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Competitive Devaluations in Commodity-Based Economies: Colombia and the Pacific Alliance Group

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Abstract

This paper investigates whether there is an S-Curve in Colombia using bilateral and disaggregated quarterly data for the period 1991-2014. More precisely, the short-run effects of a depreciation on the TB are analysed in 27 industries covered by the PAG Free Trade Agreement. The S-Curve found in sectors representing 30% of total industrial production suggests that in these cases competitive devaluations have a positive effect on the TB in the short run. However, the regression analysis using both OLS and FE methods shows that sizable ones are needed to produce the desired effects on trade flows. Our findings have important policy implications: since only large competitive devaluations can restore TB equilibrium, industrial restructuring would appear to be a more sensible strategy, though this cannot be achieved in the short run and is instead a medium/long-term goal.

JEL-Codes: F100, F400, O100.

Keywords: devaluations, trade balance, S-Curve, PAG Free Trade Agreement.

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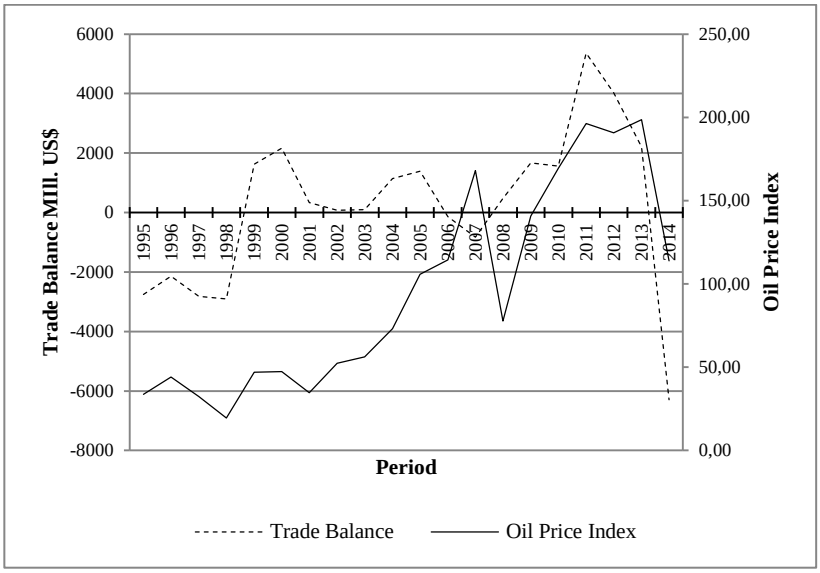
1. Introduction

The recent sharp decline in oil prices has led to a significant deterioration of the trade balance (TB) in Colombia. Policy makers have responded by devaluing the currency and signing up to the Pacific Alliance Group (PAG) Free Trade Agreement (FTA). The aim of this study is to evaluate the effects on trade flows of this type of competitive devaluation in a commodity-based economy such as Colombia. According to the price elasticity approach a devaluation should increase exports by making them cheaper in terms of the foreign currency and decrease imports by making them more expensive in terms of the domestic currency. However, the empirical evidence is rather mixed. Magee (1973) reported considerable time lags. These could be even more significant in the case of a country such as Colombia, which is highly dependent on oil exports, that represent almost 80% of total exports.[1]

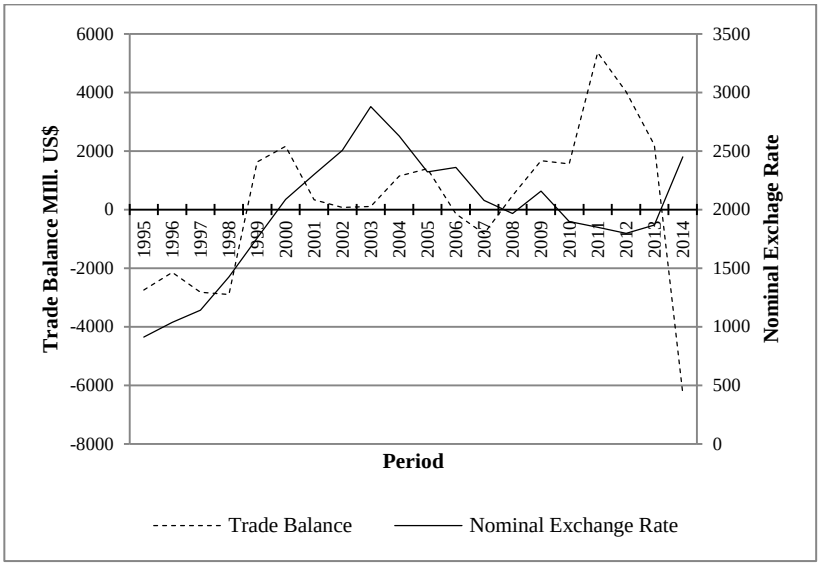
Figures 1 and 2 show that the Colombian TB is positively/negatively correlated to the oil price index/nominal exchange rate. It can be seen that during periods with higher oil prices (the first decade of this century) the TB is in surplus, and the nominal exchange rate appreciates.

Figure 1. Trade Balance and Oil Price Index



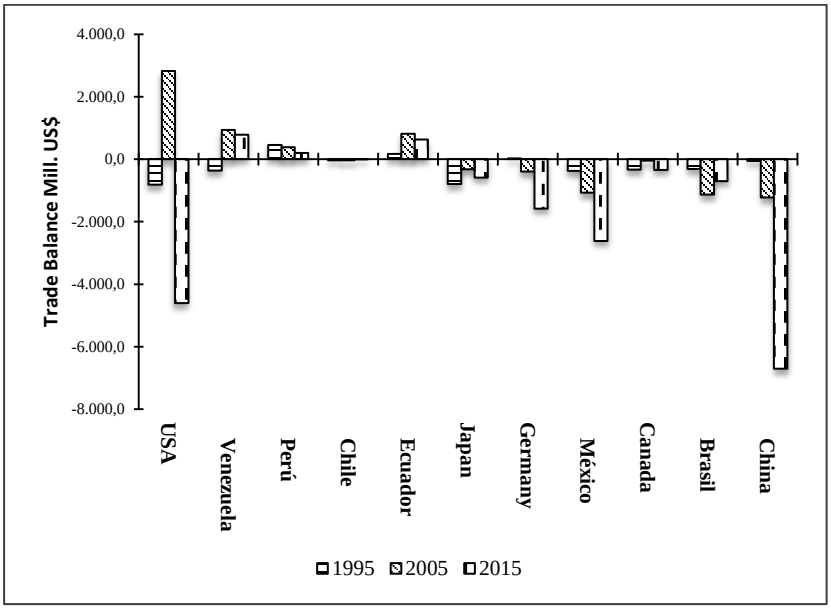
Source: DANE (www.dane.gov.co)

Figure 2. Trade Balance and Nominal Exchange Rate



Source: DANE (www.dane.gov.co)

Figure 3. Colombia's Trade Balance vis-à-vis Its Main Trading Partners



Source: DANE (www.dane.gov.co)

Figure 3 shows the Colombian TB vis-à-vis its PGA trade partners during the period 1995-2015. While it remained in surplus in all cases but vis-à-vis Mexico, overall there was a negative trend, with increasing deficits with respect to the US, China and other

advanced economies.

The present study makes a twofold contribution. First, it analyses the short-run effects of a devaluation of the peso on Colombia's TB vis-à-vis its PAG trade partners, for which no previous evidence is available, during the period 1991-2014. Second, by using bilateral data disaggregated by commodity, it sheds light on the role played by different industrial sectors, an issue that has also been relatively neglected in the literature (Bahmani-Oskooee and Ratha, 2007c; Bahmani-Oskooee and Ratha, 2008). For this purpose, it follows the S-curve approach of Backus *et al*. (1994), which is based on the shape of the cross-correlation function. In addition, both OLS and fixed effects (FE) models are estimated. As emphasised by Magee (1973), Meade (1988), and Backus *et al*. (1994)**,** price and trade dynamics are also determined by orders and time to delivery of imported goods, and the time required for exporters to change capacity.

The remainder of the paper is organised as follow: Section 2 briefly reviews the literature. Section 3 outlines the methodology. Section 4 describes the data and presents the empirical results. Section 5 offers some concluding remarks.

2. Literature Review

The literature on the TB effects of currency depreciations (appreciations) is extensive. Various papers investigated whether there is a so-called "J-curve", with devaluations leading to a short-run deterioration of the TB but a long-run improvement (see Bahmani-Oskooee, 1985; Rahman, Mustafa, and Burckel, 1997; Himarios, 1989; Rose and Yellen, 1989; Briguglio, 1989; Noland, 1989; Rose, 1990; Berument, 2005), with mixed results. Most studies use bilateral aggregate data (see, e.g., Boyd *et al.*, 2001; Lal, and Lowinger, 2002; Onafuwora, 2003; McDaniel, and Agama, 2003; Fullerton and Sprinkle, 2005; Bahmani-Oskooee et al., 2006; Narayan, 2006; Bahmani-Oskooee, and Hegerty, 2011; Dash, 2013; Costamagna, 2014), again providing mixed evidence. However, as pointed out by Rose and Yellen (1989), there might be an 'aggregation bias' affecting those results. Therefore, some recent papers have analysed disaggregate data instead (see, e.g., Baek, 2007; Bahmani-Oskooee, and Hegerty, 2010, 2014).

In commodity-based economies, higher (lower) commodity prices could lead to appreciations (depreciations) of the currency. For instance, Habib and Kalamova (2007), Kalcheva and Oomes (2007), Jahan-Parvar and Mohammadi (2008), Korhonen and Juurikkala (2009), Hasanov (2010) find that the real exchange rates in oil producing countries appreciates in the long run as a result of higher oil prices. Since the seminal paper of Backus *et al.* (1994) on the S-Curve, various studies using aggregate (Bahamani-Oskooee *et. al*, 2008c), bilateral (Bahamani-Oskooee and Ratha, 2007c), and industry-level (Bahamani-Oskooee and Ratha, 2009b; 2010) data have also been carried out on this topic.

In addition, there exists an extensive literature on the effects of regional integration on trade flows. Most studies are based on Viner's (1950) framework and analyse the dynamic effects of geographical size, industry location, and economies of scale (see, e.g., Caporale *et al.*, 2009). As Frankel and Wei (1998) pointed out, geographical proximity or distance is a key factor for Free Trade Agreements (FTAs) given the importance of transport costs (Helpman and Krugman, 1985).

3. Empirical Methodology

This study examines the short-run effects of devaluations on the Colombian TB as in Backus *et al*. (1994), namely using the cross-correlation function between the TB and the real bilateral exchange rate (RBER) of Colombia vis-à-vis each of its PAG partners (Chile, Ecuador, Mexico, and Peru).

Backus *et al*. (1994) show that the cross-correlation coefficients between the current exchange rate and future (past) values of TB are positive (negative): if a real depreciation improves the TB, then the correlation coefficient must be positive.

The cross-correlation function is the following

$$y_k = \frac{\Sigma\left(REX_t - \bar{REX}\right)\left(TB_{t+k} - \bar{TB}\right)}{\sqrt{\Sigma\left(REX_t - \bar{REX}\right)^2 \left(TB_{t+k} - \bar{TB}\right)^2}} \qquad (1)$$

where *k* takes values -5, -4, -3, ...0, +1, +2, ... +5; *REX* is the real bilateral exchange rate

defined as (P_{GPA}. NER/ P_C), P_{GPA} being the price level in each of the PGA countries and P_C the price level in Colombia; NER is the nominal exchange rate defined as the number of units of Colombian Peso per unit of foreign currency. TB_i is the TB of industrial sector i calculated as $TB_i = (X_i - M_i)/GDP$, where X_i and M_i stand respectively for exports and imports of industry i to/from each PGA country. The real TB is calculated dividing the nominal TB by the GDP deflator. Plotting y_k against *k* yields the S-Curve.

4. Empirical Results

4.1 Data and S-curve Analysis

Disaggregated data from DANE (Departamento Administrativo Nacional de Estadísticas) are used in this study to avoid any potential aggregation bias in evaluating the effects of a devaluation on trade flows. The frequency is annual and the sample period goes from 1991 to 2014. The disaggregation is based on the 2-digit CIIU (Clasificación Industrial Internacional Unificada) industrial classification. 27 industrial sectors from a total of 99 were included in the analysis (those for which there are bilateral trade flows between Colombia and the other PGA countries). Total annual exports and imports are both in US dollars, with the latter being the FOB (Free On Board) series. Table 1 shows the industrial sectors examined by SITC code. It should be noted that these data do not allow to capture the effects on trade of any tariff and/or tax reductions resulting from Colombia signing up to the PGA FTA.

Table 1 summarises the S-Curve results obtained from the cross-correlation functions in (1) with leads and lags of up to five years. Figures A1 to A4 in the Appendix show the sectoral results for Colombia vis-a-vis each of its PGA partners. The correlations are reported on the vertical axis, and the number of leads or lags *k* on the horizontal axis. It appears that there is an S-curve in 31 (29.80%) out of 104 industrial sectors in Colombia, i.e. in these cases a devaluation of the Colombian peso improves the TB in the short run.

Table 1. S-Curve and Bilateral Analysis by Industrial sector

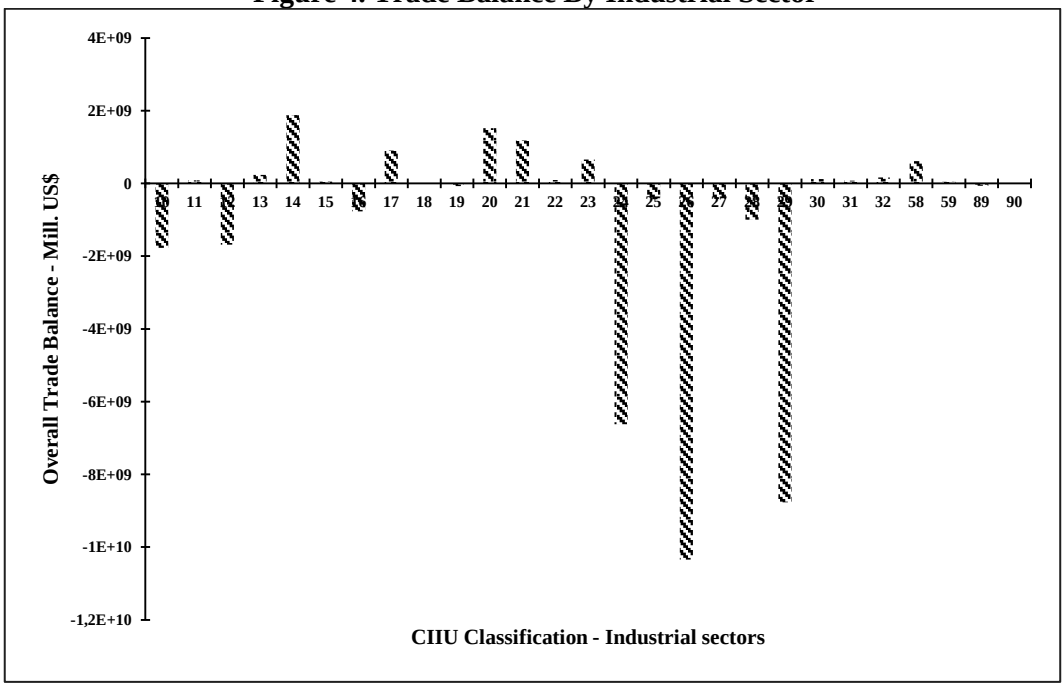
CIIU Code	Industrial Sectors	Chile	Ecuador	México	Peru
10	Manufacture of food products	Yes	Yes	No	No
11	Preparation of beverages	No	No	No	No
12	Manufacture of Tobacco	No	No	No	No
13	Manufacture of textiles	No	No	No	No
14	Manufacture of clothing	No	No	No	No
15	Tanning and retaining of leather; shoemaking; manufacture of suitcases, handbags and similar articles and manufacturing of saddler and harness; dressing and dyeing of fur	No	Yes	No	No
16	Wood processing and manufacture of products of wood and cork, except furniture; manufacture of articles of straw and plaiting	No	Yes	No	No
17	Manufacture of paper, cardboard and paper products and cardboard	No	No	No	Yes
18	Printing activities and production of copies from original recordings	Yes	Yes	Yes	No
19	Coking, manufacture of refined petroleum products and fuel blending activity	Yes	No	No	No
20	Manufacture of chemicals and chemical products	No	No	Yes	No
21	Manufacture of pharmaceuticals, medicinal chemicals and botanical products for pharmaceutical use	Yes	No	No	No
22	Manufacture of rubber and plastic	Yes	No	No	No
23	Manufacture of other non-metallic mineral products	Yes	No	No	No
24	Manufacture of basic metal products	No	No	No	No
25	Manufacture of fabricated metal products, except machinery and equipment	Yes	No	Yes	No
26	Manufacture of computer, electronic and optical products	Yes	Yes	Yes	Yes
27	Manufacturing equipment and electrical equipment	No	No	Yes	Yes
28	Manufacture of machinery and equipment	No	No	No	No
29	Manufacture of motor vehicles, trailers and semitrailers	No	Yes	Yes	Yes
30	Manufacture of other transport equipment	No	No	Yes	Yes
31	Manufacture of furniture, mattresses and box springs	No	No	No	Yes
32	Other manufacturing	No	No	No	No
58	Publishing activities	No	Yes	No	No
59	Motion picture, video and television program production, sound recording and music publishing	Yes	Yes	No	Yes
		No	No	No	No
90	Creative, arts and entertainment activities	Yes	No	No	No
	Total GPA's countries S-Curve performed	**10**	**8**	**7**	**7**

Source: DANE (www.dane.gov.co)

However, for three of the main industries (Manufacture of basic metal products sector; Manufacture of computer, electronic and optical products; and, Manufacture of Motor vehicles, trailers and semitrailers) a devaluation does not have the desired effects on trade flows.

Figure 4 shows the TB in real terms by industrial sector. The sectors with the biggest deficit are: i) Manufacture of basic metal products sector; ii) Manufacture of computer, electronic and optical products; and iii) Manufacture of motor vehicles, trailers and semitrailers.

Figure 4. Trade Balance By Industrial Sector



Source: DANE (www.dane.gov.co)

4.2 Regression Analysis

The S-curve analysis has shown that there is such a pattern in 30% of the industrial sectors. Next, in order to quantify the effects of a devaluation on the TB of the three sectors with the biggest deficits, we estimate both a baseline OLS regression and a fixed effects (FE) model for each of them. As shown by Egger (2002), the advantage of the latter is that it allows for unobserved factors affecting bilateral trade flows and also takes into account country-specific heterogeneity.

Table 2 presents descriptive statistics of the variables used for the estimation, namely the TB of each sector, GDP (in millions of US dollars) and the bilateral real exchange

rate vis-à-vis Colombia's PGA trading partners. As already mentioned, the series are annual and cover the period from 1991 to 2014.

Table 2. Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Trade Balance of Manufacture of basic metal products (US Dollars)	96	7.710.000	137.000.000	-687.000.000	50.500.000
Trade Balance of Manufacture of computer, electronic and optical products (US Dollars)	96	-91.300.000	306.000.000	-176.000.000	146.000.000
Trade Balance of Manufacture of motor vehicles, trailers and semitrailers (US Dollars)	96	-120.000.000	309.000.000	-1.210.000.000	6.600.828
GDP (Million of US dollar)	96	145.388,20	36.800,46	96.489,13	222.600,60
Bilateral Real Exchange Rate	96	94,57	27,57	53,79	145,54

The bilateral real exchange rate (RBER) between Colombia and its PGA trading partners was also obtained from DANE[2] and is defined as the product of the nominal exchange rate and the relative price level, i.e.

$$RER_{i,t} = e_{i,t} \times \frac{p_t}{p^*_{i,r}}$$

where the price level in the home and foreign country is equal to p and p^*_i respectively, and e_i is the nominal exchange rate between the currencies of the foreign country i and the home country, expressed as the number of foreign currency units per unit of home currency, so that an increase in e_i represents an appreciation of the domestic currency.

The estimated panel model is the following:

$$TB_{it} = \alpha + \beta_0 \cdot RBER_{it} + \beta_1 \cdot GDP_{it} + \eta_i + u_{it} \quad (2)$$

where TB_{it} is the annual TB measured in US dollars for sector *i* at time *t* ; $RBER_{it}$ is the corresponding annual real bilateral exchange rate expressed in log form, and GDP_{it} is the gross domestic product, also in logarithmic form, which is included in order to control for endogeneity; η_i is country *i*'s fixed effects, and u_{it} is an idiosyncratic error. We expect a positive coefficient on $RBER_{it}$ and a negative one on GDP_{it} —i.e. $(\beta_0 > 0)$ and $(\beta_1 < 0)$— since a RBER appreciation (depreciation) is expected to deteriorate (improve) the TB.

Tables 2, 3, and 4 show the estimation results.[34] The coefficients have the expected sign in all cases. From Table 2, it can be seen that in the case of manufactures of basic metal a 1% increase in RBER (a depreciation) improves the sectoral TB by approximately 673 US dollars. This sector had a trade deficit of 768^5 million of US dollars in 2014; hence, a large devaluation is required for the TB to improve significantly. A 1% increase in GDP leads to a deterioration of its TB by 333 millions of US dollars.

Table 3 shows that the OLS and FE estimates for computer, electronic and optical goods are all significant and very similar. The FE method indicates that a 1% one of RBER improves the sectoral TB by 1385 US dollars. .

However, since the trade deficit in 2014 was 1,141,907,396.4 US dollars, a much larger depreciation of the currency is needed for the sectorial TB to be pushed into equilibrium. GDP has again a negative effect.

Table 2. Regression output. Sector CIIU classification 24: Manufactures of Basic Metal

Variables	(i) OLS	(ii) FE	(iii) FE Time effects
Real Bilateral Exchange Rate	673,92*** (170,97)	627,55*** (155,85)	809,86* (349,73)
GDP	-333,61*** (45,88)	-331,69*** (37,98)	-267,53 (133,24)
Constant	2512,1*** (598,44)	2583,35*** (504,44)	1432,36* (906,39)
Observations	96	96	96
R-squared	0,396	0,49	0,544
Number of Country		4	4
Country FE		YES	YES
Year FE			YES

Country fixed effects have been included in all specifications. The dependent variable is RBER. ***Significant at 1% level; **Significant at 5% level; *significant at 10% level.

Table 3. Regression output. Sector CIIU classification 26: Manufactures of Computer, Electronic and Optical Products

Variables	(i) OLS	(ii) FE	(iii) FE Time effects
Real Bilateral Exchange Rate	1589,02*** (432,16)	1385,55*** (407,95)	1865,64 (1018,95)
GDP	-480,68*** (115,98)	-472,26*** (99,43)	-469,52 (475,78)
Constant	2386,26 (1512,62)	2626,97** (1320,42)	1643,07 (3732,30)
Observations	96	96	96
R-squared	0,222	0,25	0,34
Number of Country		4	4
Country FE		YES	YES
Year FE			YES

Country fixed effects have been included in all specifications. The dependent variable is RBER. ***Significant at 1% level; **Significant at 5% level; *significant at 10% level.

5

Finally, Table 4 shows that a 1% depreciation of RBER improves the sectoral TB for manufactures of motor vehicles, trailers and semitrailers by 1280 US dollars. Given the huge deficit in 2014 (1.168.282.646,1 US dollars), a large depreciation is also necessary in this case to bring the TB back to equilibrium. GDP has once more a negative coefficient.

Table 4. Regression output: Sector 29: Manufactures of Motor Vehicles, Trailers and Semitrailers

Variables	**(i) OLS**	**(ii) FE**	**(iii) FE Time effects**
BRER	1208,07*** (444,30)	716,98** (351,22)	1265,7 (878)
GDP	-500,60*** (119,24)	-480,32*** (85,60)	-421,28 (406,50)
Constant	3367,28** (1555,14)	4122,02*** (1136,2)	2292,40 (3363)
Observations	96	96	96
R-squared	0,191	0,266	0,317
Number of Country		4	4
Country FE		YES	YES
Year FE			YES

Country fixed effects have been included in all specifications. The dependent variable is RBER. ***Significant at 1% level; **Significant at 5% level; *significant at 10% level.

5. Conclusions

This paper investigates whether there is an S-Curve in Colombia using bilateral and disaggregated quarterly data for the period 1991-2014. More precisely, the short-run effects of a depreciation on the TB are analysed in 27 industries covered by the PAG Free Trade Agreement. The sharp drop in 2014 in the price of oil, Colombia's main export, led to a significant deterioration of the TB. Competitive devaluations followed in an attempt to restore equilibrium. The S-Curve analysis suggests that indeed these had a positive effect on the TB in the short run in sectors representing 30% of total industrial production. However, the regression results obtained using both OLS and FE methods show that sizable ones are needed to produce the desired effects on trade flows. Our findings have important policy implications: since only large competitive devaluations restore TB equilibrium, it would appear that a more sensible strategy

would be to pursue industrial restructuring, though this cannot be achieved in the short run and is instead a medium/long-term goal.

Endnotes

[1] http://www.dane.gov.co/index.php/comercio-exterior/balanza-comercial

[2] To ensure that the FE model is efficient, we tested if the idiosyncratic errors term u_{it} had a constant variance across t and no serial correlation. In this study we applied Wooldridge's test (2002) developed by Drukker (2003), based on the residuals from OLS estimation of the first difference of equation (1). We also ran the Wald-test for heteroscedasticity-robust standard error to potential unknown variance and covariance properties of the errors and data.

[3] http://www.dane.gov.co/files/observatorio_competitividad/entorno_macroeconomico/metodologia.pdf

Appendix

Figure A1. S-Curve: Chile

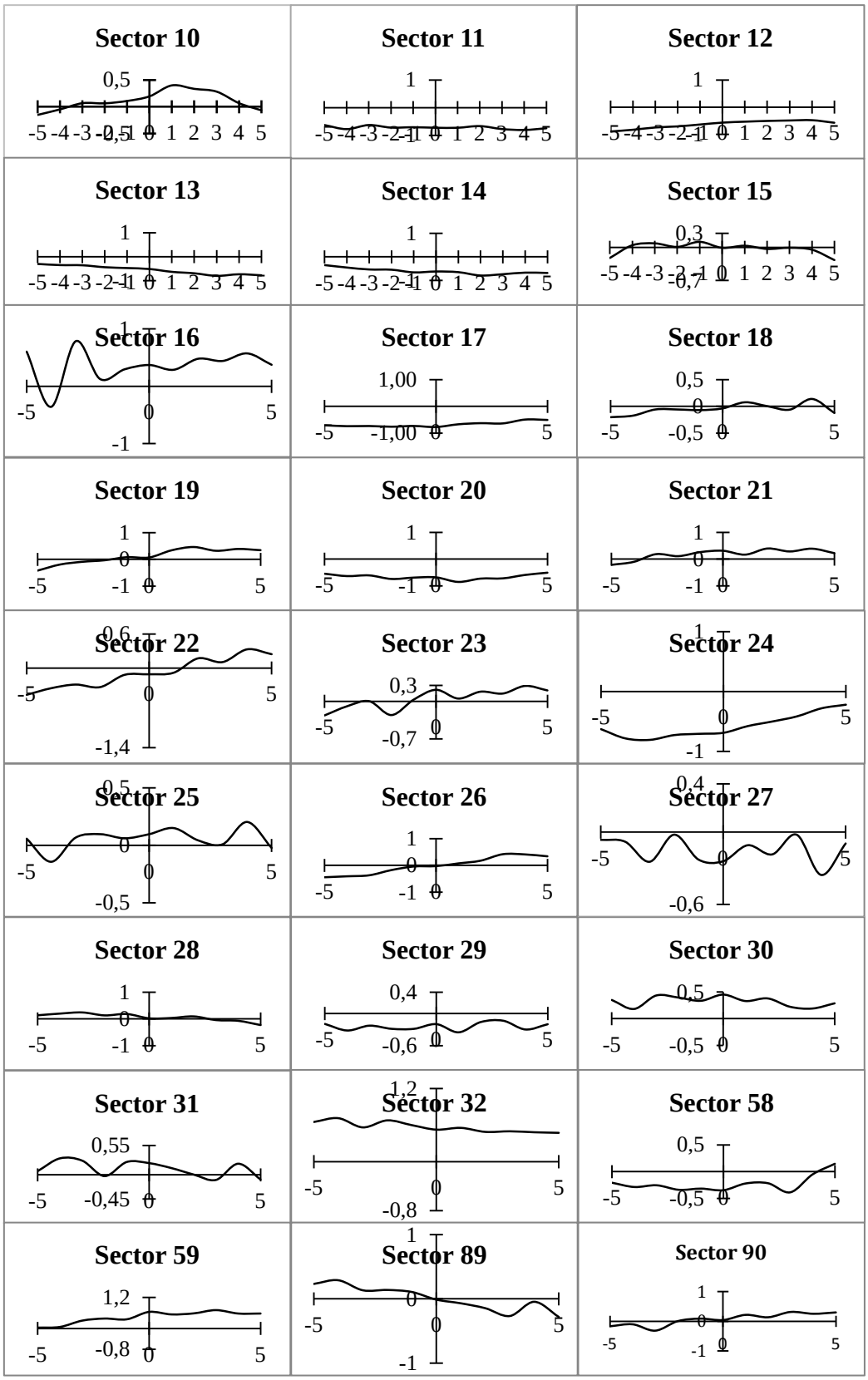


Figure A2. S-Curve: Ecuador

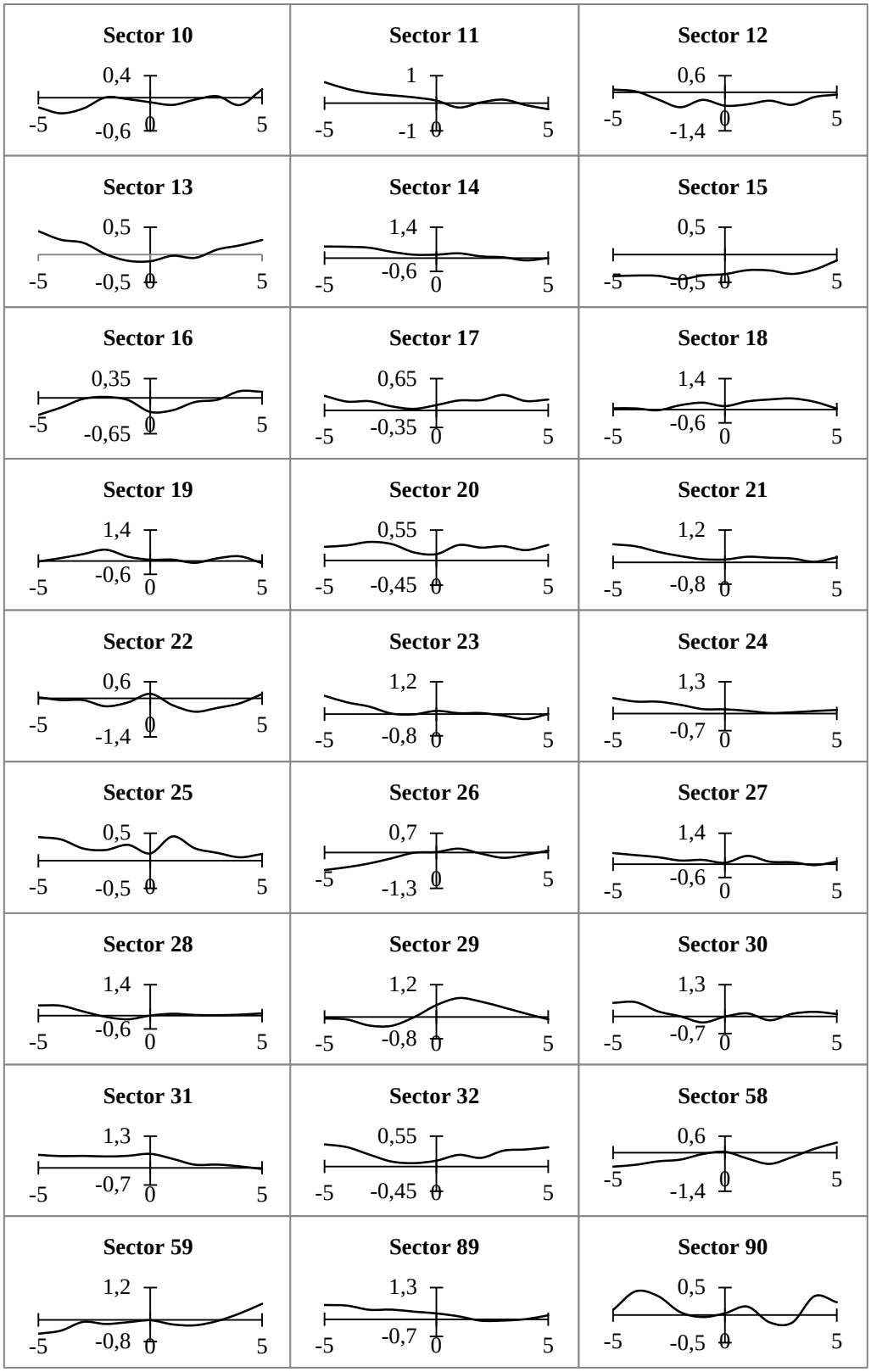


Figure A3. S-Curve: Mexico

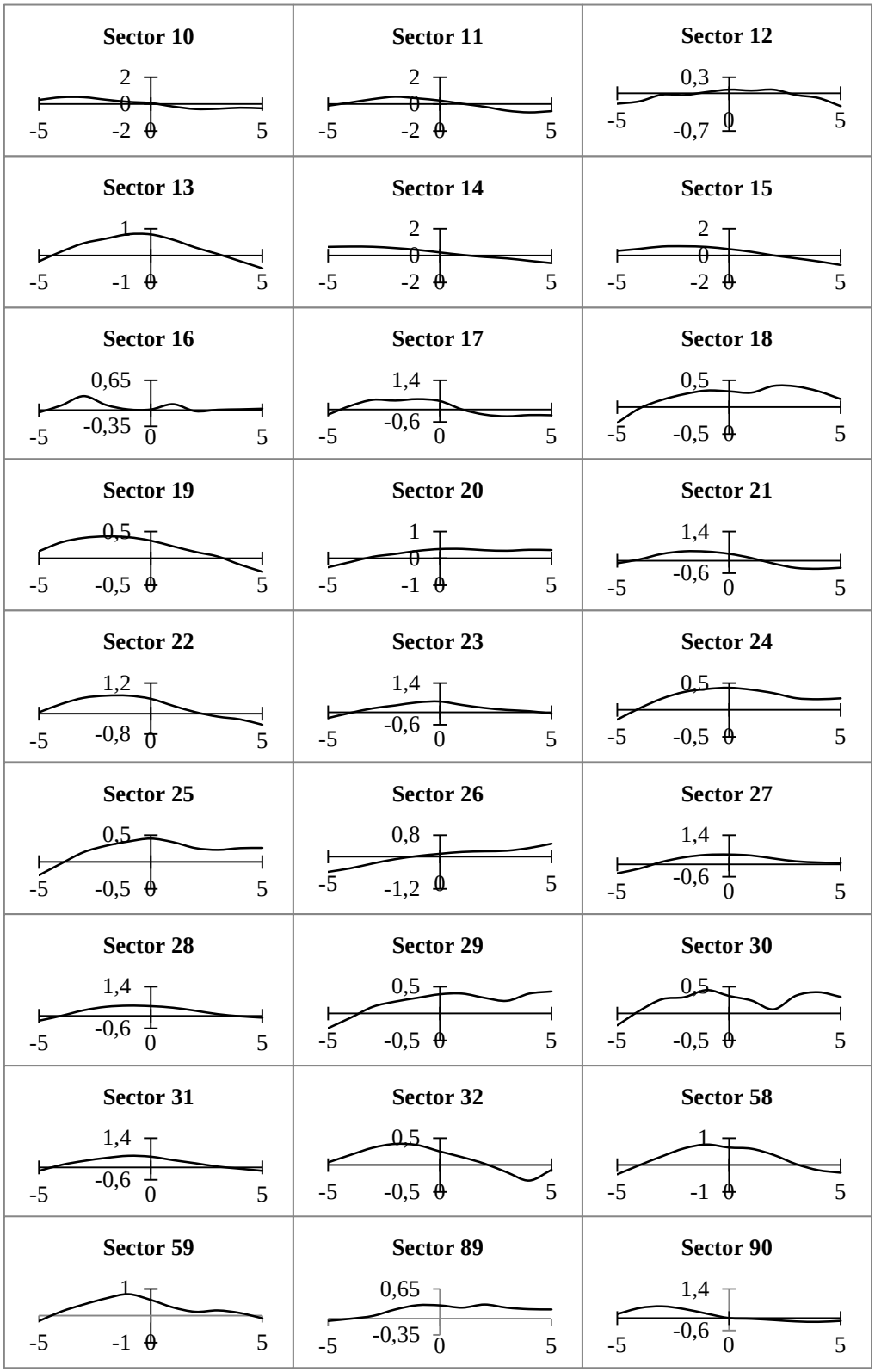
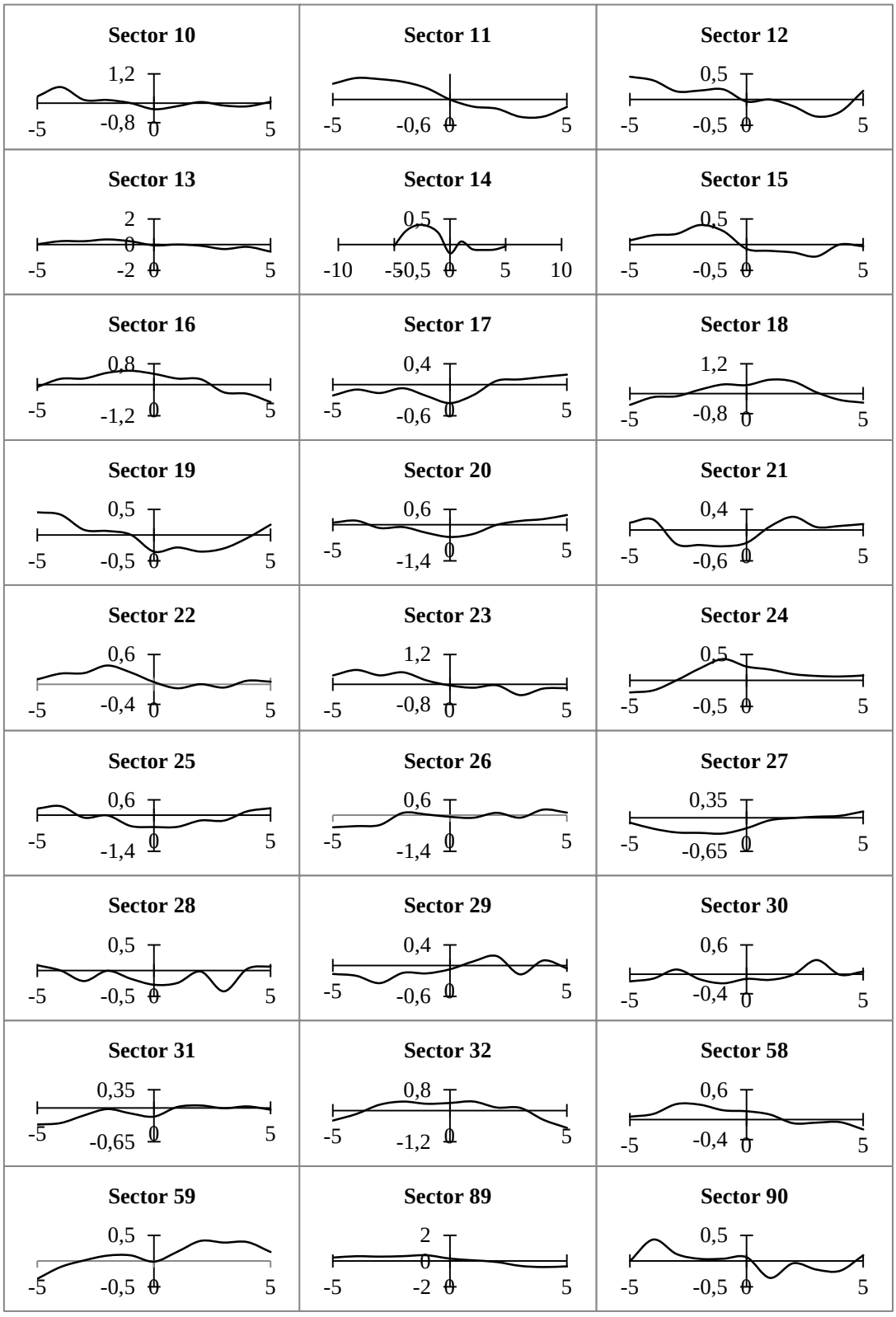


Figure A4. S-Curve: Peru



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