

Is Public Investment Crowding-In Private Investment? A Review of the Relationship between Public and Private Investment in Puerto Rico

David Álvarez*

Abstract

Public capital has a positive impact on productivity. An adequate stock of public capital not only serves as input to numerous industries but also attracts or crowds-in private capital. Simply put, sufficient and updated public capital raises the rate of return of private capital stock, thus, generating a crowd-in effect on additional private investment. This paper reviews the relationship between public and private investment in Puerto Rico as an initial attempt to determine whether public investment is effectively crowding-in private investment. This paper analyzes the historical trends of public and private investment and examines the evolution of the public-to-private investment ratio as a basic indicator of crowd-in effect. Trend and benchmark analyses show that public investment in Puerto Rico is not effectively crowding-in private investment. Local fiscal constraints and investments in non-basic infrastructure areas appear to have weakened the crowding-in effect of public investment, which has resulted in a timid crowd-in of private investment in Puerto Rico.

Keywords: Puerto Rico, public capital stock, public investment, private investment, crowd-in effect, public-to-private investment ratio.

Introduction

Public investment is the main conduit for the formation of public capital stock. An adequate level of public capital has a positive impact on overall economic productivity. This positive effect on productivity is in part brought about by the capacity of public capital to attract or crowd-in private capital. According to the World Bank (1994), surveys of prospective foreign investors show that the availability and quality of infrastructure is an essential factor in ranking potential sites for the location of direct investment. The crowd-in effect occurs when public investment forges such a public capital stock that complements and increases the rate of return of private capital.

This paper presents an introductory review of the relation between public and private investment in Puerto Rico. More specifically, this paper seeks to determine whether public investment is effectively crowding-in private investment in Puerto Rico¹.

* David Alvarez (david.alvarez@bspr.com) is a Research Associate at Santander Securities, the wealth management subsidiary of Santander BanCorp in San Juan, Puerto Rico. The author wishes to thank Professor Juan Lara and Edwin Ramos for their revisions and comments.

¹ Puerto Rico data series on public and private investment include construction and machinery and equipment. Despite that the crowd-in effect is mainly associated with the construction component of public investment and not so much to machinery and equipment, historically machinery and equipment have represented only 10% of the total public investment, which does not makes it extremely relevant to exclude it from the public investment series.

Literature Review

Despite of extensive debate, economic literature reveals a consensus asserting the positive impact of public capital on productivity and growth. It is a fact that telecommunications, electricity and water are required for the production process of nearly all sectors, and transport is an input for every good or commodity. Aschaeur (1989a) broke ground not only by considering public capital stock as a determinant of growth but by quantifying its contribution to output. Aschaeur (1989a) put forth the idea of expanding an aggregate production function to include the public capital stock. In essence, the resulting function included the following variables: an index representing total factor productivity, the stock of private capital, the labor force and the government capital stock. Initially, the results of Aschaeur (1989a) were deemed implausibly large and not robust (see Gramlich, 1994, for a summary of this literature). However, Sanchez-Robles (1998) reports that several authors attribute the disparities in Aschauer's results to specific econometric problems such as unit roots and spurious correlations, endogeneity of public capital and measurement errors in public capital proxies. Sanchez-Robles (1998) indicates that several authors have reaffirmed the positive impact of public capital on the level of output once the necessary adjustments for these shortcomings have been taken into account. Furthermore, Canning (1999) uses panel data for a large set of countries to estimate a production function that shows significant contribution of infrastructure on output. Canning (1999) asserts the high impact nature of basic infrastructure by finding that electricity generating capacity and transportation networks have nearly the same marginal productivity as capital as a whole.

Literature about the crowd-in effect is less abundant. Aschaeur (1989b) empirically analyzed the effect of public capital investment on private investment in the U.S. Using data from 1925 to 1985 Aschaeur (1989b) finds that a one percentage increase in the public capital stock is expected to raise the rate of return of private capital by 9 basis points². Aschaeur (1989b) states that "higher public investment may raise the marginal productivity of private capital and, thereby, 'crowd-in' private investment." (pg. 171). However, there is an initial downside to this effect. Aschauer (1989b) explains that crowd-in effect occurs over a time span. On the short term, public infrastructure investment lowers private capital investment as the private sector chooses to utilize public capital for its required purposes instead of expanding its own capacity. But on the longer term, public infrastructure investment comes to complement new and existing private capital investment in the production and distribution of goods and services. As a result, the rate of return on private capital rises. Aschaeur (1989b) concludes that the raise in rate of return comes to dominate, "so the net effect of a raise in public investment expenditure is likely to raise private investment. Consequently, the national level of investment is lifted." (pg. 186).

² Aschaeur and the literature in general use data on public capital after excluding military equipment and structures. Despite that national defense is considered a public good, investment in military equipment and structures is not conducive to the formation of basic infrastructure.

Erenburg (1993) finds that public infrastructure capital has an overall stimulative effect on private investment. More specifically, Erenburg (1993) finds that public capital greatly fosters private investment in equipment and machinery. This finding relates to the renowned paper by DeLong and Summers (1991) that finds private business investment on plant and equipment to be of strategic importance in economic growth and to have a significant positive correlation with GDP growth rates.

The work of Serven (1996) sheds additional light on the initial effects of public infrastructure investment on private capital investment and reveals the importance of selectively investing in infrastructure. Using data from 1961 to 1981 from India, Serven (1996) finds that in the long-term public infrastructure investment crowds-in private capital. The author determined that in the case of India the crowd-in effect takes two years to materialize. Serven (1996) indicates that during this short-term period public investment programs draw from the same pool of inputs and resources available to the private sector. Therefore, on the short-term, public investment programs cause an initial and temporary crowd-out of private investment.

Another important finding of Serven (1996) is that public investments in non-basic infrastructure (investments outside of power systems, water and sewage and transport) crowd-out private investment. Capital investments outside the mentioned areas can generate products or services that are close substitutes to those provided by the private sector. For instance, Serven (1996) indicates that India's portion of public investment in industrial and commercial activities increased from under 30% in the 1960s to close to 40% in the second half of 1980s. This expansion of public capital into such areas led to a direct competition with private firms resulting in a crowd-out of private investment. Therefore, Serven (1996) argues that fiscal and public investment priorities should be aligned in favor of basic infrastructure projects where there tends to be low degree of substitutability of private goods and services and greater chances to maximize the crowd-in effect on private investment. The World Bank (1994) appears to reaffirm this notion by stating that: "when public spending on infrastructure is not wisely deployed, it can crowd-out more productive investment in other sectors." (pg. 19).

Public capital investment is key for improving competitiveness. Calderon and Serven (2004) point out that "there is persuasive evidence that adequate infrastructure provision is... required for trade liberalization to achieve its intended objective of efficient resource reallocation and export growth" (pg. 2). The World Bank (1994) puts it more downright:

[A]dequate quantity and reliability of infrastructure are key factors in the ability of countries to compete in international trade... The competition for new export markets is especially dependent on high-quality infrastructure. During the past two decades, increased globalization of world trade has arisen not only from the liberalization of trade policies in many countries but also from major advances in communications, transport and storage technologies (pg. 17).

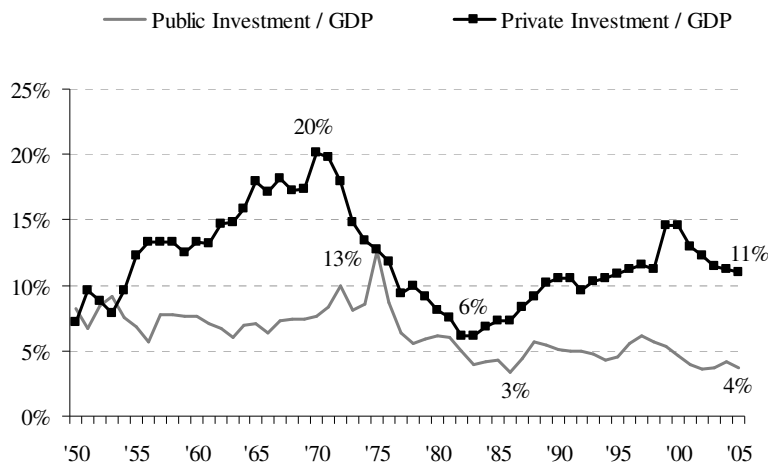
With respect to Puerto Rico, recent work by Bosworth and Collins (2006) calls attention to the role of capital accumulation on the Island's output. Bosworth and Collins (2006) shows the decline in labor productivity in Puerto Rico from the mid-1970s to the present is associated to a failure of capital accumulation. The downfall in capital accumulation is, in large part, attributable to a decrease in the contribution of physical capital to growth and a downtrend in private investment.

Using published measures of Puerto Rico GDP, Bosworth and Collins (2006) shows that growth rate of output per worker declined from an annual average of 5.2% during the period of 1950-75 to 2.0% in the subsequent period of 1975-04. The authors present a more marked decline by using an adjusted calculation that reveals a decrease in the said growth rate from 5.1% in the period of 1950-75 to 1.3% in the period of 1975-04.³ According to Bosworth and Collins (2006) much of the decline in worker productivity has to do with a failure of capital accumulation. In the period from 1950-75, physical capital per worker accounted for 52% (or 53% using the authors' adjusted measure) of the rate of growth in productivity. In contrast, physical capital has come to represent only 20% (or 31% using the adjusted measure) of productivity growth in the period of 1975-04.

Investment rates, which greatly contribute to the accumulation of physical capital, have declined dramatically. Graph 1 shows the evolution of public and private investment as shares of GDP from fiscal year 1950 to 2005. Bosworth and Collins (2006) presents similar data. Private investment declined sharply from 20% of GDP in 1972 to a mere 6% of GDP in 1982. Despite some eventual recovery, private investment has trended down again since 2000 to 11% of GDP in 2005. Meanwhile, public investment has continuously declined from a peak of 13% of GDP in 1975 down to 4% in fiscal year 2005. Total domestic investment adds up to 15% of GDP in fiscal year 2005. Bosworth and Collins (2006) convey that such an aggregate level of investment is sufficient to support only a 2.5% economic growth rate per year. This is a lower rate of economic growth compared to the real annual average growth of 2.8% experienced during the last decade.

³ The authors' adjustment is an alternative measure that corrects for income shifting within the Chemical sector in Puerto Rico. See Bosworth and Collins (2005) pg. 30.

Graph 1. Public and Private Investment as Share of GDP, Fiscal Years 1950-2005



Source: P.R. Planning Board.

The decline in public investment has had a clear impact on infrastructure. Bosworth and Collins (2006) acknowledge that infrastructure is falling behind especially in communications and the quality and smoothness of the road network has been affected. The authors conclude that Puerto Rico must convert private investment into a main priority in order to foster capital accumulation and labor productivity.

Several main points arise from the literature review. First, public capital is a determinant of productivity given that infrastructure is an important input in most economic sectors and crowds-in private investment by raising the rate of return of private capital. Second, such crowd-in effect does not happen overnight. On the short-term, public investment can crowd-out private investment. Third, public capital investment should concentrate in basic infrastructure areas such as power systems, water and sewage and transport and avoid venturing into other sectors that might compete with private sector firms and cause a substitution effect. Fourth, public capital investment is critical for competitiveness. Finally, Puerto Rico has experienced a serious decline in labor productivity due, in large part, to a decrease in the contribution of physical capital to growth that in turn is reflected in a downtrend in private investment and deterioration in infrastructure.

Fiscal Constraints Affect the Crowd-In Effect of Public Investment

There is no doubt that public investment occurs within the framework of fiscal policy. Recent data suggest that fiscal policy in Puerto Rico has not bolstered the role of public investment. Fiscal difficulties appear to have affected the level and strategic direction of public investment in Puerto Rico, thus, limiting the crowd-in capacity of public investment.

Regularly, fiscal constraints affect capital expenditures and general investment in public infrastructure. The World Bank (1994) indicates that surveys on fiscal adjustments and expense reduction reveal that infrastructure capital suffers the largest reductions relative to total capital expenditures and overall public operating expenses. Simply said, governments find less politically costly to reduce infrastructure spending than to slash employment or wages despite the negative impact on long-term economic growth (World Bank, 1994).

In Puerto Rico, excessive government operating expenditures in the presence of declining government net receipts have exerted pressure on capital expenditure programs and public investment. The need to alleviate this fiscal situation rather than conducting strategic public investments provided the bases for a surge in public debt. A ratio of public investment-to-total public debt, an indicator of the amount of public investment per each dollar of total public debt, reflects a declining trend.

Table 1. Ratio of Public Investment to Total Public Debt, Fiscal Years 1995-2005

Time Period	Public Inv. / Total Public Debt	Annual Growth of Public Investment	Annual Growth of Total Public Debt
1995	0.120	14.1%	4.8%
1996	0.142	30.8%	10.2%
1997	0.151	17.5%	10.7%
1998	0.137	3.9%	14.4%
1999	0.135	-0.3%	1.6%
2000	0.119	-7.5%	5.0%
2001	0.107	-4.5%	5.7%
2002	0.093	-3.8%	11.1%
2003	0.094	7.6%	6.1%
2004	0.096	17.2%	14.3%
2005	0.082	-7.6%	8.1%
	Avg. Ratio	Avg. Growth Rate*	Avg. Growth Rate*
1995-00	0.134	9.7%	7.8%
2000-05	0.099	0.2%	8.4%
Ch. in percentage pts.	-26.5%	-9.5	0.6

Source: P.R. Planning Board.

* Average annual rates calculated as averages of annual growth rates during each period and not as a compounded annual growth rate (CAGR). The percented change was taken from the 1995-00 period to 2005.

Table 1 above shows the trend in the ratio of public investment-to-total public debt (includes debt from the Commonwealth, public corporations and municipalities) and the annual growth of public investment and total debt between 1995 and 2005⁴. The average amount of public investment coming from each dollar of total debt declined from 0.13 during the period of 1995-00 to 0.10 in the period of 2000-05, a drop of 26.5%. This

⁴ The time period between 1995 and 2005 was selected with the sole intention to depict the trends that have dominated the last ten years.

decline can be explained as reduction in the numerator (public debt) combined with a continued increase in the denominator (total public debt). Table 1 above depicts a reduction in the growth rate of public investment while the rate of growth of total public debt has accelerated during the period of 1995 to 2005. The annual average growth rate of public investment declined 9.5 percentage points when comparing the periods of 1995-00 and 2000-05. On the contrary, the annual average growth rate of public debt has increased by 0.6 percentage points when comparing the mentioned time periods.

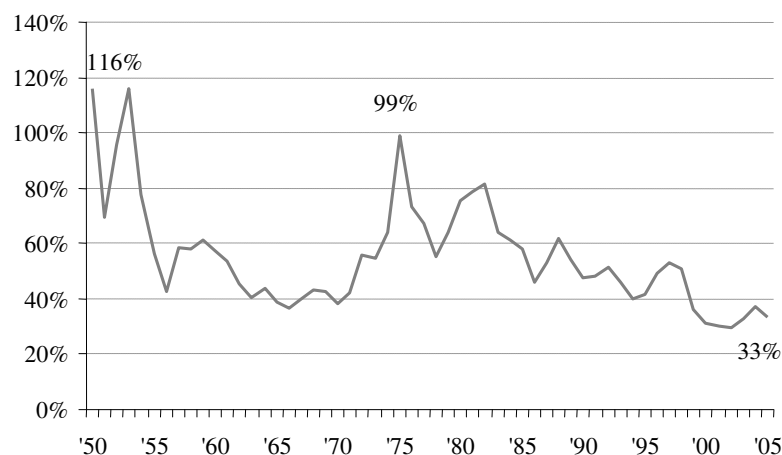
Fiscal constraints seem to have affected the level of public investment and created a fiscal context that has distorted the priorities and direction of public investment. This scenario has seriously restricted the emergence of stronger crowd-in effects. Meanwhile, public debt has been mounting with no strengthened support for long-term growth since public investment is not strongly attracting private investment.

Analysis of the Relation between Public and Private Investment

Economic literature frequently uses the ratio of public-to-private capital stock as a basic indicator of the crowd-in effect. This paper applies the public-to-private investment ratio as a fundamental indicator of the relationship between public and private investment.

Graph 2 shows the trend of the public-to-private investment ratio from 1950 to 2005. After 1975 the ratio reflects a continuous decline from a 99% in 1975 to 33% in 2005.

Graph 2. Puerto Rico's Public-to-Private Investment Ratio, Fiscal Years 1950-2005



Source: P.R. Planning Board.

The historical decline in the public-to-private investment ratio can be explained as a combination two factors: 1) a continuous reduction in the growth rate of public investment and 2) a higher growth rate of private investment vis-a-vis public investment

in several specific decades. However, there has been a dramatic decline in the period between 2000 and 2005 that has come about for a different reason: a simultaneous decrease in the growth rate of public and private investment.

Table 2 below presents a decomposition of the public-to-private investment ratio into the annual growth of public and private investment from 1950 to 2005.

Table 2. Average Annual Public-to-Private Investment Ratio and Avg. Annual Growth Rates in Public and Private Investment, 1950-2005*

Time Period	Avg. Annual Public-to-Private Inv. Ratio	Avg. Annual Growth of Public Investment	Avg. Annual Growth of Private Investment
1950-59	75.1%	9.4%	13.2%
1960-69	44.2%	11.5%	15.4%
1970-79	61.4%	11.1%	4.9%
1980-89	63.4%	9.5%	10.1%
1990-99	46.3%	7.5%	11.8%
2000-05	32.3%	0.2%	1.2%
1950-74	57.9%	11.6%	12.8%
1975-99	53.2%	6.5%	7.8%
2000-05	32.3%	0.2%	1.2%
Ch. in percentage pts.			
1975-99 / 1950-74	-4.7	-5.0	-5.1
2000-05 / 1975-99	-20.9	-6.3	-6.5

Source: P.R. Planning Board.

* Average annual rates calculated as averages of annual growth rates during each period and not as a compounded annual growth rate (CAGR).

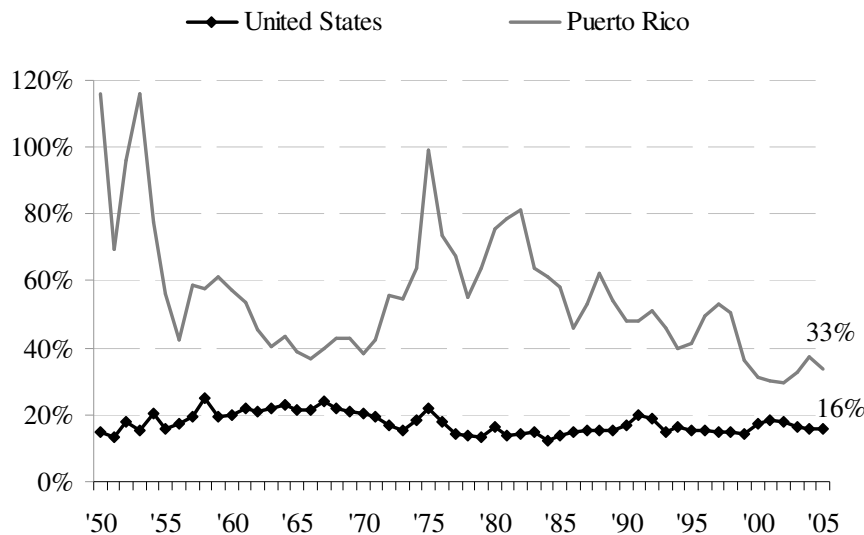
In a nutshell, one can see that the average annual ratio of public-to-private investment declined 4.7 percentage points from 57.9% in the period of 1950 to 1974 to 53.2% in the period of 1975 to 1999. Such decline was driven by decreases of 5 percentage points in the annual average rates of growth of public and private investment for the same periods. However, trends in the last five years, period between 2000 and 2005, are more worrisome. During this recent period the annual average public-to-private investment ratio declined nearly 21 percentage points relative to the previous period of 1975-99. This drop is attributable to a decline of 6.3 percentage points in the average annual rate of growth of public investment and a comparable decline of 6.5 percentage points in the rate of growth of private investment.

Besides the declines in the rates of growth of public and private investment, it is interesting to point out that the public-to-private investment ratio reveals a timid crowd-in effect. For instance, during the period of 1975 to 1999, public investment represented

slightly more than half of private investment but private investment only grew 1.3 percentage points over public investment. In other words, the share of public investment seems high with no substantial growth rate in private investment. The same rationale can be applied to the period 2000 to 2005. Between 2000 and 2005, public investment represented 32% of private investment but growth in private investment was a disappointing 1.2%, which is slightly higher than the 0.2% average annual growth of public investment.

A comparative analysis using U.S. data sheds additional light on the relation between public and private investment in Puerto Rico. Graph 3 below compares the historical trends in the public-to-private investment ratio for Puerto Rico and the U.S. There are two principal observations. First, the ratio for Puerto Rico have continued to decline after 1975 in contrast to the United States that have recovered after diving to its lowest level in 1984. Second, the level of public-to-private investment ratio is much lower for the U.S. than for Puerto Rico. For instance, the annual average ratio for the period of 2000 to 2005 for the U.S. is 16.9% compared to nearly twice that amount or 32.3% for Puerto Rico.

*Graph 3. Historical Trend in Public-to-Private Investment Ratio for Puerto Rico and United States, Fiscal Years 1950-2005**



Source: P.R. Planning

Board and U.S. Bureau of Economic Analysis.

* Years for the U.S. have been adjusted to match Puerto Rico fiscal years.

These two observations require a thorough review of the growth rates of public and private investment in Puerto Rico and the U.S, which are the main components underlying the direction of the public-to-private investment ratios. Table 3 below compares the public-to-private investment ratios and the average annual growth rates in public and private investment for Puerto Rico and the U.S. Since 1975, the rates of

growth of public and private investment have been declining in both countries. But such declines have been more pronounced in Puerto Rico than in the U.S. For example, when comparing the period of 2000-05 to the preceding period of 1974-99, one can see the average growth rate of public investment in Puerto Rico declined 6.3 percentage points while the decline in the U.S. was of only 1.6 percentage points. Similarly, the average annual growth rate of private investment have dropped 6.5 percentage points in Puerto Rico while in the U.S. the decline has been of 4.6 percentage points when comparing the mentioned time periods. These subtle declines in the U.S. relative to Puerto Rico have resulted in a more stable public-to-private investment ratio in the U.S. in recent years and a more consistent relation between public and private investment.

*Table 3. Ratio of Public to Private Investment, Puerto Rico and the U.S., Selected Periods 1950-2005**

Time Period	Avg. Annual Public-to-Private Inv. Ratio		Avg. Annual Growth Public Inv.		Avg. Annual Growth Private Inv.	
	Puerto Rico	United States	Puerto Rico	United States	Puerto Rico	United States
1950-59	75.1%	17.9%	9.4%	9.7%	13.2%	11.8%
1960-69	44.2%	21.7%	11.5%	7.5%	15.4%	6.9%
1970-79	61.4%	17.1%	11.1%	7.4%	4.9%	13.0%
1980-89	63.4%	14.5%	9.5%	7.5%	10.1%	6.5%
1990-99	46.3%	16.1%	7.5%	6.7%	11.8%	7.7%
2000-05	32.3%	16.9%	0.2%	5.6%	1.2%	4.2%
1950-74	57.9%	19.4%	11.6%	8.4%	12.8%	9.6%
1975-99	53.2%	15.5%	6.5%	7.2%	7.8%	8.8%
2000-05	32.3%	16.9%	0.2%	5.6%	1.2%	4.2%
Ch. in percentage pts.						
1975-99 / 1950-74	-4.7	-3.9	-5.0	-1.1	-5.1	-0.8
2000-05 / 1975-99	-20.9	1.4	-6.3	-1.6	-6.5	-4.6

Source: P.R. Planning Board and U.S. Bureau of Economic Analysis.

* Years for the U.S. have been adjusted to match Puerto Rico fiscal years.

The other significant observation relates to the fact that the U.S. depicts a lower public-to-private investment ratio than Puerto Rico. This means that the U.S. government invests less per each dollar of private investment than Puerto Rico. As a result, one might be tempted to think that Puerto Rico has a stronger crowd-in effect simply due to its higher public-to-private investment ratio, which is the reflection of higher public investment per every dollar of private investment. However, this conventional deduction does not hold. In fact, the data above shows that the public investment in the U.S. has a greater crowd-in effect than Puerto Rico. For instance, in the period of 1975 to 1999, the U.S. had an annual average public-to-private investment ratio of 15.5% compared to 53.2% for Puerto Rico. But the growth rate of private investment in U.S. surpassed that of Puerto Rico by 1.6 percentage points during the said period. In other words, on average, the government of the U.S. invested just 29% of what Puerto Rico's government invested per each dollar of private investment but the U.S. experienced a growth rate in private investment that was 113% of the rate of growth of private investment in Puerto Rico. In the subsequent period from 2000 to 2005, the U.S. public-to-private investment

ratio represented 52.3% of the Puerto Rico ratio, but the growth rate of private investment in the U.S. was 350% of the growth rate of private investment in Puerto Rico.

Clearly, public investment in the U.S. has a much stronger crowd-in effect than public investment in Puerto Rico, which is equivalent of stating that the crowd-in effect of public investment in Puerto Rico is much weaker relative to the U.S. This finding has a twofold explanation. First, local fiscal constraints have affected the capacity to maintain a stable level of public investment and have altered investment priorities, which ultimately have adversely impacted the capacity to crowd-in private investment. Secondly, there is a possibility that local public investment has overextended to non-basic infrastructure areas that in the end have not encouraged the emergence of significant crowd-in of private investment. This latter point also implies that private investment is potentially being crowded-out in specific non-basic areas.

Conclusion

There is an intrinsic relationship between public capital and economic growth. Public infrastructure not only serves as a direct input for nearly all economic sectors but also allows for increases in the rate of return of private capital. This increase in rates of return attracts or crowds-in private capital investment, the so-called crowd-in effect. Economic output and productivity has been gradually declining in Puerto Rico since 1975. This is partly due to a failure of capital accumulation, which is related to a drop in public and private investment. Fiscal constraints could have weakened the crowd-in effect in public investment in Puerto Rico. In addition, part of public investment in Puerto Rico could have been misdirected to areas where it further weakens the crowd-in effect or worse fosters a crowd-out of private investment. This paper reveals the necessity to strengthen the crowd-in effect of public investment, which seems plausible by establishing a strategic framework for sustaining and re-directing public investment. This task poses considerations for research and public policy. First, further research is necessary in order to define a level of public-to-private investment ratio that maximizes the crowd-in effect or the growth rate of private investment. Also, research is critical in getting to know key public investments in Singapore and Ireland that have resulted in substantial inflows of private investment. With respect to public policy, it is critical to begin to conduct a discriminatory rationalization of public investment in favor of projects in basic infrastructure such as power systems, water and sewage, transport and specific areas in telecommunications. The evaluation of such public investment projects should include a criteria based on projected rates of return for private capital investment.

Strategic public infrastructure investment is essential for augmenting Puerto Rico's competitiveness and to capitalize on the openness of the local economy. Data presented on this paper reveal that present trends in public investment are not resulting in an acceptable crowd-in of private investment, which can have serious consequences for the prospects of long-term growth.

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