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# Deindustrialization and Unsustainable Debt in Middle-Income Countries: The Case of Puerto Rico

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## Abstract:

Puerto Rico recently became the largest bankruptcy case in the history of the U.S. municipal bond market. This debt crisis has not been the subject of significant scrutiny in the economic literature, though many researchers focus on case studies, such as Greece and Argentina, to analyze a country's indebtedness. The underlying economic factors that influence unsustainable debt in upper middle-income countries are generally understudied. We attempted to contribute to filling these gaps in the related literature. Using econometric analysis, we found that Puerto Rico's government indebtedness is, to a large extent, connected to a sharp decrease in manufacturing employment (i.e. deindustrialization) suffered by this economy, and weak evidence that it was caused by an excessive government payroll or overgenerous federal programs. In light of our empirical results, we discussed how the consequences of deindustrialization ultimately led to increase government borrowing.

**Keywords:** Deindustrialization, external debt, Puerto Rico

**JEL classification:** E6, H6, R5, 02

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## 1 Introduction

The literature on debt difficulties in high-income countries tend to focus more the role of fiscal policy (primary surplus and/or the fiscal reaction function), growth and the effective interest rate to explain indebtedness (Bohn 2008; Mendoza and Ostry 2008; Ghosh et al. 2013). Research on low and middle-income countries emphasizes short-term dynamics and transmission mechanisms between current account imbalances and external shocks on sovereign debts (Aguar et al. 2015). In addition, Chipalkatti and Rishi (2001) find that episodes of capital flight are correlated with indebtedness. However, the economic literature is much less informative about how changes in the structure of the economy, added to other factors, influences public indebtedness in upper middle-income countries such as Puerto Rico.

We attempted to contribute to filling this gap with an empirical analysis that connects debt to deindustrialization, in what has become the largest bankruptcy case in the history of the US municipal bond market. After controlling for other factors, we found that two proxies for deindustrialization (employment and export contributions from the manufacturing sector) explain indebtedness in the period 1975–2014. Despite data limitations, our OLS model and Robust Regressions showed the relations between deindustrialization and indebtedness appeared to be invariant in the face of specification changes.

Findings for low and middle-income countries appear not to fully apply to a debt crisis in an upper middle-income country such as Puerto Rico. Puerto Rico had a positive trade balance throughout the period of high indebtedness. Moreover, the island is not subject to the capital flight phenomenon because it is integrated into the US currency and financial systems. Other findings in the literature also appeared implausible as explanations for Puerto Rico's debt. For instance, Kraay and Nehru (2006) find that the quality of policies and institutions explain debt distress. However, local economic institutions changed little throughout the period under study, 1975–2014 (Curet-Cuevas 2003), except for the elimination of US tax incentives for US companies operating on the island, which was exogenous to the local institutional and policy framework.

Most references on the Puerto Rican debt crisis are non-academic, such as reports entrusted to private consultants like Krueger, Teja, and Wolfe (2015). A recurring allegation is that a "large" welfare state is one of the underlying causes for the unsustainable debt, presumably because it burdened the government budget,<sup>1</sup>

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but the vast majority of government assistance programs in Puerto Rico are funded by US transfers, and the number of beneficiaries in one of the costlier programs (the Nutritional Assistance Program) was declining in the period 1994 to 2006, when debt was increasing.<sup>2</sup> It is also argued that excessive government employment (CAREF 2009), tied to political clientelism, is a major cause of the debt's growth, but some researchers have established that public-sector employment in Puerto Rico is not proportionately greater than in the US (Davis and Rivera-Batiz 2006).

It also appears unlikely that one can blame the debt crisis solely on rampant fiscal mismanagement. Corruption and fiscal mismanagement have affected Puerto Rico for decades (Castro 2010; Curet-Cuevas 2003), even prior to 1995, when the real debt and debt as percentage of GDP were flat or declining, which seems to rule these out as main factors in the crisis. We argue that fiscal policy certainly played a significant role, by not adjusting in a timely fashion to the structural change of this economy, as explained below.

Without ruling out entirely the contribution of other factors, including those mentioned above, our research points to a deeper cause located in the fragility of an economic model focused on tax-incentivized industrialization by invitation. This model had become one of diminishing returns to tax benefits before it was eliminated in 1996 by the US Congress (which had created it in 1976), as argued by, among others, Catalá-Oliveras (2007, 2013) and Dietz (1986). A deindustrialization process, triggered by a change in US tax policy and in US trade liberalization, and the subsequent failure of the island's government and private sector to foresee the structural change in the productive capacity and reshape the economic model, fueled a structural slowdown bordering on stagnation. This decline was followed by a reduction in government revenues that were compensated with larger levels of debt. These misperceptions on current and future productive capacity are not particular to Puerto Rico: they have been documented in a number of studies, such as Guzman and Stiglitz (2016) and Leijonhufvud (1973).

In Section 1.1, we provided 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 described our econometric methods and descriptive statistics. In the third section we showed the results that portray a clear description of the growth in debt. In the fourth section we discussed the conclusions and provide some policy recommendations, 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 (Dietz 1986; Curet-Cuevas 2003; 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 on 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 weakened the labor cost advantage.<sup>3</sup> 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).

Contrary to South Korea, which was able to build economic capabilities by connecting foreign industries with their local private sector (Lall 1996), the economic model of Puerto Rico depended increasingly on policies not controlled by local authorities and failed to induce the transfer economic capabilities to the small local private sector. Meanwhile, the excessive local tax incentives contributed to the reduction in government revenues. These and other criticisms were anticipated in a number of contributions (Tobin et al. 1975; Villamil 1976).

Critics of Section 936 in the US government complained of excessive tax base erosion in the US due the territory's 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 some 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.

Puerto Rico is not alone in experiencing deindustrialization. According to Rodrik (2016), many developing nations, especially in Latin America, are facing a “premature deindustrialization” owing to globalization and the relatively fast pace of technological progress. What makes the Puerto Rico experience different is the subordination of local industrial policy to US industrial and fiscal incentives, creating a modality of dependent industrialization (and dependent deindustrialization, when incentives were removed) while limiting the set of compensating policy options available to the local government. What may be revealing for other developing nations in Puerto Rico's experience is how a strong structural change in the economy can trigger a debt crisis like the one described in the next section.

## 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, although not really a state. Puerto Ricans referred to the economic aspect of this relationship as “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 municipal 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-GNP 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-GNP 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 GNP, and debt rating agencies began to press for corrective action and threatened to downgrade the government's bonds.<sup>4</sup>

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”. Gluzmann, Guzman, and Stiglitz (2018) find that to restore debt sustainability to Puerto Rico, the current debt stock of \$72.2 billion needs at least a, “...full cancellation of unpaid interest plus a face value reduction of between 60 and 73 percent” (p. 4).

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. As a backdrop to debt negotiations, the government prepared a 10-year

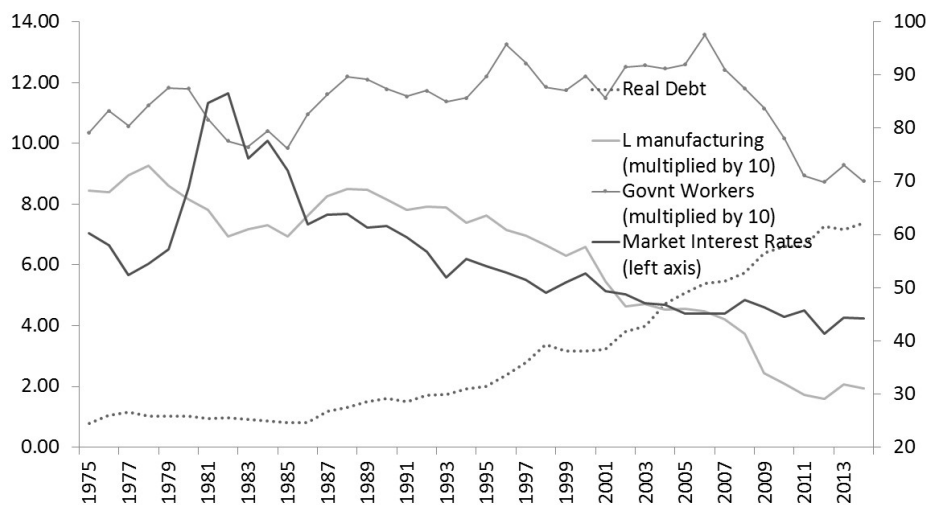
fiscal adjustment program along the lines of the recommendations of a special fiscal control board imposed by the US Congress.

## 2 Data and Methodologies

To approximate the deindustrialization phenomenon, we followed the convention of using employment in manufacturing (Rodrik 2016), but we also used the exports to GNP ratio as an additional indicator. In this study, these two proxies do not share a very high correlation (Pearson correlation of  $-0.38$ ) and this provides two types of information about manufacturing on the Island. On the one hand, movements in exports can show one aspect of trends in industrialization because, “[e]xports 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” (Ruiz and Wolff 1996, 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 evaluated whether exports or manufacturing jobs can better explain the country’s indebtedness.

We divided manufacturing employment by the civilian population 16 years of age and older because there are some doubts over the accuracy of how unemployment figures affect the labor force figures (Curet-Cuevas 2003). Figure 1 shows how the relative presence of manufacturing employment started to decline in 1989. 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:** Time series of selected variables, 1975-2014.

Notes: Market interest rate is the only one in the left axis and represents the average rate of an index composed of 20 general obligation bonds that mature in 20 years (“Go 20-Bond”). Debt was deflated by the 1954 GNP deflator (figures are in hundreds of millions of dollars). Govnt Workers indicates the proportion of government workers to civilian population 16 and over. L manufacturing stands for the ratio manufacturing employment to civilian population 16 and over.

Source: Puerto Rico Institute of Statistics (2017); FRED (2017).

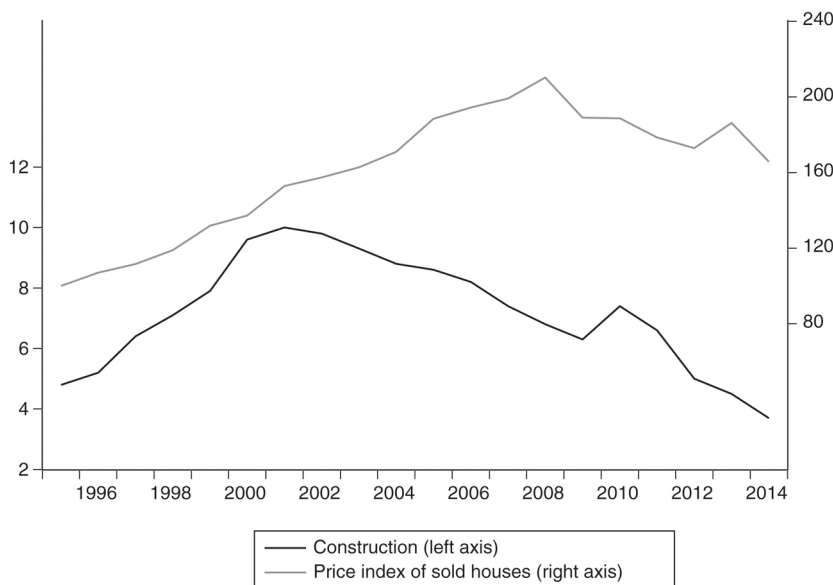
The control variables were chosen based on the hypotheses commonly found in the related literature on indebtedness and on Puerto Rico. We attempted to test all the possible hypotheses, subject to data availability. For instance, it is a widely shared belief that the debt problems of the Island were brought about by a “big government”: hiring excessive government workers pushed the government to issue additional debt to pay a “bloated” payroll (CAREF 2009). Even though it is difficult to determine the optimal size of the government workforce in a given period without knowing the expectations of policymakers about the long-run equilibrium trend of the economy, we addressed the validity of the “big government hypothesis” by empirically evaluating whether the movements in the proportion of government workers were a potential driver of debt accumulation.

As shown 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, when debt was historically low).

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 included this series into our model.

We also included net transfers between Puerto Rico and the US government to evaluate the role that dependency on federal transfers may play in public indebtedness. The government of Puerto Rico has received around \$3 billion annually from the US federal government in recent years. According to the Puerto Rico Planning Board, in 2011 the Puerto Rican 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. Furthermore, this variable can also reveal whether dependency on welfare programs is associated with public indebtedness (as discussed in the first section) given that the federal funds assigned to social programs are considered in this variable.

We also included 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, Teja, and Wolfe 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:** Construction and index of house prices, 1995-2014  
Sources: Federal Housing Finance Agency (2017), Puerto Rico Planning Board (2017).

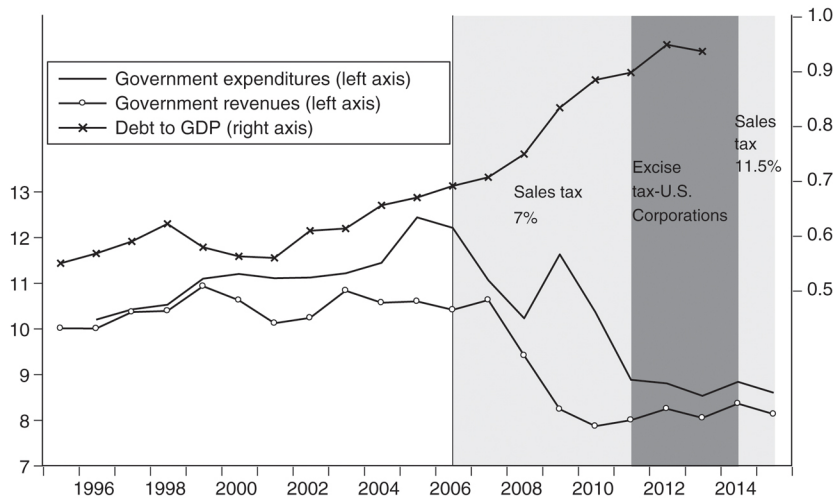
We sought to test our hypothesis on the interconnection between debt and deindustrialization with the following empirical model applied to the period 1975–2014:<sup>5</sup>

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

where  $D$  is the real total debt ( $d$  stands for debt of state-owned corporations in other regressions, as specified in each table),  $X$  is the exports to GNP ratio (proxy for industrialization reflected in the external accounts, as suggested by the related literature on low and middle-income countries),  $K$  is real GNP,  $L$  is the employment in manufacturing as percentage of the population 16 and over (a proxy for industrialization reflected in the labor market),  $G$  is the government workforce as a percentage of the population 16 and over (to evaluate the thesis on how “big 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 the interest rate, as suggested by the related literature on rich countries),  $C$  is the real total investment in the construction sector (a proxy for the influence from the housing market plunge),  $T$  is the real net transfers from the US government to Puerto Rico (to evaluate the role of US fiscal policies on an interconnected economy such as Puerto Rico), and  $\varepsilon_t$  is the error term.

Similar to many other upper middle-income countries, the unsustainable debt in Puerto Rico was preceded by a prolonged fiscal deficit, as shown in Figure 3. Thus, we treated fiscal policies as a transmission mechanism, 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, successive governments took on more debt: in fact, the real tax revenues and the debt to GDP ratio had a correlation of  $-0.92$ . What happened to the economic structure and what could accelerate such dependency on debt, were the type of questions that we sought to answer with equation (1).



**Figure 3:** Real expenditures and real tax revenues from local sources, 1995–2015. Notes: Figures in the left axis are hundreds of million of dollars at 1954 constant prices. Local Sources exclude US federal transfers. Source: Puerto Rico Planning Board (2017).

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) were not cointegrated, according to the Phillip-Ouliaris test. Some of the series in (1) had a lag to avoid colinearity, as indicated by a relatively small Variance Inflation Factor.<sup>6</sup> We included two autoregressive terms to remove signals of serial correlation. To allow direct comparison of magnitudes in the coefficients, each variable was standardized. All series in equation (1) were I(0) according to the Augmented Dickey Fuller tests.

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

$$\hat{\theta} = \operatorname{argmin}_{\theta} \sum_{t=0}^T \rho_c \left( \frac{e_t(\theta)}{\sigma} \right)$$

where  $\rho$  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).<sup>7</sup> The  $\sigma$  is a scale to be estimated iteratively by,

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

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),

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

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  $W_{js} = \sum_{t=1}^T Y_c'(e_t) x_{tj} x_{ts}$ ,  $j, s = 1, \dots, k$ . Here  $Y_c(\cdot) = \rho_c'(\cdot)$  and  $x_{tj}$  is the value of the  $j$ -th regressor for observation  $t$ .

As a robustness revision, we applied an OLS for the ratio of debt to GNP. To further test for sensitivity to specification, we applied a regime switching regression because we expected that deindustrialization was intensified after 1995 (when tax incentives to manufacturing were removed and the North America Free Trade Agreement (NAFTA) was signed) allowing Mexico to effectively compete with Puerto Rico in the attraction of foreign direct investment (FDI). Given the relatively low degrees of freedom in each regime, we only considered the statistically significant variables of our previous estimations. Namely,

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

where  $R$  is equal to  $D/K$  (the debt to GNP ratio) and  $\alpha$  is the breakpoint (the year 1995). Heterogeneous error distributions were allowed across regimes. Even when we had low degrees of freedom (there is no quarterly data available); this revision shown in equation (2), can shed light on the understanding of the implicit dynamics. This allows us to evaluate whether there were interactions with covariates in our previous estimations and whether 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 rejected the hypothesis that deindustrialization was caused by debt, but not the opposite (reviewers: please see Online Appendix 1). This is consistent with the findings of Kempa and Khan (2016).

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

### 3 Results

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

**Table 1:** Estimation of robust regression for total debt, 1975–2014.

Dependent variable: $Debt_t$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Debt_{t-1}$	0.14 (0.17)	0.17 (0.18)	0.23 (0.16)	0.25 (0.16)	0.23 (0.16)	0.37** (0.16)	0.37** (0.18)
$Debt_{t-2}$	0.18 (0.18)	0.20 (0.18)	0.26* (0.16)	0.28* (0.16)	0.28* (0.16)	0.24 (0.17)	0.25 (0.18)
Exports <sub>t</sub>	-0.22** (0.09)	-0.23** (0.10)	-0.30*** (0.09)	-0.29** (0.09)	-0.28** (0.10)	-0.16* (0.09)	-0.16* (0.09)
GNP <sub>t-1</sub>		0.20 (0.40)	0.48 (0.35)	0.40 (0.38)	0.38 (0.39)	0.12 (0.33)	0.12 (0.35)
Labor in $M_t$			-0.33** (0.10)	-0.36** (0.12)	-0.37*** (0.12)	-0.31*** (0.10)	-0.32*** (0.12)
Government <sub>t</sub>				0.03 (0.04)	0.03 (0.05)	0.05 (0.04)	0.05 (0.04)
Interest <sub>t</sub>					-0.01 (0.05)	-0.02 (0.05)	-0.02 (0.05)
Construct <sub>t-1</sub>						0.07 (0.07)	0.07 (0.08)
Transfers <sub>t</sub>							-0.01 (0.10)
$n$	36	36	36	36	36	36	36
Adjusted $Rw^2$	0.24	0.24	0.52	0.53	0.52	0.56	0.58

Observations shown are after adjustments. Debt stands for real debt, Exports for exports to GNP ratio, GNP for real GNP, Labor for manufacturing employment to civilian population 16+ ratio, Government is the government workforce, Interest is the market interest rate, Construct is the investment in the construction sector, and Transfers are the net US 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 (2017); FRED (2017).

There is some evidence, at least in the last two specifications, that indebtedness was partially a self-propelled phenomenon: the change in debt in the previous period had an impact on the change in debt in the current period. This provides supportive evidence on 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 and magnitude of our main determinants was consistently validated in each of the regressions in this table. Based on this evidence, we may conclude that a decrease in manufacturing jobs, relative to the economically active population, had the highest correlation on debt growth. Similarly, a decrease in the ratio of exports to GNP also had a relatively strong association with 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 we again observed that deindustrialization appears to be the main factor 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 reduced 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). To put it simply, with deindustrialization many government-owned corporations lost their largest customers: factories. The loss in revenues combined with a similar structure of expenditures 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 because its budget is a fixed percentage of the central government's revenues, which were reduced by the recession.

**Table 2:** Estimation of robust regression for government-owned corporations, 1975–2014.

Dependent variable: $Debt_t$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Debt_{t-1}$	0.11 (0.18)	0.14 (0.18)	0.28* (0.17)	0.29* (0.17)	0.30* (0.17)	0.23 (0.17)	0.30 (0.19)
$Debt_{t-2}$	0.23 (0.19)	0.24 (0.19)	0.28 (0.17)	0.25 (0.17)	0.27 (0.18)	0.28* (0.17)	0.26 (0.18)
$Exports_t$	-0.16** (0.08)	-0.17** (0.09)	-0.20*** (0.08)	-0.17** (0.08)	-0.16** (0.09)	-0.28*** (0.11)	-0.30*** (0.11)
$GNP_{t-1}$		0.14 (0.31)	0.36 (0.30)	0.18 (0.32)	0.20 (0.33)	0.38 (0.42)	0.42 (0.43)
$Labor_t$			-0.25*** (0.10)	-0.29*** (0.10)	-0.31*** (0.11)	-0.37*** (0.12)	-0.40*** (0.14)
$Government_t$				0.04 (0.04)	0.04 (0.04)	0.03 (0.05)	0.03 (0.05)
$Interest_t$					-0.03 (0.04)	-0.01 (0.06)	-0.009 (0.06)
$Construct_{t-1}$						0.002 (0.09)	0.02 (0.09)
$Transfers_t$							-0.07 (0.13)
$n$	36	36	36	36	36	36	36
Adjusted $Rw^2$	0.20	0.20	0.47	0.46	0.50	0.52	0.55

Observations shown are after adjustments. Debt stands for real debt, Exports for exports to GNP ratio, GNP for real GNP, Labor for manufacturing employment to civilian population 16+ ratio, Government is the government workforce, Interest is the market interest rate, Construct is the investment in the construction sector, and Transfers are the net US 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 (2017); FRED (2017).

Exports have a relatively larger relevance for explaining the debt of government-owned corporations 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 were no large differences in terms of fitness. Once again, we found deindustrialization to be the most relevant explanatory factor for the growth in the ratio of debt to GNP.

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 be argued 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 into 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 (at least in 2012).<sup>8</sup> Thus, Puerto Rico had a special absolute advantage in some manufacturing sectors: its relatively long experience in many industries, its relatively highly-trained workforce, and with the tax incentives it 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 drive Puerto Rico out of the debt trap.



From Table 1 and Table 2 we observed how the discrepancy between the coefficients of exports and employment in manufacturing had a lower magnitude for government-owned corporations than for total debt. An economic interpretation is that exports in this case were more relevant because the revenues received by some of the largest government-owned corporations were more affected by the manufacturing output than 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 triggered a bulk of calamities, including a very large migration to the US in the last five years. This resulted in more Puerto Ricans living in the US than on the Island (Carballo-Cueto 2015).

The correlations shown in Table 2 and Table 2 were found after controlling for the impact of economic growth, movements in the market interest rate, changes in the government workforce, movements in the net federal transfers, and changes in construction activity. However, there are limitations associated to the regressions: they do not consider expectations of growth variables that could affect indebtedness and they search for long-term correlations. Thus, some of these covariates deserves 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 construction wealth and, moreover, in household wealth and in the balance sheets of the remaining banks (Toro-Tulla 2013). Since, construction does not appear to be a statistically significant determinant of debt in the long run. Likewise, the proportion of government workers did not appear to hold a high correlation in explaining the debt changes over the entire 1975–2014 period, but it could have some effect on specific years. For instance, after the relatively large drop in government revenues in 2006, a rigid size in the government workforce could have exacerbated the fiscal deficit, though it would be difficult to disentangle this effect because there is no information on the expectations of future productivity.

Table 3 illustrates our robustness checks, which are consistent with our previous findings, despite the relatively low degrees of freedom. 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.

**Table 3:** Robustness revisions, 1975–2014.

Dependent variable: Debt/GNP <sub>t</sub>	OLS	Regime switching regression 1977–1994   1995–2013
Debt <sub>t-1</sub>	0.28 (0.18)	0.29** (0.13)
Debt <sub>t-2</sub>	0.10 (0.16)	
GNP <sub>t</sub>	-0.42** (0.18)	-0.15   0.49** (0.14)   (0.20)
Labor <sub>t</sub>	-0.70*** (0.23)	-0.15   -0.76*** (0.25)   (0.23)
Interest <sub>t</sub>	-0.03 (0.10)	
Construct <sub>t</sub>	0.09 (0.15)	
Transfers <sub>t</sub>	-0.14 (0.20)	
<i>n</i>	36	18   19
R <sup>2</sup>	0.49	0.50

Observations shown are after adjustments. Debt stands for real debt, Exports for exports to GNP ratio, GNP for real GNP, Labor for manufacturing employment to civilian population 16+ ratio, Government is the government workforce, Interest is the market interest rate, Construct is the investment in the construction sector, and Transfers are the net US 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 (2017) and FRED (2017).

In the regime switching regression we found, once again, similar results –reductions in exports as a percentage of GNP and in the proportion of manufacturing jobs are the most relevant explanatory factors to study debt growth, having *L* always as the greatest magnitude. The dynamics between deindustrialization and indebtedness appears to be more closely connected after 1995 when the industrial policies were changed and NAFTA was signed, this weighed upon Puerto Rico's effectiveness in attracting FDI, as explained in the first sections of this article.

## 4 Conclusions and Possible Policy Recommendations

The explanatory factors behind unsustainable debts in upper middle-income countries are understudied. 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. Thus, it was not just a failure of fiscal management, but also the miscarriage of an economic development strategy.

Some lessons from the Puerto Rico experience are meaningful to other countries. Firstly, time is of the essence in avoiding the fall into a debt trap. Countries should adopt a defensive stance in debt management and redundant tax incentives 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, Rada, and Taylor (2009), could help policymakers with countercyclical policies needed to mitigate the economic downturns without depending heavily on external financing.

Secondly, 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' debts. Similar 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.

Thirdly, it is essential to improve the quality of some macroeconomic data. Our analysis could have been complemented with the decomposition applied by Mason and Jayadev (2014), but we were unable to do so because of data limitations. Furthermore, 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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### Notes

- 1 See, for instance, several of the documents published by "Financial Oversight and Management Board" in <https://junta.pr.gov/wp-content/uploads/wpfd/50/58c1e7d75ab33.pdf>.
- 2 <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>.
- 3 This situation is related to the current situation of many Latin American countries and other jurisdictions that underwent the middle-income trap (Kharas and Kohli 2011).
- 4 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. GNP is very similar to GNI.
- 5 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.
- 6 Some of our regression tests are in Online Appendix 2 for the reviewers in the form of printouts to increase readability. However, the appendix is not intended to be published.
- 7 In general,  $e_t(\theta) = e_t = D_t - X_t'\theta$ , where  $X$  = matrix of determinants.
- 8 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>.

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**Supplemental Material:** The online version of this article offers supplementary material (<https://doi.org/10.1515/jgd-2017-0009>).