

EFFECTS OF AN EXTERNAL SHOCK ON THE ECONOMY OF BOGOTA, COLOMBIA

(PRELIMINARY VERSION)

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Abstract

We analyze the impact of the fall in international oil prices on the economy of Bogota, Colombia's capital city. After a relatively prolonged oil price and export boom, the Colombian economy is facing a rapid landing as oil prices have fallen dramatically in the last years. Even though Bogota does not export oil or hosts important oil service activities, it is clear that its economy will be shocked as national exports drop and the exchange rate appreciates, besides any input-output linkages between its economy and that of the rest of Colombia. We use a static bi-regional general equilibrium model for this purpose, featuring labor mobility between the regions, two levels of government, and public and private investment. Our results indicate that the economy of Bogotá will be negatively impacted and that the magnitude of the shock is of a similar size to that accruing to the rest of Colombia.

JEL: O19; F17; C68

Keywords: Exports, Regional economy, Regional CGE modeling, Colombia, Bogota

Introduction

From the first half of the 2000s and until 2014, the Colombian economy was under the influence of an oil and mining production and export boom that triggered the potential for Dutch Disease effects. The issue was at the center of important policy debates as the boom had the potential to induce shifts in the sectorial composition of the economy and may have had significant effects on employment dynamics and on the evolution of the employment intensity of the economy. In fact, the sectorial composition of the economy shifted in favour of mining and other services to the detriment of agriculture, manufacturing, and public services and construction between 1983 and 2010. The increase in mining production goes back to the mid-eighties but it is only at the beginning of the 2000s, after the discovery of relatively sizeable oil reserves during the mid-nineties and the increase in foreign direct investment (FDI) targeted to the sector, that oil production and exports started growing at a rapid pace.

Between 1991 and 2011, Colombian exports grew sevenfold (from 7.2 billion dollars to 56.9 billion), which is equivalent to an annual average compound growth rate of 11%. During this period, the export share of mining grew in a remarkable manner, going from 33.6% of total exports in 1991 to 71% in 2011. A breakdown of the share of mining exports by subsector shows that oil accounts for the majority throughout the 1991-2011 period. The inflow of foreign currency due to increased mining exports and incoming FDI, jointly with other foreign currency sources such as portfolio investments and remittances, had an impact on the exchange rate. The behaviour of the exchange rate and of sectorial growth until 2014, ignited a debate on the possibility that the economy was experiencing Dutch Disease effects.

In effect, while the simple annual average growth rate for the economy was 4.6% between 2003 and 2013, the corresponding figure in manufacturing was 2.9%. Aside from growing more slowly than the whole economy, manufacturing output decreased by 4.1% in 2009, 1.1% in 2012, and 1.2% in 2013. In general terms, the situation for agriculture is similar as it grew at an annual average rate of 2.2%, with moderate decreases in 2008 and 2009 and basically no growth in 2010. In contrast, mining grew at an annual rate of 5.9% and sectors readily identifiable as predominantly non-tradable, such as construction; transport and communications; commerce, hotels, and restaurants; and financial and firm services, grew at rates ranging between 7.7% and 4.9%.

Colombian value added increased (in real terms) 19.5% between 2000 and 2005, 24.8% between 2005 and 2010, and 21.7% between 2010 and 2014, while the corresponding figures for mining and

oil production were -5.5%, 39.5%, and, 26.8%. Value added in the five largest oil and mining producing regions grew on average 16.9%, 38%, and 28.6% during the same time periods, while in Bogota (Colombia's capital city) it grew 25.2%, 23.8%, and 18.8%. Therefore, there has been important variation in growth rates across regions and growth in Bogota seems to lag behind the national figures since 2005.

Examination of year on year value added growth rates shows that Bogota outperforms the rest of Colombia between 2000 and 2005, with an average difference of 1.6 percentage points, while underperforms from 2006 on, with an average difference of 0.8 percentage points. The only exceptions to this behavior are found in 2009, when the main effect of the 2008 international crisis took place, and 2014 (the year when the international oil price drop began). With the fall in oil prices the economy slowed down and total value added grew 3%, while in Bogota grew 3.9%, seemingly setting a new period in which it tends to outperform the rest of the economy.

In light of this, there is the question of whether there are real economy factors determining that, during the current low levels of international oil prices, the economy of Bogota proves more resilient than that of the rest of the economy. For this we use a multiregional general equilibrium model calibrated to a 2012 SAM that divides the economy into two regions, Bogota and the Rest of Colombia (RoC). We use the model to simulate the effects of the fall in the international price of oil between 2012 and 2015. As the economy of RoC is the lone exporter of crude oil and there are no imports of this commodity into Colombia, only the international export price of oil affecting RoC is shocked.

The paper is organized as follows. In the second section we discuss on the alternative ways for modeling shocks that only indirectly have an effect on the region of interest, as is our case. In the third section we discuss the data and our modeling approach, while in the fourth a general description of the economy of Bogota is provided. Then, in the fifth section we present and discuss the results and lastly we provide some concluding remarks.

Perspectives on regional modeling

Computable general equilibrium (CGE) models are widely used in economic analysis, particularly as a way to learn what the effects of economic and social policy and of diverse external shocks may be on the economy. The complexity of many of the shocks that are of economic interest makes CGEs

one of the best suited analysis tools for quantifying their effects on industries, regions or socioeconomic groups (Devarajan and Robinson, 2013). Due to their nature CGEs were born as national economy models, but demand from policy makers and analytical needs led to the early uprising of the regional dimension. In particular, there may be the need to assess the effects of shocks generated at the level of the national economy, of shocks specific to a region, or of shocks that differentially affect the regions of a national economy (Giesecke and Madden, 2013).

Adding a regional dimension to CGEs goes well beyond putting one more index on the equation system. It implies, for instance, considering the role of inter-regional factor mobility as it is more flexible than at the international level and so regional CGEs frequently have to properly account for inter-regional migration and capital movements. In a similar way, property over productive assets by agents outside a region can be of concern for the analysis in ways it does not reach when analyzing different countries (Giesecke and Madden, 2013). Besides, multiregional models could imply explicit consideration of distance (Isard et al, 1998) and diverse treatments of trade and transport margins, as well as of the transport sector (Haddad, 2004). The existence of different levels of government is another particularity of regional CGEs as there are taxes belonging to each level and governmental demand for goods and services for recurrent expenses and investment may be sourced from different regions.

There are three basic approaches for building regional CGEs (Giesecke and Madden, 2013). First, national economy models can be sequentially linked to regional models in a way that economy-wide results obtained from the first are transmitted to the latter; this approach is known as top-down modeling. Second, multiregional models of the national economy can be built so that the national economy is generated as the aggregation of the regions; this approach is termed as bottom-up modeling. And third, stand-alone models of a single subnational region, which seem appropriate for the analysis of local phenomena but are criticized for not taking into consideration inter-regional and nation-region feedbacks (Lofgren and Robinson, 2002).

Bottom-up modeling is currently the most popular way of working with regional CGEs when regions are relatively large (i.e. their share in national output is larger than 10%; Giesecke and Madden, 2013) or the shock analyzed is external to the region and only indirectly has an effect on it. As our problem fits both characteristics, we choose this line of modeling for our purpose.

Data and modeling approach

We built a 2012 regionalized SAM for Colombia, comprising two regions (Bogota and RoC), 13 sectors of activity,¹ two factors (labor and capital), two levels of government (regional and central) with their corresponding taxes, one household type, three sources of demand for investment (regional government, central government, and private), trade flows between the two regions, and trade flows between each region and the Rest of the World (RoW). The SAM is based on the 2012 national and regional accounts prepared by the National Statistical Office (DANE, 2015a – 2015f), a set of supply and use tables built for Bogota for 2007 (Centanaro, 2011), and on different sources of information such as the National Accounting Office (Contaduría General de la República, 2015), local governmental agencies (SDE-SHE, 2015), and several household surveys (DANE GEIH, 2012a; DANE ELPS, 2012b; DANE ENCV, 2012c).

Our modeling approach belongs to the bottom-up tradition of regional modeling in a perfect competition, static, setting. Consumer preferences are of the Stone-Geary type and goods are differentiated by region of origin (Bogota, RoC, and RoW). From the supply side, production is firstly targeted either to the export (RoW) market or to the domestic (aggregated) market and the latter is then directed either to the domestic (producing region) market or to the other's region. Both levels are modeled through CES functions while value added production is represented as a Cobb-Douglas aggregation of domestic and the other region's factors. The regions keep independent trade relationships with RoW, meaning that there are neither regional re-exports of international goods nor re-exports to Row of goods originated in the other national region. Additionally, regions are price takers in the international market.

Regions are linked through domestic trade and also through factor income transfers as their activities demand not only their own region's factors but also those belonging to the other region. Factor mobility across regions is modeled by means of a unit preserving CET function. The model identifies three governmental agents: two regional governments (Bogota and RoC) and the central government. Regional governments consume goods produced in their own regions while the central government does it from both regions, and the same happens with respect to demand for

¹ The sectorial disaggregation is as follows: Primary (agriculture and mining), Light industry (agroindustry and paper), Other industry (rest of industry), Public services (water, electricity, gas), Construction (buildings and infrastructure), Commerce (retail and wholesale), Personal services (hotels, restaurants, auto repair, education services, social services), Transport (land, air, water), Telecoms (mail, telecommunications), Finance (financial services), Real estate, Firms' services, Public administration.

investment. Activities, goods, and agents pay taxes to their own region's governments and to the central government.

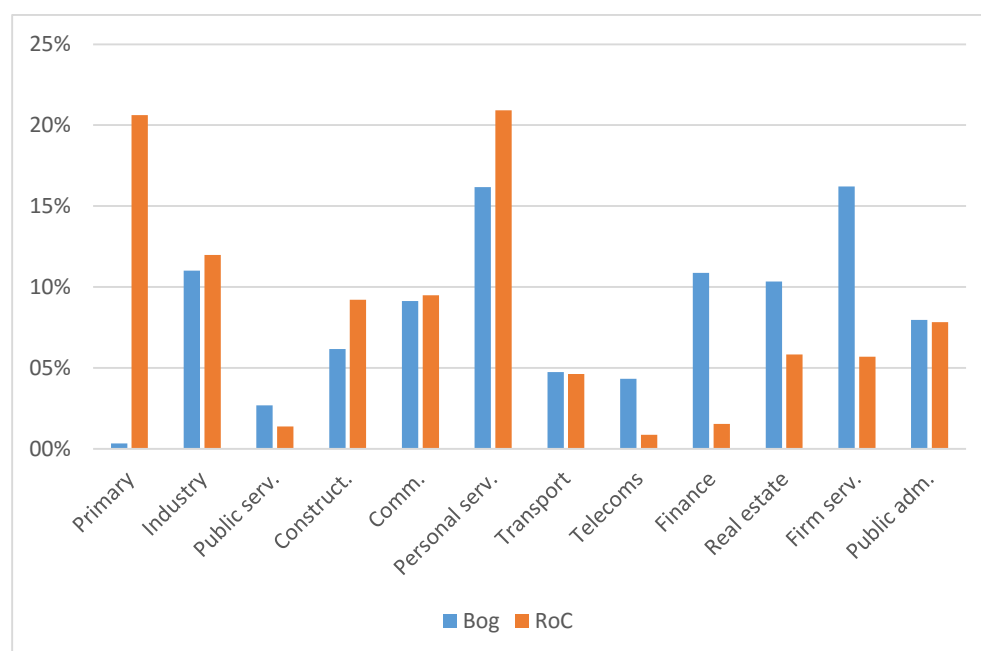
The model identifies three supra-regional accounts: RoC, the central government, and saving-investment. Therefore, the regions face the same international prices and there is a unique exchange rate that balances inflows and outflows of foreign currency. The saving-investment account is represented as a unified national agent. This implies that while it is possible to compute the balance saving-investment at the regional level, there is no way to determine how specifically this gap is filled, the options for this being savings from RoW or savings from the other region.

The economy of Bogota

Bogota's economy accounted for 26% of Colombian value added on average from 2000 to 2014, and its size with respect to RoC was equivalent to 35.2% of the latter's value added. The economy is dominated by firm and personal services, industry, financial services, and real estate services, which jointly account for 65% of value added. In terms of the sectorial composition of value added, the main differences between this economy and that of RoC are the low shares in value added of agriculture and mining and of personal services, on one side, and the high shares of telecommunication, financial, real estate, and firms' services. Figure 1 shows the sectorial shares in value added for Bogota and RoC for 2012, as implied by our SAM.

The annual average growth rate of the economy from 2001 to 2014 was 4.4%. The sectors growing above the average are, in order, commercial services, financial services, telecommunications, firms' services, and transport services, while those growing below it are industry, public services, personal services, real estate services, construction, and the primary sector. In spite of this, the composition of the economy has been relatively stable and the main changes relate to the decline in the share of industrial value added (from 13.9% to 10.7%), and the increases in the shares of commercial (from 9% to 13.1%) and financial services (from 8.6% to 11.8%).

Figure 1. Composition of value added for Bogota and Rest of Colombia, 2012



Source: 2012 SAM

Consumption accounts for 63.6% of GRP, while investment demand for 20.4%, all levels of governmental demand for 15.4%, and the trade balance for the remaining 0.6%. The economy runs a large trade surplus with RoC, equivalent to 22.4% of GRP, while holds a large trade deficit with the rest of the world (RoW), equivalent to 21.7% of GRP. Imports concentrate in other industry products, light industry products, and primary goods. The main source of other industry products is RoW while RoC is the largest supplier of primary goods and light industry products. On the side of exports, other industry products, light industry products, and financial services made up for 69% of total exports, the largest share being directed to RoC (in a proportion of nine to one on average).

Results

With the sudden and sharp fall in the international price of oil starting at the end of 2014, the sluggish international economy, and the general contraction of international trade, Colombian exports shrank dramatically. Comparing the period January-November of 2014 to the one corresponding to 2015, total exports dropped 35% in value and 11% in volume, while exports of oil and oil products dropped 51% in value and 3.4% in volume. As of 2015, the economy slowed its growth rate from 4.2% to 3% on an annualized basis and it is expect to grow at 3% in 2016, well

below the 2004-2014 average. Additionally, lower capital inflows, smaller foreign currency receipts due to lower exports, and the effects from the interest rate liftoff in the United States, have impacted the exchange rate increasing the peso value of the U.S. dollar by 31.6% between December 31st of 2014 and the same date in 2015. This has made imports more expensive, contributing to the rise of inflation that in 2015 reached 6.77%, above the Central Bank's target and 3.11 percentage points higher than in 2014.

Therefore, the Colombian economy is geared to an important adjustment process, whose characteristics are yet to be determined. We are interested in studying the effects of this process on the economy of Bogota, whose growth rate during 2015, as mentioned, outperformed that of the whole economy, raising the question as to whether there are real economy factors behind this behavior, making the city better suited for facing the adjustment process. To this end, we shock the model by changing the international price of oil in the way it has behaved between 2012 and 2015, that, according to Knoema (World Bank), dropped 50.7% (the average oil price). In the simulation, the consumer price index is the numeraire, the exchange rate is endogenous to the model (so it adjusts to clear the current account), foreign saving is exogenous, regional and central government consumption and demand for investment are exogenous, the marginal propensity to save is exogenous (making investment saving driven), and factor supplies are exogenous (so factor markets clear through prices while there is full employment). The elasticity of substitution between imported goods (from RoW) and the composite local is set to 1.5 and within the composite local good the elasticity of substitution between imports from the other region and own region's goods is set to 3. On the other hand, the elasticity of transformation between exports to RoW and national markets is set to 1.5, while the elasticity of transformation between exports to the other region a supply to the own region's market is set to 3.

Since only the economy of RoC exports oil and there are no imports of crude oil to Colombia, the shock price only affects exports to RoW from RoC. The fall in price leads to a sharp decrease in the quantity of oil exported, amounting to 60.7%, for a joint decline in quantum exported by RoC of 11.8%. This drop more than compensates the response from Bogota's exported quantum, yielding a national fall of 9.1% and a decline in foreign currency receipts due to international trade. As a consequence, the exchange rate appreciates to balance the current account and exports of other products in both regions increase while imports decrease. The nominal exchange rate increases

18.2% and the real exchange rate increases almost 20%. Table 1 reports the contribution of each product to changes in quantities exported to RoW by both regions.

Table 1. Contribution of products to changes in quantities exported

Bogota			RoC		
Product	Initial share	Contribution	Product	Initial share	Contribution
Primary	0.3%	0.3	Primary	62.3%	-37.8
Light ind.	13.3%	3.8	Light ind.	9.0%	3.5
Other ind.	42.7%	14.4	Other ind.	25.0%	20.8
Personal serv.	1.1%	0.2	Public serv.	0.6%	0.3
Transport	21.2%	5.0	Personal serv.	0.1%	0.1
Telecoms	3.8%	0.8	Transport	1.9%	0.7
Finance	1.3%	0.3	Telecoms	0.3%	0.1
Firm serv.	16.2%	4.3	Finance	0.1%	0.0
			Firm serv.	0.7%	0.5
Total		29.3	Total		-11.8

Source: CGE simulation

As implied above, the contribution of the drop in oil exports from RoC is large and leads to an overall decline in quantum exported, while exports of other industry products contribute the most, in both regions, to the positive response of exports. The relative size of quantum changes in Bogota leads to an increase in the share of other industry products from 42.7% to 44.2%, while the shares corresponding to the rest of products show moderate changes. On the other hand, for RoC the share of oil exports drops from 62.3% to 27.8%, while the shares of light industry and other industry products increase from 9% to 14.1% and from 25% to 51.9%, respectively (other products show small changes as their shares are marginal).

As mentioned, the quantum of imported goods decreases. It does so for all goods and both regions as reported in Table 2 in the form of the contributions of each product to regional changes. In general, imports decrease 10% in Bogota and light industry and other industry products are the largest contributors to this behavior (all entries shown as zero percent are in actuality negative but of a very small magnitude). In the case of RoC, again, imports of all products decrease and the more important determinants of this drop are light industry and other industry products, finance, and firm services. Even though the decrease in imports across products is uneven, this has no effects on the composition of imports for neither region as all share changes are relatively moderate. However, it should be noticed that the decrease in imports is larger for RoC (14.1%).

Table 2. Contribution of products to changes in quantities imported

Bogota			RoC		
Product	Initial share	Contribution	Product	Initial share	Contribution
Primary	4.1%	-0.4	Primary	4.9%	-0.1
Light ind.	17.0%	-2.5	Light ind.	13.0%	-2.8
Other ind.	76.3%	-6.6	Other ind.	70.5%	-8.5
Personal serv.	0.0%	0.0	Public serv.	0.2%	0.0
Transport	2.6%	-0.5	Personal serv.	0.3%	-0.1
Finance	0.0%	0.0	Transport	1.0%	-0.3
Firm serv.	0.0%	0.0	Telecoms	0.6%	-0.2
			Finance	4.6%	-1.0
			Firm serv.	5.0%	-1.1
Total		-10.0	Total		-14.1

Source: CGE simulation

As the appreciation of the exchange rate makes imports more expensive, relative prices shift in favor of domestic production. Table 3 reports the percentage changes in demand for the domestic composite good for both regions, from there it can be appreciated that while for RoC demand increases in eleven cases (it decreases for light industry products and telecommunications), for Bogota the results are mixed. There are increases for light industry and other industry products, construction, commercial services, transport, and firm services, and there are decreases for primary goods, public services, personal services, telecommunications, financial services, and real estate.

Table 3. Percentage changes in quantities demanded from domestic regions

Bogota			RoC		
Product	Initial share	Variation	Product	Initial share	Variation
Primary	2.5%	-2.0%	Primary	8.6%	3.7%
Light ind.	7.0%	3.1%	Light ind.	12.5%	-0.9%
Other ind.	7.5%	15.8%	Other ind.	10.6%	19.3%
Public serv.	3.1%	-0.4%	Public serv.	4.1%	4.5%
Construct.	7.8%	1.2%	Construct.	11.2%	1.1%
Comm.	11.4%	3.9%	Comm.	7.3%	3.9%
Personal serv.	17.5%	-0.8%	Personal serv.	17.6%	0.1%
Transport	5.9%	1.3%	Transport	6.0%	0.6%
Telecoms	3.7%	-1.1%	Telecoms	2.0%	-0.9%
Finance	7.2%	-0.3%	Finance	3.5%	4.1%
Real estate	7.8%	0.0%	Real estate	4.6%	0.4%
Firm serv.	9.7%	0.2%	Firm serv.	6.5%	10.2%
Public adm.	9.0%	0.0%	Public adm.	5.4%	0.0%

Source: CGE simulation

Therefore, there is considerable asymmetry between the two regions in this respect and its source has to be traced to the behavior of exports to RoW. Concentrating first in the case of Bogota, we

have that as quantities exported increase, quantities destined to the national market decrease, except for primary products and other industry, and, within the latter, quantities exported to RoW tend to decrease (again with the exceptions of primary products and other industry) and quantities destined to the own region's market mostly increase. In the case of RoC the picture is more straightforward: for goods other than primary products, the increase in quantities exported to RoW is paired with an increase of lesser magnitude of quantities destined to the national market and within the latter exports to Bogota grow faster than supplies to RoC's market. In all, quantities of composite goods destined to the domestic market decrease 0.3% for Bogota and increase 1.9% for RoC.

Viewed from the supply side, the increase in quantities exported by Bogota leads to a decrease in quantities targeted to the national market and this further translates in increases in quantities supplied to its own market, at the expense of exports to RoC. In the case of RoC, the increase in quantities exported to RoW is paired with an increase in quantities destined to the national market in such a way that both exports to Bogota and supplies to its own market increase. As a consequence, output of the economy of Bogota increases 0.5% while that of RoC increases 3.7%.

The price of the composite good demanded by agents in each region rises for all goods in Bogota, by an average 3% (ranging from 8.9% to 0.1%), while in the case of RoC falls by an average 3.1% (ranging from -5.9% to -0.3%), even though it increases for primary goods (13.8%). Hence, nominal GDP at market prices decreases 0.4% for Bogota and 5.4% for RoC. However, the behavior of the regional consumer price index varies between regions, increasing 3.9% in Bogotá and decreasing 1.3% in RoC, so in real terms both regions decrease 0.04%.

Concluding remarks

We assessed the impact of the decline in international oil prices on the economy of Bogota, Colombia's capital city. The results from the analysis show that even though in nominal terms there is ground for ascertaining that this economy is better suited than that of RoC for facing this external shock, in real terms there is no difference in the impact on both regions. The dynamics of the adjustment process can be briefly described as follows.

The fall in oil prices generates a fall in export revenue and the national economy adjusts by appreciating the exchange rate. This leads to an increase in exports other than oil in both regions

and to a decrease in the quantity of products that Bogota allocates to the national market with products destined to its own market substituting for exports to RoC. In contrast, the allocation of products from RoC to the national market also increases with both exports to Bogota and supplies to its own market increasing, the former growing in a more dynamic way. The force behind this behavior is falling relative prices for RoC's goods vis a vis goods produced in Bogota.

Viewed from the demand side, the decline in imports from RoW in Bogota does not translate in a systematic manner in an increase in demand for national composite goods. However, as imports from RoC increase, they tend to substitute for domestic production allocated to its own market. On the contrary, the decrease in exports from RoW makes RoC's demand for national composite goods increase and leads to domestic production supplied to the domestic market to substitute for imports from Bogota.

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