



IMF Working Paper

Western Hemisphere Department

**Determinants of Firm Profitability in Colombia's Manufacturing Sector:
Exchange Rate or Structural?**

Prepared by Naomi N. Griffin¹

Authorized for distribution by Valerie Cerra

May 2015

IMF Working Papers describe research in progress by the author(s) and are published to elicit comments and to encourage debate. The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

Abstract

The appreciation of the real exchange rate over the past several years is considered one of the key drivers behind the weak performance of Colombia's manufacturing sector in recent years. This paper examines the effects of the real exchange rate, external and domestic demand, and structural changes on firms' profitability in Colombia's manufacturing sector between 2000 and 2012. While export intensive companies have suffered lower profit growth with real exchange rate appreciation, we find no strong evidence that real appreciation has, on average, negatively affected the profitability of manufacturing firms; on the contrary, we find that real appreciation may have increased firms' profitability by reducing the cost of imported inputs as Colombian manufacturing firms become more domestically oriented. At the same time, some structural changes (related to trade disruption with Venezuela and increased trade competition from China) seem to partially explain the weakness of the manufacturing sector since 2008.

JEL Classification Numbers: L25, L60, O14, O24

Keywords: Real exchange rate, manufacturing, structural changes

Author's E-Mail Address: ngriffin@imf.org

¹ I would like to thank the Colombian Superintendence of Corporations (Superintendencia de Sociedades) for providing the firm-level data base used for the analysis, and the authorities at the Central Bank of Colombia and the Ministry of Finance for the useful comments and suggestions. All errors are my own.

Contents

Page

I. Introduction	4
II. Aggregate Trend of Real Exchange Rate and Trade.....	5
A. Data and Methodology	5
B. Real Effective Exchange Rate and External Demand	6
C. Structural Changes Related to International Trade.....	7
D. International Comparison	10
III. Firm-level Analysis.....	10
A. Theoretical Model	10
B. Data and Empirical Specification	11
C. Results.....	13
D. Further Research.....	16
IV. Conclusion	16

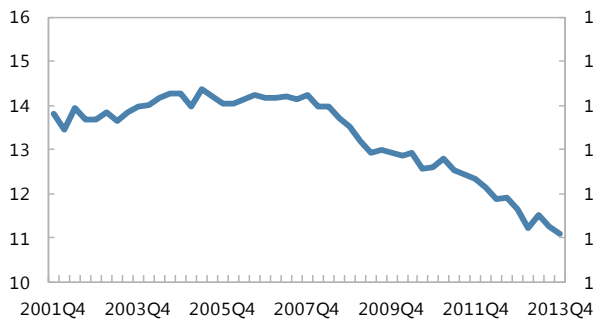
TABLES

1. OLS Panel Regression Results on Profit Growth, 2000–2012	18
2. OLS Panel Regression Results on External Revenue Growth, 2000–2012.....	19
3. OLS Panel Regression Results, 2000–2012	20
4. OLS Panel Regression Results on Profit Growth, 2000–2012 (Exporting firms).....	21
5. OLS Panel Regression Results with Export Share, 2000–2012	22
6. OLS Regression Results by Industry, 2000–2012	23
7. OLS Panel Regression Results with Export-Weighted REER Lags, 2000–2012.....	24
8. OLS Panel Regression Results with Import-Weighted REER Lags, 2000–2012.....	25

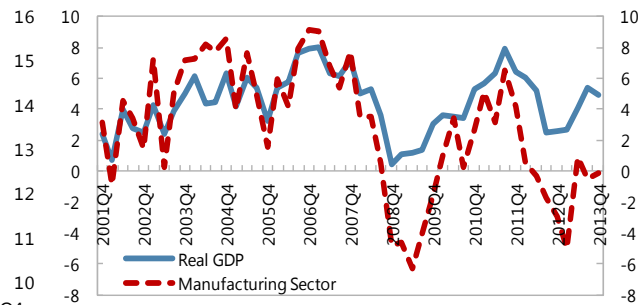
I. INTRODUCTION

Colombia's manufacturing sector has performed relatively poorly since 2008. Real GDP grew, on average, by 4 percent between 2008 and 2013 despite the global financial turmoil of 2008–09, due to favorable commodity prices and Colombia's strong economic policy framework. At the same time, Colombia's manufacturing sector output grew only by 0.2 percent on average. As a result, the share of manufacturing in percent of real GDP has declined from 14 percent at the end of 2007 to 11 percent in 2013. The contraction of the manufacturing sector relative to the overall economic activity was more pronounced during the cyclical downturns. The manufacturing sector contracted by four percent during the global financial turmoil, even though the growth of the overall economy remained positive. Similarly, the manufacturing sector contracted fairly sharply between the second half of 2012 and the first half of 2013, when overall economic activity grew at the average pace of 3 percent (y/y).

Manufacturing Sector
(In percent of real GDP)



Growth of Real GDP and Manufacturing Sector
(y/y percent change)



Source: Departamento Administrativo Nacional de Estadística (DANE).

Several possible explanations have emerged to explain the weakness of the manufacturing sector since 2008. The main policy concern has been the overvaluation of the real effective exchange rate which may have hampered the competitiveness of the manufacturing sector;² Colombia's peso has appreciated sharply in real terms against the U.S. dollar in recent years. Alternative explanations for manufacturing sector performance include weak external demand for Colombia's manufacturing products as well as structural changes induced by international trade. In particular, trade disruption with Venezuela and increased imports from countries such as China and Mexico may have contributed to the contraction of Colombian manufacturing output. Finally, other competitiveness issues, including high labor costs and poor infrastructure, have long been regarded as key obstacles for the growth of the manufacturing sector.

² Economic literature has pointed out that resource rich countries often experience a phenomenon known as the "Dutch disease," characterized by the loss of competitiveness in non-commodity producing sectors as a result of an overvalued exchange rate. For a comprehensive survey of this literature, see Frankel (2010).

This paper examines the effects of the real appreciation, external and domestic demand, and structural changes related to international trade on the recent performance of the Colombian manufacturing sector. High labor costs and poor infrastructure have existed for quite some time and are therefore unlikely to explain the recent weak performance. However, it is possible that these pre-existing competitiveness issues have made the negative effects of real appreciation and structural changes more acute than they otherwise would have been. Furthermore, recent technological changes may have affected the performance of certain manufacturing industries in Colombia, although identifying the nature of such technological changes and their impact, if any, is beyond the scope of this paper.

To investigate the fundamental relationship between the performance of the manufacturing sector and various factors mentioned above, the paper uses two methods. First, we investigate the aggregate trend of real exchange rate, external demand and the patterns of trade using data from various sources, including the United Nation's COMTRADE and the IMF's World Economic Outlook (WEO) database. Second, we conduct a firm-level analysis using a database with a large number of Colombian manufacturing companies to examine how real appreciation, external and domestic demand, and structural changes affect firms' profit growth. Section II describes the aggregate trend, section III describes the firm-level analysis, and section IV concludes.

II. AGGREGATE TREND OF REAL EXCHANGE RATE AND TRADE

A. Data and Methodology

To construct the real effective exchange rate specific to the manufacturing sector, we use the trade-partner weights taken from the United Nation's COMTRADE database for both exports and imports. The weights were calculated using the average for 2007, 2009, and 2012, the years that the database seems to have the most comprehensive coverage of manufacturing trade in Colombia.³ The data on the nominal exchange rate as well as the consumer price index of Colombia and its trading partners are taken from the WEO database. Similarly, the measure of external demand is constructed using the export-weighted real GDP growth of trading partners. In addition, using the COMTRADE database, the paper looks into the structural changes in Colombia's trading partners for both manufacturing exports and imports between 2007, 2009 and 2012. Once we have identified any major structural changes in trading partners during this period, we investigate which industries have been particularly affected by these changes. We also examine if the structural changes are in fact driven by the real exchange rate dynamics.

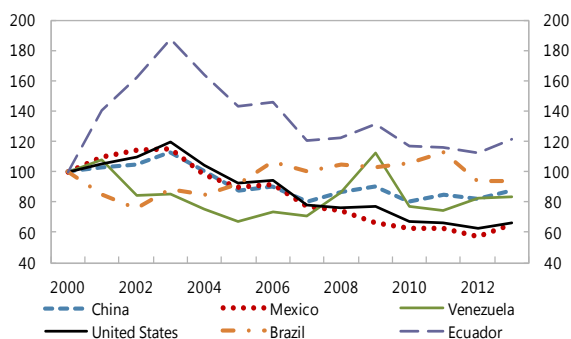
³ For this calculation, we included SITC industry code 0 (food and live animals), 5 (chemicals and related products), 6 (Manufactured goods chiefly classified by material), and 7 (machinery and transport equipment).

B. Real Effective Exchange Rate and External Demand

Colombia's strong policy framework combined with the boom in the commodity sector has strengthened Colombia's exchange rate. Colombia has enjoyed a strong inflow of foreign direct investment over the past several years. These inflows, averaging close to 4 percent of GDP between 2006 and 2012, have allowed Colombia to maintain a balance of payments surplus and to accumulate international reserves. At the same time, Colombia's real effective exchange rate, especially against the U.S. dollar, has appreciated significantly, by over 30 percent between 2006 and 2012. Appreciation of the Colombian peso has raised a concern that the exchange rate may have been a key factor for the relatively weak performance of the manufacturing sector in recent years.

Despite the real appreciation of the Colombian peso against the U.S. dollar, the appreciation of the bilateral real exchange rate since 2008 against most major trading partners has been fairly modest, with the exception of Mexico. As a result, the real effective exchange rate weighted by export trading partners of manufacturing goods remained relatively stable since 2008 (the spike in 2009 was caused by Venezuela). The real effective exchange rate weighted by import trading partner of manufactured goods exhibits slightly sharper appreciation since 2008 due to the larger weight of the United States. In both cases, the visual inspection does not reveal that the real effective exchange rate may be driving the weak performance of the manufacturing sectors since 2008.

Bilateral Real Exchange Rate
(2000=100, + depreciation)



Sources: WEO; and IMF staff calculations.

Real Effective Exchange Rate
(2000=100, + depreciation)



Sources: COMTRADE; WEO; and IMF staff calculations.

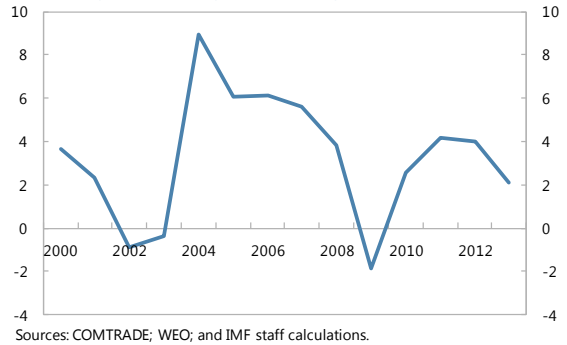
External demand for Colombia's manufacturing goods fell sharply in 2009 and dropped modestly again in 2013. The measure of external demand, constructed as the weighted average real GDP growth of main trading partners of manufacturing exports, declined sharply in 2009 as a result of the global financial crisis. Although it recovered and reached 4 percent in 2011 and 2012, the growth rate is still less than the average growth of 6 percent observed between 2004 and 2008 (the weak growth of 2002 and 2003 was caused by Venezuela). The external demand growth fell again to 2 percent in 2013. The visual inspection suggests that the sharp drop in the growth of manufacturing output in 2009 may be partly explained by the fall in external demand.

Manufacturing Goods Trading Partners
(Average for 2007, 2009 and 2012)

Export	Percent share	Import	Percent share
Venezuela	29.9	United States	38.4
United States	19.5	Argentina	9.9
Ecuador	10.6	Brazil	7.7
Peru	6.4	Mexico	7.2
Mexico	3.8	China	6.5
China	3.7	Canada	4.4
Brazil	3.2	Chile	4.4
Belgium	3.0	Ecuador	4.2
Chile	2.6	Germany	3.2
Germany	2.6	Peru	3.0
Italy	2.5	Venezuela	2.4
Japan	2.5	Japan	1.6
Panama	2.1	France	1.5
Spain	1.9	Spain	1.2
Netherlands	1.8	Italy	1.2
Others	4.1	Others	3.1

Sources: COMTRADE; and IMF staff calculations.

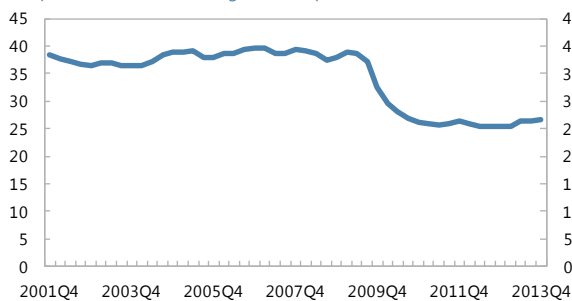
External Demand Growth for Manufacturing Sector
(Export weighted real GDP growth of trading partners)



C. Structural Changes Related to International Trade

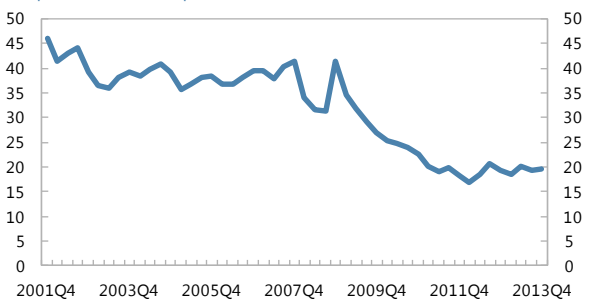
The data on manufacturing exports point to a structural break around 2008. Manufacturing sector seems to be exporting less and producing more for domestic consumption today compared to several years ago; manufacturing exports in percent of GDP has declined from around 40 percent in 2008 to 26 percent in 2013. Similarly, manufacturing exports in percent of total exports have declined from close to 40 percent in mid-2000s to roughly 20 percent in 2013.

Manufacturing Exports
(In percent of manufacturing GDP, 4-quarter MA)



Source: Departamento Administrativo Nacional de Estadística (DANE).

Manufacturing Exports
(In percent of total exports)

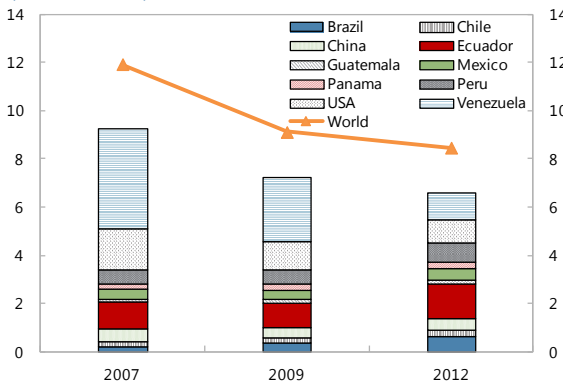


Significant portion of the decline in manufacturing exports in recent years seems to be related to Venezuela. According to COMTRADE database, manufacturing exports (excluding food, beverages and tobacco products) to Venezuela declined from US\$4 billion (35 percent of the total) in 2007 to US\$1 billion (13 percent of the total) in 2012.⁴ The sharp decline largely

⁴ Even though COMTRADE database seems to have the most comprehensive coverage on Colombia for 2007, 2009 and 2012, there could be some discrepancies between the official data due to some unreported categories. In particular, the data for 2012 seems incomplete for a small number of manufacturing categories.

reflects the deterioration in Colombia's trade relationship with Venezuela since 2008. The industries that were particularly affected by the trade disruption with Venezuela include electrical machinery, road vehicles, textiles, and medical and pharmaceutical products.⁵ Since then, however, part of the decline has been offset by an increase in exports to other countries in the region, including Brazil, Ecuador and Peru. Exports to the U.S. have declined from US\$1.7 billion in 2007 to US\$1 billion in 2012, possibly due to the real appreciation of Colombia's peso vis-à-vis the U.S. dollar. While significant, the magnitude of decline is small in comparison with the drop in exports caused by the trade disruption with Venezuela.

Manufacturing Exports by Trading Partners
(In Billions of US\$)

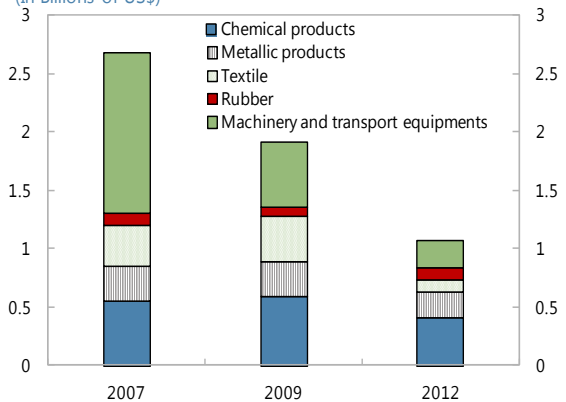


Source: COMTRADE.

Note: Excludes food, beverages and tobacco products.

Selected Manufacturing Exports to Venezuela

(In Billions of US\$)

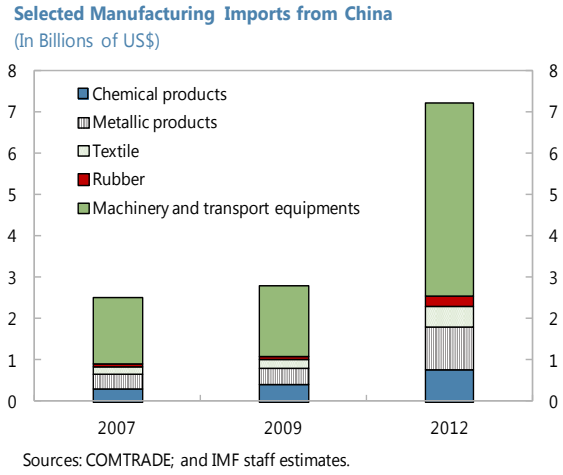
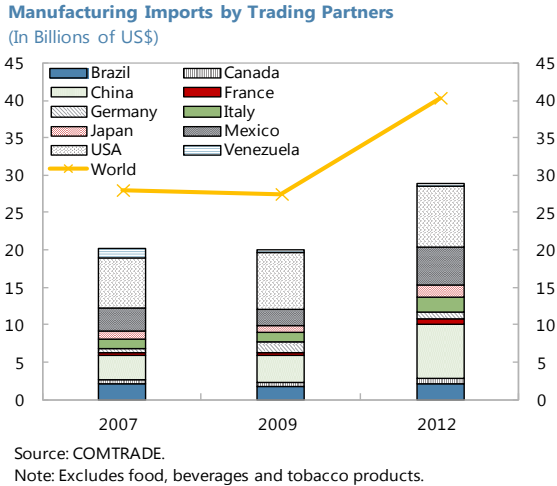


Sources: COMTRADE; and IMF staff estimates.

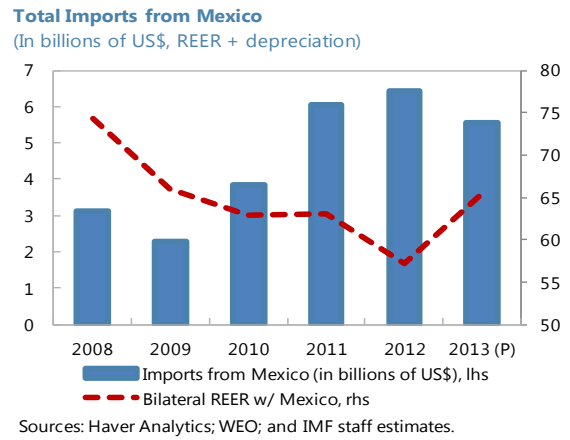
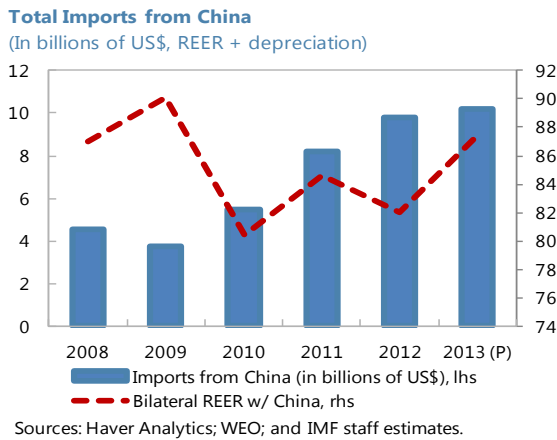
Manufacturing imports have increased significantly since 2009, especially from China and Mexico. According to the COMTRADE database, manufacturing imports from China more than doubled since 2007, from US\$3 billion (8 percent of the total) in 2007 to roughly US\$8 billion (18 percent of the total) in 2012. Increased imports from China are associated especially with machinery and transport equipment, but also with chemical products, rubber and plastic products, metallic and non-metallic mineral products and textiles. Imports from Mexico also increased during the same period, from US\$3 billion in 2007 to US\$5 billion in 2012. The increase is mostly associated with machinery and equipment. It is noteworthy that, despite the significant appreciation of the bilateral real exchange rate, the increase in imports from the U.S. was smaller than the increase in imports from China.⁶

⁵ The research by Carranza, González and Serna (2014) shows that the manufacturing industries that had high level of exports Venezuela were, on average, relatively poor performers even before the trade disruption. In contrast, manufacturing industries that exported to other countries have demonstrated robust growth in recent years.

⁶ Based on COMTRADE database, manufacturing imports (excluding food, beverages and tobacco products) from the U.S. increased from \$6.7 billion in 2007 to \$8.2 billion in 2012.



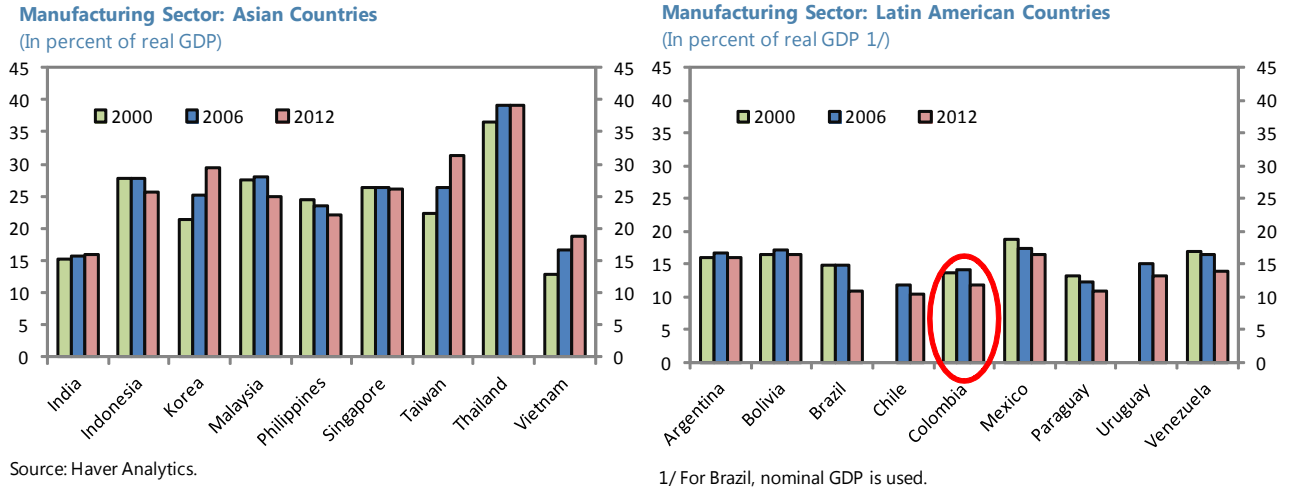
Increased imports from China appear unrelated to the real exchange rate dynamics. To investigate if the recent increase in imports from China is driven by the real exchange rate appreciation, the bilateral real effective exchange rate vis-à-vis the Chinese currency is plotted against total imports from China. The figure highlights that the recent surge in imports did not accompany steady real appreciation of the Colombian peso against the Chinese currency. Therefore, higher imports are more likely to be associated with the increased access by Colombia to Chinese manufacturing products rather than the exchange rate.



Increased imports from Mexico seem to be partly driven by the real exchange rate appreciation. Unlike the case of China, the bilateral real effective exchange rate vis-à-vis the Mexican peso has steadily appreciated since 2008, except in 2013. Accordingly, it seems likely that increased manufacturing imports from Mexico are at least partially driven by exchange rate dynamics, rather than increased access by Colombia to Mexican manufacturing products. The renewal of the Free Trade Agreement with Mexico in 2011 may also have contributed to the higher volume of imports from Mexico after 2011.

D. International Comparison

Colombia's experience does not seem particularly unusual in the international context. In recent years, many countries in the region, including Brazil, Chile, Mexico, Paraguay, Uruguay and Venezuela, have experienced a reduction in the share of the manufacturing sector. Some Asian countries, such as Indonesia, Malaysia, and the Philippines, have also experienced a decline in the share of manufacturing, although Asian countries generally have a higher share of manufacturing in comparison with Latin American countries. In contrast, some Asian countries such as Korea, Taiwan, and Vietnam have experienced very strong growth in the manufacturing sector relative to real GDP.



III. FIRM-LEVEL ANALYSIS

A. Theoretical Model

A simple model is developed to shed light on the key relationship between profit growth and REER at the firm level. Consider a simple short-run model where firms have only one input of production: intermediate inputs, m_t . For simplicity, it is assumed that firms sell the predetermined fraction s of the output $f(m_t)$ to the domestic market at the price p_t^d and export the rest $(1 - s)$ to the world market at the price p_t^w and the nominal exchange rate, E_t . The profit maximizing firms decide the optimal level of output by choosing m_t^* that would solve the following problem:

$$\begin{aligned} \max_{m_t} \quad & p_t^d \cdot s \cdot f(m_t) + p_t^w \cdot E_t \cdot (1 - s) \cdot f(m_t) - c(e_t) \cdot m_t \\ \text{s.t.} \quad & p_t^d = \varphi(d_t, e_t) \text{ and } p_t^w = \lambda(d_t^w) \end{aligned} \quad (1)$$

The production function has the standard property (i.e., $f'(m_t) > 0$ and $f''(m_t) < 0$). The domestic price p_t^d positively depends on domestic demand d_t as well as real exchange rate

e_t , where $e_t = E_t \cdot p_t^w / p_t^d$. Real appreciation (lower e_t) would drive down the price of imported substitutes in domestic currency, pressuring the domestic price to fall (i.e., $\varphi'_e(\cdot) > 0$). The world market price p_t^w positively depends on the global demand d_t^w . It is further assumed that all intermediate inputs are produced abroad and their costs depend on real exchange rate. Real depreciation (higher e_t) would increase the costs of intermediate inputs (i.e., $c'(e_t) > 0$). Profit maximizing firms would choose the optimal level of m_t to equate the marginal increase in revenues from production with the marginal cost.

The effect of real depreciation on firms' profits is given by the following equation:

$$\frac{\partial \pi_t}{\partial e_t} = \underbrace{\varphi'_e(d_t, e_t) \cdot s \cdot f(m_t^*)}_{(+)\text{ import substitution}} + \underbrace{(p_t^d + \varphi'_e(d_t, e_t) \cdot e_t) \cdot (1-s) \cdot f(m_t^*)}_{(+)\text{ higher export revenues}} - \underbrace{c'(e_t) \cdot m_t^*}_{(+)\text{ higher costs}} \quad (2)$$

The first term explains the rise in profits associated with import substitution. Real depreciation would raise the price of imported substitutes, making domestic products more profitable in the domestic market. The second term explains the rise in profits associated with higher export revenue through real depreciation. The last term explains the higher costs of imported intermediate inputs.

For firms that only produce for domestic market (i.e., $s = 1$), the effect of real depreciation is given by the following equation:

$$\frac{\partial \pi_t}{\partial e_t} = \underbrace{\varphi'_e(d_t, e_t) \cdot f(m_t)}_{(+)\text{ import substitution}} - \underbrace{c'(e_t) \cdot m_t}_{(+)\text{ higher costs}} \quad (3)$$

For these firms, the effect of real depreciation is negative if the pass-through of real exchange rate to domestic price is low (i.e., φ'_e is small).

B. Data and Empirical Specification

Colombia's Superintendencia of Corporations (Superintendencia de Sociedades) collects a large amount of data on financial and income statements from private corporations that satisfy certain threshold asset levels, and it makes some of this information publicly available.⁷ The database used for this analysis consists of an annual unbalanced panel data from 2000 to 2012 for about 4,850 manufacturing firms. The database does not cover large

⁷ The Superintendencia of Companies exercises inspection, monitoring and control of commercial companies, branches of foreign companies and sole proprietorships that are not listed in stock exchange (the corporations that are listed in stock exchange are supervised by other superintendents) and whose assets exceeds 500 times the minimum monthly legal wage. The minimum monthly legal wage is set each year by the government and was 589,500 pesos (US\$315) in 2013. As a result of this criterion, some corporations whose assets are close to the threshold may leave the database one year (if the assets fall below the threshold) and enter again the following year (if the assets rise above the threshold).

publicly listed companies that are generally most export intensive.⁸ In the subsequent analysis, the firm-level data was complemented with various industry and aggregate time series data. In particular, the measures of real effective exchange rate and external demand are constructed at the 2-digit industry level, while aggregate time series data is used for domestic demand and interest rate.

The following regression specification is used to investigate the factors affecting the profitability of manufacturing firms:

$$\begin{aligned} \textit{Profit Growth}_{i,k,t} \\ = \alpha + \beta_1 \textit{REER}_{k,t} + \beta_2 \textit{ExtD}_{k,t} + \beta_3 \textit{DomD}_t + \beta_4 R_t \\ + \textit{Structural trade dummies}_{k,t} + u_{i,k,t} \end{aligned}$$

The regressions include firm-level fixed effects.

- $\textit{Profit Growth}_{i,k,t}$: The real growth of profits of firm i that belongs to industry k in year t . The operational profits are deflated by manufacturing producer price index (PPI).
- $\textit{REER}_{k,t}$: The growth of export-weighted real effective exchange rate (REER) of industry k in year t . Industry k is classified at the 2-digit level of ISIC (International Standard Industrial Classification).⁹
- $\textit{ExtD}_{k,t}$: Export-weighted real GDP growth of trading partners for industry k in year t .
- \textit{DomD}_t : Colombia's real GDP growth in year t .
- R_t : Colombia's interest rate in year t .¹⁰
- $\textit{Structural trade dummies}_{k,t}$: Structural trade dummies include the trade dummy with Venezuela (which takes the value of 1 if industry k faced reduced exports to Venezuela after 2008), and the trade dummy with China (which takes the value of 1 if industry k faced increased competition from China after 2008).¹¹

In the second regression, U.S. real GDP growth is added. In the third regression, we also included the growth of import-weighted REER for each industry in order to investigate the import substitution effects through REER. The observations with very large real growth of profits (300 percent in absolute terms) are excluded from the regressions, as those large

⁸ The omission of these large firms may generate biases in the results, although the number of listed manufacturing companies is fairly small to date (i.e., less than 10 as of April 2014).

⁹ Export weights are calculated using COMTRADE database. Since the trade data from COMTRADE were based on SITC (Standard International Trade Classification), while the firm-level manufacturing database was based on ISIC (International Standard Industrial Classification), the industry codes were mapped at 2-digit level.

¹⁰ The central bank's policy rate (overnight lending rate) is used.

¹¹ The Venezuela dummy includes apparel, leather products, electrical machinery, road vehicles, furniture and medical and pharmaceutical products. The China dummy includes textiles, chemicals and chemical products, rubber and plastic products, basic metals, metallic and non-metallic mineral products, and machinery and transport equipment.

movements are unlikely to be explained by the simple specification given above.¹² We note that the aggregate shocks that are not captured by the right-hand side variables (i.e., domestic real GDP growth, domestic interest rate and external demand) could be the source of endogeneity in explaining the relationship between firm-level profit growth and the REER growth at the 2-digit industry level. The direction of the bias could be positive or negative, depending on the nature of the omitted variables.

C. Results

The results show that the coefficient on REER is significant, but has an unexpected sign (Table 1). If real appreciation has contributed to the contraction of the manufacturing industry through reduced competitiveness, one would expect a positive coefficient on REER (i.e., the depreciation promotes profit growth). However, the negative sign in the regressions indicates that real appreciation increases manufacturing firms' profit growth on average. In fact, real profits grew by 0.3 percent on average in response to the appreciation of REER by one percent. This relationship may be caused by the presence of imported intermediate inputs, to the extent that export-weighted REER (at ISIC 2-digit level) is correlated with the REER for intermediate inputs.¹³

The effect of domestic demand is positive and significant. The results of the first regression show that, on average, one percent increase in Colombia's real GDP increases profit growth by 2.7 percent. The results also show that the effect of external demand is generally positive, but weak as the coefficients are not significant. The weak correlation may be caused by the construction of the external demand index as the weights are not variable over time.¹⁴ Surprisingly, the effect of the domestic interest rate is positive and significant. Given that the results may be driven by certain omitted variables, the growth rate of U.S. real GDP is included in the second regression. However, the coefficient on the interest rate remained positive and significant.

Furthermore, structural changes in trade seem to have affected firms' profit growth. The structural trade dummies both have negative and significant coefficients. Based on the first regression, the profit growth after 2008 was on average 12 percent lower for those industries that were affected by trade disruption with Venezuela. Similarly, the profit growth after 2008

¹² Such observations consist roughly 9 percent of available sample observations. As a robustness check, quantile regressions—which are more robust to outliers—were run with all observations using similar specifications. The results of quantile regressions are generally similar.

¹³ Ideally, we would like to separate the effect of the imported intermediate inputs from the effect of export revenues or the effect of import substitution, as described in the previous section. Unfortunately, this was not possible due to the lack of data on imported inputs and the corresponding exchange rate.

¹⁴ Export destinations could change in response to the demand growth of the external markets. Unfortunately, missing observations made it difficult to construct the variable weights at the 2-digit level.

was, on average 8 percent lower for those industries that faced higher competition from Chinese imports.

There is no strong evidence that import-weighted REER reduced manufacturing firms' profits. In the third regression, we included import-weighted REER instead of export-weighted REER in the regression. If the profitability of manufacturing firms has fallen as a result of competition with cheaper imported substitutes (due to real appreciation), the coefficient on this variable should be positive. However, the coefficient is negative and significant. Therefore, we cannot conclude that REER appreciation has reduced manufacturing firms' profitability via import substitution channel.

Despite the negative effect of REER on profit growth, we find that external revenues responded positively to REER depreciation and external demand. The same regressions were run by using real external revenue growth as a dependent variable (Table 2).¹⁵ The results show the expected positive relationship between REER and external revenue growth: real external revenue grew by 0.3–0.5 percent in response to one percent REER depreciation. Similarly, real external revenue grew by roughly 3 percent in response to one percent growth in external demand. To investigate why REER depreciation negatively affects profit growth despite its positive impact on external revenues, a simple regression was run just using external revenue growth and domestic demand growth (Table 3). The results show that external revenue growth affects profit growth positively, and the coefficient is significant, but the magnitude is small. Accordingly, the positive impact of REER depreciation through higher external revenue may be dwarfed by negative effects through other channels, such as the higher cost of imported material inputs. Confirming this, the baseline regressions including only firms with positive external revenues still show the negative effect of REER on profit growth, although the magnitude is smaller and they are no longer statistically significant at the 1 percent level (Table 4).

We also find that companies with higher share of external revenues suffered lower profit growth with REER appreciation. Even though REER appreciation does not seem to have reduced the profit growth of Colombian manufacturing companies on average, it could have prevented the growth of export oriented companies. To investigate this issue, the export share (i.e., the average share of external revenues in total revenues) for each firm was interacted with REER (Table 5). The positive and significant coefficients confirm that the benefits of REER depreciation are larger for firms that are more export oriented. However, the

¹⁵ External revenues reported to the Superintendence of Corporations may include revenue unrelated to exports, and could be subject to some measurement errors.

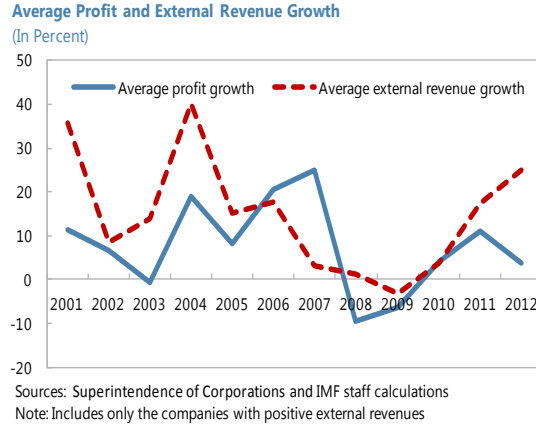
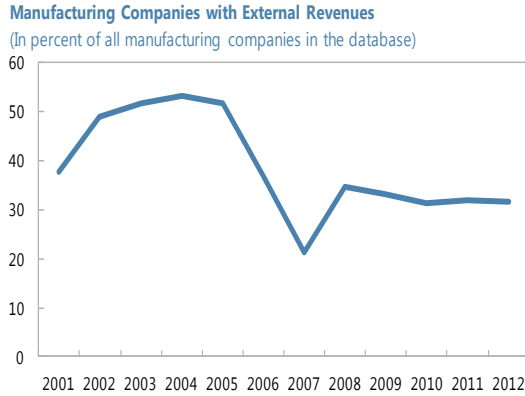
magnitude of the coefficient is relatively small, suggesting once again that the impact of REER on firms' profitability through this channel is rather limited.¹⁶

The results hold for most industries, although there is some heterogeneity across industries.¹⁷ For each industry, we ran the baseline regressions and compared the coefficients of REER on profit growth across industries (Table 6). The first column of the table shows the REER coefficient when export-weighted REER growth is used, while the second column of the table shows the results when import-weighted REER growth is used. For most industries, the coefficient of REER is negative. For some industries—including publishing and printing, rubber and plastic products, fabricated metals, machinery and equipment, motor vehicles, and furniture—the coefficient on REER is negative and significant. The coefficient on REER is positive for some industries, but insignificant in almost all cases. The only industry with a positive and significant REER coefficient is manufacturers of basic metals.

To see how real exchange rate may have affected profit growth with lags through changes in competitiveness in the external markets, the regressions were run with one-year and two-year lagged export-weighted REER (Table 7). The first four columns use profit growth as a dependent variable, while the last four columns take external revenue growth as a dependent variable. For profit growth, the results show that, except with one year lag, the coefficients are negative and significant. The third column in Table 5 shows that, when one-year lagged REER alone is included in the regression, export-weighted REER depreciation positively affects profit growth and the coefficient is statistically significant at the one-percent level. At the same time, external revenue growth does not have any statistically significant relationship with one-year lagged export-weighted REER. The difference may be partly driven by the fact that external revenue growth became a less powerful indicator of profit growth after 2007, as the share of the companies with external revenues dropped.

¹⁶ The coefficient on REER changes from -0.35 to -0.30 as the share of external revenues goes up from zero to one half. The results are essentially the same when we exclude firms with zero external revenues, although the coefficients on the interactive term are significant only at the 10 percent level.

¹⁷ For detailed studies on the heterogeneity of performance across industries within Colombian manufacturing sector, see the research by Carranza, González, Moreno and Serna (2013) and Carranza, González and Serna (2014).



Similarly, to examine how real exchange rate may have affected profit growth with lags through import substitution, the regressions were run with one-year and two-year lagged import-weighted REER (Table 8). Here again, when one-year lagged REER alone is included in the regression as shown in the third column, import-weighted REER depreciation positively affects profit growth and the coefficient is statistically significant at the one-percent level. Nonetheless, when all REERs with and without lags are included as shown in the first column, the coefficient on one-year lagged REER becomes smaller. Overall, we do not find robust evidence that real exchange rate affects profit growth through import substitution with one year lag.

D. Further Research

These results, however, do not suggest that real exchange rate appreciation is irrelevant for the development of the manufacturing sector. A persistent overvaluation of real exchange rate could reduce the size of the manufacturing sector over time through weakened competitiveness in the external markets as well as import substitution in the domestic markets.¹⁸ This paper did not look into the long-term effects of real exchange rate appreciation, as it is focused on the manufacturing sector performance during the relatively short period between 2008 and 2012. In addition, the negative effects of real appreciation may appear gradually over time through lower investment. The paper also did not look into this channel, but the issue will be left for future investigation.

IV. CONCLUSION

This paper looked into the effects of the real exchange rate, external and domestic demand and structural changes on Colombia's manufacturing sector in recent years, in order to better understand its relatively weak performance since 2008. The paper investigated this issue in

¹⁸ Clavijo, Fandiño and Vera (2014), for instance, find a support for the Dutch disease hypothesis during the 1970–2010 period using the VEC model.

two stages: first, by examining the aggregate trend of real exchange rate and external demand, as well as structural changes induced by international trade; and second, by analyzing the fundamental relationship between firms' profit growth and key variables between 2000 and 2012 using a database with a large number of manufacturing firms.

Examination of the aggregate trend of the real exchange rate show that despite a strong real appreciation of the Colombian peso against U.S. dollar, real effective exchange rate appreciation for manufacturing exports since 2008 has been fairly modest. At the same time, there have been some significant structural changes in the international trade of manufacturing products. First, exports of manufacturing goods to Venezuela declined sharply after 2008 following deterioration in their trade relations. Second, imports of manufacturing goods from China and Mexico increased significantly. Increased manufacturing imports from China have not been driven by the real effective exchange rate, but rather, it seems to be largely driven by increased access to Chinese manufacturing products.

The results of the firm-level analysis show no strong evidence that real exchange rate appreciation negatively affected manufacturing firms' profitability during this period. On the contrary, we find that real appreciation may have increased firms' profitability by reducing the cost of imported inputs as Colombian manufacturing firms become more domestically oriented. At the same time, the regression results show that export intensive companies suffered lower profit growth with real exchange rate appreciation in comparison with the companies that exported less. The results of the firm-level analysis also show that structural changes caused by trade disruption with Venezuela and greater competition from China seem to have reduced the average profitability of those firms in the affected industries.

Persistent real exchange rate appreciation can certainly be detrimental to the growth of manufacturing industries as demonstrated by the economic literature on the Dutch disease phenomenon. At the same time, these results seem to suggest that policies to improve the overall competitiveness of the manufacturing sector in Colombia should also aim at productivity enhancing measures, including labor market reform and infrastructure improvements.

Table 1. OLS Panel Regression Results on Profit Growth, 2000–2012

	<i>Dependent variable: Profit Growth</i>		
	(1)	(2)	(3)
REER Growth (export-weighted)	-0.339*** (0.0597)	-0.342*** (0.0637)	
External Demand Growth	0.0513 (0.240)	0.0673 (0.266)	-0.228 (0.259)
Domestic Demand Growth	2.731*** (0.442)	2.737*** (0.444)	3.368*** (0.452)
R	1.100*** (0.306)	1.081*** (0.334)	0.773*** (0.287)
U.S. Growth		-0.0665 (0.484)	
Dummy (Venezuela)	-12.45*** (2.401)	-12.53*** (2.458)	-13.80*** (2.376)
Dummy (China)	-6.760*** (1.902)	-6.855*** (2.024)	-7.571*** (1.884)
REER Growth (import-weighted)			-0.436*** (0.0811)
Constant	-6.771** (3.106)	-6.605** (3.333)	-6.846** (3.120)
Observations	29,699	29,699	29,699
R-squared	0.147	0.147	0.147

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of profits (above 300 percent in absolute terms) are excluded.

Table 2. OLS Panel Regression Results on External Revenue Growth, 2000–2012

	<i>Dependent variable: External Revenue Growth</i>		
	(1)	(2)	(3)
REER Growth (export-weighted)	0.289** (0.144)	0.535*** (0.155)	
External Demand Growth	2.919*** (0.502)	2.210*** (0.530)	3.549*** (0.582)
Domestic Demand Growth	-2.477** (1.039)	-3.433*** (1.063)	-3.495*** (1.114)
R	-0.499 (0.851)	0.476 (0.881)	-0.505 (0.797)
U.S. Growth		4.689*** (1.119)	
Dummy (Venezuela)	-23.27*** (5.407)	-17.49*** (5.575)	-21.89*** (5.314)
Dummy (China)	-14.48*** (4.323)	-6.938 (4.679)	-13.63*** (4.248)
REER Growth (import-weighted)			0.588*** (0.205)
Constant	25.97*** (8.233)	16.36* (8.538)	28.81*** (8.276)
Observations	10,509	10,509	10,509
R-squared	0.200	0.202	0.200

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of external revenues (above 1000 percent) are excluded.

Table 3. OLS Panel Regression Results, 2000–2012
(Includes Only Firms with Positive External Revenues)

Dependent variable: Profit Growth

Domestic Demand Growth	3.737*** (0.517)
External Revenue Growth	0.050*** (0.00816)
Constant	-9.794*** (2.476)
Observations	9,424
R-squared	0.196

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of profits (above 300 percent in absolute terms) and external revenues (above 1000 percent) are excluded.

Table 4. OLS Panel Regression Results on Profit Growth, 2000–2012

(Includes Only Firms with Positive External Revenues)

	<i>Dependent variable: Profit Growth</i>		
	(1)	(2)	(3)
REER Growth (export-weighted)	-0.245** (0.107)	-0.295** (0.115)	
External Demand Growth	-0.0132 (0.368)	0.135 (0.388)	-0.357 (0.426)
Domestic Demand Growth	2.910*** (0.767)	3.094*** (0.783)	3.533*** (0.820)
R	0.852 (0.625)	0.633 (0.651)	0.690 (0.585)
U.S. Growth		-0.987 (0.832)	
Dummy (Venezuela)	-13.38*** (3.964)	-14.65*** (4.105)	-14.75*** (3.889)
Dummy (China)	-8.508*** (3.186)	-10.10*** (3.458)	-9.405*** (3.131)
REER Growth (import-weighted)			-0.382** (0.150)
Constant	-7.148 (6.075)	-4.925 (6.357)	-7.790 (6.092)
Observations	9,388	9,388	9,388
R-squared	0.196	0.196	0.196

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of profits (above 300 percent in absolute terms) and external revenues (above 1000 percent) are excluded.

Table 5. OLS Panel Regression Results with Export Share, 2000–2012

	<i>Dependent variable: Profit Growth</i>		
	(1)	(2)	(3)
REER Growth (export-weighted)	-0.350*** (0.0598)	-0.353*** (0.0639)	
External Demand Growth	0.0527 (0.240)	0.0679 (0.266)	-0.224 (0.259)
Domestic Demand Growth	2.728*** (0.442)	2.734*** (0.444)	3.364*** (0.452)
R	1.097*** (0.306)	1.079*** (0.334)	0.768*** (0.287)
U.S. Growth		-0.0635 (0.484)	
Dummy (Venezuela)	-12.47*** (2.401)	-12.54*** (2.458)	-13.82*** (2.376)
Dummy (China)	-6.770*** (1.902)	-6.861*** (2.024)	-7.587*** (1.884)
Ex Share * REER Growth (export-weighted)	0.000926** (0.000378)	0.000926** (0.000378)	
REER Growth (import-weighted)			-0.448*** (0.0816)
Ex Share * REER Growth (import-weighted)			0.00107 (0.000775)
Constant	-6.737** (3.105)	-6.578** (3.333)	-6.795** (3.121)
Observations	29,699	29,699	29,699
R-squared	0.148	0.148	0.147

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of profits (above 300 percent in absolute terms) and external revenues (above 1000 percent) are excluded.

Table 6. OLS Regression Results by Industry, 2000–2012*Dependent variable: Profit Growth*

Sector	(1)	(2)	Obs.
	REER Growth (export-weighted)	REER Growth (import-weighted)	
Manufacture of food products and beverages	-0.209	-0.556***	5,279
Manufacture of tobacco products	-2.114	-2.904	19
Manufacture of textiles	-0.257	-0.317	1,717
Manufacture of wearing apparel; dressing and dyeing of fur	-0.0440	-0.275	2,672
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	-0.117	0.349	836
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-0.401	-1.425**	415
Manufacture of paper and paper products	-0.498	-0.478	587
Publishing, printing and reproduction of recorded media	-0.643***	-0.620**	2,677
Manufacture of coke, refined petroleum products and nuclear fuel	1.565	3.134	2
Manufacture of chemicals and chemical products	-0.198	-0.170	3,699
Manufacture of rubber and plastics products	-0.378*	-0.902***	3,234
Manufacture of other non-metallic mineral products	1.446	1.261	240
Manufacture of basic metals	2.531**	3.389***	257
Manufacture of fabricated metal products, except machinery and equipment	-0.743***	-0.589*	2,187
Manufacture of machinery and equipment n.e.c.	-1.026**	-1.126**	986
Manufacture of office, accounting and computing machinery	4.103	1.693	30
Manufacture of electrical machinery and apparatus n.e.c.	-0.119	0.633	605
Manufacture of radio, television and communication equipment and apparatus	0.736	0.180	23
Manufacture of medical, precision and optical instruments, watches and clocks	1.032	0.779	260
Manufacture of motor vehicles, trailers and semi-trailers	-0.512**	-0.686*	1,092
Manufacture of other transport equipment	-0.0971	-0.196	139
Manufacture of furniture; manufacturing n.e.c.	-0.411**	-0.510*	2,743

Notes:
*** p<0.01, ** p<0.05, * p<0.1
For each industry, regressions with the baseline specification were run. The first column of the table shows the coefficient on REER for each industry when export-weighted REER growth is used. Similarly, the second column of the table shows the coefficient on REER when import-weighted REER growth is used instead. The observations with very large real growth of profits (above 300 percent in absolute terms) are excluded.

Table 7. OLS Panel Regression Results with Export-Weighted REER Lags, 2000–2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	Profit growth	Profit growth	Profit growth	Profit growth	External Revenue Growth	External Revenue Growth	External Revenue Growth	External Revenue Growth
REER Growth (export-weighted)	-0.429*** (0.115)	-0.339*** (0.0597)			0.568** (0.254)	0.289** (0.144)		
REER G. lagged 1 (export-weighted)	-0.00863 (0.108)		0.332*** (0.0565)		0.307 (0.228)		0.0416 (0.135)	
REER G. lagged 2 (export-weighted)	-0.215*** (0.0747)			-0.116** (0.0493)	0.0453 (0.175)			-0.204* (0.118)
External Demand Growth	-0.382 (0.308)	0.0513 (0.240)	0.221 (0.235)	0.264 (0.252)	3.016*** (0.646)	2.919*** (0.502)	2.203*** (0.474)	2.108*** (0.510)
Domestic Demand Growth	3.888*** (0.574)	2.731*** (0.442)	4.524*** (0.511)	3.823*** (0.491)	0.596 (1.336)	-2.477** (1.039)	-0.504 (1.232)	0.0145 (1.148)
R	0.986*** (0.327)	1.100*** (0.306)	0.504* (0.298)	0.0794 (0.292)	-2.175** (0.941)	-0.499 (0.851)	-1.092 (0.834)	-1.221 (0.829)
Dummy (Venezuela)	-9.741*** (2.584)	-12.45*** (2.401)	-10.86*** (2.460)	-12.20*** (2.558)	-22.11*** (5.770)	-23.27*** (5.407)	-20.01*** (5.406)	-20.23*** (5.699)
Dummy (China)	-3.611* (2.105)	-6.760*** (1.902)	-4.867** (1.994)	-5.752*** (2.041)	-11.19** (4.737)	-14.48*** (4.323)	-11.50*** (4.391)	-11.10** (4.604)
Constant	-12.08*** (3.546)	-6.771** (3.106)	-11.66*** (3.363)	-6.685** (3.233)	20.57** (9.210)	25.97*** (8.233)	20.61** (8.666)	18.66** (8.288)
Observations	27,032	29,699	28,385	27,032	9,463	10,509	10,011	9,463
R-squared	0.161	0.147	0.153	0.160	0.211	0.200	0.204	0.210

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of profits (above 300 percent in absolute terms) and external revenues (above 1000 percent) are excluded.

Table 8. OLS Panel Regression Results with Import-Weighted REER Lags, 2000–2012

	<i>Dependent variable: Profit Growth</i>			
	(1)	(2)	(3)	(4)
REER Growth (import-weighted)	-0.335*** (0.106)	-0.436*** (0.0811)		
REER G. lagged 1 (import-weighted)	0.211* (0.110)		0.399*** (0.0763)	
REER G. lagged 2 (import-weighted)	-0.0139 (0.0840)			-0.149** (0.0720)
External Demand Growth	-0.193 (0.290)	-0.228 (0.259)	0.161 (0.236)	0.482* (0.254)
Domestic Demand Growth	4.395*** (0.516)	3.368*** (0.452)	4.029*** (0.488)	3.430*** (0.480)
R	0.634** (0.310)	0.773*** (0.287)	0.491 (0.300)	0.0757 (0.292)
Dummy (Venezuela)	-11.20*** (2.572)	-13.80*** (2.376)	-11.34*** (2.454)	-12.61*** (2.542)
Dummy (China)	-3.914* (2.113)	-7.571*** (1.884)	-5.387*** (1.986)	-6.176*** (2.028)
Constant	-11.93*** (3.409)	-6.846** (3.120)	-8.598*** (3.209)	-5.641* (3.194)
Observations	27,032	29,699	28,385	27,032
R-squared	0.161	0.147	0.153	0.160

Notes:

Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

All regressions include firm-level fixed effects. The observations with very large real growth of external revenues (above 1000 percent) are excluded.

References

- Carranza, J. E., A. Gonzalez, and N. Serna, 2014, “La relación entre la producción y el comercio exterior de la industria manufacturera colombiana,” Borradores de Economía, no. 806, Central Bank of Colombia.
- _____, 2013, “Breve Análisis de los efectos de la demanda venezolana sobre el desempeño de la industria colombiana,” Central Bank of Colombia.
- Carranza, J. E., A. Gonzalez, S. Moreno, and N. Serna, 2013, “Reporte sobre la coyuntura industrial (enero–mayo, 2013),” Central Bank of Colombia.
- _____, 2013, “Analysis de la heterogeneidad de la industria colombiana,” Central Bank of Colombia.
- Clavijo, S., R. A. Fandiño, and A. Vera, 2013, “Deindustrialization of Colombia: Quantitative Analysis of Determinants,” SSRN Working Paper Series No. 2362369.
- Frankel, J., 2010. “The Natural Resource Curse: A Survey,” NBER Working Paper No. 15836, (Boston: National Bureau of Economic Research).