From deindustrialization to unsustainable debt: The Case of Puerto Rico

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ABSTRACT

The literature usually focuses on case studies, such as Greece's and Argentina's, to analyze countries' indebtedness. While the international media extensively covered the severe debt and economic problems in Puerto Rico, the economic literature in general did not. Beyond the fiscal space, the underlying economic factors that influence unsustainable debts in middle-income countries are understudied. We attempt to contribute in filling these gaps in the related literature. We found that the Puerto Rican indebtedness is, to a large extent, connected with the deindustrialization suffered by this economy in the absence of an executable economic plan. In light of our results, we contextualize why this process of deindustrialization created a structural change in this economy and provide various policy recommendations that are meaningful to other countries.

Keywords: external debt, deindustrialization, Puerto Rico

1. Introduction

Puerto Rico's public debt crisis has become a favorite topic for the media worldwide, often drawing comparison with the economic and financial drama unfolding in Greece. Like Greece, Puerto Rico is a member of a currency union forced to undergo an internal devaluation as part of a drawn-out fiscal adjustment process under the burden of unsustainable debt service obligations. More important, and also like Greece, Puerto Rico suffers from a crippled economy and is structurally unable to grow its way out of the debt trap. In fact, Greece is in its worst economic depression in at least 50 years and Puerto Rico probably is in its deepest economic depression in 100 years, using the output series in Devereux (2014) as reference.

Unlike Greece, the Puerto Rican indebtedness is under-researched in the economic literature. In this article we attempt to fill this gap in the literature. Most of the references on the Puerto Rican case are reports entrusted to private consultants such as Krueger et al. (2015). Some casual observers argue that excessive indebtedness was caused by corruption and corruption had affected Puerto Rico for decades (Castro, 2010), but real debt and debt as percentage of GDP was flat or declining prior to 1995, as shown below. Some others argue that a large welfare state creates the unsustainable debt by pressuring the government budget, but the vast majority of the social policies in Puerto Rico are funded by U.S. transfers. Political status is a key element affecting several economic elements in Puerto Rico, but which element is exactly explaining the debt growth has remained unexplained so far.

In terms of the economic literature, there are many references on how debt problems or debt overhang impact economic growth: from Krugman (1988) and Cohen (1995) to more recent authors such as Reinhart and Rogoff (2010) and Herndon et al. (2014). However, the literature is much less informative on how the underlying structure of the economy influences

public indebtedness in a upper middle-income country such as Puerto Rico, as classified by the World Bank. For instance, in Bohn (2008), Gosh et al. (2013), and Mendoza and Ostry (2008) debt dynamics in rich countries such as the U.S. are determined by fiscal policy (primary surplus and/or the fiscal reaction function), growth and the effective interest rate. On the other hand, in low and middle-income countries there is research on short-term dynamics and transmission mechanisms between current account imbalances and external shocks on sovereign debts (Aguiar et al., 2015). Similarly, Chipalkatti and Rishi (2001) find that episodes of capital flight are correlated with indebtedness. However, Puerto Rico had a positive trade balance throughout the period of high indebtedness and shares the currency and financial system with the US and is, thus, not subject to large capital flights. There are other debt determinants that can be found in cross country analysis but that cannot explain the indebtedness of a single country. For instance, Kraay and Nehru (2006) find that the quality of policies and institutions explain debt distress. However, Puerto Rico has a similar quality of policies and institutions throughout our period under study, 1975-2014 (Curet-Cuevas, 2003).

To persons unfamiliar with Puerto Rico's economic history (most persons, in fact), it may come as a surprise that the island had been a model debtor in the municipal bond market for decades; it is only since the mid-2000s that the Commonwealth's credit image has been tarnished. As with Greece, casual observers are quick to blame this fall from grace on rampant fiscal mismanagement. Fiscal mismanagement certainly played a significant role, not because there is any evidence that recent authorities managed worse than those in charge in the 1970s or 1980s (Curet-Cuevas, 2003), but in the sense of not adjusting in a timely fashion to the structural change of the economy, as explained below. Contagion was also to blame, in part:

the first real plunge in the value of Puerto Rico bonds followed soon after Detroit's default in 2013 and within days of a cover story in Barron's Magazine predicting that the island would be the next major debtor to default. However, our research points to a deeper cause in the economic structure: deindustrialization brought about by a change in US tax policy and the subsequent failure of the island's government and private sector to reshape the economy's fundamentals. It was not just a failure of fiscal management, but also the miscarriage of an economic development strategy. As in Greece, procyclical policies have been applied in the middle of the economic depression without an executable economic recovery plan.

In section 1.1, we provide a brief background on the Puerto Rican economy to situate our main thesis: deindustrialization, without an alternative development plan, brought about stagnation and indebtedness. In the second section, we introduce the methodology and descriptive statistics. In the third section we show the results that portray a clear description of the growth in debt. In the fourth section we discuss the conclusions and provide some policy recommendations for overcoming the debt crisis in Puerto Rico, which are meaningful for other countries and jurisdictions as well.

1.1 Historical overview of Puerto Rico

Puerto Rico's transition from a low-income traditional agrarian economy to a manufacturing and services medium-high income society is well documented in the literature (Curet-Cuevas, 2003; Dietz, 1986; ECLAC, 2005). In the second half of the 20th century, an economic development "miracle" was realized within the lifespan of a single generation, bestowing the fruits of modernization to children whose parents grew up in a mostly pre-modern environment. A unique set of circumstances helped to produce this dramatic change:

Puerto Rico's fully free access to the US market in a pre-globalization trading system, a large wage differential with the US economy, and generous tax incentives for US manufacturing firms setting up business on the island. A strategy of "industrialization by invitation" (called "Operation Bootstrap") succeeded in populating the local economy with US-owned factories producing for the US market, attracted by low wages and tax breaks in the security of a US territory. The local government complemented the inflow of private industrial capital with large investment in power, transport and water-and-sewers infrastructure, and with massive investment in human capital (mostly education and healthcare). Borrowing in US financial markets to finance the public side of the investment program was a feature of this strategy from the start.

Trade liberalization in the US gradually eroded Puerto Rico's advantage in access to the US market, and the predictable rise in wages with successful industrialization also eroded the labor cost advantage. This situation is related to the current situation of many Latin American countries. Consequently, the island's continued industrialization came to depend increasingly on tax incentives. By the mid-1970s, the US Congress created a special tax regime for US corporations in the territories under Section 936 of the US Tax Code, providing a significant enhancement to the local incentives in Puerto Rico and launching an era of capital-and-knowledge intensive operations in electronics, medical devices and pharmaceuticals. In 1995, at the height of the Section 936 bonanza, manufacturing accounted for 42% of GDP, created more than 30% of deposits in the island's banking system, and directly generated 17% of total employment (indirect employment creation was more than twice the direct employment, according to Ruiz and Wolff (1996)).

Critics of Section 936, including the US Treasury and several influential US senators, complained of excessive tax base erosion in the US due the territories' tax system and eventually succeeded in bringing the system to an end. Congress phased out the section over a ten-year period beginning in 1996, and left Puerto Rico without a federal complement to the local industrial incentives program, effectively forcing most of the affected businesses to reincorporate as Controlled Foreign Corporations (CFCs). However, many corporations chose to downsize their Puerto Rico operations or to leave the island outright for more attractive locations such as Ireland, Mexico or Costa Rica. As a result, the removal of Section 936 did not bring significantly higher revenues to the US Treasury while it set the stage for the worst depression in the Puerto Rican economy in more than 100 years. It is far from coincidence that Puerto Rico's current economic depression began in 2006; the last year in the phase-out of Section 936. The lack of economic growth—accentuated by the international oil and financial shocks in the mid and late 2000s—has led to a public debt crisis and a massive wave of outmigration to the US. Puerto Rico now faces a triple challenge in debt, demography, and economic growth.

1.2 Evolution of the Public Debt

Puerto Rico has a unique political and economic relationship with the United States. In most aspects, the island is like a state, but, not being really a state, it has what Puerto Ricans have come to call "fiscal autonomy." Most US taxes do not apply to Puerto Rico's residents, ostensibly because they do not vote to elect the US president and are not represented in the US Congress (and, of course, taxation without representation is tyranny). Puerto Rico thus operates its own tax system, largely tailored to mirror the US tax code. In the context of this

"fiscal autonomy," Puerto Rico has been allowed triple tax exemption on the bonds placed by the island's government and state-owned corporations in the US municipal bond market: interest on such bonds is not taxed by the federal government, the Puerto Rico government, or any of the 50 state governments. This, and a generally good credit history, made Puerto Rico public bonds very attractive to muni market investors over several decades.

Able to tap a large source of funds with very convenient yields and maturities, Puerto Rico's government and state-owned corporations launched an aggressive program of investment in infrastructure to modernize the island's economy in the second half of the past century. Arguably, the social return on such investment was more than enough justification for the financial burden incurred. Prudent debt management was evidenced by a low and stable debt-to-GNI ratio and the institutional safeguards imposed by the Commonwealth's Constitution and other legislation to ensure that the debt would not grow ahead of the economy and government revenues. This was the general picture until the 1990s.

As growth slowed in the 1990s, the central government, many municipalities, and some of the larger state-owned corporations began to run current deficits. The pernicious practice of borrowing long-term to finance current deficits became a regular modus operandi and the debt-to-GNI ratio began to creep upward as growth slowed and debt accelerated. By 2005, the central government acknowledged the existence of a structural deficit approaching 2% of GNI, and debt rating agencies began to press for corrective action and threatened to downgrade the government's bonds.[1]

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[1] Gross National Product (GNP) is generally used in Puerto Rico in preference to GDP because much of the GDP is distorted by the transfer pricing of multinational companies.

In February 2014, the central government bonds and those of several state-owned corporations were downgraded to below-investment grade, blocking the public sector's access to the municipal bond market. With government agencies and state corporations unable to refinance repayments falling due, and with tax revenues flat or declining, default seemed only a matter of time. Finally, in the closing days of June 2015, the Governor García-Padilla, told the New York Times that the island's public debt is "not payable". Unlike Greece, Puerto Rico is not an independent nation, but an unincorporated territory—a "possession"—of the United States, and while Greece could abandon the euro in an extreme scenario (the so-called "Grexit" option), "PRexit" is not the favorite alternative for the vast majority of Puerto Ricans, as suggested in recent referendums on the political status. Thus, most of Puerto Rico's debt crisis must be processed within the US financial and judicial systems, in a manner probably more akin to Detroit's bankruptcy or to Argentina's recent confrontation with creditors in US courts over bonds sold in US jurisdictions. Due to the sheer size of the island's public debt—representing 94% of GNI as of 2015—and the large portion of it acquired by "vulture" hedge funds and nontraditional investment firms in recent years, Puerto Rico's debt renegotiation will make history and probably create precedents in the municipal bond market.[2] As a backdrop to debt negotiations, the government is drafting a five-year fiscal adjustment program along the lines of the recommendations of a special report prepared on commission by a group of former IMF economists headed by Anne Krueger (Krueger et al., 2015).

2. Data and Methodologies

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[2] In words of Alan Valdes, director of floor trading at DME Securities; "To tell you the truth, Puerto Rico is a bigger problem for American investors than Greece". (for more details, http://money.cnn.com/2015/07/01/investing/puerto-rico-bond-holders/)

To address the question of whether deindustrialization caused indebtedness or not, we apply the exports to GNI ratio and employment in manufacturing as our main determinants of debt. These two proxies do not share a very high correlation (Pearson correlation of -0.38) and can provide two types of information about manufacturing in the Island. On one hand, movements in exports can show one aspect of trends in industrialization. As stated by Ruiz and Wolff (1996), "Exports consist almost exclusively of manufacturing products, which have been promoted by the Puerto Rican government through a variety of incentives, including tax relief (Section 936 of the federal tax code), the provision of infrastructure and other subsidies" (p. 393).

On the other hand, exports can edge up without an increase in jobs due to a rise in productivity, especially in the very sophisticated sectors such as pharmaceutical or biotechnology. In our specification below we evaluate if exports or manufacturing jobs can better explain the country's indebtedness.

We divided manufacturing employment by the population 16 years of age and older because there are some doubts over the accuracy of the unemployment figures, affecting labor force figures (Curet-Cuevas, 2003). Figure 1 shows how from 1989 the relative presence of manufacturing employment started to decline. However, this decline was due to the fact that population grew faster than employment in manufacturing: in 1995 there were about 2,000 more jobs in manufacturing than in 1989. In relative terms, the decline in the ratio of manufacturing employment to the economically active population was also greater in the period 1995-2001 (12 points) than in the period 1989-1995 (5 points). The impact of the

elimination of Section 936 on manufacturing employment without any alternative economic plan is clear in Figure 1.

Figure 1 goes here

The control variables were chosen based on the related literature and on the hypotheses shared by various ad hoc economic reports on Puerto Rico. We attempt to test all the possible control variables into our model, subject to data availability. For instance, it is a widely shared belief that the debt problems of the Island were brought about by "big government" (CAREF, 2009). However, in Figure 1 the ratio of government workforce to the population 16 and over edged up in 1985, stabilized in 1988 to 2007 with two peaks in 1996 and 2006, and decreased afterwards to a historical low point in 2014 (lower than in 1975).

In general, the interest rate in the municipal bond market steadily decreased from a double-digit rate in 1982 to around 4% in the last 10 years. Can this decline explain the surge in Puerto Rico's debt? To answer this question we include this series into our model.

We also include net transfers between Puerto Rico and the US government. The government of Puerto Rico received around $3 billion annually from the US federal government in recent years. This represents almost 25% of the total government funds. However, according to the Puerto Rico Planning Board, in 2011 the Puerto Rico government received $5.2 billion thanks to the American Recovery and Reinvestment Act (ARRA). The loss of $2 billion in the years after the end of the ARRA fiscal stimulus could exacerbate the budget deficit of the Puerto Rican government.

We also include the total investment in construction to evaluate the effect of the decrease in this sector, which is found by some authors to be important (Krueger et al., 2015). In fact, the first housing market bubble in Puerto Rico emerged in the early 2000s and 2007, a year after the beginning of the depression, as can be observed in Figure 2.

Figure 2 goes here

Given the lack of theoretical models on how the economic structure affects excessive indebtedness in upper middle-income countries (as explained above), we seek to test our hypothesis on the interconnection between debt and deindustrialization with the following empirical model (the control variables were chosen based on the related literature and on the hypotheses shared by various ad hoc economic reports on Puerto Rico, as stated below):

$$\Delta D_t = \alpha + \beta_1 \Delta D_{t-1} + \beta_2 \Delta D_{t-2} - \theta \Delta X_t - \delta \Delta K_{t-1} - \gamma \Delta L_t + \vartheta \Delta G_t - \mu \Delta I_t \\ - \varphi \Delta C_{t-1} - \tau \Delta T_t + \varepsilon_t \qquad (1)$$

where D is real total debt (d stands for debt of state-owned corporations in other regressions, as specified in each table), X is the exports to GNI ratio (proxy for industrialization reflected in the external accounts, as suggested by the related literature in low and middle-income countries), K is real GNI, L is employment in manufacturing as percentage of the population 16 and over (proxy for industrialization reflected on the labor market), G is the government workforce (to evaluate thesis on how "bloated government" affects indebtedness), I is the average interest rate of an index composed of 20 general obligation bonds that mature in 20 years ("Go 20-Bond", to approximate the effect on interest rate, as suggested by the related literature in rich countries), C is real total investment in the construction sector (proxy for the influence from the housing market plunge), T is real net transfers from the US government to Puerto Rico (to evaluate the role of U.S. fiscal policies on an interconnected

economy such as Puerto Rico), and ε is the error term. Note that we treated fiscal policies as a transmission mechanism (in middle-income countries many unsustainable debts are preceded by prolonged fiscal deficits), not as the underlying factor that may explain why the fiscal deficits escalated so high in the first place. Real tax revenues decreased steadily since 2005 even when new taxation was introduced, as shown in Figure 3, without any major tax relief. To compensate those losses, governments took more debt: in fact, real tax revenues and debt to GDP ratio had a correlation of -0.92. What happened to the economic structure, what could cause such dependency on debt, are the type of questions that we seek to answer with equation (1).

FIGURE 3 goes here

As explained above, around of 70% of the total debt was issued by government-owned corporations. Their debt increased 156% during our sample period, significantly faster than the 118% growth in the central government's general obligation bonds (GOs). Thus, studying Puerto Rico's public debt calls for special attention to the debt of the government-owned corporations. Therefore, equation 1 was also estimated separately for the state corporations' debt.

The series considered in (1) are not cointegrated, according to the Phillip-Ouliaris test. Some of the series in (1) have a lag to avoid colinearity, as indicated by a relatively small Variance Inflation Factor.[3] We included two autoregressive terms to remove signals of serial correlation. To allow direct comparison of magnitudes in the coefficients, each variable was

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[3] Some of our regression tests are in Appendix 2 for the reviewers in the form of printouts to increase readability. However, the appendix is not intended to be published.

standardized. We are applying first differences to remove problems of non-stationarity because, in levels, all these series are I(1) according to the Augmented Dickey Fuller tests.

Given the presence of outliers, we first applied a panel robust regression that seeks to minimize the effects of outliers in (1) by estimating the coefficient θ through a Huber M estimation of the type,

$$\hat{\theta} = argmin_\theta \sum_{t=0}^{T} \rho_c(\frac{e_t(\theta)}{\sigma})$$

where ρ is a Bisquare function of the residuals e and c is a tuning constant that was set at 4.685 following Holland and Welsch (1977).[4] The σ is a scale to be estimated iteratively by,

$$\hat{\sigma}^{(s)} = median[\frac{abs(e_t^{s-1}) - median(e_t^{s-1})}{0.6745}]$$

where e_t^{s-1} are the residuals associated with $\hat{\theta}_m^{s-1}$. The coefficient covariance matrix was estimated by following Huber (1981),

$$\Delta^2 \frac{\left[\frac{1}{T-K}\right] \sum_{t=1}^{T} Y_c(e_t)^2}{[(\frac{1}{T}) \sum_{t=1}^{T} Y_c'(e_t)]^2} (X'X)^{-1}$$

with $\Delta = 1 + \frac{T}{k} \frac{\sum_{t=1}^{T} [Y_c'(e_t) - \bar{Y}_c']}{(\bar{Y}_c)^2}$, $\bar{Y}' = \frac{1}{N} \sum_{t=1}^{T} Y_c'(e_t)$ and $W_{js} = \sum_{t=1}^{T} Y_c'(e_t) x_{tj} x_{ts}$,

j,s = 1,...,k. Here $Y_c(\cdot) = \rho_c'(\cdot)$ and x_{tj} is the value of the j-th regressor for observation t.

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[4] In general, $e_t(\theta) = e_t = D_t - X'_t\theta$, where X = matrix of determinants.

As a robustness revision, we applied an OLS for the ratio debt to GNP. To further test for sensitivity to specification, we apply a regime switching regression since we can expect that deindustrialization was intensified after 1995 (when tax incentives to manufacturing were removed). Given the relatively low degrees of freedom in each regime, we only consider the statistically significant variables of our previous estimations. Namely,

$$\Delta R_t = \beta_0 - \beta_1 \Delta D_{t-1} - \theta_1 \Delta X_{t<\propto} - \theta_2 \Delta X_{t>\propto} - \gamma_1 \Delta L_{t<\propto} - \gamma_2 \Delta L_{t>\propto} + u_t \qquad (2)$$

where R is equal to D/K (debt to GNI ratio) and α is the breakpoint (year 1995). Heterogeneous error distributions were allowed across regimes. Even when we have relatively low degrees of freedom, the robustness revision showed in equation (2) can shed light to the understanding of the implicit dynamics: let us evaluate if there were interaction with covariates in our previous estimations and if the changes in the institutional framework (described above) shaped the relationship between deindustrialization and indebtedness.

We did not find evidence of reverse causality in our specification. According to the Granger causality tests, we can reject the hypothesis that deindustrialization was caused by debt, but not the opposite (reviewers: please see Appendix 1). This is consistent with the findings of Kempa and Khan (2016).

We check that our estimates have a reasonable stability (reviewers: please see recursive residuals in Appendix 2), though we acknowledge that a change in the institutional framework in the future may change the relationships found here.

3.   Results

In Table 1 we first show the regression output for the total real debt. In every table the squared-Rw was shown in lieu of the robust R-squared, which is a suboptimal measure of fitness according to Renaud and Victoria-Feser (2010).

Table 1 goes here

Indebtedness appears to partially be a self-propelled phenomenon: the change in debt in the previous period has the largest impact on the change in debt in the current period. This would be supportive evidence of how "debt spirals" are created, a phenomenon that has been referred to in the literature (Milbourne, 1997).

The other two statistically significant variables found were our proxies for (de) industrialization. In fact, the statistical significance of our main determinants was consistently validated in each of the regressions in this table. Based on this evidence, we could conclude that a decrease in manufacturing jobs relative to the economically active population had the greatest impact on debt growth. Similarly, a decrease in the ratio of exports to GNP also had a relative strong repercussion on the debt of Puerto Rico.

Similar findings are represented in Table 2 where we applied the same regression to the government-owned corporations. In Table 2 it is found again that deindustrialization was the main responsible for the debt increase in government-owned corporations. One way that deindustrialization affected debt was through the loss of revenues in the government-owned corporations: deindustrialization reduces the demand for energy and water, directly affecting two of the largest government-owned corporations, the Puerto Rico Electric Power Authority (PREPA) and the Puerto Rico Aqueduct and Sewer Authority (PRASA). The loss in revenues

combined with a similar structure of expenditures –these corporations have a relatively weak administration with a relatively high wage structure– brought indebtedness to these government-owned corporations. The case of PREPA was even worse due to shocks in oil prices, which further reduced the demand for electricity. The central government, on the other hand, was not in the economic position to increase subsidies to these government-owned corporations given its own fiscal problems. For instance, the University of Puerto Rico, another government-owned corporation, was directly impacted by the economic downturn since its budget is a fixed percentage of the central government's revenues, which were reduced by the recession.

Table 2 goes here

Exports have a relative larger relevance to explain government-owned corporations' debt than to explain total debt. As in Table 1, a parsimonious estimation is found in the third regression of Table 2 because the rest of the variables in estimation (7) were not statistically significant and there are no significant differences in terms of fitness. Once again, deindustrialization is found to be the most relevant explanatory factor for the growth in the ratio of debt to GNI.

Both proxy variables, exports and manufacturing employment, were decreasing during the last 20 years. Once the economy lost its growth engines, the debt problems followed. It might argue that even with the Section 936 benefits, Puerto Rico would still have lost jobs to outsourcing by some labor-intensive firms. This occurred in many high-wage economies after the entrance of China to the World Trade Organization (Milberg and Winkler, 2010). However, the average wage in Puerto Rico is almost half the average wage in the US and much lower than

other industrialized economies, even when Puerto Rico is among the top 20 countries in terms of average years of schooling.[5] Thus, Puerto Rico had a special comparative advantage in many manufacturing sectors given its relatively long experience in many industries coupled with a relatively high-trained workforce and with the tax incentives that were provided. It is highly likely that the loss in manufacturing jobs was much higher than it would have been had the incentives not been removed. Thus, an effective new industrial policy is one of the elements that can take Puerto Rico out of the debt trap.

From Table 1 and 2 we can observe how the discrepancy between the coefficients of exports and employment in manufacturing was smaller for government-owned corporations than for total debt. An economic interpretation is that exports in this case are more relevant because the revenues received by some of the largest government-owned corporations were more affected by the manufacturing output than in the case of the total debt. However, we stress that the most important explanatory factor in all the estimations was the number of manufacturing jobs in proportion to the economically active population. It is possible to conclude that the reduction in the number of these well-paid positions brought a bulk of calamities that also included a very large migration to the US in the last five years, resulting in more Puerto Ricans living in the US than on the Island (Caraballo-Cueto, 2015).

The correlations shown in Tables 1 and 2 were found after controlling for the impact of economic growth, movements in the market interest rate, changes in the government's size, movements in net federal transfers, and changes in construction activity. Nonetheless, this last

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[5] According to the Census Bureau and the World Bank:
http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t and
http://databank.worldbank.org/data/home.aspx.

factor deserves some deeper analysis. The decline in construction is an exacerbating factor that contributes to the economic and fiscal crisis but only in the recent period, after the first bubble burst in the Puerto Rican housing market. The bursting of the real estate bubble interacted with a local financial crisis and generated a contagion process that ended up with the disappearance of around one third of commercial banks, causing great losses in wealth not only in construction, but also in household wealth and in the balance sheets of the remaining banks (Toro-Tulla, 2013). Since the regressions search for long-term explanatory variables, construction does not appear to be a statistically significant determinant of debt in the long run.

Table 3 illustrates our robustness checks, which are consistent with our previous findings. In the case of OLS, the negative growths in the ratio of exports to GNP and in the proportion of manufacturing jobs are, again, the main determinants of the increases in debt. As stated above, to allow sensitivity testing we changed the specification of (1): this is a standard OLS having the debt to GNP ratio as the dependent variable, though we are not totally convinced that the ratio of debt to GNI has a theoretical foundation as an accurate measurement of the optimal debt (e.g., Singapore had a 106% debt ratio in 2011 and its economy was growing at a 6% rate).

Table 3 goes here

In the regime switching regression we found, once again, similar results –reductions in exports as a percentage of GNI and in the proportion of manufacturing jobs are the most relevant explanatory factors to study debt growth, having L always the greatest magnitude. The

dynamics between deindustrialization and indebtedness appears to be more closely connected after 1995 when the industrial policies were changed, as explained in the first sections.

4.   Conclusions and Possible Policy Recommendations

We found that deindustrialization, as measured by the proportion of manufacturing jobs and exports, was the most important factor in Puerto Rico's growing indebtedness. This result is invariant to changes in the specification of the dependent variable and to the model chosen.

Some lessons from the Puerto Rico experience are meaningful to other countries. One is that time is of the essence in avoiding the fall into a debt trap. Countries should adopt a defensive stance in debt management as soon as the economy shows signs of a structural weakening, as there may not be as much elbow room available to policymakers as may appear in a cyclical recession. In Puerto Rico, the pace of deterioration of the debt picture was quicker than expected, and policy reactions were belated due to lack of preparedness. In this sense, an emergency fund raised during economic booms, as proposed in Ocampo et al. (2009), could help policymakers with countercyclical policies needed to mitigate the economic downturns without depending heavily on external financing.

Contagion and news effects can play an important role in triggering a debt crisis, which underscores the need to be sensitive to early warning signs. Market values of Puerto Rico's bonds were less volatile until Detroit's default and a front page story in Barron's Magazine warning that the island could be the next major debtor to default. Not coincidentally, there was a run on Puerto Rico bonds in the weeks after the Barron's story. Similarly, rating agencies were

catalytic agents in the debt crisis, as their decisions were not based on a transparent and quantitative methodology, such as the transition matrices that are used to rate private corporations. Rather, their ratings are followed by market sentiments, thus exacerbating economic cycles (Stiglitz et al., 1999). A new platform for the important task of rating external debt should be designed globally, with more than three agencies and with a clear methodology to objectively rate countries. This rating task could be better implemented by a non-governmental organizations than by private corporations that may have conflicts of interest.

Another lesson that stem from the Puerto Rican case is that, when there is a structural change, a new economic development plan with aggressive industrial policies has to be part of debt negotiations. An economic recovery is in the best interest of bondholders since a stagnant economy is likely to stay in the debt trap for a long time, increasing uncertainty and risks to bondholders. Thus, bond exchanges to swap existing debt for new debt should be tied by clear formulas to the pace of economic stabilization and recovery. The GDP-indexed bonds already proposed in the literature and in some country cases are one possible means to accomplish this end (Borensztein and Mauro, 2004). The yields on these bonds, and maybe also the principal repayments, could be time-variant depending on whether the economy recovers sooner or later than envisioned in negotiations. This approach also creates positive-sum-game incentives for countries and creditors to maximize the efficiency of reforms and pro-growth measures.

One way to implement this idea is by issuing new debt with a fixed interest rate of around 4.5% (above current yield of the Energy Authority of Detroit, which is in bankruptcy) with a premium indexed to economic performance. This premium can be based on the growth reflected in the Puerto Rico Economic Activity Index, a coincident index that is based solely on

non-monetary variables (which are easier to monitor externally). Again, this approach would promote a win-win scenario by promoting the economic recovery targeted by policymakers and protecting the investments of bondholders.

In the case of Puerto Rico, the government-owned corporations need a mechanism, such as Chapter 9 of the US bankruptcy law, to engage in orderly debt renegotiation. This debt was not backed by the Constitution and, as in any other corporation, they should have access to an organized legal mechanism to restructure. The wealth losses attached to the elimination of Section 936 could be sufficient to demand that the US authorities allow the creation of a bankruptcy mechanism for these corporations. Some are afraid that this approach will cut the access to credit for future governments, but Reinhart and Rogoff (2009) show that industrialized countries such as Japan and the United States that now pay low interest rates in their debt also had to announce a default at some point in the past century.

Privatization of natural monopolies (such as the aqueduct and water utility) has not brought good experiences, either in terms of efficiencies or in debt management. However, part of the negotiation with these government-owned corporations can include the enforcement of hard budget constraints. Puerto Rico's difficulties in "ring fencing" the central government's debt (general obligation bonds) from financial turmoil in the state-owned corporations underscore the importance of enforcing hard budget constraints on state entities. The generalized practice of subsidizing state-owned corporations from the central government's general fund created a presumption in the financial markets that the commonwealth government would ultimately respond for the corporations' debt. The line between general obligation bonds and state-corporations bonds was thus blurred. These

policies should apply also to political subdivisions, such as Puerto Rico's municipalities. Similarly to state-owned corporations, many municipal governments became dependent on last-minute financing from the central government's general fund. Contrary to some expectations, this accounting practice is not a Keynesian prescription: countercyclical fiscal policies do not require a permanent deficit to be financed at the last minute.

Other more complicated solutions are changing the political status, letting government-owned corporations to search for funds in the international capital markets or international institutions, or negotiate with the US Treasury department some type of refinancing mechanisms.

Future studies can highlight the importance of producing good estimates of dynamic fiscal multipliers à la Mittnik and Semmler (2012).In Puerto Rico, as well as in other countries, it appears that there is a sort of "increasingly adverse multiplier" in that the economy's negative response to austerity is greater in the later phases of the fiscal adjustment process than in the early stages. In other words, austerity measurements that may work in the early stages of the downturn can be excessive and counterproductive further down the line. The economy's tolerance to austerity is endogenous and time variant.

In connection to the point immediately above, it is essential to improve the quality of some macroeconomic data. Calculating fiscal multipliers, or more generally, gauging the dosage and effectiveness of corrective policies is made unnecessarily difficult in cases where, as in Puerto Rico, the uncertainty of a path-changing process is compounded by excessive noise in the data.

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Figures and Tables

Figure 1. Time Series of Selected Variables
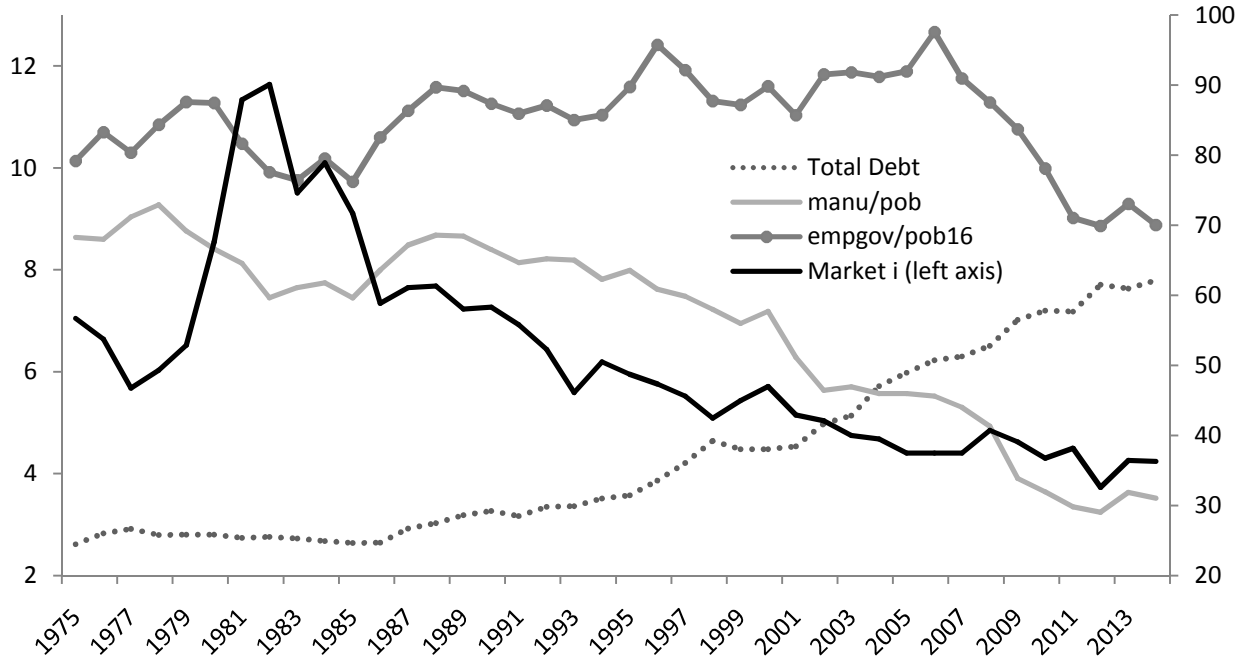
Notes: Market i is the average rate of an index composed of 20 general obligation bonds that mature in 20 years ("Go 20-Bond"). Total debt is in real terms, deflated by the GNP deflator. Empgov/pob16 indicates the proportion of government workers to population 16 and over. Manu/pob stands for the ratio manufacturing employment to population 16 and over.
Source: Puerto Rico Institute of Statistics (2015); FRED (2015)

Figure 2. Construction and Index of House Prices

Construction (left axis)
Price Index of Sold Houses (right axis)

Sources: Federal Housing Finance Agency (2015), Puerto Rico Planning Board (2015)

Figure 3. Real Tax Revenues from Local Sources, 1995-2015

sales tax 7%

excise tax- U.S. corporations

sales tax 11.5%
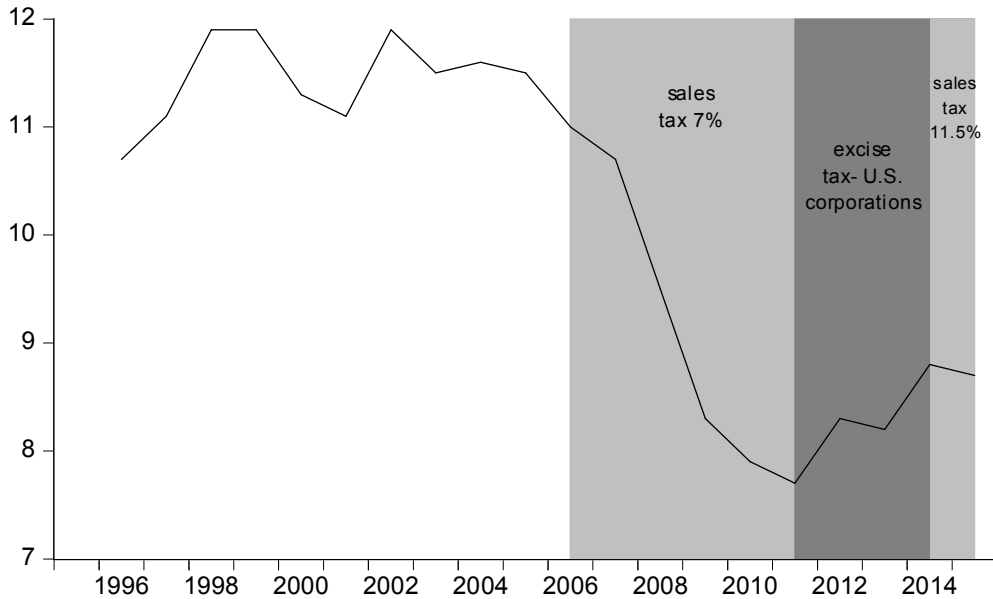
Notes: Local Sources exclude U.S. federal transfers.
Source: Puerto Rico Planning Board (2015)

Table 1. Estimation of Robust Regression for Total Debt, 1975-2014

Dependent Variable: $\dot{D}_t$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\dot{D}_{t-1}$	.14 (.17)	.17 (.18)	.23 (.16)	.25 (.16)	.23 (.16)	.37** (.16)	.37** (.18)
$\dot{D}_{t-2}$	.18 (.18)	.20 (.18)	.26* (.16)	.28* (.16)	.28* (.16)	.24 (.17)	.25 (.18)
$\dot{X}_t$	-.22** (.09)	-.23** (.10)	-.30*** (.09)	-.29** (.09)	-.28** (.10)	-.16* (.09)	-.16* (.09)
$\dot{K}_{t-1}$		.20 (.40)	.48 (.35)	.40 (.38)	.38 (.39)	.12 (.33)	.12 (.35)
$\dot{L}_t$			-.33** (.10)	-.36** (.12)	-.37*** (.12)	-.31*** (.10)	-.32*** (.12)
$\dot{G}_t$				.03 (.04)	.03 (.05)	.05 (.04)	.05 (.04)
$\dot{I}_t$					-.01 (.05)	-.02 (.05)	-.02 (.05)
$\dot{C}_{t-1}$						.07 (.07)	.07 (.08)
$\dot{T}_t$							-.01 (.10)
n	36	36	36	36	36	36	36
Adjusted Rw²	0.24	0.24	0.52	0.53	0.52	0.56	0.58

Notes: Observations shown are after adjustments. D stands for debt, X for export to GNP ratio, K for real GNP, L for manufacturing employment to civilian population 16+ ratio, G is the government workforce, I is the market interest rate, C is the investment in the construction sector, and T are the U.S. transfers. A constant was added but not showed for space considerations. M-estimation was performed. Standard errors are in parentheses. The *** indicates statistical significance at 99% confidence interval, ** at 95% and * 90%.

Sources: Authors' estimations, applying data from Puerto Rico Institute of Statistics (2015); FRED (2015)

Table 2. Estimation of Robust Regression for Government-Owned Corporations, 1975-2014

Dependent Variable: $\dot{d}_t$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\dot{d}_{t-1}$	.11 (.18)	.14 (.18)	.28* (.17)	.29* (.17)	.30* (.17)	.23 (.17)	.30 (.19)
$\dot{d}_{t-2}$	.23 (.19)	.24 (.19)	.28 (.17)	.25 (.17)	.27 (.18)	.28* (.17)	.26 (.18)
$\dot{X}_t$	-.16** (.08)	-.17** (.09)	-.20*** (.08)	-.17** (.08)	-.16** (.09)	-.28*** (.11)	-.30*** (.11)
$\dot{K}_{t-1}$		.14 (.31)	.36 (.30)	.18 (.32)	.20 (.33)	.38 (.42)	.42 (.43)
$\dot{L}_t$			-.25*** (.10)	-.29*** (.10)	-.31*** (.11)	-.37*** (.12)	-.40*** (.14)
$\dot{G}_t$				.04 (.04)	.04 (.04)	.03 (.05)	.03 (.05)
$\dot{I}_t$					-.03 (.04)	-.01 (.06)	-.009 (.06)
$\dot{C}_{t-1}$						.002 (.09)	.02 (.09)
$\dot{T}_t$							-.07 (.13)
n	36	36	36	36	36	36	36
Adjusted Rw²	0.20	0.20	0.47	0.46	0.50	0.52	0.55

Notes: Observations shown are after adjustments. D stands for debt, X for export to GNP ratio, K for real GNP, L for manufacturing employment to civilian population 16+ ratio, G is the government workforce, I is the market interest rate, C is the investment in the construction sector, and T are the U.S. transfers. A constant was added but not showed for space considerations. M-estimation was performed. Standard errors are in parentheses. The *** indicates statistical significance at 99% confidence interval, ** at 95% and * 90%.

Source: Authors' estimations, applying data from Puerto Rico Institute of Statistics (2015); FRED (2015)

Table 3. Robustness revisions, 1975-2014

Dependent Variable: D/K_t	OLS	Regime Switching Regression 1977-1994 | 1995-2013
D_{t-1}	.28 (.18)	.29** (.13)
D_{t-2}	.10 (.16)	
X_t	-.42** (.18)	-.15 | .49** (.14) | (.20)
L_t	-.70*** (.23)	-.15 | -.76*** (.25) | (.23)
I_t	-.03 (.10)	
C_t	.09 (.15)	
T_t	-.14 (.20)	
n	36	18 | 19
R²	0.49	0.50

Notes: Observations shown are after adjustments. D stands for debt, X for export to GNP ratio, L for manufacturing employment to civilian population 16+ ratio, G is the government workforce, I is the market interest rate, C is the investment in the construction sector, and T are the U.S. transfers. Variables were standardized. The vertical line is the coefficient estimated is dividing the results for the two regimes. The *** indicates statistical significance at 99% confidence interval, ** at 95% and * 90%. SE stands for standard error.
Source: Authors' estimations, applying data from Puerto Rico Institute of Statistics (2015) and FRED (2015)

Appendix 1: Pairwise Granger Causality Tests

Lags: 1

| Null Hypothesis:	Obs	F-Statistic	Prob.
D(MANUPOB16) does not Granger Cause D(DEBTGnP)	37	3.35477	0.0758
D(DEBTGnP) does not Granger Cause D(MANUPOB16)		0.71440	0.4039

Appendix 2: Statistical tests

Date: 06/13/15   Time: 11:26
Sample: 1950 2014
Included observations: 36
Q-statistic probabilities adjusted for 9 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob...
		1	-0.06...	-0.06...	0.1753	0.675
		2	0.075	0.071	0.3999	0.819
		3	-0.30...	-0.30...	4.3688	0.224
		4	-0.08...	-0.13...	4.6589	0.324
		5	-0.10...	-0.08...	5.1365	0.399
		6	0.222	0.144	7.3934	0.286
		7	-0.01...	-0.05...	7.4043	0.388
		8	0.060	-0.03...	7.5774	0.476
		9	-0.22...	-0.16...	10.192	0.335
		1...	-0.07...	-0.10...	10.521	0.396
		1...	-0.00...	0.035	10.523	0.484
		1...	-0.18...	-0.36...	12.472	0.409
		1...	-0.01...	-0.20...	12.492	0.488
		1...	0.118	0.075	13.357	0.499
		1...	0.003	-0.11...	13.358	0.575
		1...	0.013	-0.17...	13.370	0.646
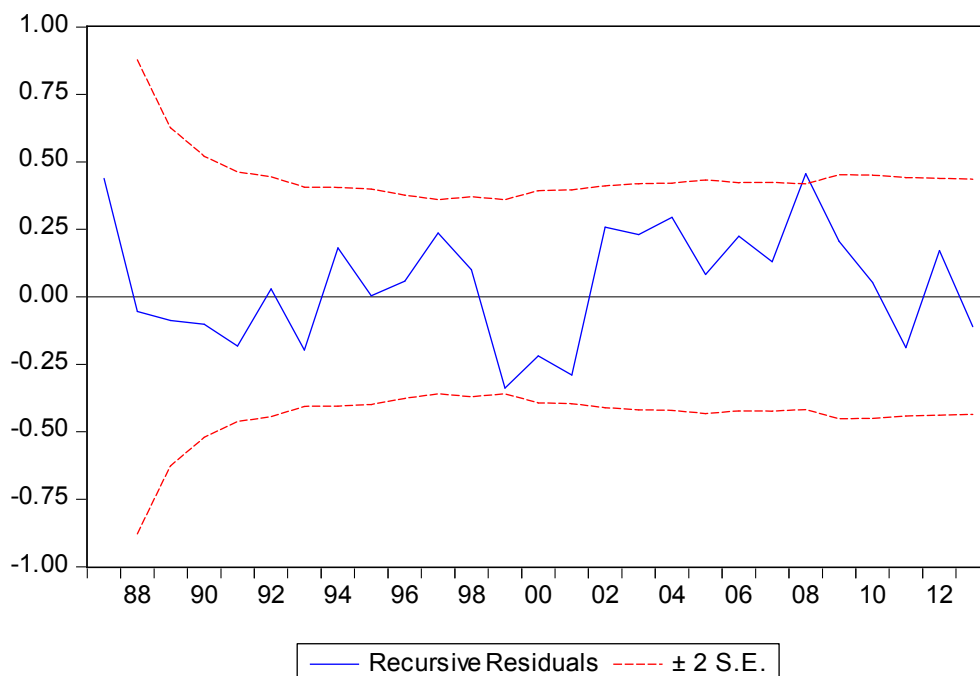
Variance Inflation Factors

Sample: 1950 2015
Included observations: 36

Variable	Coefficient Variance	Uncentered VIF
D(MANUPOB16)	0.054630	1.861672
D(REALTRANSFER)	0.038903	1.504492
D(EXPGNP)	0.034128	1.540081
D(GOVPOB16)	0.008101	1.932063
D(GNPREAL(-1))	0.000826	1.614897
D(MARKETINTEREST)	0.009387	1.343375
D(CONSTRUC(-1))	0.023184	1.376541
DDEBTGDP(-1)	0.030724	1.696328
DDEBTGDP(-2)	0.025443	1.327598

Phillips-Ouliaris test for cointegration
Series: DEBTGDP MANUPOB16 REALTRANSFER EXPGNP GOVPOB16 CONSTRUC
MARKETINTEREST
Sample (adjusted): 1975 2013
Included observations: 39 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C

Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth)
No d.f. adjustment for variances

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
DEBTGNP	-3.055558	0.8392	-15.84596	0.8242
MANUPOB16	-4.133706	0.3865	-24.25747	0.3636
REALTRANSFER	-4.556700	0.2309	-24.42975	0.3546
EXPGNP	-3.524708	0.6589	-18.24308	0.7061
GOVPOB16	-3.762240	0.5515	-20.56527	0.5738
CONSTRUC	-2.663930	0.9333	-13.00221	0.9238
MARKETInterest	-3.252079	0.7713	-17.07203	0.7671

*MacKinnon (1996) p-values.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.220666	Prob. F(2,25)	0.8035
Obs*R-squared	0.552393	Prob. Chi-Square(2)	0.7587