs compared to using a conventional procurement method. Table 3 displays the results.

These cost savings are important in that they free up funds that can be used for additional public projects or for other public investment priorities or, simply returned to the taxpayers, likely through future tax relief. They account for what we will call the "static" effects of P3 financing, by which we mean they do not account for the benefits to the broader economy.

In a letter dated November 17, 2015 to Representative Lee M. Zeldin, the Joint Tax Committee estimated that the creation of $5 billion in tax-exempt bonds would cause the federal government to lose $48 million in revenue over the period 2016-2025 (Barthold, 2015 #84). That is a static effect in that it does not account for the effects on the broader economy that could result from cost savings and incremental funding for other needed projects that the PBRA would make possible – or, in the case of tax relief, from more productive allocation of resources to the private sector.

Table 3: Estimated Savings from P3 Projects in the United States ($ millions)*

Project	Savings (%)	Savings $	Total Cost ($)
Denver FasTracks	27	300	2,143
Port of Miami Tunnel	50	750	1,500
Ohio River Bridges (East End Crossing)	23	228	1,004
Long Beach Courthouse	15	52	346
Goethals Bridge	10	150	1,500
I-4 Ultimate	35	1,300	3,714
Presidio Parkway	23	147	635
Purple Line Maryland	10	600	5,600
PA Rapid Bridge Replacement	20	200	1,000
635 (LBJ Freeway)	50	1,300	2,600
University of Kansas Campus	29	100	350
Richmond, highway Loop	17	47	283
UC Merced	12	Na	Na
Average	**24.6**	**5,174**	**20,676**

Sources: PPP Council 2016, MTA 2016, PennDOT 2015, CODOT 2014, MccCown Gordon 2016, NCPPP 2015. *Total may not add due to rounding.

Economic Theory and the Impacts of New Infrastructure

A dynamic analysis of P3s requires attention to macroeconomic effects, that is, effects on such economic indicators as employment, output and tax receipts. Economic theory suggests the existence of both short-run and long-run dynamic effects. Short-run dynamic effects arise from the existence of gaps between potential and actual real Gross Domestic Product (GDP), as explained in Appendix II, and from increases in government investment or decreases in taxes that can help close that gap. Long-run dynamic effects arise from the contribution of infrastructure improvements to productivity and production. Both effects arise from the cost savings attributable to P3s.[5]

Consider how buyers adjust to cost savings that they sometimes enjoy in the marketplace. Suppose a shopper checks the price of a gallon can of hydrangeas at a retail outlet on Wednesday and finds it listed at $25 and returns to the store on Thursday with $200 in his pocket planning to buy four cans of the hydrangeas and $100 worth of other plants. Then, to his surprise, he finds that the

[5] U.S. real Gross Domestic Product equals the market value of final goods produced in the United States, expressed at an annual rate and adjusted for inflation.

hydrangeas have been marked down to $20 per can. Indeed, he could decide just to save the $20 that he no longer has to spend to get his four cans of hydrangeas. Or he could apply that money to the purchase of other plants. He might even end up spending more on the hydrangeas than he originally planned. This is because hydrangeas are now cheaper relative to other items in his budget (including the pansies, impatiens and petunias that he planned to buy and therefore a more attractive use of his money). It is possible that he will buy six cans of hydrangeas, at a total cost of $120 and $80 worth of other plants.

Now extend this reasoning to local governments. Of course, the discussion now centers on schools, courthouses and other public buildings, and not hydrangeas. But the principle is the same. Government officials (and, ultimately, voters) could simply return the cost saving made possible by a P3 to the taxpayers. Or they could decide to build more or bigger schools and courthouses and possibly also invest more money on schools and courthouses than they would have without the P3. A school building authority might budget for the construction of 10 new schools at $20 million apiece for a total cost of $200 million. But if, by adopting P3 financing, it could reduce the cost to $15 million per school, it might decide to build 15 new schools, for a total cost of $225 million.

If the adoption of a P3 and the resulting cost saving bring about an increase in the physical volume of infrastructure, it will contribute to the long-run expansion of the economy because the new infrastructure will increase the productivity of private capital. It will also bring about a short-run expansion in the economy if it induces the government to invest more on construction or if the government decides to return the cost saving to taxpayers as a tax cut (or reduce the rate of future tax increases).

Because P3s might therefore lead to the expansion in infrastructure and in infrastructure investment, we are compelled to determine what the academic literature tells us about how governments react to reductions in the cost of public projects. Continuing the earlier example, if we were studying the demand for hydrangeas, we could determine how consumers adjust their purchases to price changes simply by observing their behavior in the marketplace. It is more complicated when it comes to public projects. The reason is that decisions in the public sector are not made by a single, autonomous consumer, but rather by elected officials who act on the basis of the interests of their constituents as well as their own private tastes for public investment. Just who decides how much to investment in a democracy?

Among economists, the "median voter" model is probably the most accepted method for answering this question. In this model, candidates for office will be driven to match their positions on the issues as closely as possible with what they believe the median or "typical" voter prefers. We define the median voter as the voter whose opinion on an issue lies exactly between the opinions of all the voters on that issue, i.e., fifty-percent above and fifty-percent below.

Suppose the issue is how much to invest on school buildings. There will be as many voters who want to invest less than the median voter on school buildings as there are voters who want to invest more than the median voter. If the range of possible expenditures is $0 to $100 million, if the median voter wants to invest $50 million and if there are two candidates for school committee, each candidate will promise to invest $50 million. If one of the candidates promises to invest this amount and the other candidate promises to invest either more or less than this amount, the other candidate will lose. It is helpful to our analysis that there is a rich body of academic literature that utilizes this model to determine the sensitivity (i.e., "elasticity") of government demand to changes in the cost of providing social goods.

These and other considerations that went into our modeling of P3s require a fuller explanation, which we provide in Appendix I. There is also more to be said about precisely what assumptions go into distinguishing between short-run and long-run economic effects. We delve into those assumptions in Appendix II. In Appendix III, we discuss some considerations that bear on the advantages (or disadvantages) of P3s relative to conventional financing methods. Finally, in Appendix IV we offer a case study of one P3, namely the Long Beach Courthouse project.

Economic Impact of Public-Private Partnerships

BHI assesses both the short-run and long-run economic impacts of the PBRA. As noted above, we gathered cost savings estimates for over a dozen P3 projects in the United States and determined that the average cost saving is 24.6%. That cost saving motivates the government to acquire more infrastructure, just as cost savings in the private sector motivate consumers to acquire more private goods. We utilize estimates in the academic literature of the sensitivity (that is, "elasticity") of demand for government services. Specifically, we find and use an estimate that a 1% fall in the price of government buildings will bring about a 1.546% increase in government demand for those buildings.

We divide our analysis into short-run and long-run effects and into narrow and broader definitions of eligibility for PABs. When considering short-run effects, it is necessary to decide how to interpret an increase or decrease in infrastructure investment for its effects on the aggregate economy. We apply our assumed elasticity of demand to the $5 billion in bonds allowed under PBRA to obtain our estimate of how the PBRA would affect investment under a narrow interpretation of eligibility. We then apply it to a broader interpretation of eligibility. See Appendix I for the details.

First consider short-run effects. There exists a gap between actual real GDP and potential (or full-employment) GDP that can be closed by an increase in aggregate demand. Government can increase aggregate demand by increasing investment. If government increases infrastructure investment, the new investment will become an "injection" into the economy that will help close the GDP gap.

We use the proprietary IMPLAN model to estimate the short-run economic impacts of the PBRA(IMPLAN).[6] We also make a second set of calculations under which we assume that Congress extends the use of PABs to a broader set of projects listed in the Act. Table 4 displays the results.

The cost savings afforded by the PBRA would increase public infrastructure investment by $591 million in the short-run. As a result, the PBRA would increase employment by 8,800 jobs and real GDP by $1.654 billion. The increase in economic activity would boost federal tax collections by $118 million and state tax collections by $57 million.

The expansion of P3s to 20% of all state and local PBRA qualifying projects beyond the $5 billion cap would expand investment by $2.796 billion in 2018. In the short-run, employment would increase by 43,200 jobs, which would increase real GDP by $8.285 billion. The increase in economic activity would boost federal tax collections by $579 million and state tax collections by $281 million.

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[6] IMPLAN is a world leader in providing economic impact data and modeling to governments, universities and public and private sector organizations for assessing the economic impacts of project decisions in all industry sectors. IMPLAN, which accounts for interindustry relationships through the use of output, earnings and employment multipliers, is a useful tool for conducting economic impact analysis.

Table 4: Economic and Fiscal Effects of Expanding the Use of P3s for Public Buildings

Short-run Incremental Effects	$5 billion PABS (PBRA)	Uncapped PABs
Investment Increase (2018 $, millions)	591	2,796
Employment (jobs)	8,800	43,200
Real GDP (2018 $, millions)	1,654	8,285
Federal Income Tax (2018 $, million)	118	579
State Income Tax (2018 $, million)	57	281

Long-run Incremental Effects	$5 billion PABs (PBRA)	Uncapped PABs	
	1st year	1st year	10th year
New Infrastructure (2018 $, million)	1,899	7,920	85,900
Employment (jobs)	750	3,100	32,400
Real GDP (2018 $, million)	169	1,766	8,060
Federal Income Tax (2018 $, million)	14	57	643
State Income Tax (2018 $, million)	3	13	146

As stated, however, this accounts for only short-run effects, that is, effects that end once the project is completed. As stated above, however, new infrastructure also increases total factor productivity and thus increases economic growth in the long-run. We therefore also estimate the long-run effects of infrastructure investment attributable to the PBRA. Appendix I provides the details of our calculations.

The PBRA would expand new infrastructure by $1.899 billion, given our assumption about the magnitude of the elasticity of demand for public projects. Taking into account, the long-run productivity effects, employment would increase by 750 jobs, real GDP would increase by $169 million, federal personal income tax collections would increase by $14 million and state personal income tax collections by $3 million.

We make another calculation by assuming that Congress expands the use of tax exempt bond status and P3s to 20% of all state and local infrastructure projects listed in the PBRA, using the same assumptions as above. In this instance, we also assume that P3s would apply to 20% of the new infrastructure investment every year and that the productivity effect would accumulate over the years. Therefore, we report these results for the first year and for the tenth year under this assumption.

The expansion of P3s beyond the $5 billion outlined in the PBRA begins with $7.92 billion in new public buildings in 2018, generating a modest initial economic impact. In the first year, employment would increase by 3,100 jobs, real GDP would increase by $1.766 billion, federal income tax collections would increase by $57 million and state personal income tax collections would increase by $13 million.

However, as the use of P3 expands and increases investment on infrastructure and thus, increases the quantity and quality of infrastructure, the effect becomes cumulative. In ten years, the expansion of P3 projects would increase public buildings by $85.9 billion and create 32,400 jobs, increase real GDP by $8.06 billion, increase federal personal income tax collections by $643 million and state personal income tax receipts by $146 million due to rising economic activity.

Conclusion

A common refrain from both public officials and private citizens is the woeful state of infrastructure in the United States. We find that P3s provide substantial cost savings that will assist in building projects quicker and less expensively than traditional approaches.

The Public Buildings Renewal Act (PBRA) of 2017 (H.R. 960, S. 326), now before Congress, would allow state and local governments to issue $5 billion in PABs to fund qualified projects and thus extend the use of P3s and provide for the expected cost savings.

This cost savings afforded by the PBRA would increase public infrastructure investment by $591 million within the $5 billion cap. We find that in the short-run, the PBRA would increase:

- employment by 8,800 jobs,
- real GDP by $1.654 billion and
- federal tax collections by $118 million and state tax collections by $57 million.

The extension of P3s to 20% of all state and local infrastructure projects listed in the PBRA without the cap of $5 billion in PABs, would expand investment by $2.796 billion in 2018 and then by larger amounts going forward. The short-run effects would increase:

- employment by 43,200 jobs,
- real GDP by $8.285 billion and
- federal tax collections by $579 million and state tax collections by $281 million.

In the long-run, once the initial qualified projects have been built, new public building construction would rise by $1.899 billion under the provisions of the PBRA. The additional public buildings would increase:

- employment by 750 jobs
- real GDP by $169 million and
- federal tax collections by $14 million and state tax collections by $3 million.

The long-run impact based on expansion of P3 to 20% of all projects listed in the PBRA, as opposed to restricting the PABs allotment to $5 billion, would increase the construction of new public buildings by $7.92 billion in 2018. The additional public buildings would increase:

- employment by 3,100 jobs,
- real GDP by $1.766 billion and
- federal tax collections by $57 million and state tax collections by $13 million.

In ten years, the expansion of P3 projects would increase public buildings by a cumulative $85.9 billion. The new buildings would increase:

- Employment by 32,400 jobs,
- real GDP by $8.06 billion and
- federal tax collections by $643 million and state tax collections by $146 million.

Lawmakers from both parties have shown willingness to work with the president on improving the nation's aging infrastructure. Again, we find that the combination of allowing additional capital investment projects to be funded through tax-exempt bonds and the use of P3s to build the projects would provide substantial short-run and long-run benefits to the national economy.

Appendix I: Modeling the Economic Effects of P3 Cost Savings

The task of modeling the economic effects of P3 cost savings requires an understanding of how public officials adjust to cost savings when they budget for public expenditures, and then how economic activity responds to their adjustment to these cost savings. There are many ways to consider what public officials do when presented with cost savings. As explained in the body of this report, we turn to the median voter model in order to undertake this consideration. That model has the advantage of being both plausible and as applied by economists to public investment decisions a source of data on just how public officials adjust their investment decisions to a cost saving when presented with one.

Probably the best-known articulation of the median voter theorem can be found in a 1929 article by the economist Harold Hotelling. The article explains why the profit motive drives economic competitors to offer an "excessive sameness" to their customers (Hotelling, 1929). If the residents of a town are distributed normally or uniformly along a road running from east to west, two stores competing for business will eventually end up locating next to each other in the center of the road, even though it would be more convenient for their patrons if the stores spread themselves further apart. Thus, the two gas stations servicing a small town will end up locating across the street from each other in the center of town. The phenomenon is not limited to gas stations.

> So general is this tendency that it appears in the most diverse fields of competitive activity, even quite apart from what is called economic life. In politics it is strikingly exemplified. The competition for votes between the Republican and Democratic parties does not lead to a clear drawing of issues, an adoption of two strongly contrasted positions between which the voter may choose. Instead, each party strives to make its platform as much like the other's as possible (Hotelling, 1929, p. 54).

By applying the Hotelling assumptions to the problem of predicting infrastructure investment, we, in effect, put the median voter in charge. The median voter becomes sovereign over the choice of investment levels in exactly the way that the individual consumer is sovereign over the choice of spending in the marketplace. School committees and other building authorities will figure out how much public investment the median voter wants and that is how much they will invest.

Economist Anthony Downs provided an analysis similar to Hotelling's. He presented the problem of choosing how much of a social good to provide as one in which competing political parties will attempt to position themselves as closely as possible to the preferences of the greatest number of voters (Hotelling, 1929, p. 54). Thus, the first step in any analysis of government decision making is to decide which voter calls the shots. The median voter model answers that question.

The second step is to determine how the median voter will adjust to a reduction in the cost of infrastructure. The founding article on this subject was authored by economist Howard Bowen in 1943 (Bowen, 1943). "Economic goods," said Bowen, "are of two types: individual goods and social goods. The two types are similar in that each serves the needs of human beings and each is produced only through the use of scarce resources. They differ, however, in the character of their demand. Individual goods are characterized by divisibility (Bowen, 1943, p. 27).

Social or "public" goods are different from individual goods in that they are not divisible into units that can be the unique possession of individuals. Rather, they become part of the general environment — available to all persons within that environment (as, for example and, to a degree, with education, protection against foreign enemies, beautification of the landscape and flood control). Consequently, these goods cannot easily be sold to individual consumers and the quantities available to different individuals cannot be adjusted according to their respective tastes. The amount of the good must be set by a single decision applicable jointly to all persons. Social goods, therefore, are subject to collective or political demand rather than individual demand.

The problem of determining the demand for these goods is complicated by the various degrees of "rivalry" that separate various goods from one another. Thus, for example, education can be "rivalrous" insofar as students who attend a school with a good athletic or music program benefit from that school more than students who attend a school that does not offer equally good programs. Some benefits of education are "nonrivalrous," however, insofar as everyone benefits from having an educated citizenry. The question then is how school officials choose to invest on schools insofar as they are accountable to the local residents who pay for them.

Bowen solved this problem by positing a state of affairs in which voters are informed that they can vote for however much of a social good they want, given that each voter understands that, however much is provided, he will pay a certain "tax price" for each unit he buys. This price will equal the total cost of providing the good divided by the number of voters. The amount of the good provided will then equal the amount demanded by the greatest number of voters. So, if the cost per school is $20 million and if there are 100,000 voters, each will pay a tax price of $200 per school. Then each voter registers his demand for schools according to his individual willingness to invest on schools. Assuming that voter preferences for schools are subject to the "law of normal error," the number of schools built will equal the number that the median, or modal, voter demands at that price.

The median voter will thus determine the number of schools built, given the cost to him per school. In the foregoing example, the number of schools built will equal the number the median voter wants to "buy" at a price of $200 per school. Given that voters' preferences are in accord with the same "law of demand" that applies to individual goods, a decrease in the tax price will induce the median voter to demand the construction of more schools.

This line of reasoning provides some determinacy to the question of how, if at all, P3 cost savings translate into infrastructure investment. The empirical question is to what degree a decline in cost (or here, "tax price"), induces an increase in the physical and dollar volume of public construction? Suppose, as above, that it costs $100 million to build five schools at a cost of $20 million per school without a P3 and that there are 100,000 voters, so that the tax price per school for each voter is $200. If the median voter is willing to pay this price per school for five schools, the school authorities will build the five schools. Now the authorities decide to build the schools under a P3, cutting the cost per school by 20%, from $20 million to $16 million, or from $200 to $160 per voter. The questions are (1) will the district now build more than five schools, and (2) will it investment more than $100 million? The first question relates to long-run benefits from productivity enhancement and the second to short-run benefits of expanding aggregate demand.

Economists tackle problems like this by estimating the price elasticity of demand of the median voter. This elasticity (η) equals the percentage change in quantity demanded (here, the number of schools or the amount of school space demanded by the median voter) that will result from a one percent change in price. Under the law of demand, this elasticity will be negative, which is to say a fall in price will increase the number of schools demanded. Suppose the elasticity is -1. Then the 20% decrease in tax price, from $200 to $160, will bring about a 20% increase in the demand for school construction. In this example, the number of schools will rise from five to six. At $16 million per school, total expenditure will be $96 million, close to the $100 million already budgeted.[7] Now suppose the elasticity is -1.5. Then the 20% cut in price yields a 30% rise in quantity, so that the number of schools rises from five to 6.5. Investment rises from $100 million to $104 million.

The task here is to answer three questions:

1. By how much does "tax price" fall if a P3 makes a cost saving possible?
2. By how much does construction, as measured by number or size of buildings constructed, rise?
3. By how much does investment rise or fall?

The first question relates to how we translate cost savings into reductions in tax price. The second relates to short-run effects on aggregate demand and third to what we will call "long-run productivity effects." We say more about these effects below. We assume that a given percentage decrease in cost translates into an equal percentage decrease in tax price.

So now let

(1) $Exp = PQ$,

where Exp is expenditure on infrastructure, P is price per unit of infrastructure and Q is the quantity of infrastructure provided. We can think of Q, for example, as the number of schools, built to the same specifications and P as the cost per school.

Given that:

(2) $\%Exp = \%\Delta P + \%\Delta Q$,

and

(3) $\eta = \frac{\%\Delta Q}{\%\Delta P}$, then

(4) $\%\Delta Exp = \%\Delta P(1+\eta)$.

---

[7] The number would be exactly $100 million if we did the calculation in logs. Let $\eta = \frac{\ln q_2 - \ln q_1}{\ln p_2 - \ln p_1} = -1$. Then, in this example, $\frac{\ln q_2 - \ln 5}{\ln 160 - \ln 200} = -1$, so that

$\ln q_2 = -(5.08 - 5.30) + 1.61 = 1.83$, and $\exp(1.83) = 6.25$ (before rounding). The cost of 6.25 schools at $16 million apiece is $100 million.

We use equation (4) to calculate the effects of P3 savings on public investment. Note that investment will rise when P falls if $(-\eta) > 1$ and fall if $(-\eta) < 1$.

In order to estimate long-run productivity effects, we use data (Bowen, 1943) that permit us to infer that a given percentage change in *Exp* translates into an equal percentage change in *Q*. We then find the percentage change in *Q* for this purpose by computing:

(5) $\%\Delta Q = \eta\%\Delta P$, where

(6) $\%\Delta Q = \%\Delta Exp$.

We use equations (5) and (6) to determine how a given percentage change in price affects the volume of physical infrastructure and therefore investment on infrastructure.

Measuring η

There are two foundational studies that estimate of the tax price elasticities of demand for social goods: one by Thomas E. Borcherding and Robert T. Deacon (1972) and a second by Theodore C. Bergstrom and Robert P. Goodman (1973). The major difference between the two is that Borcherding and Deacon use U.S. state level data while Bergstrom and Goodman use New York state municipal data. Ultimately both papers suggest that "local and state governments provide goods which have roughly the same amount of rivalry in consumption as private goods do and some have even more" (1972).

In a more recent paper, Turnbull and Djourdourian used a similar methodology to estimate tax price elasticities for municipal governments (1994). In the spirit of the median voter model, Turnbull and Djourdourian assumed that voters are informed about the costs and benefits of government investment and that the median voter determines policy outcomes. They estimated demand equations for general expenditures, police, roads, and sewers and sanitation. For each public service classification, they explained expenditures as a function of tax price, median voter income plus local aid, the local population and combination of other variables for urbanization and other demographic characteristics. They also made a second set of model specifications that separate state and federal aid from income and use them as separate independent variables.

Turnbull and Djourdourian utilized then same explanatory variables listed above using the average voter model instead. These alternative specifications reflect the notion that the public demand for services reflects the demands of an "average" taxpayer household and not the median taxpayer household in a jurisdiction. They replaced the tax price term with the average household tax share, the income term with average household income and the aid term with the average household's share of the jurisdiction state and federal aid payments.

They created four models to estimate the price elasticity of demand for general expenditures, with the following results:

- -1.480 for model A;
- -1.879 for model B;
- -1.342 for model C; and
- -1.482 for model D.

These were significant at the 5% level. Models A and B were specified using the median voter model and models C and D were specified using the average voter model. The elasticities are quite similar across both models. The average elasticity for all four models is -1.546.

The task of modeling the macroeconomic effects of the cost savings from P3s becomes one of identifying both short-run and long-run effects. We can use equations (1) – (4) above to model short-run effects and equations (5) and (6) to model long-run effects.

Consider equation (4):

$$(4)\ \%\Delta Exp = \%\Delta P\left(1+\eta\right).$$

If the elasticity, η, is numerically greater than one, then we know that expenditures increase when there are cost savings resulting in a decreasing *P*. If cost and therefore *P* fall by 24.6% (the average savings for P3s in the United States), then expenditures will rise by 13.43% (=.546 X .246). Thus, we will have an increase in public investment if we apply the average of the Turnbull/ Djourdourian elasticities. As for long-run effects, equations (5) and (6) tell us that there would be a 38.03 % (= .246 X 1.546) increase in infrastructure building and public investment.

At this point, we have to remind ourselves that what economists try to do, in estimating η, is get at the underlying political realities. The elasticity of demand here represents how politicians react when they discover that it becomes cheaper to add infrastructure, in much the same way a consumer reacts when he discovers that it becomes cheaper to buy some good offered in the marketplace. The takeaway from Turnbull and Djourdourian and precursor studies is that a reduction in the cost of public construction projects will almost always lead to an increase in the number and size of such projects (though not necessarily to an increase in investment).

Methodology

BHI utilized a multistep process to estimate the economic effect of the PBRA. First, we estimated the amount of infrastructure investment that would result if the PBRA becomes law. The PBRA allows $5 billion in PAB financing that would allow for the expansion of P3's to public buildings.

However, this represents a ceiling which investment can increase due to the $5 billion restriction contained in the PBRA. In the absence of the cost savings resulting from the use of P3s, investment on public buildings would be less than $5 billion. Therefore, the $5 billion in investment under the PBRA reflects the total expansion of infrastructure investment due to the P3 cost savings and the increase in demand in response to those cost savings. We need to find the initial level of investment that would take place in the absence of the PBRA, from which investment increases to $5 billion under the PBRA. We can calculate initial level of investment using equation (7):

$$(7)\quad TotExp = y\left[\%\Delta P\left(1+\eta\right)\right]+y\ ,$$

where $TotExp$ is the total expenditure under the PBRA, or $5 billion and y is the initial expenditure without the PBRA. We can rewrite equation (7) as:

$$(8)\quad TotExp = y\left(1+(\%\Delta P\left(1+\eta\right)\right)$$

Because we know the values of $TotExp$, $\%\Delta P$ and $\left(1+\eta\right)$, we can write

$$(9)\quad \$5.0 = y(1+(-24.6\times -0.546)\ .$$

Solving,

$$(10)\quad y=\frac{\$5.0}{1.134316}=\$4.409 \text{ billion.}$$

Therefore, for $4.409 billion in investment without the PBRA, the PBRA increases infrastructure investment to $5 billion, for a difference of $591 million. We entered the $591 million into the IMPLAN model as our increase in investment due to the PBRA.

We distributed the $591 million across three construction sectors within the IMPLAN model: (55) construction of new educational and vocational structures, (52) construction of new healthcare structures and (58) construction of new other nonresidential structures. We distributed the $591 million to these categories based on the percentage of state and local government investment in fixed assets as estimated by the U.S. Bureau of Economic Analysis (BEA) in the categories allowed under the

Bill. We included the categories Education (69% of the total investment), Hospitals (5.3%), Public Safety (4%), Commercial (0.5%), and Office (21%). We entered the Public Safety, Commercial and Office categories into the IMPLAN sector (58), "new other nonresidential structures" (BEA, 2016). Table 5 displays historical state and local government investment in structures in each category from above and the increase due to P3s.

According to the 2016 "State of Our Schools" study, local school districts face a $46 billion investment gap for operations and maintenance and construction (Filardo, 2016).

Table 5: State and Local Government Investment Increase Due to PBRA and P3 ($, billions)

	Historical				Increase due to P3	
Building type	**2012**	**2013**	**2014**	**2015**	**PBRA**	**Expansion**
Office	20.4	19.3	19.6	20.4	0.399	4.160
Commercial	0.5	0.4	0.4	0.5	0.010	0.102
Health care	6.5	6.1	5.6	5.2	0.102	1.060
Educational	67.3	60.9	61.9	67.1	1.313	13.682
Public safety	4.2	3.8	3.9	3.9	0.076	0.795
Total	**98.9**	**90.5**	**91.4**	**97.1**	**1.899**	**19.800**

Table 6 shows that the cost savings from P3s under the PRBA would barely dent this investment gap. However, without the $5 billion cap under the PBRA, the expansion of P3s could close approximately 30% of the gap ($13.682 billion /$46 billion = 29.74%).

Table 6: Facilities Investment Gap for K-12 Public Schools ($ billions)

Capital Investment	Historical Investment	Modern Standards	Gap	PBRA	Expansion
Maintenance & Operations	50	58	8	0.228	2.380
Construction & New Facilities	49	87	38	1.084	11.303
Total	99	145	46	1.313	13.682

Next, we calculated the short-run economic impact of expanding P3s to 20% of all state and local infrastructure projects listed in the PBRA. According to the BEA, state and local governments spent $97.1 billion in capital investment in 2015 for the categories listed above.

We used the average compound annual growth rate for total capital investment from 2004 to 2014 (1.79%) to grow this figure to 2018, or to $104.247 billon. We assumed that P3s would apply to

20% of this total, or $52.134 billion. We applied the Turnbull/Djourdourian elasticity of -0.546 to the P3 cost savings of 24.6% to get the additional expansion of capital expenditure due to the cost savings. As a result, we get $2.796 billion in additional investment for 2018. We inserted the $2.796 billion into the same IMPLAN categories as above.

We calculated the long-run economic effects using the method outlined in the Holtz-Eakin study. The study, finds that a 1% increase in new public-sector capital stock increases total factor productivity by between 0% and 0.1%. The study uses 0.03% as a conservative estimate. We used the actual midpoint of 0.05% as more in line with the Holtz-Eakin findings. We also calculated the long-run economic effects assuming the $5 billion limit in the PBRA and assuming expansion to 20% of all projects listed in the PBRA.

To apply the Holtz-Eakin methodology, we used the same methodology as outlined above. However, we used η (or -1.546) in place of $(1+\eta)$ to calculate the change in the quantity of new buildings constructed instead of expenditures. We applied the Turnbull/Djourdourian elasticity (-1.546) above to the P3 cost savings of -24.6% to get the additional expansion of capital expenditure due to the PBRA. As a result, we calculated $1.899 billion in additional public buildings under PBRA and $7.9 billion under expansion scenario in 2018.

Next, we obtained the amount of public capital stock from the BEA estimates of the current-cost net stock of government fixed assets for state and local government for 2008 through 2015. We used the average compound annual growth rate over the period, 3.09%, to grow the figure to 2018, or $10.86 trillion (B. o. E. A. BEA, 2016).

We divided the $1.899 billion and $7.9 billion into the $10.86 trillion to obtain our percentage change in public capital stock, or 0.02% and 0.2% respectfully. We applied the Holtz-Eakin elasticity to the percentage change in capital stock and multiplied it by our estimate of real GDP, using growth rates estimated by the Congressional Budget Office (CBO, 2017). This calculation provided our estimate of the change in real GDP resulting from the increase in state and local capital stock under PBRA and expansion to all applicable, qualified buildings under the PBRA.

To translate the change in real GDP into a change in employment, we calculated an elasticity of employment with respect to real GDP. We used quarterly real GDP data from BEA for the first quarter of 1947 to the first quarter of 2017 (BEA, 2016b). We used monthly employment data from the Bureau of Labor Statistics for the same time-period, using the data for March, June, September, and December as our quarterly employment figures (BEA, 2016a). We calculated the natural logarithm for each variable and then ran a regression of the log of real GDP on the log of employment to calculate the employment elasticity with respect to real GDP. The result is an elasticity of 0.568, meaning a one-percent increase in real GDP results in a 0.568% increase in employment. See Table 7 below.

We calculated the percentage change in real GDP due to the new infrastructure and multiplied the result by the elasticity and by total employment, which gives us our estimate of the change in employment due to the change in state and local infrastructure investment.

Table 7: Log Real GDP and Log of Employment Regression

Regression Statistics	Multiple R	R Square	Adjusted R Square	Standard Error	Observations			
Multiple R	0.9952033	0.99042973	0.990395	0.016314	281			
	Df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	7.6853636	7.685364	28873.73	0.0000%			
Residual	279	0.0742618	0.000266					
Total	280	7.7596255						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95%*	*Upper 95%*
Intercept	2.699	0.013	204.446	0	2.673	2.725	2.673	2.725
X Variable	0.586	0.003	169.922	0	0.58	0.593	0.58	0.593

To calculate the change in federal individual income tax collections, we used IRS Statistics of Income to find the average federal tax rate. Federal taxable income was $6.846 trillion and federal income tax collections were $1.378 trillion in 2014 (IRS, 2014). Using these data, we assumed that income tax revenues are 20.1% of taxable income. Taxable income is 39.36% of nominal GDP. Thus, we multiplied the federal income tax rate of 20.1% by 39.36% to find the fraction of GDP accounted for by federal income tax revenue, which turns out to be 7.91%. We applied the 7.91% to our estimate of the change in nominal GDP due to the new infrastructure (using the Holtz Eakin elasticities) enabled by P3 savings to arrive at the change in federal individual income tax collections under P3.

We used a similar method to calculate the change state individual income collections due to a P3. The U.S. Census Bureau reports that FY 2014 individual state income tax collections were $313.242 billon (2014). Thus, state individual income taxes as a fraction of GDP is 1.8% (= $313.242 billion/$17.393 trillion). We applied the 1.8% to our estimate of the change in nominal GDP due to the new infrastructure enabled by P3 savings to arrive at the change in state individual income tax collections under a P3.

Appendix II: Modeling Short-Run Macroeconomic Effects

The construction of new infrastructure has both short-run and long-run economic effects. In the short run, any additional investment on infrastructure can exert positive effects on an economy that is operating below potential real GDP. An increase in investment can help close the GDP gap. We call the investment changes that help close the GDP gap "short-run" because they exist only if actual GDP is less than potential GDP. If an economy is operating at or above potential GDP, then the new investment would lead to an increase in the price level, as suppliers compete for scarce resources.

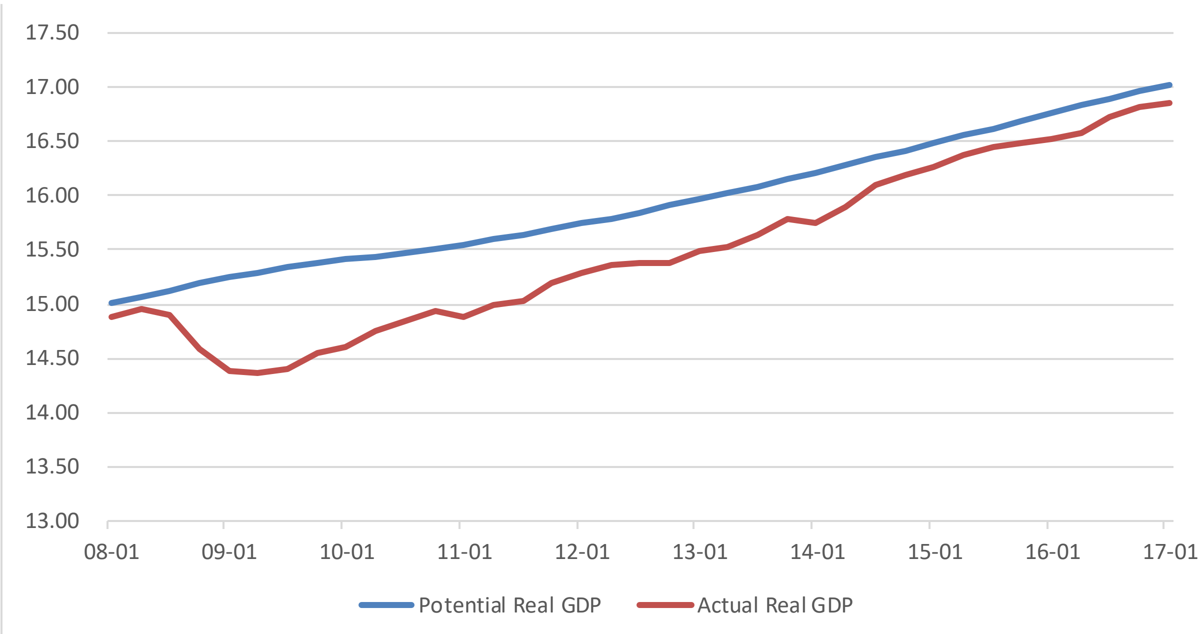
The Congressional Budget Office provides estimates of potential real GDP that we can compare to actual real GDP. At the height of the last recession, in the first quarter of 2009, potential real GDP exceeded actual real GDP by almost a trillion 2009 dollars. Since then, the gap has steadily closed. In the first quarter of 2017, potential real GDP exceeded actual real GDP by $166 billion dollars. See Figure 2.

The GDP gap is the hypothetical amount by which short-run stimulus investment could increase real GDP. Therefore, any new investment on infrastructure resulting from the PBRA will increase employment, incomes and real GDP and not the overall price level, as long as there exists a GDP gap.

New government investment will have a "ripple effect" as it flows through to other sectors and households in the community. In essence, the new investment in one sector brings about investment in other sectors. This process creates income and employment as it reverberates through the business community. Depending on the size of the initial shock, these ancillary effects can be quite large. For example, Boeing's contribution to the Greater Seattle economy extends far beyond its initial outlay in wages and purchases. In other words, each expenditure has what economists call a "multiplier effect" that represents the recycling of money and income in an economy. By determining the multiplier for each category of expenditures, it is possible to simulate the macroeconomic effects of an increase in government investment.

In the long-run, when the GDP gap approaches zero and there is no further scope for capturing short-run effects of new public investment, there is another effect to consider, which is the effect of new infrastructure on the productivity of private capital. The existence of a productivity effect is most obvious when we think about new investment on roads and bridges. New investment on transportation

Figure 2: Potential and Real GDP, January 2008-January 2017 (trillion 2009 dollars)



Source: [1]U.S. Bureau of Economic Analysis and U.S. Government Budget Office. Retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GDPC1. Accessed May 27, 2017.

infrastructure increases productivity by permitting firms to get their goods to market at lower cost. This, in turn, causes actual (and potential) GDP to rise. Similar reasoning applies to schools and hospitals.

Appendix III: How Does a P3 Work in Public Buildings?

A typical P3 is structured as a long-term agreement in which the public sector assigns to a private sector company the right to design, build, finance, maintain and/or operate the public building for a defined period, per a financial arrangement and to defined performance metrics.

The ownership of the building remains with the government entity. The following provides some attributes of a P3 Project:

- Payment: Unlike a toll or revenue model road, P3 building projects are not financed through user-fees. Instead, the government pays the project operator an availability payment - a payment for performance achieved (irrespective of demand) by the availability of the facility. P3 projects are financed based solely on the private sector expectation of repayment through successful earning of the future availability payments over the contractual term. This creates an incentive for the private operator to deliver the expected performance results. Should any aspect of the building not perform (eg the passenger elevator is out for a week, or the air conditioning does not function properly), the operator's payment is abated to compensate for the lack of availability and performance of that building element.
- Risk Transfer: This innovative project delivery method transfers risk to those parties that best understand and manage risk: financiers, developers, construction contractors, operators, suppliers, service providers under a contractual arrangement between the public sector and the developer who is accountable to ensure the risk as appropriately managed such that the transaction is financeable. The public sector focuses on providing its program in the purpose built and operated facility.
- On Time, On Budget: P3 projects, by the way they are structured, ensure completion of projects on time, on budget and with increased sustainability and elimination of deferred maintenance. This avoids current and future cost overruns and costs from projects delays.

An extensive body of literature provides competing interpretations of P3s.

- Välilä contends that P3 savings arise because the public sector tends to be more "heterogeneous and dispersed; have more ambiguous objectives, with no clear measure against which to assess his performance; and is more likely to face soft budget constraints" (Välilä, 2005).
- Hellowell notes that the return on investment is linked to performance and that payment mechanisms effect transfer of risk to the private sector as "the operator is penalized when the facility is unavailable for use or if the services it delivers fall short of the specialized standard" (Hellowell, 2015).

- Stephenson notes that P3s involve a tradeoff between the public and private entities because partnerships combine relative strengths and weaknesses of each sector as these exist in each community. He notes that distressed cities that can't meet the needs of their citizens consider P3s out of desperation, raising the fear that the private entity will take advantage of public officials. To abate this fear, public officials must be held accountable for "both their economic outcomes and for the political implication of those project results" (Stephenson Jr, 1991). Hall contends that private companies have a responsibility to demonstrate that they can run previously public activities in a way that supports long-run objectives and social responsibility (Hall, 2015).

Appendix IV: The Long Beach Courthouse: A Case Study

A new Long Beach Courthouse project used a P3 after the Judicial Council and Administrative Office of the Courts (AOC) was granted the authority to investigate the use of a P3 in the development of the project (Administrative Office of the Courts, 2012). The project replaced a more than 50-year-old downtown courthouse, considered by one official to be "one of the worst courthouses in California in terms of security, overcrowding and physical condition"(Hall, 2015). The AOC entered into a P3 for the Long Beach project to capture benefits that they might not have been captured under a more traditional approach, such as design, bid and build. These potential benefits included "greater price and schedule certainty and the transfer of various project risks to a private partner" (Peters, 2012).

Amy Bodek, director of Development Services for the City of Long Beach, pointed out that the state was responsive to maintenance issues. Building failures were causing court proceedings to be delayed or re-scheduled (Bodek, 2016). By having the P3 agreement, all of the maintenance responsibility was included in the total cost and delivered by the private party. Not only that, Bodek also mentioned that having a P3 "motivates you to design the building with long-run operation and maintenance in mind…You're more likely to put in quality systems and redundancies to avoid constant maintenance which can save money in the long-run" (Bodek, 2016).

The Judicial Council in charge of the project established strict and clear instructions to the private party after the project was approved, which included all the performance risks and incentives (Administrative Office of the Courts, 2012). The preparation, review, and approvals of benchmarks, project requirements and contract agreements began in late July 2007 and ended with the Project

Agreement execution on December 20, 2010 (Administrative Office of the Courts, 2012). The AOC concluded that P3 procurement has "merit and may be the best option for some of the state's infrastructure needs, especially when the state lacks the upfront funding to begin a vital construction project" (Willoughby, 2012).

Curtis Child, Chief Operating Officer for the AOC expressed confidence in the P3 project. In response to worried questions about the Long Beach Court House success, he said, "You'd get a building built 14 months earlier than under a traditional build and under this P3 model, the building will be maintained at a quality level throughout the 35-year agreement… [I]t assures that you get a quality facility because the developer is on the hook for maintaining the facility, so they have every incentive to build a quality facility" (Meeks, 2012). In its evaluation, the AOC stated that the

> project has surpassed the design and construction progress normally achieved by traditional AOC delivery methods…Traditional AOC delivery methods would have taken at least two years to accomplish this same major milestone. There have been key lessons learned that should be taken into consideration with any follow-on projects using this delivery method… Progress has been quick and efficient, the design is excellent, and there have been minimal change orders *(Administrative Office of the Courts, 2012).*

The Long Beach Courthouse isn't the only project that has been financially feasible only through a P3. In Saskatchewan, Canada, the Province agreed to build nine joint-use schools by the fall of 2017 using a P3. SaskBuilds Minister Gordon Wyant said, "It is a major undertaking that could not have been achieved through a conventional approach…Getting these schools built on schedule and cost effectively in some of the fastest-growing communities is a priority for our government and the P3 model will achieve this on-time and on-budget" (Ali, 2015).

The University of Georgia found itself in a similar dilemma. The University was looking at ways to keep costs down and still provide a quality education and student services. Chancellor Hank Huckaby said that

> the Public-Private Partnership initiative will help keep the cost of student housing provided by our colleges and universities low and affordable and is expected to help maintain the affordability of housing for students and improve the fiscal health of the University System by providing financial tools and resources while reducing student-housing debt by nearly $300 million (USG, 2014).

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