An Analytic Estimation of the Multiplier Effect of Public Consumption in the Dominican Republic: 2007-2012

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Abstract

This study estimates the multiplier effect of public consumption in the Dominican Republic via an analytic methodology that works with input-output tables using data on the years 2007-2012. This study finds that the public sector has an employment multiplier of 1.5, which means that for every 10 jobs that are created within the public sector because of public consumption, 5 jobs are created within the private sector. Also, the study finds that around 20% of imports are directly and indirectly caused by the effect of public consumption. The proportion of GDP explained by public consumption is also estimated around 20%. However, when one takes into account (and discounts) the effect that the money directed to public spending would've had if it had been spent by the private sector on consumption and investment, the impact is reduced by at least a quarter.

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*Winning proposal of the 2017 call for papers by the World Bank on fiscal reform and equitable growth. All opinions reflected within this document correspond to the author and not necessarily to World Bank or the Korean Development Institute.

†Can be contacted at e.penson.brisindi@gmail.com. All errors are my own.

Keywords: Dominican Republic, Public Consumption, Input-Output Models, Multiplier Effect.

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1 Acknowledgments

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Finally, I thank World Bank and the Korean Development Institute for promoting the study of the relationship between fiscal policy and economic growth in the Dominican Republic. The analysis of this relationship is essential for the creation and implementation of efficient public policies that promote equitable and inclusive growth.

2 Introduction

This paper estimates the multiplier effect of public consumption in the Dominican Republic via an analytic methodology that derives from the input-output framework, using available data published by the Central Bank of the Dominican Republic. This methodology facilitates the detailed estimation of the way public consumption has indirect effects on employment (directly and indirectly), private consumption, investment, imports, taxes, among other factors in each industry in the Dominican economy.

One of the main contributions of this study will be to complement the local literature on fiscal multipliers with an input-output approach, that contrasts with the usually applied models (SVAR, DSGE), and allows a more detailed analysis of results since the entire economy by keeping track of the flow of funds between industries, households, firms and the government.

The estimation of the indirect effect that government spending has on the Dominican economy allows policy makers to better understand the impact of government spending in both aggregate and industry level. This information is of vital importance for several reasons:

First, currently there's a general consensus about the need for reducing excessive public spending in the Dominican Republic, and this would have a negative impact on the economy via the multiplier effect. This methodology could allow policy makers to better anticipate and preemptively target the sectors that would be most impaired by a decrease in public consumption.

Secondly, the detailed estimation of the multiplier effect of government spending can also serve as an important new source of economic data, since it allows one to evaluate the impact of fiscal policies through the business cycle. In this way, one could better understand the relationship between fiscal policy and growth, with special attention to the distributive impact of public spending in the Dominican Republic.

Third and last, further developments of this line of work could guide the way in which the distribution of public spending, not its level, could be modified to maximize its economic impact on employment, welfare and growth.

The results of this study indicate that indeed public spending has an important

effect on economic growth and employment, but this effect is estimated to be significantly smaller when taking into account the impact that the same quantity of money would've had if it had been spent by the private sector as consumption and investment.

The rest of the paper is structured as follows: First, a brief literature review, followed by and explanation of the methodology and a description of the available data. Then, a review of the main results of the study. Lastly, concluding remarks about the study, a section outlining the references used, and an appendix that further elaborates on the way the simulations utilized in the paper work.

3 Literature Review

The concept of a fiscal multiplier goes back to the renowned economist John Maynard Keynes, who argued that in normal times an increase of public spending could "crowd out" private spending, but in some instances government stimulus induces an increase in aggregate demand, boosting income in the economy [Keynes, 1936]. This is one of the main foundations of the school of thinking that proposes that government has an active role to play in smoothing cycles in real economic activity.

Before the financial crisis most models employed to measure the effect of fiscal policy on the economy utilize either vector auto-regressions (VAR) or dynamic stochastic general equilibrium (DSGE) models [Warmedinger et al., 2015]; this type of models implicitly assume that each country has a fixed fiscal multiplier that's specific to that country and is constant through the years [Parker, 2011]. Recent studies, such as [Warmedinger et al., 2015], have reviewed modern literature on the subject and found that the size of the fiscal multiplier is not constant, but instead depends on:

1. *Composition of the Fiscal Shock:* Public consumption may induce a higher of lower response on output depending on whether its concentrated on different types of goods and services.

2. *State of Public Finances:* It's been found that when public finances are weak, fiscal consolidation (lowering of the deficit) is less damaging to the economy.

3. *Financial Frictions:* When the financial system is less developed, that capacity to smooth consumption over time is limited, leading to a higher multiplier.

4. *Rigidity in the Economy:* In the presence of rigid prices and wages, the adjustment that must happen after fiscal stimulus es greater.

5. *Monetary Policy Reaction Function:* If monetary policy is less sensitive to aggregate demand, fiscal policy should have a greater effect.

6. *Exchange Rate Regime:* When the exchange rate regime is tighter, the fiscal multiplier is greater because of the need for restrictive policies that assures parity.

7. *Openness of the Economy:* If an economy has a low degree of openness, the fiscal multiplier es greater because one cannot count on the external sector as a means of adjustment.

Adding to the issue of estimating a consistent fiscal multiplier, it appears the economic literature is far from a consensus on the average effect of public policy. A comprehensive review of the literature [Andrés and Doménech, 2013] that drew from [Gechert and Will, 2012] and [Spilimbergo et al., 2009] to consolidate 220 studies, found that the estimation of the fiscal multiplier for Europe is certainly heterogeneous; estimated fiscal multipliers range from -1.5 to 5.2.

During recent history there have been some studies on the relationship of fiscal policy and economic growth in the Dominican Republic. Through the estimation of structural vector auto-regressions (SVAR) several papers have confirmed that gross domestic product (GDP) indeed responds to fiscal stimuli and a manner congruent with Keynesian theory ([Morla, 2013], [Pérez and Ramírez, 2014]).

The estimations made in the modern Dominican literature on the effect of fiscal stimulus on the economy have mostly drawn inspiration from the seminal paper by Blanchard and Perotti, which obtained the effect of fiscal policy on the United States economy via a SVAR model that utilizes post-war era data [Blanchard and Perotti, 2002].

The traditional methodology of estimating fiscal multipliers via econometric models contrasts with the one used in this paper, that's analytic instead of econometric; the proposed model instead keeps track of the flow of funds within the economy. However, for comparison purposes the discussion of previous international and local results is relevant.

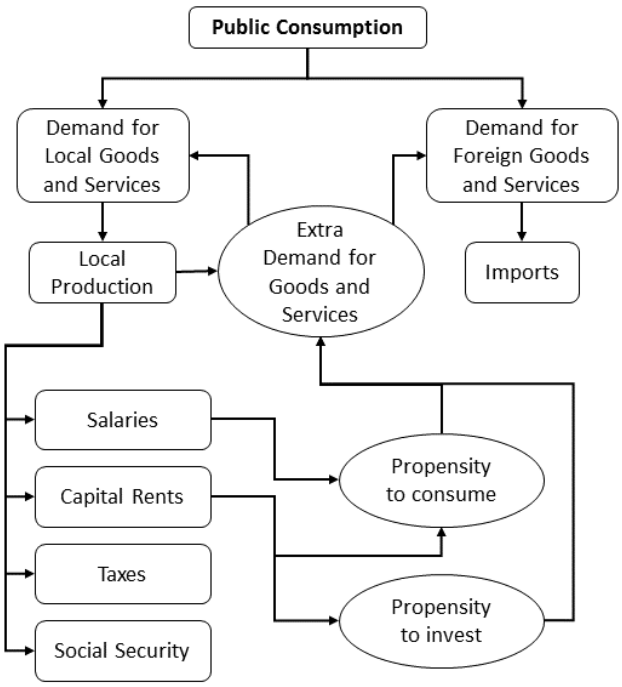
The methodology used in this study derives from the work of [Leontief, 1966] on Input-Output tables. This work suggests that the estimation of the expected increase in production due to an increase in final demand can be determined if one knows the structure of inter-linkages between industries. This methodology has applications not only to the economic field, but also to every other area of knowledge, since it can be used to describe any system of interconnected inputs and outputs with a relatively fixed structure.

4 Methodology

The methodological approach consists of simulations that replicate the way that government spending augments the demand for all the goods and services it consumes. The supply of those goods and services must augment, either via imports or local production (in most cases a mix of both). The way the public consumption shock moves through the economy can be seen on Figure 1, which illustrates the flow of funds through the economy.

When local demand for foreign products increases, this in turn generates imports, that negatively affect the current account. In the case of increasing local production, this in turn generates further demand for the goods and services consumed by the industries that supply the government; by extending this iterative analysis, one can simulate the shock through the entire value chain of the economy.

Figure 1: Flowchart of Public Consumption Shock in Economy



Source: Author's own sketching.

The methodology will also keep track of salaries, capital rents and taxes generated directly and indirectly via the increase in production in every industry affected via the value chain that starts with government spending. Through a propensity for consumption and investment of both capitalists and workers [1], these salaries and rent distribute themselves again through the economy, buying goods and services, thus furthering the iteration process, as can be seen on Figure 1.

Lastly, one can estimate the impact on the quantity of employment directly and indirectly caused by government spending, assuming that every industry has a set ratio of production per worker. For every increase in production by industry, employment would increase proportionally according to the structure of every particular industry.

Via the estimation of all the above, one could calculate in aggregate and by industry the share of jobs, salaries, rents, value added, imports and taxes that are directly and indirectly created because of government spending.

Additionally, the way the model is set up can be used to simulate the shock that would arise from an increase in private consumption and investment of a size similar to the size of public consumption. The contrast of the results of the public consumption shock and the private consumption and investment one would show the distributive impact that government has by taking money from the private sector and spending it in a different way (different structure of costs/spending) both in aggregate and industry by industry.

[1] See appendix for details on the selection criteria for these parameters.

5 Data

The primary information source of this research proposal is the Supply and Utilization Chart (COU, for its initials in Spanish) published by the Central Bank of the Dominican Republic [Central Bank of the Dominican Republic, 2014]. Currently this data is available in a yearly frequency between 2007 and 2012.

The COU allows one to visualize in a coherent way the economic structure of the Dominican Republic's economy at an industry level, taking into account exports and imports, and the way value added is divided between salaries, capital rents and taxes. This data structure has four main components:

1. *Supply:* Constitutes all the local production and imports, including taxes, margins and subsidies associated with said production and imports. This information is available by product and industry.
2. *Demand or Intermediate Consumption:* Shows all intermediate consumption made by each industry by product.
3. *Final Utilization:* Includes, by product, the consumption or final utilization made by motive of final consumption (private and public), exports (goods and services), investment and variation of inventories.
4. *Value Added:* Defines the way in which value added is distributed by industry between mainly salaries, capital rents and taxes. The number of employees by industry is also known, thus facilitating the calculation of value added per capita, a proxy for productivity.

The COU maintains equilibrium by making sure that supply always equals total demand or intermediate consumption plus final utilization. Additionally, the subtraction of supply (production or sales) minus intermediate consumption equals value added for both aggregate and industry by industry analysis.

$$Supply = Intermediate\ Consumption + Final\ Utilization \quad (1)$$

$$Supply - Intermediate\ Consumption = Value\ Added \quad (2)$$

6 Results

As seen in Table 1, public consumption is estimated to create 807,574 jobs, of which 318,160 correspond to jobs within the public sector and 489,414 to jobs in the private sector. This results in an employment multiplier of 1.54; for every job created in the public sector, at least one and a half are created in the private sector. The impact of public consumption on GDP is estimated at around US$11,891 millions, which amounts to 20% of GDP. Within this impact on value added, US$5,379 millions (8.87% of GDP) corresponds to salaries, US$1,011 millions (1.67% of GDP) to social security, US$5,377 millions (8.87% of GDP) to capital rents and US$125 millions (0.21% of GDP) to taxes net of subsidies. Finally, the impact of public consumption on imports totals US$3,078 millions, which amounts to 5.08% of GDP.

Table 1: Estimated effect of public consumption in 2012

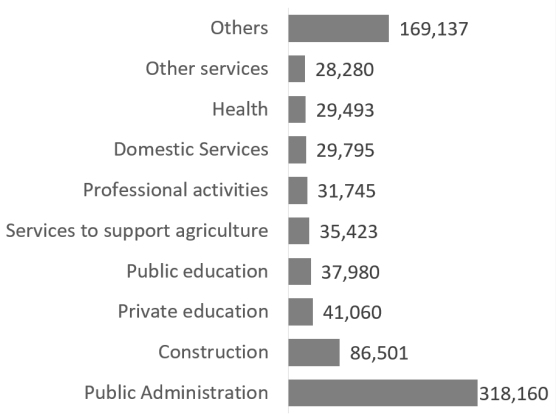
Indicator			
Jobs	**807,574**		
Public Administration	*318,160*		
Others	*489,414*		
Employment Multiplier	*1.54*		
	RD$MM	**US$MM**	**%GDP**
Value Added	**467,577**	**11,891**	**19.61%**
Salaries	**211,497**	**5,379**	**8.87%**
Public Administration	*87,895*	*2,235*	*3.69%*
Others	*123,602*	*3,143*	*5.18%*
Social Security	**39,736**	**1,011**	**1.67%**
Public Administration	*24,791*	*630*	*1.04%*
Others	*14,945*	*380*	*0.63%*
Capital Rents	**211,427**	**5,377**	**8.87%**
Public Administration	*7,807*	*199*	*0.33%*
Others	*203,620*	*5,178*	*8.54%*
Taxes (Net of Subsidies)	**4,917**	**125**	**0.21%**
Public Administration	*7*	*0*	*0.00%*
Others	*4,910*	*125*	*0.21%*
Imports	**121,010**	**3,078**	**5.08%**

Source: Simulations using Central Bank data.

6.1 Employment

As can be seen in Figure 2, most jobs are directly created within the public sector (318,160). However, a significant quantity of indirect jobs is created in the construction (86,501), private education (41,060), public education (37,980), services to support agriculture (35,423), professional activities (31,745), domestic services (29,795) and health (29,493).

Figure 2: Jobs created by public consumption in 2012
(Quantity of jobs, by industry)

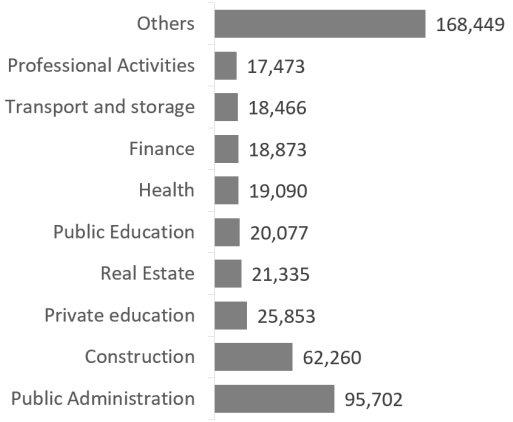


Source: Simulations using Central Bank data.

6.2 Value Added

Public consumption is estimated to have an impact on GDP that impacts, other than the public sector itself, the construction sector (RD$62,260 millions), private education (RD$25,853 millions), real estate (RD$21,335 millions), public education (RD$20,077 millions), health (RD$19,090 millions) and finance (RD$18,873 millions).

Figure 3: Value added created by public consumption in 2012
(Dominican pesos, by industry)

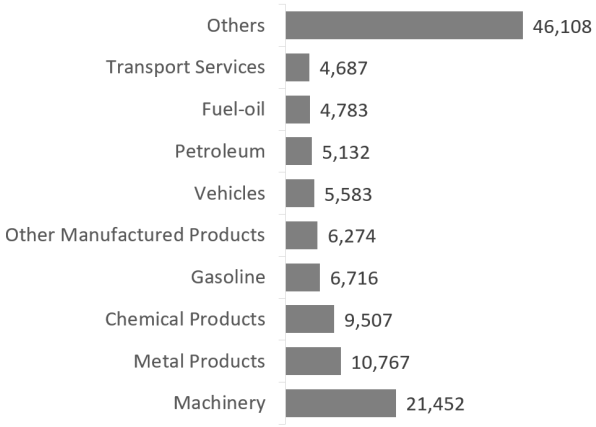


Source: Simulations using Central Bank data.

6.3 Imports

The estimated impact of public consumption on imports is RD$121,010 millions (US$3,078 millions and 5.80% of GDP), and concentrates on machinery, metal and chemical products, gasoline, other manufactured products, vehicles, petroleum, fuel-oil and transport services, as can be seen on Figure 4.

Figure 4: Imports induced by public consumption in 2012
(Dominican pesos, by product)



Source: Simulations using Central Bank data.

6.4 Sensitivity Tests

One can estimate sensitivity of the impact of public consumption on several key indicators by running the simulations utilizing the economic structure of each year and simulating what the economic impact would have been if public consumption was that of each year in the sample.

The key economic indicators selected for the sensitivity analysis were:

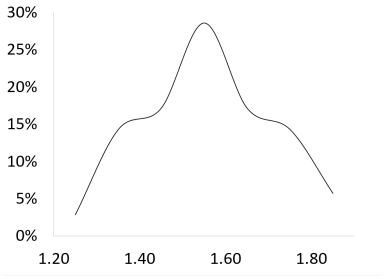
- *Employment multiplier:* The estimated quantity of jobs created indirectly in the private sector for every job that's created in the public sector as a result of public consumption.
- *Employment created over total:* The estimated quantity of jobs created directly and indirectly in the economy as a share of total labor.
- *Impact on GDP over total GDP:* The share of GDP that's estimated to have been caused directly and indirectly by public consumption.
- *Import shock over total imports:* The share of national imports that's caused by public consumption of goods and services.

Since data exists between the years 2007-2012, we have $6x6 = 36$ simulations, which we use to estimate a probability density for each shock indicator, as is shown on Figure 5.

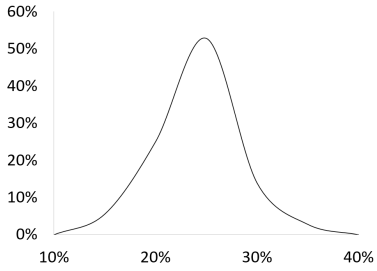
The employment multiplier mostly varies from 1.4 to 1.7, as can be seen on Figure 5. The share of employment in the economy that corresponds directly and indirectly to public consumption has a mean around 25%, and varies from 20% to 30%. The portion of GDP that is estimated to be caused directly or indirectly by public consumption varies from 19% to 21%, with a mean around 20%. Finally, the share of national imports that's explained by public consumption has a distribution that's far from normal, but has a mean around 20%.

Figure 5: Estimated probability density of public spending shock to selected indicators

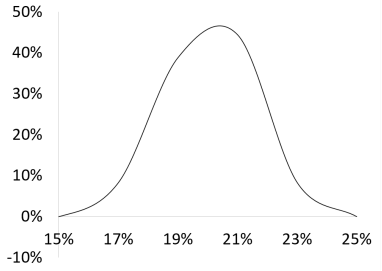
(a) Employment multiplier



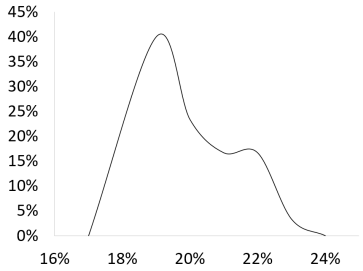
(b) Employment created over total



(c) Impact on GDP over total GDP



(d) Import shock over total imports



Source: Simulations using Central Bank data.

6.5 Substitution of Private Consumption and Investment

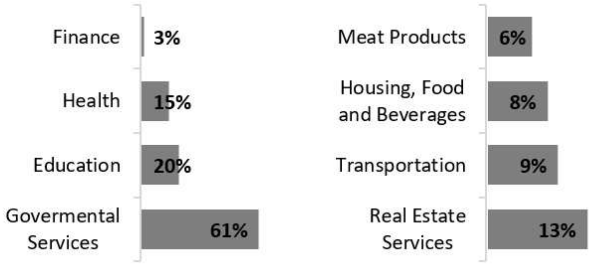
Because of the way that the model is organized, one could potentially insert a shock not only through public consumption, but also via investment and private consumption. The difference between the effect of spending the same amount of money via public consumption vs private investment and consumption shows the distributive impact that government has by taking money from the private sector and spending it in a different manner that firms and households would.

The difference between the effect of public consumption and private consumption and investment lies on the dissimilarity of the spending structure of each component. In Figure 6 we can see the top goods and services used by public consumption, public administration[2], private consumption and private investment. One can observe that public consumption is directed mainly at governmental services, which is 100% produced by the public administration sector, that then spends mainly on food (17%), professional services (17%), energy (12%) and manufactured products (10%). The structure of public spending contrasts with private investment, which mainly spends on construction (70%), and with private consumption, which concentrated on real estate services (13%), transportation(9%), housing, food and beverages (8%) and meat products (6%).

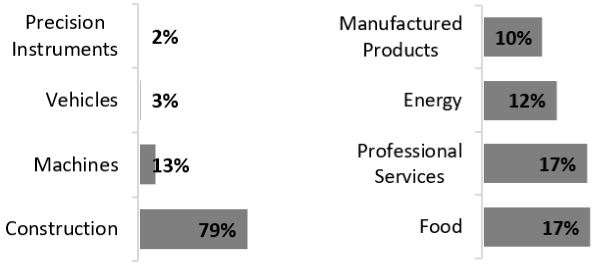
[2]We need to introduce public administration into the discussion since, because of the accounting framework that the Dominican Central Bank uses, public consumption is highly concentrated (61%) on a service called "governmental administrative services", which is 100% produced by the public administration sector.

Figure 6: Top Goods and Services Bought by Selected Industries or Sources of Spending

(a) Public Consumption (b) Private Consumption



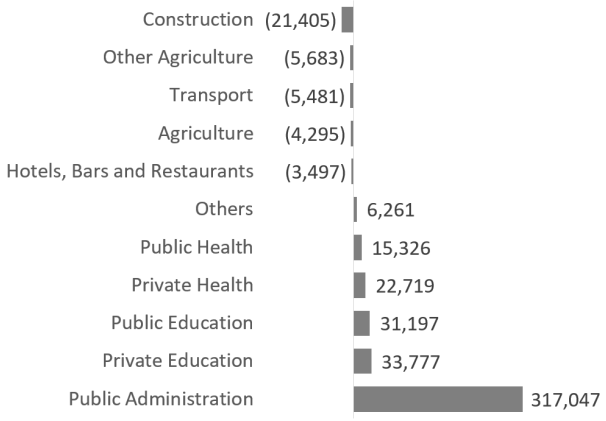
(c) Private Investment (d) Public Administration



Source: Dominican Central Bank

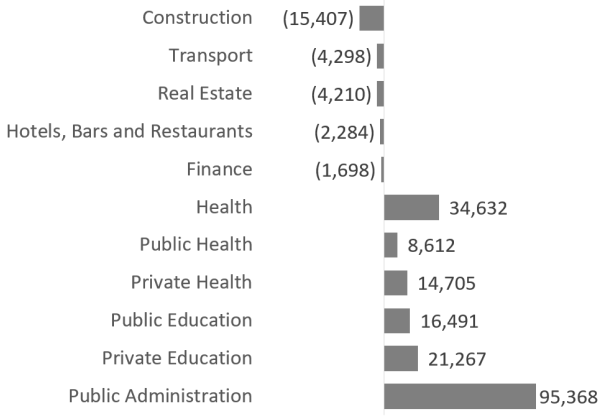
Because of the differences in the spending structure of the public sector and the private sector, the impact of the substitution of private spending in the form of consumption and investment for public spending is heterogeneous across different industries. As can be seen on Figures 7 and 8, the industries that benefit the most from public consumption (after discounting the substitution effect for private consumption and investment) are public administration itself, public and private education, public and private health, among others; the industries that lose the most value added and employment are construction, agriculture, real estate, hotels, bars and restaurants, finance, among others.

Figure 7: Jobs created by public consumption net of substituted jobs created by private sector
(Quantity of jobs, by industry, 2012)



Source: Simulations using Central Bank data.
Note: This graph shows the effect of public consumption by industry after subtracting the effect that the same amount of money would've had if it had been spent by the private sector.

Figure 8: Value added created by public consumption net of substituted value added created by private sector
(Dominican pesos, by industry, 2012)



Source: Simulations using Central Bank data.
Note: This graph shows the effect of public consumption by industry after subtracting the effect that the same amount of money would've had if it had been spent by the private sector.

7 Conclusion

The impact of public consumption on the Dominican economy is significant, both in terms of value added and employment; in addition, the indirect effect of public consumption on national imports is relatively high (20% of GDP). However, when one discounts from its impact the effect that the same amount directed towards public spending would have gone to private consumption and investment, the impact is reduced by at least a quarter.

The distributive impact of public investment is mainly directed towards the public administration sector itself, health, education, among others. The main losers from government taking taxes from the private sector and spending them in a different manner are the construction, agriculture, real estate, hotels, bars and restaurants, and finance sector.

Future studies should estimate the effect of public consumption on the Dominican economy when the Central Bank updates its input-output tables through the period 2013 to 2016, which oversaw a restructuring and consolidation of public expenditure, so as to determine the way this affected its distributive impact.

Analyzing the impact of public consumption as a contrast of the shock that would've happened if the private sector had spent the same amount on consumption and investment, though, is an incomplete endeavor. The effect of public spending can't be measured only through its effect on the value chain of the goods and services it provides, but also through the positive externalities of its services (health, education, among others). Further studies should study this effect and incorporate it into a similar model.

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8 Appendix

The mathematical formulation that best explains the logic behind the estimation of the impact of public consumption on the Dominican economy is described below. First one will review the basic input-output methodology, and then understand the basic relationships between economic variables in the proposed Dominican model.

In practice the model used for the purposes of the analysis in this paper incorporates the fact that some industries produce multiple goods and that some goods are produced by multiple industries. For simplicity, however, we will assume in this appendix that each sector produces only one good, and that each good is only produced by one sector.

8.1 Input-Output Tables

The seminal work on Input-Output tables was published by Wassily Leontief, who proposed a simple framework for understanding the interrelationships between sectors in an economy [Leontief, 1966].

The basic structure of input-output analysis rests on the definition of a matrix A that contains the information on what each industry needs of every other industry in the economy to produce one dollar of output. This matrix (known as the input-output matrix or technology matrix) takes the form shown in Equation 3, which each row totals the amount that industry i has to consume from each industry j to produce one dollar of output.

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1j} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2j} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{i1} & a_{d2} & a_{d3} & \dots & a_{ij} \end{bmatrix} \tag{3}$$

Let D be a matrix containing a demand shock, so that every variable within demands goods produced by each particular industry i, as is shown on Equation 4.

$$D = \begin{bmatrix} d_{11} \\ d_{21} \\ \vdots \\ d_{i1} \end{bmatrix} \tag{4}$$

Let X be a matrix containing the production of each industry i, as is shown on Equation 5.

$$X = \begin{bmatrix} x_{11} \\ x_{21} \\ \vdots \\ x_{i1} \end{bmatrix} \tag{5}$$

Now, we can define the multiplication of the technology matrix and the production matrix (AX) as the part of production that is use within the internal structure of the economy to satisfy inter-industry consumption. Then $X - AX = (I - A)X$ equals the part of output that's available, after discounting the consumption of every industry's output by all the others, to satisfy final or external demand D. Supposing that there's no accumulation or disaccumulation of inventories, then it must be true that:

$$(I - A)X = D \tag{6}$$

Solving Equation 6 for X we get:

$$X = (I - A)^{-1}D \tag{7}$$

From Equation 7 we get the basic principle of input-output analysis; having identified the technology matrix of an economy (or any system of interconnected inputs and output) one can easily estimate the increase in production due to an increase in final demand.

8.2 Equations in the Dominican Model

8.2.1 Supply

The total supply (S_i) of a product i will be equal to the sum of total local production (Y_i), imports (I_i), commercialization margin ($Margin_i$) and taxes (T_i) of said product, as can be seen on Equation 8. Likewise, the total supply of all products in the economy (S) is the sum of the same elements for all products, as can be seen on Equation 9.

$$S_i = Y_i + I_i + Margin_i + T_i \tag{8}$$

$$S = \sum_{i=1}^{n}(S_i) = \sum_{i=1}^{n}(Y_i + I_i + Margin_i + T_i) \tag{9}$$

8.2.2 Production

All production (Y_i) of product i is equal to the intermediate consumption (IC_i) of the industry plus the value added (VA_i), as can be seen on Equation 10.

$$Y_i = IC_i + VA_i \tag{10}$$

Then, intermediate consumption made by the sector that produces product i is the sum of the intermediate consumption of every product j that's necessary in the production process (IC_ij), as can be seen on Equation 11.

$$IC_i = \sum_{j=1}^{n} IC_{ij} \tag{11}$$

We will define parameters α_i and α_{ij}, the first being the proportion of the production value of product i that corresponds to intermediate consumption,

and the second being the proportion of intermediate consumption made to produce product i that corresponds to the acquisition of product j, as can be seen on Equation 12 and 13.

$$\alpha_i = \frac{IC_i}{Y_i} \tag{12}$$

$$\alpha_{ij} = \frac{IC_{ij}}{IC_i} \tag{13}$$

Then we multiply both factors defined in Equations 12 and 13 to get βij, which amounts to the proportion of the production value of good i that must be destined to pay for the cost of good j, which is necessary in the production process. This can be seen on Equation 14.

$$\beta ij = \alpha_i \alpha_{ij} = \frac{IC_i}{Y_i}\frac{IC_{ij}}{IC_i} = \frac{IC_{ij}}{Y_i} \tag{14}$$

We can define intermediate consumption of product j to produce product i as:

$$IC_{ij} = \beta ij * Y_i \tag{15}$$

Substituting Equation 15 on 11 we get:

$$IC_i = \sum_{j=1}^{n} (\beta ij Y_i) \tag{16}$$

Total intermediate consumption in the economy IC can be defined as the sum of intermediate consumption made to produce each product, as can be seen on Equation 17.

$$IC = \sum_{i=1}^{n} IC_i = \sum_{i=1}^{n}\sum_{j=1}^{n} (\beta ij Y_i) \tag{17}$$

8.2.3 Value Added

Value added in the production of each product i (VA_i) can be defined as the proportion of sales (defined in Equation 12) that's not a part of the cost of goods necessary, as can be seen on Equation 18.

$$VA_i = (1 - \alpha_i)Y_i \tag{18}$$

At the same time, value added totals salaries plus capital rents, as can be seen on Equation 19[3]. W_i equals the wage paid the the entire quantity of workers (L_i) involved in the production of product i. K_i is the amount of capital invested in the production of product i, and r_i is its average return.

$$VA_i = (W_i L_i) + (r_i K_i) \tag{19}$$

We can define the proportion of value added that corresponds to salaries in the production of product i as:

$$\delta_i = \frac{W_i L_i}{VA_i} \tag{20}$$

Transforming Equation 20 and substituting from Equation 18 we get:

$$W_i L_i = \delta_i VA_i = \delta_i (1 - \alpha_i) Y_i \tag{21}$$

We transform Equation 21 to obtain Equation 22, which can be used to estimate the quantity of labor that's created for every increase in the value of Y_i.

$$L_i = \frac{\delta_i (1 - \alpha_i) Y_i}{W_i} \tag{22}$$

[3]In practice there's a proportion of value added that's paid in taxes, which is accounted for in our model. However, for simplicity we have omitted that from our mathematical specification.

In a manner similar to the estimation of labor, one can estimate capital gains, as can be seen on Equation 23. However, the structure of the Supply and Utilization Chart (COU, for its initials in Spanish) published by the Central Bank of the Dominican Republic doesn't allow one to estimate the average return of capital in the economy. Because of this, it's necessary to make assumptions about an average rate of investment in the economy to estimate the impact of reinvestment of capital rents on aggregate demand.

$$r_i K_i = (1 - \delta_i) VA_i = (1 - \delta_i)(1 - \alpha_i) Y_i \tag{23}$$

8.2.4 Aggregate Demand

Let the production or sales of an industry (Y_i) be the sum of local demand (which includes government demand of local goods and services) and foreign demand (which amount to exports for the product i that is produced. This relationship can be observed in Equation 24.

$$Y_i = D_i^L + D_i^F \tag{24}$$

Local demand for product i equals the sum of all local intermediate consumption (IC_i^L) plus local private consumption (C_i^L), local government spending (G_i^L) and local investment (I_i^L), as can be seen on Equation 25.

$$D_i^L = \sum_{j=1}^{n} IC_i^L + C_i^L + G_i^L + I_i^L \tag{25}$$

8.2.5 Private Consumption and Investment

Let total private consumption (C) be equal to the propensity to consume of households (Θ_L) multiplied by total salaries plus the propensity to consume of capital owners (Θ_K) multiplied by capital rents. This relationship can be seen on Equation 26.

$$C = \Theta_L \sum_{i=1}^{n}(W_i L_i) + \Theta_K \sum_{i=1}^{n}(r_i K_i) \tag{26}$$

Substituting Equations 21 and 23 into 26 we get:

$$C = \Theta_L \sum_{i=1}^{n}(\delta_i(1-\alpha_i)Y_i) + \Theta_K \sum_{i=1}^{n}((1-\delta_i)(1-\alpha_i)Y_i) \tag{27}$$

In the case of investment, we assume a propensity to invest (μ) that transforms total capital rents into new investment, as can be seen on Equation 28.

$$I = \mu \sum_{i=1}^{n}(r_i K_i) \tag{28}$$

8.2.6 Taxes

Total taxes paid in the economy (T) equal the sum of all taxes paid by industries, households and firms:

- Taxes on salaries (ρ_L): Equal to a fixed proportion of all salaries.
- Taxes on capital rents (ρ_K): Equal to a fixed proportion of all capital rents.
- Taxes on the sale of products (ρ_Y): Equal to a fixed proportion of all sales.

$$\begin{aligned} T = \sum_{i=1}^{n} T_i = \rho_L \sum_{i=1}^{n}(W_i L_i) + \rho_K \sum_{i=1}^{n}(r_i K_i) + \rho_Y \sum_{i=1}^{n}(Y_i) \\ = \rho_L \sum_{i=1}^{n}(\delta_i(1-\alpha_i)Y_i) + \rho_K \sum_{i=1}^{n}((1-\delta_i)(1-\alpha_i)Y_i) + \rho_Y \sum_{i=1}^{n}(Y_i) \end{aligned} \tag{29}$$

8.3 Parameter Selection

Because of the way the simulations are designed in the model proposed in this study, results depend mainly on three assumptions:

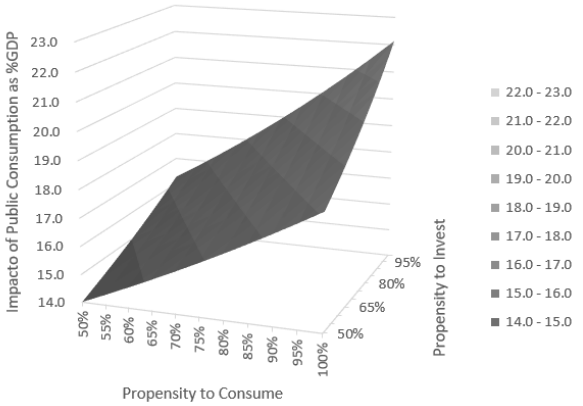
1. The size of the shock.
2. The economic structure coefficients.
3. The propensity to consume and invest.

The first parameter is easily addressed, since we are not simulating future public spending shocks, but simply using the level and structure of public spending in the past.

The second parameter is given by the actual economic structure of the Dominican Republic, as it is published by the Central Bank [4].

The third set of assumptions, the propensity to consume and invest, is a major driver of our model. Figures 9 and 10 show the impact of this assumption by calculating the GDP shock and employment multiplier for combinations of propensities to consume and invest from 50% to 100%.

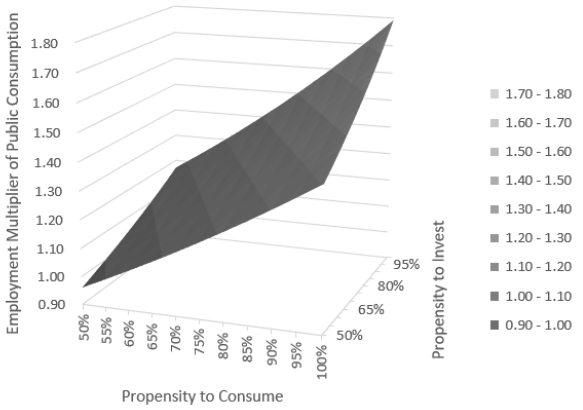
Figure 9: Estimated % GDP Shock of Public Consumption in 2012



Source: Simulations using Central Bank data.

[4]See data section for more detail on this topic

Figure 10: Estimated Employment Multiplier of Public Consumption in 2012



Source: Simulations using Central Bank data.

Having determined that the assumption of certain parameters that are indicative of the propensity to consume and the propensity to invest in the Dominican Republic is not a trivial one, this study proposes a way to estimate them.

The method for selecting parameters for the propensity to consume and invest is via an econometric approach using official macroeconomic data published by the Dominican Republic's Central Bank. Let private consumption (C_t) and investment (I_t) be a function of a constant, GDP and an error term, as can be seen on equations 30 and 31.

$$\ln C_t = \alpha_1 + \alpha_2 * \ln GDP_t + e_t \tag{30}$$

$$\ln I_t = \beta_1 + \beta_2 * \ln GDP_t + v_t \tag{31}$$

The results for the estimated equations can be seen below on Table 2. Because we have estimated the equations using variables as logarithms, we can interpret each coefficient as an elasticity. For every 1% that GDP grows, consumption augments 0.91% and investment augments 1.40%. An important result of this estimation is that firms overreact to an increase in GDP; this could be explained by an expectation that growth shocks are permanent.

Table 2: Estimated Equations for Consumption and Investment

	Consumption	**Investment**
GDP	0.91	1.40
	0.00	*0.00*
Intercept	0.44	(1.93)
	0.00	*0.00*
R2	98%	90%
Adj. R2	98%	90%
Obs.	105	105
F test	5,666	975

[1] Source: Regressions using Central Bank data via Ordinary Least Squares (OLS).

[2] Notes: Estimated coefficient values are shown next to each variable, with their associated probabilistic value (p-value) below in italics. In the second part of the table we show goodness of fit statistics and the number of observations. Consumption, investment and GDP were inserted into the regressions having been transform with a natural logarithm.

The value of the estimated propensity to re-invest (140%) could be explained by overreaction to the increase in production, expecting an even higher demand in the future. In terms of the source of the funds invested (that will be greater than the value added of firms in the period), this could be assumed to originate from loans or savings that are taken from the financial sector balance sheet.

The introduction of the consumption parameter in the model (91%) is consistent with its internal logic, but that's not the case with the investment one. Because the model is not an econometric one, but instead works analytically by keeping track of all flows, firms cannot invest more capital than they perceived via their share in value added.

As an alternative to the estimation of the re-investment parameter, one could

use the dividend ratio (dividend over earnings) of publicly traded companies as an indicator of the proportion of firms' utilities that are reinvested.

During the period covered in our simulations, European firms re-invested about 50% of earnings and US firms around 33% [Allianz Global Investors, 2013]. In the case of Latin America, a recent paper [Julian Benavides, 2016] collected consolidated data for all public firms in six countries (Argentina, Brazil, Chile, Colombia, Mexico and Peru); from this document we extracted the divided ratios shown on Table 3. We will assume for the Dominican Republic a reinvestment parameter of the average of all countries shown, which is 85%.

Table 3: Reinvestment Ratio for Public Firms in Latin America

Country	Reinvestment Ratio
Argentina	84%
Brasil	83%
Chile	86%
Colombia	86%
Mexico	91%
Peru	82%
Total	85%

Source: [Julian Benavides, 2016].