Dutch Disease Exchange Rate Incidence over Profits of Traded and Nontraded Goods

Eduardo Sarmiento G.
Martha López

Abstract

Oil prices hikes since 2004 caused a natural resource windfall in the Colombian economy like in many other developed and developing countries. This paper finds strong empirical support of a positive and negative relation between the real exchange rate and the profits of the traded and nontraded sectors, respectively. Moreover, the effect on the manufacturing sector shows a deindustrialization in the Colombian economy due to the shock in oil prices. Compared by size, smaller firms are more vulnerable to exchange rate appreciation. We discuss the role of fiscal policy in addressing the Dutch disease.

Keywords: Dutch disease; traded and nontraded goods profits; real exchange rate; booming sector.

JEL classification: C1, F20, F41, F43, O1, O4, O5, Q0, O2.

Eduardo Sarmiento G. <eduardo.sarmientog@escuelaing.edu.co>, Escuela Colombiana de Ingeniería, y Martha López <mlopezpi@banrep.gov.co>, Banco de la República, Colombia. Authors thank Peter Ireland and two anonymous referees for very helpful comments; as well as, Carlos Murcia for very helpful collaboration.

1. INTRODUCTION

The increase in global oil prices since 2004 led to a booming oil sector in the Colombian economy, which in turn resulted in the appreciation of the exchange rate until 2012, and a Dutch disease over the profits of traded and nontraded goods. This process led to increased specialization in the resource and nontraded sectors leaving the economy more vulnerable to resource-specific shocks. The main goal of our article is to present empirical evidence of Dutch disease in the Colombian economy based on a theoretical framework that takes into account the transmission mechanism through profits. We use microdata of 3,385 Colombian firms with a methodology that is innovative in the empirical literature.

In the theoretical framework developed in this article, we consider traded and nontraded goods, the prices of traded goods that equal the exchange rate, and the prices of nontraded goods that depend on the exchange rate, wages, and monetary policy. This corresponds to an economy with nominal wages that are exogenous, varying in real terms depending on price adjustment. The model considers the dynamics of profits in traded goods (agriculture and manufacturing) and nontraded goods (construction and services) as a result of the expansion of the booming mining sector, that corresponds to traded goods.

When the exchange rate depreciates, the prices of traded goods increase more than the prices of nontraded goods, wages remain fixed; and the profits of traded goods rise, simultaneously the profits of nontraded goods go down. Conversely, when the exchange rate appreciates, the prices of traded goods decrease more than the prices of nontraded goods, wages remain fixed; and the profits of traded goods fall in tandem with an increase in the profits of nontraded goods. The decline in traded goods profits and improvement in nontraded goods profits has, respectively, negative and positive incidence over the sectors' growth.

In the theoretical literature, Corden and Neary (1982) considered a neoclassical framework in which the Dutch disease results from a booming sector that causes a resource movement effect and a spending effect. The resource movement effect results from the booming sector that draws factors from other sectors, causing a reduction in the production of nontraded and nonbooming traded goods. The spending effect results from an increase in income of the booming mining sector that appreciates the exchange rate, raising the production of nontraded goods and reducing the production of nonbooming traded goods. If the nontraded goods are labor intensive with respect to the nonbooming traded goods, the resource movement effect and the spending effect cause an increase in wages and a reduction in the rental of capital.

If traded goods prices remained fixed in the model of the theoretical framework developed in our article, as in Corden and Neary, the booming sector that causes the Dutch disease, and the exogenous increase in nominal wages due to inertia,[1] would result also in an increase in the prices of nontraded goods, but lower than the one in wages. This is equivalent, in terms of relative prices, to a fall in traded goods prices greater than the decrease in nontraded goods prices, and fixed wages. Besides, the implications of our results in terms of the Dutch disease are similar to those of Corden and Neary.

Regarding the empirical literature that supports the evidence on macroeconomic impact of Dutch disease, this has been mainly related to the *natural resource curse*. The influential studies by Sachs and Warner (1995, 2001) are representative of a stream of literature that finds that natural resource abundance has a strong negative impact on growth. With a cross-country growth equation based on Barro (1991), Sachs

[1] In an inflationary economy the booming sector, holding traded goods prices fixed, results in an increase in wages greater than nontraded goods prices. In this case, the appreciation of the exchange rate reduces inflation, with an increase in prices that results only from the adjustment of wages and monetary policy.

and Warner (1995) show regression evidence that the resource intensive economies did indeed have slower growth in manufacturing exports, after holding constant the initial share of manufacturing in total exports. In addition, their results show that resource-intensive economies had a higher ratio in output of services to output of manufactures. Moreover, these authors provide evidence that a crowding-out logic explains the curse.

In Sachs and Warner (2001) the positive wealth shocks from the natural resource sector cause excess demand for nontraded goods, increasing their prices, and also nontraded input costs and wages. This squeezes profits in traded activities such as manufacturing that use nontraded products as inputs and sell their products on international markets at fixed foreign prices. The decline in manufacturing then reduces growth. Their empirical evidence shows first that the natural resource intensive economies indeed tend to have higher price level, and second that this lower competitiveness impeded export growth and that, therefore, resource-abundant countries never successfully pursued export-led growth.

Sala-i-Martin and Subramanian (2003) also address the question if natural resources such as oil and minerals may or not be a curse on balance. They examine the case of oil discoveries in Nigeria between 1965 and 2000 and relate those to economic growth during this period. Their main finding is that the oil revenues did not add to the standard of living. The main explanation given to stunted institutional development (corruption, rent seeking and weak governance among others). In addition, they do not find strong evidence of Dutch disease.

Much stronger evidence of Dutch disease is presented by Ismail (2010) whose study for oil-exporting countries during the period 1977 to 2004 shows that permanent increases in oil price negatively impact output in manufacturing and that oil windfall shocks have a stronger impact in countries with more open capital markets to foreign investment (like Colombia). Ismail develops a static model that focuses on two

structural aspects, relative factor intensities of the sectors and the mobility of factors across countries (capital mobility), and estimates the model using cross-sectional reduced form estimation of the effect of permanent oil price shocks on the industries across countries.

Finally, with respect to the relation between exchange rate overvaluation and growth, there is empirical evidence that suggests that substantial exchange rate overvaluation has a strong negative impact on growth (Brahmbhatt, Canuto and Vostroknutova, 2010). This evidence is relevant to the extent that the real exchange rate overshoots, for example, if agents overestimate mistakenly the permanence of a terms-of-trade improvement.

However, it must be considered that not always natural resources are a curse (Van der Ploeg, 2011). This can sometimes result in a blessing. The volatility in some countries determines the result. For example as documented by Sala-i-Martin and Subramanian (2003) the case of Nigeria is the most representative of the curse, as mentioned before. Other countries like Iran, Venezuela, Libya, and Iraq also present deindustrialization and a declining GDP per capita. Meanwhile, the case of Botswana and Norway is a successful story. Botswana has the second highest public expenditure in education as a share of GDP and enjoys the world's highest growth rate since 1965. Norway has shown remarkable growth of manufacturing and the rest of the economy compared with its neighbors. Van der Ploeg provides evidence that the result depends on the severity of volatility of countries in terms of the quality of institutions and lack of rule of law, corruption, presidential democracies, and underdeveloped financial systems. For example, the author points out that:

> The political economy of massive resources rents combined with badly defined property rights, imperfect markets, and poorly functioning legal systems provide ideal opportunities for rent seeking behavior of producers, thus diverting resources away from more productive activities (pp. 388).

The evidence described before is related mainly to economic growth. However, the evidence of Dutch disease is scant. In this paper, we present empirical evidence of Dutch disease for Colombia, a country that like other small open economies was affected by the hikes in oil prices since 2004. Based on an accounting framework the article considers the exchange rate incidence over profits of traded and nontraded goods. As mentioned before, we use information on a panel of 3,385 Colombian firms during the period 2002-2014. To our knowledge, this is the first time that such empirical study, based on profit-by-profit information of a panel of firms relating real exchange rate and actual behavior of profits is being carried out.

Griffin (2015) used a similar approach, but studied only the manufacturing sector. Because we distinguish further between traded and nontraded sectors, we get more results that provide sharper tests of the theory.

In the document, firms' profits for traded and nontraded goods are determined by the exchange rate, domestic output growth, and leverage. In the case of traded goods, we also consider the incidence of trade partners' output growth. In our results, as expected, the exchange rate appreciation incidence over profits is to reduce the ones of traded goods and increase the ones of nontraded goods. Meanwhile, profits relate positively with the output growth and negatively with the leverage.

In addition, the incidence of the import component over profits is considered for the manufacturing sector. Finally, the regressions consider interactions that take into account the size of the firms, and the result is that the effect of the exchange rate over profits is higher the smaller the firms are.

The rest of the paper is organized as follows. The second Section corresponds to the theoretical framework. The third Section presents a brief discussion about Dutch disease and fiscal policy in Colombia. The fourth Section describes the incidence of the exchange rate over profits by means of a regression analysis with ordinary least squares (OLS) and Arellano-Bond

panel methods. Finally, the last Section corresponds to the conclusions.

2. THEORETICAL FRAMEWORK

In this Section, a simple model is developed to shed light on the key relation between profits and real exchange rate at the firm level.

The article considers the exchange rate incidence over firms' profits, assuming traded goods prices equal the exchange rate; nontraded goods prices are determined by the exchange rate, wages and money supply; and quantities remain fixed. In the incidence over profits the nominal exchange rate varies, meanwhile wages and money supply are constant.

Firms' profits equal revenue minus costs. Revenue depends on sales, meanwhile costs result from wages, and traded and nontraded inputs. Real profits are shown in Equations 1 and 2, and are assumed positive before the exchange rate shock.

1 $$\pi_T = \frac{(P_T q_T - wL_T - P_T i_{TT} q_T - P_N(P_T, w, M) i_{TN} q_T)}{\propto_N P_N(P_T, w, M) + \propto_T P_T},$$

2 $$\pi_N = \frac{(P_N(P_T, w, M) q_N - wL_N - P_T i_{NT} q_N - P_N(P_T, w, M) i_{NN} q_N)}{\propto_N P_N(P_T, w, M) + \propto_T P_T},$$

3 $$P_N(P_T, w, M) = \rho_1 P_T + \rho_2 w + \rho_3 M,$$

$$\propto_N + \propto_T = 1, \quad 0 \leq \rho_1 \leq 1,$$

where π_T is traded goods profits; π_N, nontraded goods profits; P_T, traded goods price; P_N, nontraded goods price; w, wages; M, money supply; q_T, quantity of traded goods; q_N, quantity of nontraded goods; L_T, employment of traded goods firm; L_N, employment of nontraded goods firm; $\propto_N$, and $\propto_T$ are the proportion in general prices of nontraded and traded goods, respectively; and i_{TT}, i_{NT}, i_{TN}, and i_{NN} are the proportion in output of traded and nontraded inputs.

For both traded and nontraded goods, we consider the incidence of the exchange rate over profits. The parameter ρ_1 is the main incidence determinant. With a smaller value of ρ_1, the increase in traded goods profits and as well the fall in nontraded goods profits is stronger when the exchange rate depreciates (Equations 4 and 5).[2]

At the same time, the higher the increase in the value of sales, the stronger the positive effect of the exchange rate on traded goods profits, and the higher the increase in the costs of domestic inputs and of the general prices the lower the impact of the exchange rate over profits.

By the same token, the higher the increase in the price of inputs and of the general prices, the stronger the negative incidence of the exchange rate over nontraded goods profits; however, this can be compensated partially or totally by the increase in the value of sales when nontraded prices become higher.

$$\frac{\partial \pi_T}{\partial P_T} = \frac{(1-i_{TT})q_T - \rho_1 i_{TN} q_T}{\propto_N P_N(P_T,w,M) + \propto_T P_T} - \frac{\pi_T(\propto_N \rho_1 + \propto_T)}{\propto_N P_N(P_T,w,M) + \propto_T P_T}, \quad (4)$$

$$\frac{\partial \pi_N}{\partial P_T} = \frac{\rho_1(1-i_{NN})q_N - i_{NT} q_N}{\propto_N P_N(P_T,w,M) + \propto_T P_T} - \frac{\pi_N(\propto_N \rho_1 + \propto_T)}{\propto_N P_N(P_T,w,M) + \propto_T P_T}, \quad (5)$$

$\frac{\partial \pi_T}{\partial P_T} > 0$ when:

$$\frac{\left((1-i_{TT}) - \rho_1 i_{TN}\right)q_T}{\propto_N \rho_1 + \propto_T} > \pi_T,$$

$\frac{\partial \pi_N}{\partial P_T} < 0$ when:

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[2] The incidence of ρ_1 over nontraded goods applies since:

$$(1-i_{NN}q_N) > \frac{(1-i_{NN}q_N) - \frac{wL_N}{P_N(P_T,w,M)} - \frac{P_T i_{NT} q_N}{P_N(P_T,w,M)}}{1 + \frac{(\alpha_T/\alpha_N)P_T}{P_N(P_T,w,M)}}.$$

$$\frac{(\rho_1(1-i_{NN})-i_{NT})q_N}{\propto_N \rho_1+\propto_T} < \pi_N .$$

In one extreme, when $\rho_1 = 1$, and $\rho_2 = \rho_3 = 0$, the prices of nontraded goods equal P_T and a depreciation increases both the profits of traded and nontraded goods in the amount that real wages decrease (Equation 6).

6 $$\frac{\partial \pi_T}{\partial P_T} = \left(\frac{w}{P_T^2}\right) L_T; \quad \frac{\partial \pi_N}{\partial P_T} = \left(\frac{w}{P_T^2}\right) L_N .$$

In the other extreme, when $\rho_1 = 0$ the nontraded prices do not depend on the exchange rate, the depreciation incidence over traded goods profits is the highest possible and over nontraded goods is the lowest possible. The traded goods profits increase because of higher sales prices, which are only partially compensated by traded input costs and the increase in the general price level, with sign unambiguously positive (Equation 7). In nontraded goods, profits decrease because of the increase in traded inputs price and in the general prices, and the sign is unambiguously negative (Equation 8).

7 $$\frac{\partial \pi_T}{\partial P_T} = \frac{(1-i_{TT})q_T}{\propto_N P_N(w,M)+\propto_T P_T} - \frac{\pi_T \propto_T}{\propto_N P_N(w,M)+\propto_T P_T} =$$

$$= \frac{\propto_N P_N(w,M)\left((1-i_{TT})q_T\right)+\propto_T wL_T+\propto_T P_N(w,M) i_{TN} q_T}{\left(\propto_N P_N(w,M)+\propto_T P_T\right)^2},$$

$$\frac{\partial \pi_T}{\partial P_T} > 0.$$

8 $$\frac{\partial \pi_N}{\partial P_T} = \frac{-i_{NT} q_N}{\propto_N P_N(w,M)+\propto_T P_T} - \frac{\pi_N \propto_T}{\propto_N P_N(w,M)+\propto_T P_T} =$$

$$= \frac{-\propto_N P_N(w,M) i_{NT} q_N - \propto_T P_N(w,M) q_N + \propto_T wL_N + \propto_T P_N(w,M) i_{NN} q_N}{\left(\propto_N P_N(w,M)+\propto_T P_T\right)^2},$$

$$\frac{\partial \pi_N}{\partial P_T} < 0.$$

Although the above equations do not show changes in quantities, the maximizing behavior of firms adjusts production, inputs, exports, and imports to obtain the highest possible profits. This reduces the profits fluctuations caused by the exchange rate. Although this behavior reduces fluctuations, the incidence of an appreciation on profits is expected to be negative over traded goods and positive over nontraded goods.

3. DUTCH DISEASE AND FISCAL POLICY IN COLOMBIA

3.1 Stylized Facts

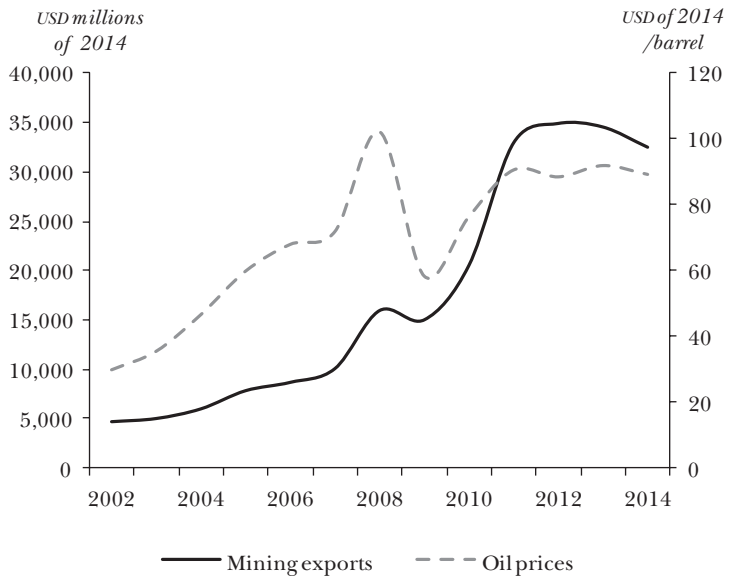
As mentioned before, the global increase in oil prices since 2004 caused considerable fluctuations in the behavior of traded sectors (agriculture, manufacturing and mining) and nontraded sectors (construction and services) in Colombia. The mining sector expansion caused by the foreign exogenous shock resulted in a Dutch disease that was characterized by an increase in profits of the nontraded sectors and a fall in profits in the nonbooming traded sectors.

In traded and nontraded goods models the exchange rate depreciation or appreciation has incidence over relative prices and production (Obstfeld and Rogoff, 1996). The traded and nontraded goods framework is usually considered to analyze the Dutch disease, as is the case in this article. This framework is used to analyze the Colombian case during 2002-2014.

The oil price reached a value of 89 USD per barrel in 2014; meanwhile, the growth of mining exports in Colombia was considerable: 2004 (19.8%), 2005 (31.1%), 2006 (10.9%), 2007 (16.2%), 2008 (58.9%), 2010 (37.0%) and 2011 (60.7%) (Figure 1). The increase in global oil prices since 2004 caused the mining boom in the economy and appreciated the exchange rate until 2012. Although the appreciation stopped in 2013 and

Figure 1

MINING EXPORTS AND OIL PRICES



Source: DANE and Illinois Crude.

2014, during both years the exchange rate level remained appreciated with respect to 2002 and 2003 (Figure 2).[3]

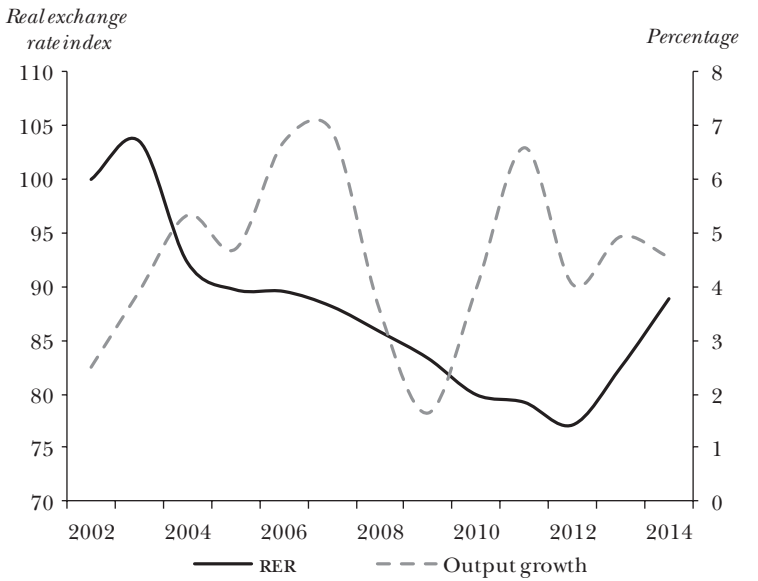
Although the Colombian economy grew well since 2004, this economic growth was unbalanced towards a higher increase in mining and nontraded goods. In consequence, the sectors with smaller growth were agriculture and manufacturing. The growth of the economy reached high rates since 2004 until 2014, with a decline only in 2008 and 2009 due to the international financial crisis (Figure 2).

Since 2004, there was an appreciation of the exchange rate, which implied an increase in relative prices of nontraded goods

[3] The exchange rate is considered in terms of producer prices. The appreciation considered varies in terms of producer prices from 100 in 2002 to 88.9 in 2014, and in terms of consumer prices, respectively, from 100 to 73.7.

Figure 2

REAL EXCHANGE RATE AND OUTPUT GROWTH



Source: Banco de la República and DANE.

with respect to nonbooming traded goods. Meanwhile, the increase in minimum wages, which are set in Colombia by the agreement between the government and the workers, was close to the increase in productivity. During 2004-2014, the minimum wage mean growth was 1.5% and the per capita income mean growth was 3 percent.

During 2002-2014 there was a reduction of unemployment from 15.6% to 9.1%. The adjustment of wages during the period, although lower than per capita income, was higher than nominal devaluation, which in addition to the currency expansion and low interest rates caused an inflation that appreciated the real exchange.

The nominal and real exchange rate appreciation of the Colombian peso has been mainly explained by the direct effect of

the increase in terms of trade. However, the permanent character of the capital inflows in Colombia, which had an important long-term component, played an important role in the appreciation of the currency.

The Colombian economy experienced a growing current account deficit and, at the same time, a surge in capital inflows since 2004. The financing of the current account deficit during 2002-2014 relied upon foreign direct investment (FDI) net inflows, even though foreign indebtedness was still an important source. The importance of FDI as a source of funding of the growing current account deficit of the Colombian economy is noticeable also when it is compared with other countries in the region as pointed out by Vargas and Varela (2008):

> At the beginning of the decade FDI represented 2.9% of GDP, one of the lowest among the largest Latin American economies. Between 2004 and 2006, FDI in Colombia surged and reached ratios of GDP among the highest in the region (around 6% of GDP) (p. 3).

Foreign direct investment in the oil and mining sectors as a share of total FDI went from 19.6% in the 1990s to 41.0% in 2008. This was related mainly to the increase of the international prices of these commodities, and the more favorable contractual conditions for foreign firms.

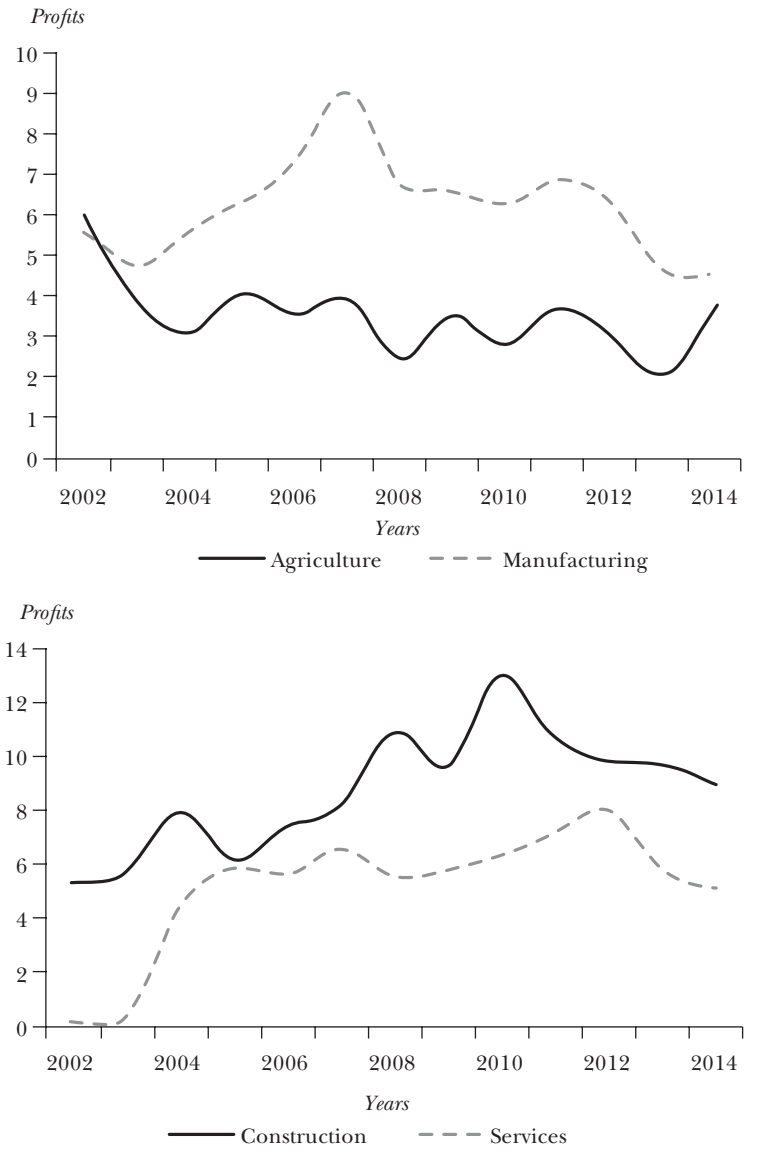
On the side of the public debt inflows, these increased since 2000-2004, but they were reduced after 2004 within a strategy of decreasing the foreign exchange exposure of the public sector and in coordination with the Central Bank to avoid the continuous appreciation of the exchange rate caused by the capital inflows.

Another factor that contributed to the appreciation of the exchange rate was the declining trend of the country risk premia (EMBI). This was an important factor given that between 2004 and 2008 the US short-term interest rates were increasing relative to domestic rates.

Finally, during 2004-2014, consumption –in terms of aggregate demand households– grew at similar rates as product;

Figure 3

SECTOR PROFITS



Source: Superintendencia de Sociedades.

public consumption grew at higher rates; and total investment increased at very high rates. The increasing households and public demand contributed to the appreciation of the exchange rate.

The appreciation of the currency since 2004 caused a Dutch disease during 2004-2014, with an increase in the profits of nontraded goods and a fall in profits of nonbooming traded goods. The Dutch disease originated a squeeze in profits of agriculture (measured as return on equity, ROE) during 2003-2014 and in profits of manufacturing from 2008 to 2014.[4] Simultaneously, the profits of construction and services had a strong positive trend for the same period (Figure 3).

3.2 Fiscal Policy

One of the policy responses addressed in the literature to curve the Dutch disease is related to the role of fiscal policy. As pointed out by Brahmbhatt, Canuto, and Vostroknutova (2010), fiscal policy is the main instrument for dealing with the negative impact of Dutch disease because it is a tool that can make the increase in wealth permanent. It can constrain the spending effect and can smooth expenditures to reduce volatility, particularly in a country with a large share of non-Ricardian agents like Colombia.[5] The smoothing is achieved through the introduction of fiscal rules and the detachment of spending from the resource revenues.

There is empirical evidence that government spending is correlated with the increase in resource revenues. In the case of Colombia, government's oil revenues from Ecopetrol (the largest oil company in the country) increased from 0.4% of GDP in 2002 to 1.9% of GDP in 2013. At the same time, government total spending increased from 16.4% of GDP in 2002 to 19.1% of GDP in 2013.

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[4] ROE = profits/equity.

[5] In Colombia near 70% of the population is credit constrained.

In Colombia, in July 2011, a fiscal rule was introduced according to which the structural surplus target for the year 2014 was −2.3%, which aimed to reduce the long-run debt to GDP ratio to 12%, compared to the actual 30% of GDP level. The structural rule had also the implication that it would help to stabilize the business cycle and volatility of fiscal instruments. The so-called structural surplus rule tied the government spending to structural/permanent government revenues. Countries like Chile (Céspedes, Fornero and Galí, 2012), and Norway (Pieschacón, 2012) have used this kind of rule. In the case of Colombia, González et al. (2014) calibrated a DSGE model for its economy, and showed how in addition to the spending smoothing effect of a structural surplus rule it allows the Central Bank to be less aggressive in fighting inflation when an oil price shock hits the economy, and welfare is improved.

In addition to the fiscal rule, the Colombian government implemented the General System of Prerogatives (Sistema General de Regalías) of Law 1530 of 2012, which regulates the use by the regions of the government revenue participation over mining activities. As the fiscal rule, this regulates spending and savings, depending on the amount of resources. The budget, determined by the Secretary of Finance (Ministerio de Hacienda), establishes savings with the objective of stabilizing regional investment.

The budget is biannual, independent from the one of the National Central Government, used only for investment and assigned between expenditure and savings. The expenditures correspond to the Regional Compensation Fund, Regional Development Fund, Science, Technology and Innovation Fund and Direct Regional Assignments. Meanwhile, savings correspond to the Savings and Stabilization Fund and the Territorial Pension Fund.

4. INCIDENCE OF DUTCH DISEASE OVER PROFITS

In this Section we present empirical evidence about the relation between the real exchange rate and the profitability of the

firms. In our econometric study, we do not subscribe ourselves to the type of aggregate analysis used in the existing works of the empirical literature about Dutch disease, but instead, using information about 3,385 Colombian firms, we estimate a model using profit-by-profit level information to assess the effect of the exchange rate over the profitability of firms.

The model presented in Section 2 briefly highlights the expected relation between profits and the real exchange rate. In addition, for our econometric specification we complement the model with macroeconomic and microeconomic variables using the same approach that Griffin (2015) applied for the case of the industrial sector.

Our basic regression equation is the following:

$$\pi_{ft} = \alpha_0 + \alpha_1 RER_t + \alpha_2 GDPG_t + \alpha_3 Leverage_{ft} + \\ + \alpha_4 PartnersGDPG_t + \mu_f + \varepsilon_{ft}, \quad (9)$$

where π_{ft} represents the profits of firm *f;* RER_t is the real exchange rate of the economy; $GDPG_t$ is the annual output growth; $Leverage_{ft}$ is the ratio of total debt to total assets of the firm *f;* $PartnersGDP_t$ corresponds to the real GDP growth of the three main commercial partners of Colombia; μ_f is a firm fixed effect to control for idiosyncratic characteristics of the firm; and ε_{ft} is a random error.

The theoretical framework of Section 2 presented the expected sign for the RER_t depending on the sector to which the firm belongs. For the traded sector we expect a positive relation between profits and RER_t, and for the nontraded sector a negative sign. Two other factors are included to explain the behavior of profits; the demand for goods of the firm whose proxy in our model is $GDPG_t$, and the level of $Leverage_{ft}$. We decided to use leverage because the Colombian firms increased their level of domestic borrowing during the analysis period due to the strong capital inflows in the economy (see González et al., 2014). The expected sign is negative because the higher the level of leverage the riskier the firm and according to Bernanke, Gertler and Gilchrist (1999) the higher will be the external

Table 1

SUMMARY STATISTICS

Variable	*Definition*	*Mean*	*Std. dev.*	*Min*	*Max*
ROE_{ft}	Firm net profits/equity (%)	6.7	1.6	3.0	8.3
Real exchange $rate_t$	Is considered in terms of producer prices 2002=100 and a basket of goods with the main countries with which Colombia trades	87.7	7.7	77.2	103.6
Output $growth_t$	Real gross domestic product growth (%)	4.6	1.6	1.7	6.9
Partners $GDPG_t$	Trade partners real gross domestic product trade (%)	3.8	1.9	–0.5	6.4
$Leverage_{ft}$	Firm total liabilities/total assets (%)	32.7	2.1	30.6	36.8
Firm $size_{ft}$	ln(firm total assets)	26.1	0.4	25.5	26.7
$Exports_{ft}$	Real exports considered in terms of consumer price index 2002=100 (billions of COP)	7,329	1,089	5,370	9,256

Source: Author's calculations.

finance premium charged by the financial intermediaries to the firm to finance investment and the lower the profits will be. In the case of the traded sector, we also included *Partners* GDP_t and expect a positive effect on profits.

For our analysis, we use a panel that consists of 3,385 firms including large ones that are publicly listed. The data is annual from 2002 to 2014. The number of firms is in agriculture 289, in manufacture 897, in services 1,932, and in construction 267. The firms in the panel are the same for the whole period. The source of the data are the Colombia's Superintendence of Corporations (Superintendencia de Sociedades), that collects a large amount of data on financial and income statements from private corporations that are not listed in the stock exchange, and the Financial Superintendence (Superintendencia Financiera) that reports information for large firms that are listed in the stock exchange.

Table 1 presents the descriptive statistics of the aggregated variables. The average level during the period was 87.7 for RER_t; 4.6%, $GDPG_t$; 6.7%, ROE_{ft}; 32.7%, $Leverage_{ft}$; 7,329 billion of 2002 Colombian pesos (COP), $Exports_{ft}$; 3.8%, $PartnersGDP_t$; and 26.1, $Firm\ size_{ft}$ [measured as the ln(total assets)].

The subsectors' descriptive statistics are presented in Table 2. In manufacturing, the ROE's mean during 2002-2014 was lowest in the subsectors of manufacture of textiles (0.2%); manufacture of rubber and plastics products (1.5%); and manufacture of basic metals (2.5%). In the main manufacturing subsectors, leverage mean was between 18.4% and 52.5%. The subsectors with higher exports were manufacture of chemicals and chemical products; and manufacture of food products and beverages.

In agriculture, the ROE was lower in growing of bananas (0.8%), farming of cattle (1.8%), growing of flowers (2.1%), growing of sugar cane (2.8%), and growing of cereals and oil crops (2.9%). The exports mean was 279 billion of 2002 COP for growing of flowers, which was the highest in agriculture.

During the period, in construction, the results were for ROE 8.9% and leverage 51.8%. In the services subsectors with more number of firms, the ROE was between 3.1% and 11.5%, and leverage was between 10.4% and 57.8 percent.

Table 2

SUBSECTORS' SUMMARY STATISTICS (MEAN)

ISIC rev. 3	*Subsector*	*ROE*	*Leverage*	*Number of firms*	*Exports (2002 million COP)*
112	Growing of flowers	2.1	45.0	48	278,724
113	Growing of bananas	0.8	29.9	17	4
114	Growing of sugar cane	2.8	14.1	49	314
115	Growing of cereals and oil crops	2.9	27.0	37	1,741
117	Growing of fruit, nuts, beverage, and spice crops	6.4	42.9	8	1,658
121	Farming of cattle	1.8	17.3	30	0
15	Manufacture of food products and beverages	6.5	28.5	176	1,116,543
17	Manufacture of textiles	0.2	42.1	46	457,327
18	Manufacture of wearing apparel; dressing and dyeing of fur	4.5	50.7	54	326,507
21	Manufacture of paper and paper products	4.8	26.1	20	507,168
24	Manufacture of chemicals and chemical products	8.7	43.2	116	1,722,759
25	Manufacture of rubber and plastics products	1.5	46.9	88	461,965
26	Manufacture of other non-metallic mineral products	3.6	18.4	42	263,687
27	Manufacture of basic metals	2.5	45.4	19	178,922

28	Manufacture of fabricated metal products, except machinery and equipment	4.3	49.3	64	547,560
29	Manufacture of machinery and equipment n.e.c.	5.5	50.8	29	218,946
31	Manufacture of electrical machinery and apparatus n.e.c.	7.2	52.5	19	201,821
34	Manufacture of motor vehicles, trailers and semitrailers	7.4	49.0	37	133,897
45	Construction	8.9	51.8	267	-
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	11.5	57.8	177	-
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	8.9	53.8	529	-
52	Retail trade, except motor vehicles and motorcycles; repair of personal household goods	4.1	44.4	187	-
55	Hotels and restaurants	3.1	42.4	74	-
65	Financial intermediation, except insurance and pension funding	4.3	10.4	214	-
70	Real estate activities	3.3	22.6	268	-

Source: Authors' calculations.

Table 3

DESCRIPTION OF MANUFACTURING SUBSECTORS

ISIC rev. 3	*Description*
	High Tech
24	Manufacture of chemicals and chemical products
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting, and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semitrailers
35	Manufacture of other transport equipment
	Low Tech
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
36	Manufacture of furniture; manufacturing n.e.c.

Source: Organisation for Economic Co-operation and Development, Eurostat, and United Nations.

4.1 The Impact of the Real Exchange Rate over Profits

As explained above, the real exchange rate has a direct effect on profits of traded and nontraded goods. Here we study this effect using the specification presented in equation 9.

In a preliminary step, using data for the period 2002-2014 we estimated the impact of real exchange rate on profits of traded goods[6] and nontraded goods and over the individual sectors (agriculture, manufacturing, construction and services), using OLS (Table 4).[7] The results are very suggestive, in all the cases the incidence of the exchange rate is significant and with the expected sign, except for agriculture and construction in which it is not significant. According to the regressions, the exchange rate appreciation had a negative impact on the profitability of traded goods and manufacturing; and a positive effect on the profitability of nontraded goods and services.

In Table 4 the relation of profits to output growth results positive and with leverage results negative. The output growth has the expected sign in all cases except agriculture, but it is not significant; while, leverage results significant and with the expected sign for traded goods, agriculture, and manufacturing. The GDP growth of the trade partners resulted with a positive sign as expected but not significant.

However, in order to take into account the lagged dependent variable and given that some of the explanatory variables might be determined at the same time as the left-hand-side variable, we use a generalized method of moments estimator. This is a better approach because linear dynamic panel-data models include p lags of the dependent variable as covariates and contain unobserved panel-level effects, fixed or random. By construction, the unobserved panel-level effects are correlated with the lagged dependent variables, making standard

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[6] Traded goods in regressions include manufacturing and agriculture, and do not include mining.

[7] This period corresponds to the years of appreciation of the real exchange rate in Colombia due to the continuous increase in oil prices.

Table 4

Variable	Traded (1)	Nontraded (2)	Agriculture (3)	Manufacturing (4)	Construction (5)	Services (6)
	PANEL: OLS					
Dependent variable: Profits/Equity$_{ft}$ (ROE)						
Constant	−13.47	115.99[c]	−3.32	−16.45[c]	42.89	126.15
	(7.80)	(64.28)	(13.16)	(8.17)	(28.88)	(75.41)
Real exchange rate$_t$	0.24[a]	−1.38[c]	0.17	0.27[a]	−0.42	−1.51[c]
	(0.06)	(0.73)	(0.11)	(0.07)	(0.30)	(0.86)
Output growth$_t$	0.15	1.83	−0.93	0.50	0.54	2.01
	(0.80)	(1.34)	(1.04)	(0.81)	(0.87)	(1.57)
Leverage$_{ft}$	−14.61[b]	−9.40	−30.81[c]	−12.55[c]	−9.46	−9.59
	(6.47)	(12.08)	(14.79)	(7.16)	(11.26)	(12.81)
Partners GDPG$_t$	0.48		0.88	0.36		
	(0.38)		(0.64)	(0.38)		
Number of observations	15,418	28,587	3,757	11,661	3,471	25,116
Number of groups	1,186	2,199	289	897	267	1,932
Tests						
F (variables −1, 12)	5.37	1.68	3.19	4.48	0.77	1.42
p-value	0.01	0.22	0.05	0.02	0.53	0.28

Notes: Clustered by time, standard errors reported in parenthesis. The symbols [a], [b] and [c] indicate significance at levels 1%, 5% and 10%, respectively.
Source: Authors' calculations.

estimators inconsistent. Arellano and Bond (1991) derived a consistent generalized method of moments estimator for the parameters of these models.

Table 5 presents the results. The incidence of the exchange rate is significant and with the expected sign, except for construction. The exchange rate appreciation decreased the profitability of traded goods, agriculture and manufacturing; and increased the profitability of nontraded goods and services. An increase of one unit in the RER_t index increases the profitability of the traded goods firms in 0.49% and decreases the profitability of nontraded goods firms in 3.40%. The highest impact is on the services sector.[8]

Regarding the manufacturing subsectors, the more affected by the appreciation of the exchange rate were: manufacture of textiles (17); manufacture of wearing apparel, dressing and dyeing of fur (18); manufacture of rubber and plastics products (25); manufacture of non-metallic mineral products (26); manufacture of basic metals (27); manufacture of fabricated metal products, except machinery and equipment (28); and manufacture of motor vehicles, trailers and semitrailers (34).[9] In the Colombian economy, these subsectors are characterized by their higher value of exports and production with respect to the rest of manufacturing.

Colombia has been characterized with respect to other Latin American countries by the more diversified and highest proportion of manufacturing in total output, with comparative advantage in the production of low technology subsectors as textiles and wearing apparel. Besides, the Colombian economy has an important production in manufacture of chemicals and chemical products that has been more successful with respect to the production of other high technology products. This subsector was not affected by the appreciation of the real exchange rate during the period. Meanwhile, in the manufacture of motor vehicles, trailers and semitrailers, the profits during the

[8] The real exchange rate index is 100 in 2002.

[9] ISIC classification (rev. 3).

Table 5

PANEL: ARELLANO-BOND

Variable	*Traded (1)*	*Nontraded (2)*	*Agriculture (3)*	*Manufacturing (4)*	*Construction (5)*	*Services (6)*
Dependent variable: Profits/Equity$_{ft}$ (ROE)						
Profits/equity$_{ft-1}$	0.00	−0.01[c]	−1.50[a]	0.03[b]	−0.19[a]	−0.01
	(0.01)	(0.01)	(0.08)	(0.01)	(0.01)	(0.01)
Constant	−29.53[c]	283.31[a]	−61.69[b]	−34.10[c]	31.17[c]	326.02[a]
	(16.49)	(67.99)	(25.38)	(20.14)	(18.99)	(77.33)
Real exchange rate$_{t}$	0.49[a]	−3.40[a]	0.85[a]	0.52[b]	0.10	−3.93[a]
	(0.18)	(0.75)	(0.28)	(0.21)	(0.20)	(0.86)
Output growth$_{t}$	−0.12	2.98	−2.85[b]	0.37	−0.39	3.46
	(0.90)	(2.63)	(1.42)	(1.10)	(0.75)	(2.99)
Leverage$_{ft}$	−28.97[b]	−6.25	−15.05	−22.70	−62.24[a]	−5.38
	(12.28)	(10.48)	(19.09)	(14.91)	(10.56)	(11.23)
Partners GDPG$_{t}$	1.06[c]		3.05[a]	0.76		
	(0.65)		(1.02)	(0.79)		
Number of observations	13,042	24,136	3,179	9,863	2,928	21,208

Number of groups	1,186	2,199	289	897	267	1,932
Sargan-test [$\chi^2(11)$] / *p*-value	17.5630 0.0923	11.1268 0.4327	5.7927 0.8868	20.4605 0.0394	13.3876 0.2688	11.3187 0.4170
First-order autocorrelation [*z*-stat / *p*-value]	−1.6363 0.1018	−1.6579 0.0973	−1.4040 0.1603	−1.5417 0.1231	−1.6415 0.1007	−1.6544 0.0981
Second-Order Autocorrelation [*z*-stat / *p*-value]	1.2119 0.2255	0.0048 0.9961	0.8297 0.4067	1.0189 0.3082	0.0636 0.9493	0.0242 0.9807

Note: Standard errors reported in parenthesis. The symbols [a], [b] and [c] indicate significance levels at 1%, 5% and 10%, respectively.
Source: Authors' calculations.

period decreased with the appreciation of the exchange rate because of the expansion in the demand of durable goods, which competed with domestic production.

In agriculture, the subsectors that declined more in profitability were growing of flowers (112), growing of sugar cane (114), growing of cereals and oil crops (115), and growing of fruit, nuts, beverage and spice crops (117).

The appreciation of the exchange rate and positive capital movements caused an increase in real estate prices and a boom in consumption of durable goods along with high rates of GDP growth. The expansion of profits of the construction sector was significant. Among the subsectors with highest profits growth in services were trade, and hotels and restaurants.

Finally, in our Arellano-Bond regressions in Table 5, output growth is not significant. With respect to leverage the relation has the expected negative sign for all of the sectors and is significant for traded goods and construction. The GDP growth of the trade partners has the expected sign in all cases and it is significant for traded goods and agriculture.

The results of the Sargan test shows that in all cases the overidentified restrictions are valid and the *AR(i)* test shows no autocorrelation for the Arellano Bond estimations.

4.2 Controlling for the Imported Component

One important aspect to take into account when examining the impact of the exchange rate over profits is the imported component of goods. However, there are not data available at the firm level. Our approach to take into account the imported component was the following: for the manufacturing sector, we divide the 2-digits subsectors into high tech and low tech according with the Organisation for Economic Co-operation and Development and Eurostat (Table 3). The high tech subsectors such as chemicals have an important imported component. So we use a dummy variable equal to one for high tech and equal to zero for the low tech subsectors and we call it $Technology_{ft}$.

We run the regression:

$$\pi_{ft} = \alpha_0 + \alpha_1 RER_t + \alpha_2 GDPG_t + \alpha_3 Leverage_{ft} + \alpha_4 PartnersGDPG_t + \\ + \alpha_5 Technology_{ft} + \mu_f + \varepsilon_{ft}. \quad (10)$$

The results are presented in Table 6. As we can see, the real exchange rate presents the expected sign and it is significant when controlling for this variable. The $Technology_{ft}$ variable has the expected sign but it is not significant. The other variables also have the expected sign but are not significant.

Table 6

PANEL: OLS (IMPORTED COMPONENT)

Variable	*Manufacturing*
Dependent variable: Profits/Equity$_{ft}$ (ROE)	
Constant	−16.84[c] (8.27)
Real exchange rate$_t$	0.27[a] (0.07)
Output growth$_t$	0.49 (0.81)
Leverage$_{ft}$	−12.58 (7.17)
Partners GDPG$_t$	0.35 (0.37)
Technology$_{ft}$	1.69 (1.71)
Number of observations	11,661
Number of groups	897
Tests	
$F(5, 12)$	3.76
p-value	0.03

Notes: Clustered by time, standard errors reported in parenthesis. The symbols [a], [b] and [c] indicate significance levels at 1%, 5% and 10%, respectively.
Source: Authors' calculations.

4.3 Which Firms Are Affected the Most?

A last question that we ask in our article is: does the real exchange rate affect more to some firms? Until now, we presented evidence that in average an appreciation of the real exchange rate results in a reduction in profits of traded goods and improvement in non-traded goods. In Table 7 we consider if the profits reaction is stronger for some type of firms, more precisely, smaller or larger firms. For doing so, we introduce interaction effects between the real exchange rate and the size of the firm (as measured by the natural logarithm of total assets) with Arellano-Bond regressions. The specification used is:

$$\pi_{ft} = \alpha_0 + \alpha_1 RER_t + \alpha_2 GDPG_t + \alpha_3 Leverage_{ft} + \alpha_4 RER_t * Firm_{size_{ft}} + \\ + \alpha_5 PartnersGDPG_t + \mu_f + \varepsilon_{ft}. \quad (11)$$

The results show that the interactions have a negative sign for traded goods and a positive sign for nontraded goods. This implies that when the exchange rate appreciates and the profits of traded goods decrease, the result is stronger for smaller firms. Similarly, for nontraded goods the firms more affected are the smaller ones. This is that smaller firms are more vulnerable to the movements in the real exchange rate.

Additionally, the exchange rate was significant and its sign was the expected for traded goods, manufacturing, agriculture and construction. The incidence of output was of the expected sign for nontraded goods and services. The leverage was of the expected sign and significant in all cases, with the exception of nontraded goods and services.

Finally, the interactions in all of the sectors indicate that fluctuations become more pronounced for smaller firms with respect to a mining boom. This is that all the regressions indicate that the sectors are sensitive to the exchange rate in the expected sign, and that it causes greater fluctuations in smaller firms.

Table 7

PANEL: ARELLANO-BOND (INTERACTIONS)

Variable	*Traded (1)*	*Nontraded (2)*	*Agriculture (3)*	*Manufacturing (4)*	*Construction (5)*	*Services (6)*
Dependent variable: Profits/equity$_{ft}$ (ROE)						
Profits/equity$_{ft-1}$	−0.02[b]	−0.01	−1.05[a]	−0.01[c]	−0.19[a]	−0.01
	(0.01)	(0.01)	(0.06)	(0.01)	(0.01)	(0.01)
Constant	−12.62	256.40[a]	23.89	−22.92	−33.58	300.34[a]
	(19.07)	(79.97)	(27.59)	(23.24)	(22.06)	(91.00)
Real exchange rate$_{t}$	1.89[a]	−3.90	5.01[a]	2.12[b]	−3.42[a]	−3.91
	(0.73)	(2.44)	(0.92)	(0.93)	(0.55)	(2.86)
Output growth$_{t}$	−0.24	3.01	−1.14	0.00	−0.16	3.52
	(0.92)	(2.62)	(1.44)	(1.11)	(0.74)	(2.99)
Leverage$_{ft}$	−44.12[a]	−6.30	−36.81[b]	−41.48[a]	−89.29[a]	−5.50
	(11.92)	(10.48)	(18.73)	(14.35)	(10.98)	(11.24)
Real exchange rate$_{t}$*Firm size$_{ft}$	−0.09[b]	0.05	−0.32[a]	−0.10[c]	0.27[a]	0.02
	(0.05)	(0.15)	(0.06)	(0.06)	(0.03)	(0.18)
Partners GDPG$_{t}$	1.40[b]		1.03	1.49[c]		
	(0.68)		(1.03)	(0.82)		

Variable	*Traded (1)*	*Nontraded (2)*	*Agriculture (3)*	*Manufacturing (4)*	*Construction (5)*	*Services (6)*
Number of observations	13,046	24,189	3,179	9,867	2,937	21,252
Number of groups	1,186	2,199	289	897	267	1,932
Sargan-test [$\chi^2(11)$] / p-value	14.1432 0.2252	10.4604 0.4011	5.6771 0.8940	14.0156 0.2321	22.3032 0.0136	10.5990 0.3896
First-order autocorrelation [z-stat / p-value]	−1.6316 0.1028	−1.6658 0.0957	−1.4116 0.1581	−1.5308 0.1258	−1.6320 0.1027	−1.6625 0.0964
Second-order autocorrelation [z-stat / p-value]	1.2150 0.224	0.0309 0.9754	0.8406 0.4005	0.9975 0.3185	0.1448 0.8849	0.0006 0.9995

Note: Standard errors reported in parenthesis. The symbols [a], [b] and [c] indicate significance levels at 1%, 5% and 10%, respectively.
Source: Authors' calculations.

5. CONCLUSIONS

The increase in oil prices since 2004 caused a Dutch disease in the Colombian economy that was characterized by the increase in mining exports, the appreciation of the exchange rate, and the decrease in profits of nonbooming traded goods and the increase in profits of nontraded goods. The exchange rate stopped appreciating during 2013-2014, but the level remained below 2002-2003.

The government macroeconomic policy could enable high rates of growth during the period, but the Dutch disease resulted in an unbalanced growth with smaller rates in the manufacturing and agriculture sectors. On the other side, the amount of spending of the economy increased in both the private and public sectors, behavior that caused the appreciation of the exchange rate during the period.

In the article, the theoretical framework considers traded and nontraded goods, and nontraded goods prices depending on the exchange rate, wages and money supply. It is shown that the depreciation (appreciation) of the exchange rate has a positive (negative) impact on traded goods profits and a negative (positive) impact on nontraded goods profits. The overall result depends critically on the parameter of the relation between the nontraded goods prices with the exchange rate. When the parameter is lower, the depreciation (appreciation) causes higher (lower) traded goods profits and lower (higher) nontraded goods profits.

The regression analysis shows strong evidence that the appreciation of the exchange rate during 2002-2014 reduced the profits of traded goods, manufacturing and agriculture; and increased the profits of nontraded goods, construction, and services. In all goods, more leverage caused a reduction of profits, and nontraded goods and services were more related with output growth than other sectors. The real exchange rate has a positive and significant impact on manufacturing when controlling by the imported component in this sector. Finally, smaller firms in both traded and nontraded goods are more affected by the movements in the exchange rate.

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