Universidad del Rosario

Facultad de Economía

MEDIA BIAS AND CENTRAL BANK RESPONSE.
EVIDENCE FROM THE NOMINAL EXCHANGE RATE BEHAVIOR IN COLOMBIA

Rodrigo Taborda.

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Abstract

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JEL codes: A19, C25, E58.

Key words: News bias, Central banking, Colombia, Nominal Exchange Rate (NER), Negative Binomial Regression Model (NBRM), probit model.

[*]Universidad del Rosario. Departamento de Economía. Calle 14 # 4 - 69. Bogotá, Colombia. E-mail: *rordrigo.taborda@urosario.edu.co*.

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1 Introduction

The behavior of the Nominal Exchange Rate (NER) is constantly reported in Colombian newspapers and commented in editorials and op-eds. However, the number and flavor of news and commentary seems to increase disproportionately during revaluation in contrast to a devaluation of the NER.[1] During the course of a revaluation it is common to read in the press claims, not facts, of firms and entire industries in distress due to revaluation and the benefits of outdated policies such as: fixed and multiple exchange rates —as it happened since 1967 with the enactment of the Law 444 (Congreso de Colombia, 1967)—, if not a dollarization of the economy.[2]

On one hand, news and op-eds maintain the idea that revaluation is devastating for the macroeconomic performance of the country, due to the reduced income for exporters and the subsequent effects on employment and wages of workers in related industries. On the other hand, when devaluation occurs few news, editorials and op-eds are published. There are no complaints addressing plausible effects of a devaluation, such as high prices of foreign capital (machinery and equipment) or imported raw materials. Furthermore, there is seldom reference regarding the associated risks on local inflation.

This asymmetry in the number of news, editorials and op-eds is hard to understand. Why would it be more important to report and discuss revaluation instead of devaluation? Why are there claims of benefits of a fixed exchange rate when the country already went through the crippling effects of an exchange rate black market premium? As depicted by Easterly (2002, p. 222) "[a high black market premium] is a punitive tax on exporters—not a good incentive for growth." Finally, after 18 years of a market determined NER, why revaluation is still reported as harmful for the economy, when after all, there are more devaluation episodes than revaluation ones? This paper purports that an answer to these questions lie on the existence of media bias reporting the behavior of the NER.

More specifically, the existence of an interest group populating media outlets with news to increase awareness on readers and government officials of revaluation and its "catastrophic" consequences is considered. When this is the case, the media benefits from an increasing audience and subsequent higher income, i.e., via advertising. The interest group's goal is also fulfilled when government (fiscal authority) offers subsidies or the central bank (monetary authority) intervenes in the exchange rate market. Both institutions may tame the expression of discomfort with policy measures upon the exchange

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[1]The Nominal Exchange Rate (NER) in Colombia is defined as the number of Pesos per Dollar. Devaluation is defined as an increase in the number of local currency –pesos– for one US dollar. Revaluation is a reduction in this relationship. In Colombia devaluation and revaluation are used indistinctively with respect to appreciation or depreciation which are more appropriate definitions. In this paper the former are used for consistency with the use in the media.

[2]For example, see Córdoba (2001) for dollarization claims and and Caballero (2008) on returning to the 1967 exchange rate regime.

rate or subsidies in favor of the affected industries, gaining the affection of the interest group and the public.

There is a growing literature in the topic of media bias and media slant. Gentzkow and Shapiro (2008) offer a review of the theoretical and empirical approaches to this topic. There are supply and demand side models. On the supply side, the distortions of news and its relationship with private sector and government capture of media are the core subjects. On the demand side the distortion comes from the public, the public likes to see more news with certain bias or slant and media compete for them. The empirical evidence of media bias shown in this paper fits into the supply side models. Specifically, the work of Corneo (2006) is an appropriate analytic framework for the alleged sources of media bias and slant in this paper.

Corneo builds a voting and media capture model. To begin, an interest group seeks to form a coalition with the media. The interest group is looking for a policy that will favor his current (ill-fated) status. Media can accept or not to form a coalition, when it does not, media shows independence and presents an honest state of the world. When it does, media reaches the citizen presenting a state of the world accordingly with the interest group's view. Based on this state of the world, citizens vote in the next elections in favor of a policy (or policy maker) that alleviates it. Corneo establishes the conditions for the coalition to be formed, and how citizens vote in the next elections under the state of the world presented by the media.

This theoretical sequence of events seems to fit well the Colombia's news bias when reporting the behavior of the NER. The media, attentive to the message from an interest group, presents to the public the outrageous effects of a revaluation. The interest group is in search for sympathy and help from fiscal and monetary authorities. Once the message of disaster has been spread, a mix of timid-but-realistic and decisive-but-chimerical expressions of support from public servants appear. The bearer of the message becomes an allied of the interest group, increases his visibility and capitalizes political power for the next elections.

This paper finds empirical evidence of Corneo's sequence of events related to reporting the behavior of the exchange rate in Colombia. First the relationship between the number of news, editorials and op-eds discussing the behavior of the NER and the occurrence of revaluation or devaluation is explored. The findings support the hypothesis of asymmetrical number of news with a high (low) correlation of news and revaluation (devaluation). Second, not only the number, but the content and flavor of the news is explored using text analysis techniques. The results confirm the association of language and emphasis between "revaluation" (as a word) and the appearance of words such as: central bank, government and exporters; while the word "devaluation" is far from such words. Finally, the paper shows that the Colombian central bank's decision to inter-

vene in the exchange rate market is positively correlated with the asymmetric number of news discussing the behavior of the NER and not only with the arguments purported by the central bank, such as to control short term volatility or accumulate international reserves.

The contribution of the paper is twofold. The first one is methodological, by framing media bias as the uneven reporting of an economic outcome, and using the asymmetry specification with a Negative Binomial Regression Model (NBRM) regression, the media bias is easily shown empirically. When text analysis is used and the correlation of words of interest shows a particular grouping, bias becomes more transparent. The second one is the new evidence on the motivation for a central bank to intervene in the exchange rate market. Showing how the number of news is correlated with intervention, even after taking into account the endogeneity of the variable, the paper introduces, so far an unobserved variable not taken into account in previous studies of central bank intervention of the exchange rate market (Taylor, 1995; Humpage, 2003). In the current macroeconomic policy setting were central bank independence is, by principle, unquestioned and fundamental for inflation targeting, the finding that the central bank responds to an interest group pressure –via an excess of news and emphasis on harmful effects– allows to challenge the assumption of independence as it has been defined and studied so far. This is an open door to examine further the motivations of a central bank when conducting monetary and exchange rate policy.

The remainder of this paper is structured as follows. Section 2 presents the data. Using a difference in means tests and the NBRM estimation section 3 shows the bias and asymmetry of the number of news with respect to the behavior of the NER. Applying text analysis, section 4 examines the content of news and shows the closeness of the word "revaluation" with words related to the need of government intervention. Section 5 shows the response from the central bank to the reporting of the exchange rate and section 6 concludes.

2 Data

This section briefly describes the data used in this paper, firstly, the different arrangement under the NER has functioned. Secondly, how the number of news was collected and finally some additional manipulation to this data for the analysis.

2.1 The Nominal Exchange Rate

Since December 1, 1991, Colombia has had a market determined exchange rate. The daily NER is determined as the average exchange rate from eas operation in the market. Since then, multiple financial entities provide financial services in relation to foreign exchange
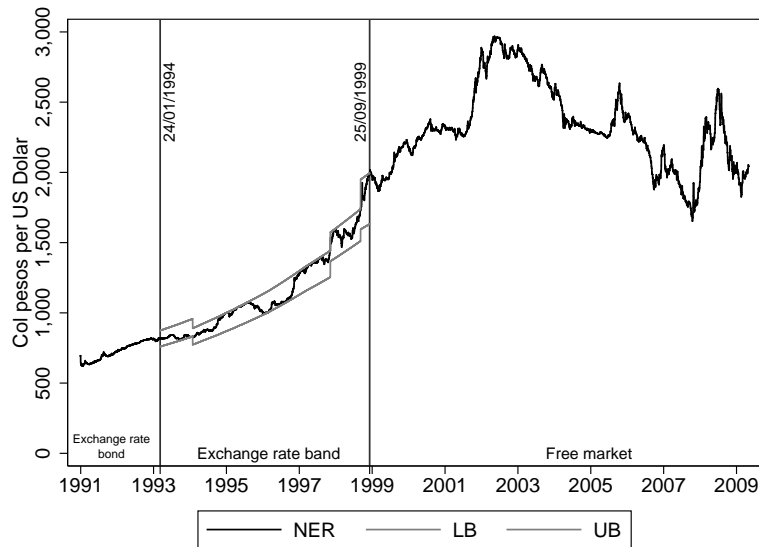
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Figure 1. Colombia's Nominal Exchange Rate (NER).
Note: Daily data. UB is the upper bound and LB the lower bound for the exchange rate band.
Source: Banco de la República (2010).

currency on behalf of businesses or individuals. These financial entities are the participants of the exchange rate market.

From December 1, 1991 to January 23, 1994, the Colombian central bank used the existing "certificado de cambio" or exchange rate bond to follow up the behavior of the NER. This bond was available to exporters and local financial institutions holding US dollars. The bond had a maturity of 12 months, the price was set by the central bank with a maximum discount of 12.5 percent. The main purpose of the "certificado de cambio" was to phase-out the fixed exchange rate and to introduce market based mechanisms.

From January 24, 1994 to September 25, 1999, crawling bands were in place. The exchange rate bands were realigned several times: a reduction or revaluation (7 percent December 13, 1994) and two increments or devaluation (9 percent September 3, 1998 and 5 percent June 29, 1999). Since September 26 of 1999 the NER has been determined solely by market forces in a dirty float scheme. Figure 1 shows the daily NER for the period of analysis. The NER data used in this paper is the daily NER.[3]

2.2 News, editorials and op-eds on revaluation and devaluation

The number of news, editorials and op-eds comes from the electronic archive of Colombia's main newspaper conglomerate, *Casa Editorial El Tiempo*.[4] The economics newspaper

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[3]The NER data is available from Colombia's central bank web site, www.banrep.gov.co or from the author.

[4]The news market in Colombia is rather small, using different outlets would had easily led the count of news to double counting the report of the behavior of the NER. For editorials and op-eds there is a fairly well organized news syndicate of commentators that distribute the same op-ed to different outlets, leading again to a double counting if were taken into consideration.

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Table 1. Nr of news by section and authored

Newspaper section	No. of news	Nr. of authored news
Economy	1,015	243
Editorial - Opinion	439	288
General news	336	88
Weekend magazine	10	10
Nation	17	3
Other	36	4
Politics	5	2
Special issue on the economy	67	15
Total	1,925	653

Note: Authored news correspond to those where the name of author is published. News without author are assumed to be authored by newspaper staff. Editorial - opinion section include editorials and op-eds, op-eds are those which include the name of the author.

Source: Casa Editorial El Tiempo (2010)

Portafolio holds records of its content and the partner newspaper *El Tiempo* and weekly magazine *Cambio* in a web-based archive. The words "devaluación" and "revaluación" were used jointly in the search. The output is a total of 2,109 news, editorials and op-eds (1,707 from *El Tiempo*, 394 from *Portafolio* and 8 from *Cambio*). This information was extracted from January 1992 to December 2009. Information on date, author (if any identified), section of the newspaper and title was recorded. News found in sections: science and technology, culture and leisure, international, car sales, home sales, Bogotá local news, and paid commercial information were excluded from the sample. News were collected on daily frequency, and aggregated to the monthly number of news.

Figure 2 shows the monthly number of news.[5] Peak periods are 1994, 1995, 2004, 2007 and 2008, with more than 20 news per month. There were also periods when the number of monthly news is low and even zero. The number of news per newspaper section and those that are authored is summarized in table 1. After removing news published in non-relevant sections (described above), the total number of news used in this study is of 1,925. Of these were 151 editorials, 288 op-eds and 1,486 news discussing revaluation and devaluation in different newspaper sections. News were mainly published in the economy, editorial - opinion and general news sections.

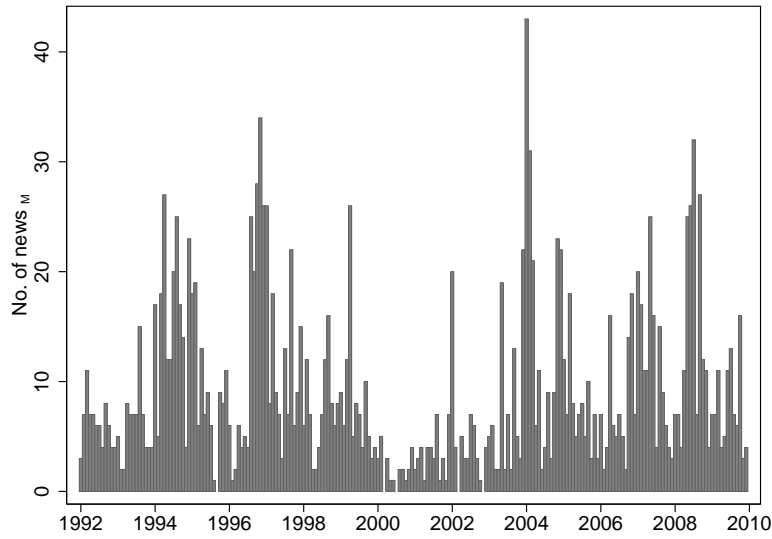[5]From now on news, editorials and op-eds will be used interchangeably.

Figure 2. Devaluation/Revaluation news, editorials and op-eds.
Note: Number of news, editorials and op-eds published by the *El Tiempo*, *Portafolio* and *Cambio*.
Source: Casa Editorial El Tiempo (2010).

2.3   News and NER behavior

The number of news and behavior of the exchange rate were aggregated to monthly data
in the following way:

$$No.\ of\ news_M = \sum_i^I News_i \tag{1}$$

and

$$\Delta\%NER_{m\ M} = I^{-1} \sum_i^I \left(\frac{NER_t - NER_{t-m}}{NER_{t-m}} \right) \tag{2}$$

where M stands for monthly, m stands for the lag used in estimating the percentage
change in the NER (30, 60, 90 and 180 days as lags were estimated), and $I = 30$ stands for
the aggregation period, 30 days for the monthly aggregate.

The time series of the monthly percentage change of the exchange rate and the number of news is shown in figure 3 and a combined histogram and scatter in figure 4, the 60 days lag is used for illustrative purposes. Both figures help to identify the suggested bias in favor of more news during a revaluation than a devaluation period. Figure 3 shows there are not only more news in a revaluation period but even when devaluation is decreasing, as in the 1994 and 1997 revaluation episodes. The scatter plot of both variables suggests a negative, non-linear, relationship between the number of news and the NER. Histograms show that the number of monthly news is skewed to less than 10 news, and there are more devaluation than revaluation episodes. Summary statistics of the number of news for both events and a test of difference of means is provided in table 2 for all news and editorials and op-eds only.

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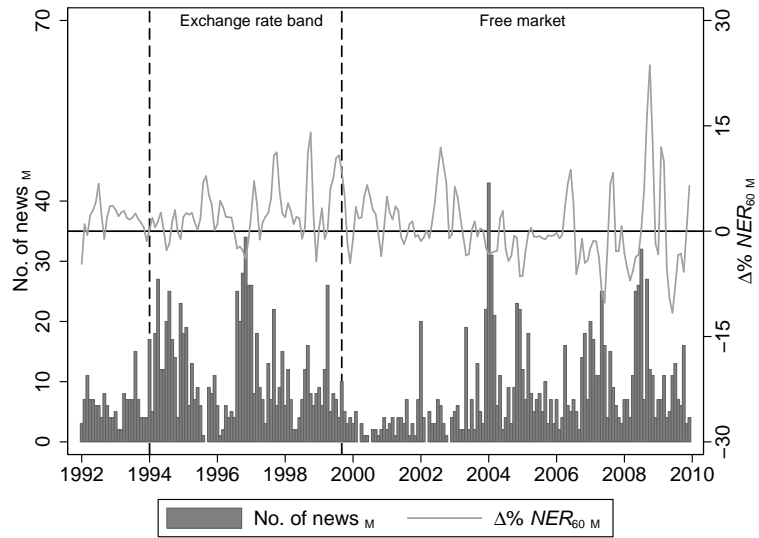
Figure 3. NER behavior, news, editorials and op-eds.
Note: Left axis, Number of news, editorials and op-eds (monthly) published by the *El Tiempo*, *Portafolio* and *Cambio*. Right axis monthly 60 days percentage change in the NER.
Source: NER behavior from Banco de la República (2010); Nr. of news from Casa Editorial El Tiempo (2010).
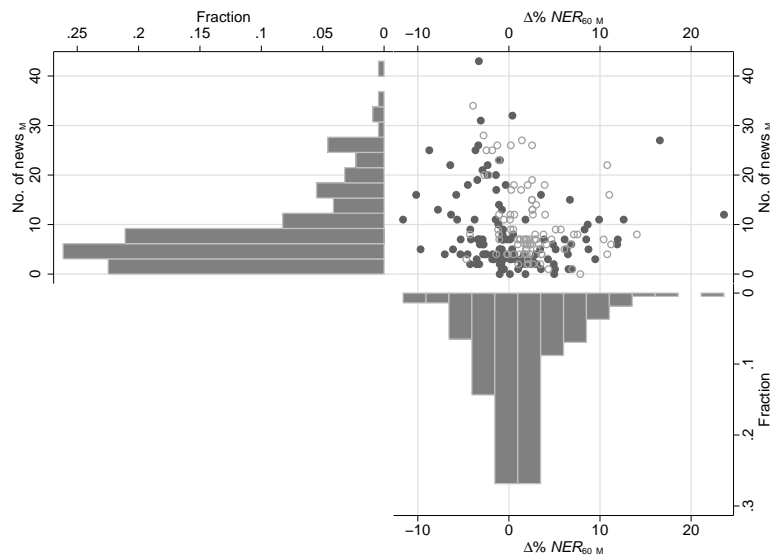
Figure 4. Distribution and scatter plot of NER and news.
Note: Hollow circles correspond to pre-market observations, solid circles to market period observations.
Source: NER from Banco de la República (2010); Nr. of news from Casa Editorial El Tiempo (2010).

3 Media bias for revaluation

3.1 Test on means

The first approach to assess media bias as a disproportionate reporting of revaluation is a test of equality on means (test of means) and distribution (Wilcoxon rank-sum test) of monthly news over the number of devaluation and revaluation events. The test is performed using the count of devaluation and revaluation cases as defined in equation 2 for $m = 30, 60$ and the monthly number of news and editorials and op-eds only. If the first test is accepted it would mean that the average number of news reporting the behavior of the exchange rate (devaluation and revaluation) per month is statistically equal, if the second test is accepted it would mean that the distribution of news is the same for both instances (devaluation and revaluation), invalidating the hypothesis of media bias.

Both tests reject the null hypothesis that the mean and distribution are equal at high levels of statistical confidence. The tests confirm the hypothesis that revaluation episodes are over-reported in Colombia. This comes clear from the fact that for the monthly average revaluation in the last 30 (60) days there are 96 (91) months of revaluation against 121 (125) of devaluation, and the average number of total news discussing the behavior of the NER is 10.3 (10.7) against 7.7 (7.5), and the average number of editorials and op-eds is 7.8 (8.1) against 6 (5.9), correspondingly.

Table 2. Test equality of means and Wilcoxon rank-sum test of equal distribution for the number of news and op-eds

m	All news	Revaluation $N = 96$		Devaluation $N = 121$		Test	
		Mean	SD	Mean	SD	Stat	P-value
30	T test of means	10.312	8.613	7.727	6.471	-2.443	0.015
	Wilcoxon rank-sum test					-2.067	0.019
	Editorials and op-eds						
	T test of means	7.802	6.714	6.090	5.311	-2.0411	0.042
	Wilcoxon rank-sum test					-1.509	0.065

m	All news	Revaluation $N = 91$		Devaluation $N = 125$		Test	
		Mean	SD	Mean	SD	Stat	P-value
60	T test of means	10.758	8.843	7.568	6.207	-2.952	0.003
	Wilcoxon rank-sum test					-2.418	0.007
	Editorials and op-eds						
	T test of means	8.120	6.876	5.976	5.143	-2.508	0.013
	Wilcoxon rank-sum test					-1.957	0.025

Note: N is the number of devaluation / revaluation episodes, *Mean* is the average number of news, *SD* is the standard deviation, *Stat* is the statistic of each test and the *P-value* the probability of equal means and distribution correspondingly.

3.2 Econometric estimation

In order to study further the media bias in favor of revaluation episodes, the following equation is estimated using a negative binomial econometric regression:

$$No.\ News_M = f\left(\Delta\%^{+}NER_{mM}, \Delta\%^{-}NER_{mM}, Duration, Market\ dummy\right) \qquad (3)$$

plus the interaction with market period dummy.[6]

The NBRM was chosen for the discrete, non-zero, nature of the monthly number of news (*No. News$_M$*) as dependent variable.[7] As explanatory variables $\Delta\%NER_{mM}$ is mod-

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[6]The volatility of the NER was also considered as an explanatory variable in the econometric estimation. Volatility measured as the standard deviation is highly correlated with the behavior of the nominal exchange rate $\Delta\%NER_{mM}$ as shown in figure 13 in the appendix, for this reason it was not included in the final results.

[7]In preliminary estimations NBRM exhibited better fit to the observed data than the Poisson Regression Model (PRM) (as the alpha parameter for over dispersion suggests in the results below). This paper is an application of count regression models and the basic formulation of NBRM, for this reason no formulae regarding the econometric methodology is presented. Full presentations of this technique can be obtained from Wooldridge (2001), Long and Freese (2006), Cameron and Trivedi (2005) and Cameron and Trivedi (2009).

ified with an interaction dummy variable for the coefficient to capture the asymmetry:

$$\Delta\%^- NER_{mM} = \Delta\% NER_{mM} \times Dummy^R \quad \text{where} \begin{cases} Dummy^R = 1 & \text{if} \quad \Delta\% NER_{mM} < 0 \\ Dummy^R = 0 & \text{otherwise} \end{cases}$$

$$\Delta\%^+ NER_{mM} = \Delta\% NER_{mM} \times Dummy^R \quad \text{where} \begin{cases} Dummy^R = 1 & \text{if} \quad \Delta\% NER_{mM} > 0 \\ Dummy^R = 0 & \text{otherwise} \end{cases}$$

In addition as explanatory variable the duration of $\Delta\% NER_{mM}$ is used (*Duration* in the results). The variable counts (in months) the duration of a devaluation/revaluation episode. It takes a value of 1 when the devaluatoin/revaluation lasts one month, and 2 the second month and so forth, the behavior of the variable is shown in figure 10 in the appendix for the case of $m = 30, 60$. A scatter plot of the three variables used in the regression is shown in figure 9 in the appendix. Finally a dummy variable equal to 1 for the free market (from September 1999 to present) period and 0 otherwise is also included in the estimation (*Market dummy* in the results). This variable accounts for the difference in the number of news during the free market with respect to the previous exchange rate schemes.

The estimation of equation 3 serves to the purpose of testing the hypothesis of whether there is a bias in the number of news when a revaluation event occurs (as in section 2.3), plus if this has changed after the free NER market began. Furthermore, allows to measure the response of the number of news to the degree of devaluation/revaluation via the asymmetry coefficients.

The econometric results are in table 3 and 4 ($m = 30, 60$) using as dependent variable the total number of news, editorials and op-eds. On general grounds, the coefficients of interest ($\Delta\%^+ NER_{mM}$ and $\Delta\%^- NER_{mM}$) show the expected sign and magnitude. All coefficients corresponding to a revaluation ($\Delta\%^- NER_{mM}$) have positive and significant coefficient in both tables (except for columns 5, 11 and 12 in table 3), suggesting that revaluation increases the number of news. The lag of this variable is not significant.

The coefficients corresponding to a devaluation ($\Delta\%^+ NER_{mM}$) are not significant. Coefficients are only significant for the equations with 1 lag, in this case the lag has a negative and significant sign. Therefore either devaluation does not generate news or it decreases the number of news after two months. Furthermore, for each equation, if both coefficients were similar, the hypothesis of asymmetry and media bias would be rejected, but this is not the case since they are quite different.[8]

Variable *Market period dummy* is significant and negative in all equations. This result suggests that the number of news is systematically lower during the dirty floating period (after Oct. 1999) with respect to the crawling bands period. However, the interaction

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[8]A simple test on equality of coefficients would suffice.

dummy with devaluation and revaluation episodes is not significant in all the estimated equations. The duration of the devaluation or revaluation period (*Duration Dev/Rev*) is only significant in some equations of the specification with $m = 60$. Equations 9 and 10 in table 4 are a good example: the negative coefficient suggests a reduction in the number of news while the duration of the devaluation or revaluation period is longer. This result can be interpreted as a decreasing effect of the behavior of the exchange rate over the news or awareness of the media. In all, the econometric estimation complements the results of table 2 in favor of the media bias for revaluation episodes hypothesis.

Table 3. Negative Binomial Regression Model (NBRM) estimation for Equation 3, with $m = 30$.

	1	2	3	4	5	6	7	8	9	10	11	12
$\Delta\%^+ NER_{30M}$	0.0242	0.0503^c	0.0328	0.0598^b	-0.0217	0.0357	0.0239	0.0502^c	0.0324	0.0594^b	-0.0235	0.0334
	(0.0263)	(0.0279)	(0.0259)	(0.0272)	(0.0438)	(0.0463)	(0.0264)	(0.0280)	(0.0259)	(0.0272)	(0.0437)	(0.0464)
$t-1$		-0.0530^c		-0.0452^c		-0.0869^c		-0.0529^c		-0.0451^c		-0.0871^c
		(0.0278)		(0.0271)		(0.0478)		(0.0278)		(0.0272)		(0.0478)
$\Delta\%^- NER_{30M}$	0.121^b	0.126^b	0.175^a	0.180^a	0.0385	0.251^c	0.121^b	0.126^b	0.175^a	0.180^a	0.00840	0.232
	(0.0488)	(0.0534)	(0.0520)	(0.0546)	(0.121)	(0.143)	(0.0488)	(0.0534)	(0.0519)	(0.0546)	(0.121)	(0.144)
$t-1$		0.0430		0.0780		0.135		0.0424		0.0763		0.114
		(0.0528)		(0.0528)		(0.119)		(0.0531)		(0.0530)		(0.119)
Market period dummy			-0.340^a	-0.407^a	-0.528^a	-0.470^a			-0.344^a	-0.409^a	-0.750^a	-0.655^a
			(0.114)	(0.113)	(0.162)	(0.182)			(0.115)	(0.113)	(0.215)	(0.236)
$\Delta\%^+ NER_{30M}$ x Market dummy					0.0789	0.0390					0.0822	0.0429
					(0.0544)	(0.0568)					(0.0543)	(0.0568)
$t-1$						0.0565						0.0573
						(0.0566)						(0.0566)
$\Delta\%^- NER_{mM}$ x Market dummy					-0.170	0.0699					-0.199	0.0533
					(0.134)	(0.155)					(0.134)	(0.155)
$t-1$						0.0718						0.0460
						(0.132)						(0.132)
Duration Dev/Rev							-0.00578	-0.00211	-0.0102	-0.00591	-0.0386	-0.0209
							(0.0201)	(0.0198)	(0.0199)	(0.0195)	(0.0260)	(0.0260)
Duration x Market dummy											0.0613	0.0492
											(0.0402)	(0.0394)
Constant	2.052^a	2.048^a	2.183^a	2.178^a	2.305^a	2.222^a	2.072^a	2.055^a	2.220^a	2.200^a	2.458^a	2.316^a
	(0.0800)	(0.0880)	(0.0918)	(0.0947)	(0.119)	(0.137)	(0.106)	(0.114)	(0.117)	(0.120)	(0.159)	(0.179)
lnalpha	-0.650^a	-0.722^a	-0.695^a	-0.791^a	-0.711^a	-0.816^a	-0.651^a	-0.722^a	-0.696^a	-0.792^a	-0.726^a	-0.826^a
	(0.115)	(0.117)	(0.117)	(0.120)	(0.117)	(0.121)	(0.115)	(0.117)	(0.117)	(0.120)	(0.118)	(0.121)
Observations	217	216	217	216	217	216	217	216	217	216	217	216
AIC	1378	1367	1371	1356	1373	1360	1380	1369	1373	1358	1374	1362
BIC	1391	1387	1388	1380	1396	1397	1397	1392	1393	1385	1404	1406
R^2	0.00479	0.0111	0.0111	0.0205	0.0130	0.0236	0.00485	0.0112	0.0113	0.0206	0.0150	0.0247
ll	-685.0	-677.4	-680.6	-671.0	-679.3	-668.9	-684.9	-677.4	-680.5	-670.9	-678.0	-668.1

Note: Negative Binomial Regression Model. Dependent variable is the monthly number of articles and op-eds. Market dummy refers to the post-exchange rate band period or free market period for the NER determination. Standard errors in parenthesis. a. p<0.01, b. p<0.05, c. p<0.1

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Table 4. Negative Binomial Regression Model (NBRM) estimation for Equation 3, with $m = 60$.

	1	2	3	4	5	6	7	8	9	10	11	12
$\Delta\%^{+}NER_{60M}$	0.00460	0.0366^c	0.0108	0.0438^b	-0.0194	0.0117	0.00437	0.0348^c	0.0112	0.0413^b	-0.0181	0.00243
	(0.0150)	(0.0196)	(0.0145)	(0.0188)	(0.0267)	(0.0299)	(0.0149)	(0.0197)	(0.0143)	(0.0188)	(0.0264)	(0.0301)
$t-1$		-0.0475^b		-0.0448^b		-0.0306		-0.0450^b		-0.0403^b		-0.0213
		(0.0198)		(0.0191)		(0.0292)		(0.0200)		(0.0193)		(0.0297)
$\Delta\%^{-}NER_{60M}$	0.0953^a	0.0778^b	0.135^a	0.110^a	0.229^b	0.221^b	0.0976^a	0.0769^b	0.144^a	0.110^a	0.242^b	0.184^c
	(0.0295)	(0.0358)	(0.0313)	(0.0355)	(0.0910)	(0.0989)	(0.0294)	(0.0356)	(0.0310)	(0.0351)	(0.0957)	(0.0983)
$t-1$		0.0318		0.0605^c		0.185^b		0.0316		0.0629^c		0.149
		(0.0372)		(0.0367)		(0.0930)		(0.0371)		(0.0366)		(0.0921)
Market period dummy			-0.401^a	-0.462^a	-0.451^a	-0.389^b			-0.460^a	-0.500^a	-0.799^a	-0.720^a
			(0.112)	(0.111)	(0.159)	(0.169)			(0.113)	(0.113)	(0.202)	(0.211)
$\Delta\%^{+}NER_{60M}$ x Market dummy					0.0443	0.0520					0.0434	0.0607^c
					(0.0319)	(0.0366)					(0.0314)	(0.0365)
$t-1$						-0.0230						-0.0325
						(0.0350)						(0.0353)
$\Delta\%^{-}NER_{60M}$ x Market dummy					0.102	0.115					0.120	0.0801
					(0.0967)	(0.106)					(0.101)	(0.105)
$t-1$						0.145						0.113
						(0.100)						(0.0993)
Duration Dev/Rev							-0.0209	-0.0154	-0.0316^b	-0.0273^c	-0.0547^a	-0.0456^b
							(0.0152)	(0.0151)	(0.0150)	(0.0149)	(0.0182)	(0.0185)
Duration x Market dummy											0.0809^a	0.0722^b
											(0.0310)	(0.0307)
Constant	2.049^a	2.059^a	2.201^a	2.211^a	2.236^a	2.154^a	2.135^a	2.121^a	2.355^a	2.334^a	2.504^a	2.408^a
	(0.0785)	(0.0837)	(0.0892)	(0.0907)	(0.119)	(0.129)	(0.101)	(0.104)	(0.114)	(0.113)	(0.156)	(0.166)
lnalph^a	-0.705^a	-0.755^a	-0.774^a	-0.846^a	-0.802^a	-0.914^a	-0.720^a	-0.759^a	-0.810^a	-0.864^a	-0.886^a	-0.956^a
	(0.117)	(0.119)	(0.119)	(0.122)	(0.120)	(0.125)	(0.117)	(0.119)	(0.120)	(0.122)	(0.124)	(0.127)
Observations	216	215	216	215	216	215	215	215	215	215	215	215
AI^c	1366	1356	1355	1341	1354	1339	1360	1357	1346	1340	1339	1336
BI^c	1379	1376	1372	1365	1378	1376	1377	1381	1366	1367	1370	1380
R^2	0.00898	0.0152	0.0182	0.0274	0.0217	0.0352	0.0110	0.0160	0.0228	0.0299	0.0319	0.0404
ll	-678.9	-672.0	-672.5	-663.7	-670.1	-658.4	-674.9	-671.5	-666.8	-662.0	-660.7	-654.9

Note: Negative Binomial Regression Model. Dependent variable is the monthly number of articles and op-eds. Market dummy refers to the post-exchange rate band period or free market period for the NER determination. Standard errors in parenthesis. a. p<0.01, b. p<0.05, c. p<0.1

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3.2.1 Model selection and interpretation

The econometric results for equation 3 support the hypotheses of bias for more news when a revaluation episode occurs rather than when a devaluation one happens, confirming the suggested relationship between the number of news and the NER behavior. The interpretation of the NBRM coefficients in tables 3 and 4 goes further, the response and probabilities can be predicted offering a more meaningful message. Based on the preferred regression, this section provides further interpretation of the coefficients.

The NBRM results in tables 3 and 4 include the AIC and BIC. Both criteria, and coefficient significance, suggest that regression 2 and 4 in table 3 and regression 4 and 10 in table 4 should be preferred, they have the lowest AIC and BIC.[9] In these regression the variables of interest are significant and can offer a plausible interpretation once the marginal effects are computed, the remainder of this section brings additional interpretation to the econometric results presented in section 3.2.

Table 5 shows the coefficient and marginal effect for regressions results with $m = 30$ and 60, and the preferred specifications. The marginal change in $E(y|\mathbf{x})$ is $\frac{\partial E(y|\mathbf{x})}{\partial x_k} = E(y|\mathbf{x})\beta_k$ which is computed at the means of the continuous variables and the discrete change for dummy variables from 0 to 1. The results of the marginal effect are conclusive in regards with the media bias and the asymmetric response for more news when revaluation happens with respect to a devaluation. Starting with Reg 2 when $m = 30$ a 1% change in devaluation has a contemporaneous effect of increasing the number of news in 0.43%, offset by the first lag effect of 0.46%. While the same 1% change in revaluation increases the contemporaneous number of news in 1.09% plus 0.37% from the first lag. This effect is also observed in regression 4 when the *Market dummy* is significant. The coefficient for *Market dummy* in regression 4 suggests a reduction in the number of news in the free market period of 3.6%. While the devaluation and revaluation effects (including the lag) are not very different from the observed for regression 2.

The set of marginal effects for the specification with $m = 60$ is very similar to the $m = 30$ cases. For this case it is worth to highlight the marginal effect of the duration of the devaluation or revaluation episodes. This time the longer the devaluation/revaluation has a negative effect upon the number of news. This result follows the logic presented above where the emphasis of the news decreases as the behavior of the exchange rate continues.

The predicted probabilities for a specific number of news using different values of the explanatory (and continuous) variable used in the regression are also obtained. This was done for regression 2 from table 3 (the set of results when $m = 30$ is used). The predicted

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[9]An informal method for assessing the fit between count models is to compare their mean predicted probability with respect to the observed probability (Long and Freese, 2006). Figure 11 in the appendix shows this deviation, the differences between regressions is nil.

Table 5. Marginal effect for selected estimation results.

	Marginal effect coefficients from table 3 and $m = 30$				
	Reg 2				
	$\Delta\%^{+}NER_{30M}$	$t-1$	$\Delta\%^{-}NER_{30M}$	$t-1$	
Coeff	0.0503	-0.053	0.126	0.043	
Marginal effect	0.4386	-0.462	1.09	0.3751	
	Reg 4				
	$\Delta\%^{+}NER_{30M}$	$t-1$	$\Delta\%^{-}NER_{30M}$	$t-1$	Market period dummy
Coeff	0.0598	-0.0452	0.18	0.078	-0.407
Marginal effect	0.5122	-0.3876	1.5387	0.6681	-3.6191

	Marginal effect coefficients from table 4 and $m = 60$					
	Reg 4					
	$\Delta\%^{+}NER_{60M}$	$t-1$	$\Delta\%^{-}NER_{60M}$	$t-1$	Market period dummy	
Coeff	0.0438	-0.0448	0.11	0.0605	-0.462	
Marginal effect	0.3723	-0.3803	0.9318	0.5139	-4.0974	
	Reg 10					
	$\Delta\%^{+}NER_{60M}$	$t-1$	$\Delta\%^{-}NER_{60M}$	$t-1$	Market period dummy	Duration Dev / Rev
Coeff	0.0413	-0.0403	0.11	0.0629	-0.5	-0.0273
Marginal effect	0.349	-0.3408	0.934	0.5323	-4.4361	-0.2306

probabilities where estimated for 11 news published each month (average number of news observed during revaluation periods, see table 2), and a revaluation / devaluation from 0 to 15 percent. The results are shown in figure 5.[10]

The figure corroborates the results discussed previously, the number of news is influenced by the occurrence and degree of a revaluation instead of a devaluation. This result keeps suggesting the media bias for news in revaluation periods. The predicted probabilities show how about 8 percent devaluation would be necessary to obtain the average of 11 news, but how only 2.5 percent revaluation is needed to have the same number of news.

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[10]This equation was chosen for simplicity in the generation of predicted probabilities and the fact that coefficients are similar with respect to the preferred regression results discussed above.
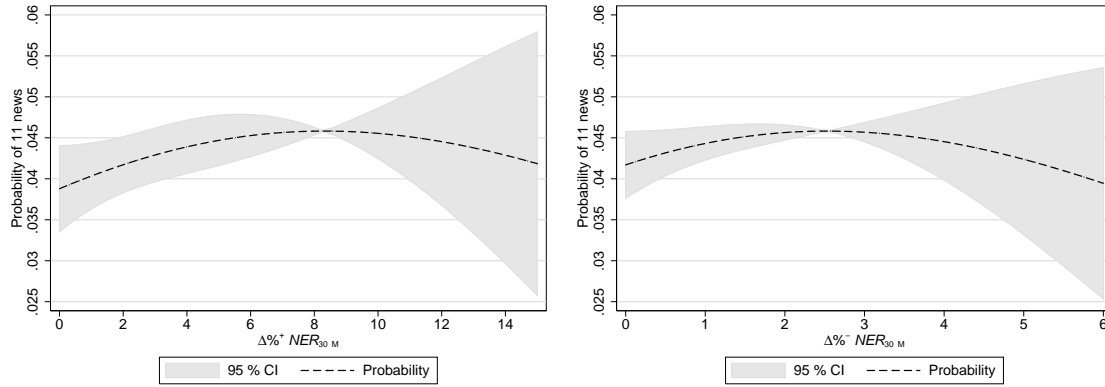
a. Predicted probability for devaluation   *b.* Predicted probability for revaluation

Figure 5. Predicted probability for 11 news per month.
Note: Predicted probability for 11 news per month for different values of variation
in the NER, from regression 2 in table 3.

4   The flavor of news, editorials and op-eds discussing devaluation and revaluation in Colombia

As argued in the introduction, economics commenters and journalists in Colombia react easily to revaluation rather than to devaluation, likely influenced by an interest group seeking sympathy and assistance, suggesting the existence of media bias. Furthermore, such dislike for revaluation is accompanied with circumstantial evidence of the harmful effect upon the export industries; and at the same time with a call for help from fiscal or monetary authorities. In the previous section, such bias has been shown using statistical test and regression results. However the mere count of news containing the words "devaluación" and "revaluación" ant its correlation can not show wether the news actually have the taste of dislike and the connection with an interest group. This section reports on the flavor of news, editorials and op-eds discussing devaluation and revaluation in Colombia using text analysis or text mining.

Text analysis seeks to transform text, or a collection of text also called corpus, into numerical information. Such data is intended to present text in a systematic way for further statistical analysis (Francis and Flynn, 2010; Fagan and Gencay, 2011). Standard text analysis implies preprocessing unstructured text and statistical analysis of the processed text. Preprocessing includes determining the format of the text, the length of the text or collection of texts (corpus), parse the text eliminating spaces, punctuation and non informative words, collect in a single word plurals and variants of words conveying the same meaning, and transforming words into a data structure where for each document in the corpus words are counted becoming a variable. Once preprocessing is done, different statistical procedures can be applied upon this data structure, conveying information

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about the text.

4.1 Preprocessing

The text of 1,854 news was collected and preprocessed using `tm: Text Mining Package` (Feinerer et al., 2008; Feinerer, 2011) in R statistics software (R Development Core Team, 2011). The preprocessing included:

1. Converting text to lower case.
2. Removing white spaces and punctuation.
3. Collecting similar meaning words into a single expression / word:
   a) asistencia (assistance) $\Leftarrow$ asistencia, ayuda, financiación, subsidio, subsidios (assistance, help, financing, subsidy, subsidies).
   b) bancodelarepública (central bank) $\Leftarrow$ banco de la república, banco, emisor, junta directiva (central bank, bank, issuer, board).
   c) bandacambiaria (crawling band) $\Leftarrow$ banda cambiaria (crawling band).
   d) crecimientoeconómico (economic growth) $\Leftarrow$ crecimiento económico (economic growth).
   e) dolar (dollar) $\Leftarrow$ dólares (dollar).
   f) estadosunidos (United States) $\Leftarrow$ estados unidos (United States).
   g) flores (flowers) $\Leftarrow$ floricultor, floricultores (flower growers).
   h) gobierno (government) $\Leftarrow$ ministro, ministerio (minister, ministry).
   i) medidas (measures) $\Leftarrow$ medida (measures).
   j) salario (wages) $\Leftarrow$ salarios (wages).
   k) tasadecambio (exchange rate) $\Leftarrow$ tasa de cambio, tasa de cambio nominal (exchange rate, nominal exchange rate).
   l) tasadecambioreal (real exchange rate) $\Leftarrow$ tasa de cabmio real (real exchange rate).
   m) tasadeinterés (interest rate) $\Leftarrow$ tasa de interés (interest rate).
4. Removing stop words in Spanish, such as: el, lo, los, las, etc.

4.2 Statistical analysis

Once the text preprocessing stage is done, the software transforms the remaining words into a document term matrix in which numerical data is collected based on a given criteria. The first criteria used in this analysis is to obtain words that appear at least 1,500 times in the corpus (table 6 shows the output). There are 27 words meeting this criteria, several words are clearly part of standard speech discussing the behavior of the nominal exchange rate.

As expected, the words "devaluación" and "revaluación" are part of this list. Not surprisingly as well, Colombia's central bank (bancodelarepública) is the most repeated

Table 6. Words appearing more than 1,500 times in the corpus.

bancodelarepública	colombia	crecimiento
devaluación	dólar	economía
exportaciones	**gobierno**	**inflación**
interés	mayor	mercado
millones	país	parte
pasado	peso	pesos
política	precio	precios
presidente	**revaluación**	sector
tasadecambio	tasas	

Note: The table shows from left to right the words that appear more than 1,500 times in the corpus.

word, news discussing the behavior of the exchange rate should mention this institution. Less obvious, however, is the absence of the word "imports" (importaciones) since the word "exports" (exportaciones) is on the top 10; if the treatment of the behavior of the exchange rate were not biased then the word "imports" as the activity affected because of an increasing exchange rate should be mentioned in the corpus as often as the word "exports". Finally the word "president" (presidente) is also part of this group, rasing the question of why the president of the government is brought into the discussion of the behavior of the exchange rate if there were no intention to request assistance to the executive.

The second criteria to analyze the corpus is to obtain the top correlated words with the target words of this study, i.e.: "devaluation" (devaluación), "revaluation" (revaluación) and "colombia's central bank" (bancodelarepública). Table 7, shows the words with a correlation higher than 25% for the entire period of analysis, from 1992 to 2009. The results are a clear indication of the argument raised in the paper about the over-emphasis of a revaluation episode. The word "devaluation" (devaluación) is correlated with naturally corresponding words such as "dollar" (dólar) and "exchange rate" (tasadecambio) and only two more words; for a total of 4 words. However the word "revaluation" (revaluación) is highly correlated with 21 words, including: the central bank, exporters, and government. This shows again the use of the words and the context on which they are employed, while devaluation is employed along other words to simply describe the behavior of the exchange rate, revaluation is highly associated with the central bank, exporters, government and stopping (frenar) the exchange rate's decreasing trend. If the treatment of the behavior of the exchange rate by the media where equalitarian, the association of words would not show such disparity.

The third expression of interest is "central bank". Clearly the central bank is in the core of the news reporting not only the behavior of the exchange rate but inflation targeting, hence associated words appear (inflation, monetary policy, target, rates, etc.). However it must be highlighted that the word devaluation is not part of this list, showing

Table 7. Words with a correlation of 25% or higher for Devaluation, Revaluation and Colombia's central bank.

Devaluation		Revaluation		Colombia's central bank	
devaluación	1	revaluación	1	bancodelarepública	1
dólar	0.31	peso	0.38	gobierno	0.43
tasadecambio	**0.28**	**bancodelarepública**	**0.37**	**revaluación**	**0.37**
efecto	0.26	**dólar**	**0.37**	**hacienda**	**0.36**
venezuela	0.25	**exportadores**	**0.34**	manejo	0.34
		gobierno	**0.33**	**tasadecambio**	**0.34**
		tasadecambio	**0.32**	dólar	0.33
		frenar	**0.29**	**inflación**	**0.33**
		mayor	0.28	monetaria	0.33
		tema	0.28	bandacambiaria	0.32
		controlar	0.27	**frenar**	**0.32**
		importante	0.27	interés	0.32
		inflación	0.27	política	0.31
		parte	0.27	cambiario	0.30
		últimos	0.27	meta	0.30
		exterior	0.26	público	0.30
		fenómeno	0.26	tasas	0.30
		problema	0.26	divisas	0.29
		sido	0.26	medida	0.29
		capitales	0.25	medidas	0.29
		país	0.25	**mercado**	**0.28**
		sino	0.25	**controlar**	**0.27**
				decisión	0.27
				parte	0.27
				presidente	0.27
				tema	0.27
				evitar	0.26
				tasa	0.26
				liquidez	0.25

Note: The table shows the correlation for the words "revaluation", "devaluation" and "central bank".
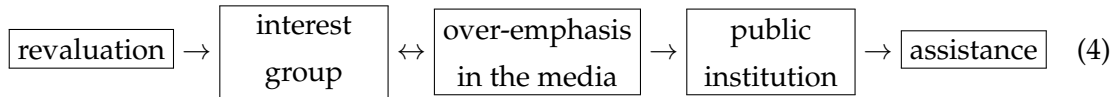
how in the media, revaluation is a principal component of the language and is directly associated with the central bank, but not devaluation in spite of being the other side of the same coin.

The previous two criteria to analyze the corpus were unstructured, on the sense that no limits were imposed on the number or correlation between the words being studied. The third, and final, criteria imposes a set of words to be studied, from this set of words an association metric is obtained and summarized in an association matrix, then hierarchical clustering methods "collapse" the number of words into groups based on the association between words, reducing the dimension of the matrix, this process is displayed in a dendrogram or tree diagram that shows the grouping or clustering of words within the corpus. The hierarchical method used is the single linkage method upon an association matrix containing the cross correlation for the chosen set of words (a good

introduction to the topic can be found in Johnson and Wichern, 2002). Table 8 shows the set of words chosen for this analysis and figures 6 and 7 the dendrogram for all the period of analysis, and the exchange rate band period and free market period.

The core words analyzed are devaluation and revaluation (keywords category in table 8), going through the closeness of both words and the branch structure around them can help to show the hypothesis of overemphasis on revaluation, sustained thorough the paper. In second place are the words associated with public institutions such as the "central bank" (bancodelarepública) and "government" (gobierno), the closeness of these words to any of the core words are indication of the implied link of public institutions with the behavior of the exchange rate.

Thirdly comes the interest group words. These words gather private interest groups that might have a particular interest in the behavior of the exchange rate and then, play a role in shaping the emphasis to report unfavorable circumstances and unfolding a message of disaster and need of assistance. Fourth in importance is "assistance" (asistencia), if such word is or is not close to revaluation and public institutions, and at the same time is far from devaluation, is evidence of the link:

$$\boxed{\text{revaluation}} \rightarrow \boxed{\begin{array}{c}\text{interest}\\\text{group}\end{array}} \leftrightarrow \boxed{\begin{array}{c}\text{over-emphasis}\\\text{in the media}\end{array}} \rightarrow \boxed{\begin{array}{c}\text{public}\\\text{institution}\end{array}} \rightarrow \boxed{\text{assistance}} \quad (4)$$

The remaining group of words are included to populate the information matrix with relevant terms or words concerning the behavior of the exchange rate and public institutions. If these words were not included in the analysis, the information matrix and the clustering method would generate a naive correlation and dendrogram, obviously linking a limited number of terms. By including a variety of related terms the correlation and the clustering will make the right connection between words, unfolding the existence or not of the proposed closeness in diagram 4.

Table 8. Words used in the hierarchical clustering analysis.

Cathegory	Spanish	English
Economic variables	competitividad	competitiveness
	desempleo	unemployment
	industria	industry
	inflación	inflation
	exportaciones	exports
	importaciones	imports
	tasadeinterés	interest rate
Goods	banano	banana
	café	coffee
	flores	flowers
	petroleo	oil
Interest group	andi	Colombia's national industry association
	fenalco	Colombia's national retailers association
	exportadores	exporters
	importadores	importers
Keywords	revaluación	revaluation
	devaluación	devaluation
Positive and negative wording	crisis	crisis
	exito	success
	progreso	progress
Public institutions	bancodelarepública	Colombia's central bank
	gobierno	government
Public assistance	asistencia	assistance

From the dendrogram corresponding to the whole period of analysis (figure 6), the closeness or similarity between the "central bank", "government" and "revaluation" (bancodelarepublica, gobierno and revaluación) is clear, these words gave shape to the first cluster. The word "assistance" is the nearest expression to this cluster, such outcome shows the closeness among these expressions. In contrast, the word devaluation is far from this cluster. If media covered the behavior of the exchange rate evenly and inadvertently, the words "devaluation" and "revaluation" should form a cluster themselves, and if naturally interest parties were involved in creating awareness of the behavior of the exchange rate, the words "exporters" and "importers" should also form a cluster close to this one, both associations would have happened regardless of a public institution were included in the analysis or not.

This patter of association is also observable in panel (*a*) of figure 7 for the exchange rate band period. In this case, the word "assistance' is not par of the cluster "central bank", "government", "exporters" and "revaluation" (bancodelarepública, gobierno, exportadores and revaluación). A notable cluster is formed by "fenalco", "crisis", "andi" and "unemployment". This grouping still shows the emphasis from business and exporters to qualify revaluation as a negative event, without resorting to public institu-
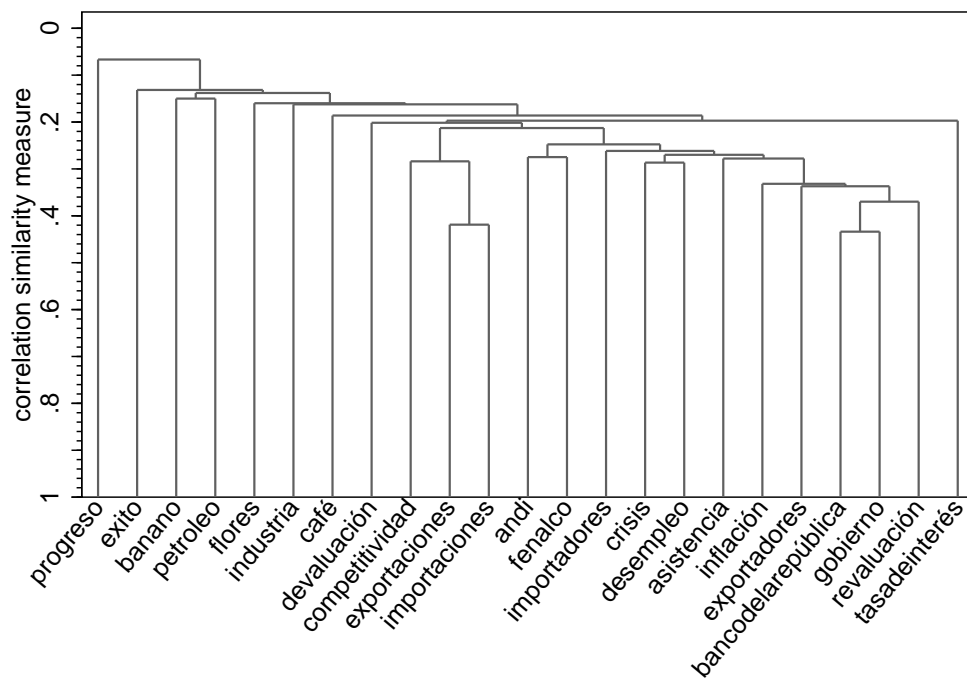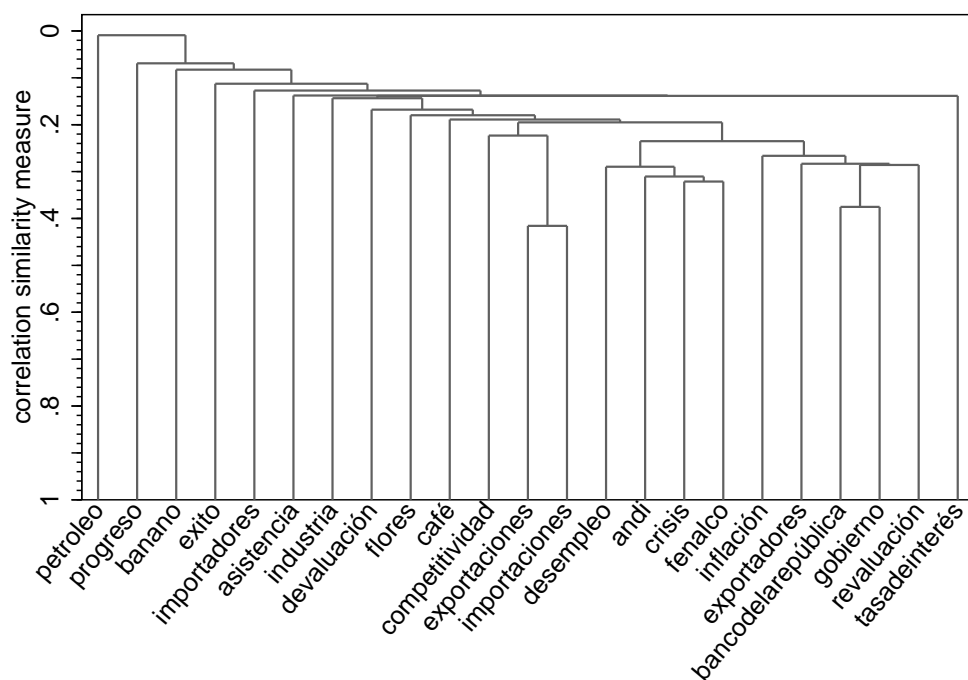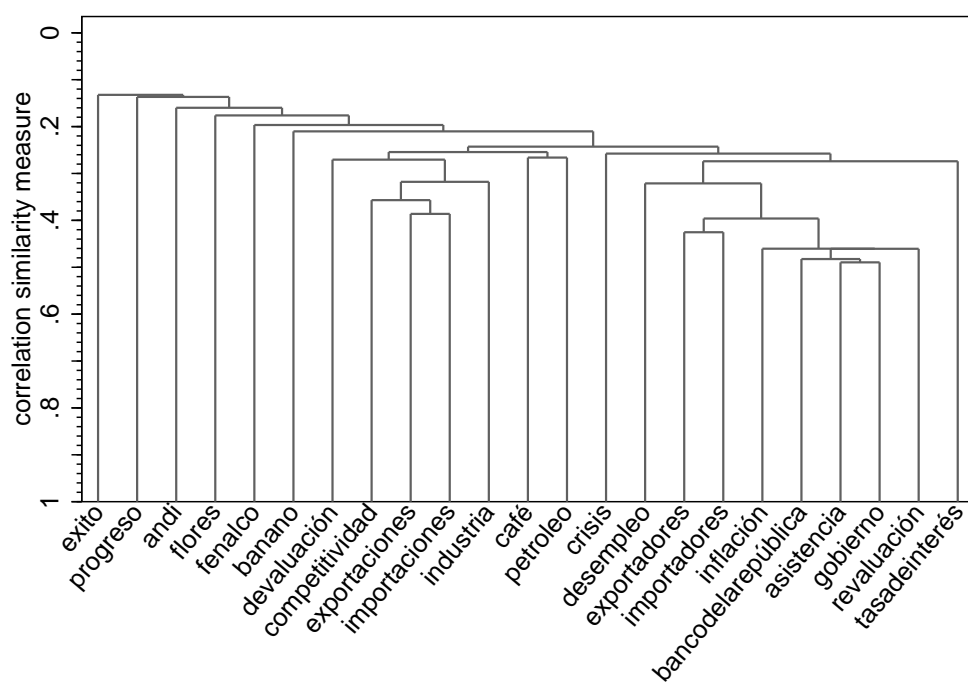
Figure 6. Dendrogram for hierarchical clustering from correlation matrix. Corpus from 1992 to 2009.

tions for assistance. Finally, panel (*b*) shows the dendrogram for the free market period. Here again "central bank", "assistance", "government" and "revaluation" (bancodelarepública, gobierno, assistance and revaluación) are the first cluster with a high correlation.

In all, using text analysis supports the regression analysis results of section 3 from a different perspective. In the previous section, bias was defined as the uneven reporting of the behavior of the exchange rate, and using the count of news the proposed asymmetric relationship was established. In this section, by examining the content of the news, it has been shown that the reporting of the behavior of the exchange rate is strongly linked with words such as: "assistance", "public institutions" and "exporters", unveiling the link revaluation – exporters – public assistance. Beyond showing the media bias, it remains to see if such over-reporting has any effect upon public authorities, this is, if the bias does have effect or not on the behavior of economic authorities. The next section addresses this issue.

a. Exchange rate band period

b. Free market period

Figure 7. Dendrogram for hierarchical clustering from correlation matrix. Corpus split from 1992 to 1999 for the exchange rate band period, and from 1999 to 2009 for the free market period.

5 Does media bias matters? Modeling the central bank intervention in the exchange rate market

Having established the asymmetric character of news reporting the behavior of the NER, and the link within the news between revaluation, an interest group and public institutions; this section investigates wether the bias gives shape to the exchange rate policy. There are two policy response options for the behavior of the NER. First from government officials (fiscal authorities). They can offer subsidies and support programs for specific exporting industries that seem to be affected by a revaluation episode. This is often the case in Colombia, there has been financial assistance (or at least the announcement of) throughout different government departments and ministries. Unfortunately such programs are easily politicized, and broadly defined in scale and scope to be measured as a proper response from policymakers to the media bias, and not to be confused with favoritism of another kind.

The second, and more plausible option is the response from the central bank (monetary authority). Colombia's central bank can intervene in the NER market. Statutorily, reducing and controlling inflation is the sole function of the central bank, containing the NER is not a priority, furthermore the exchange rate policy is shaped to support holding inflation. However, the central bank has become an active agent in the market. Using a probit estimation, this section models the central bank decision to intervene in the NER market. The variable of interest is the number of news, which should show if the excessive reporting of news of a revaluation episode has any effect upon the central bank's decision to intervene or not.

After the end of the exchange rate or crawling band system in late 1999, Colombia's central bank has applied three mechanisms to intervene in the exchange rate market. A Dutch auction of financial options with the purpose to accumulate international reserves, a Dutch auction of financial options with the purpose to tame NER's volatility, and third, direct purchase/sell operations in the market.

The options to accumulate international reserves has a length of a month, during this period if the daily exchange rate is below the previous 20 days average, then the central bank will buy the option to the bearer. These options where employed from November 1999 to may 2008. Options to tame volatility are executed whenever the exchange rate deviates 5% with respect to the moving average of the exchange rate of the last 20 days. These options where employed from December 2004 to July 2009. Since September 2004, purchase/sell operations have been performed at will of the central bank, for no more than US $20 million per day.

Following kamil (2008) and Echavarria et al. (2010), since volatility, international reserves and inflation (deviation from the target) shape the decision to intervene in the exchange rate market a probit model is estimated using these variables plus the number of

news. This estimation does not intend to completely model the central bank's exchange rate policy, but only to find if news, and the subsequent bias, does or does not have an effect upon central bank intervention in the exchange rate market. The dependent variable (*CB buy$_M$* – central bank buy) is a dummy variable that takes the value of 1 if the central bank bought US dollars in the market in month M, and zero otherwise. Data on market intervention is only publicly available at a monthly basis. Several requests of daily or weekly data were undertaken with Colombia's central bank officials and access to disaggregated data was denied on confidentiality grounds. However since inflation and international reserves are only available on a monthly basis this data frequency binds the subsequent analysis.

The explanatory variables are:

1. The monthly number of news (used in the media bias estimation) (*No. News$_M$*).

2. The volatility of the NER, defined as the monthly average of the standard deviation of the last S days (SD_{SM}).

3. Inflation, measured as the deviation from the inflation target (π - *Target* $= \pi_{m-12} - \pi_{Target}$). Where

4. international reserves (*Int. Reserves*), measured as the S days percentage change.

The estimated equation is 5, and the results are shown in table 9.

$$CB\ buy_M = f\left(No.\ News_M, SD_{SM}, \pi\ \text{-}\ Target, INT.\ RES_{SM}\right) \tag{5}$$

The estimation output in table 9 shows a positive relationship between the number of news and the probability to intervene in the exchange rate market from the central bank (Reg 1). Adding volatility, inflation target deviation and international reserves does not change the positive relationship in Reg 1. Furthermore, the increasing volatility suggests lower probability of intervention, while deviation from inflation target suggests an increasing probability. The results are neither quantitative nor qualitative different between $m = 30$ and $m = 60$. A further view of this result comes with the predicted probability for each significant explanatory variable holding the remaining variable at the mean (figure 8).

The probability of the central bank buying dollars increases from 40% to almost 100% as long as the number of news increases, it also increases with a positive deviation from the inflation target, while decreases from 70% to 30% as volatility increases.

The variable number of news per month (*No. News$_M$*) may be endogenous if there were news reporting the intervention of the central bank. From the text analysis in section 4 no evidence of words such as: intervention, purchase or buy was found, however this variable is susceptible to be endogenous in the estimation. Regression 3 in table 9 shows the instrumental variable estimation when regression 2 is estimated instrumenting the number of news with the number of news of the last month (*No. News (t-1)$_M$*). The lagged

**Table 9.** Probit estimation for central bank intervention in the NER market.

	$m = 30$			$m = 60$		
	Reg 1	Reg 2	Reg 3	Reg 1	Reg 2	Reg 3
No. News$_M$	0.0442^b	0.0471^b	0.0384	0.0442^b	0.0418^b	0.0384
	(0.0172)	(0.0230)	(0.0505)	(0.0172)	(0.0211)	(0.0474)
SD$_{mM}$		-0.0168^b	-0.0161^b		-0.00892^c	-0.00882^c
		(0.00750)	(0.00866)		(0.00477)	(0.00497)
π - Target		0.152^b	0.162^c		0.153^c	0.158^c
		(0.0716)	(0.0835)		(0.0702)	(0.0852)
INT. RES$_{mM}$		-0.0371	-0.0366		-0.0191	-0.0192
		(0.0311)	(0.0315)		(0.0217)	(0.0217)
Constant	-0.158	0.225	0.275	-0.158	0.192	0.215
	(0.172)	(0.227)	(0.325)	(0.172)	(0.237)	(0.359)
ρ			0.0736			0.0289
			(0.260)			(0.254)
σ			1.864^a			1.873^a
			(0.0635)			(0.0635)
Instrumental variable for No. News$_M$			Yes			Yes
Exogeneity test Ho: $\rho = 0$ for No. News$_M$ (P-value)			0.777			0.910
Observations	124	124	124	124	124	124
AIC	165.9	162.7	990.8	165.9	164.5	994.8
BIC	171.6	176.8	1025	171.6	178.6	1029
Linktest (t-value)	-0.725	-2.363		-0.725	-1.711	
R^2	0.0434	0.0981		0.0434	0.0876	
ll	-80.97	-76.33	-483.4	-80.97	-77.23	-485.4

Note: Dependent variable is the dummy variable for central bank purchasing US dollars in the NER market. Linktest is a specification test for binary dependent variable models that estimates the regression $y = f(\hat{y}, \hat{y}^2)$ the t value of the coefficient corresponds to the significance test for $\hat{y}^2$. The instrumental variable for *No. News$_M$* is *No. News$_M(t-1)$*. Heteroscedasticity robust standard errors in parenthesis, a. p<0.01, b. p<0.05, c. p<0.1.

value is a good instrument of the current monthly number of news since it is correlated with it and not with the central bank intervention in the current period.[11] The estimation result of this specification goes against the endogeneity of *No. News$_M$*, the ρ coefficient, showing the correlation between the instrument and the endogenous variable, is not statistically different from zero (probability 0.77 of $\rho = 0$), therefore the hypothesis of endogeneity can be rejected, and this estimation discarded.

The finding of this section closes the logic proposed in the paper when a public institution, the central bank in this case, reacts to the number of news reporting the behavior of the exchange rate, after have shown that the news are biased in favor of revaluation

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[11]A relationship such as *No. News$(t-1) = f(CB\ buy_M)$* is not expected to be significant, simply because the current intervention in the market can not explain the number of news in the last period.
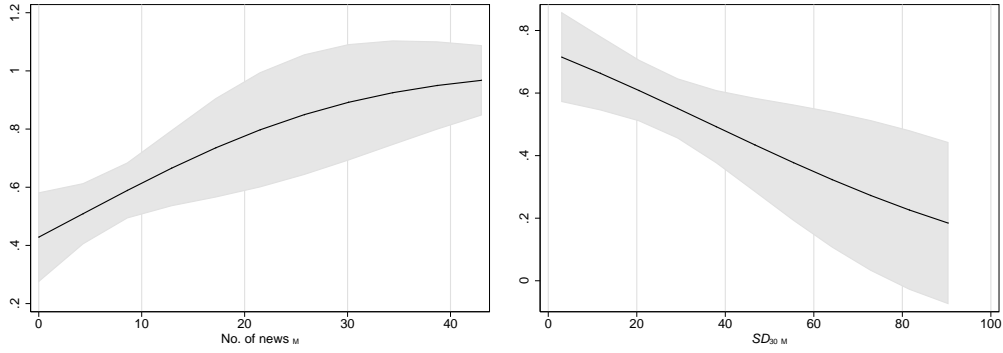
a. Predicted probability for the number of news *b.* Predicted probability for volatility
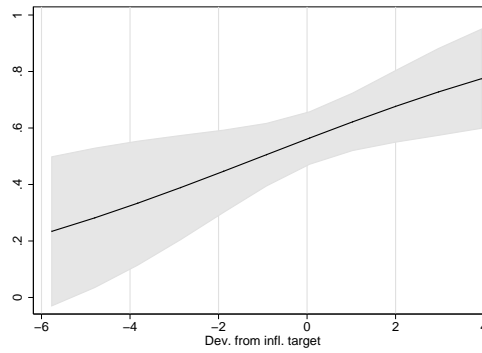
c. Predicted probability for inflation

Figure 8. Probability of central bank buying dollars in the NER market, from regression 2 with $m = 30$ in table 9.
Note: Each figure shows the probability (solid line) and confidence intervals (gray area) from regression 2 of the central bank buying dollars in the NER market holding the other variable at its mean.

episodes and its content is mainly from exporters in search of assistance. This result is important since it challenges the decision making process of the central bank to intervene in the exchange rate market.

6   Conclusion

The paper reaches three main conclusions. First, there is media bias when reporting the behavior of the NER, the paper shows there are more news during a revaluation episode than a devaluation one. This bias is measured in a model of asymmetric response of the devaluation/revaluation against the number of news that discuss the behavior of the NER. The interaction coefficient between the asymmetric coefficient and the market period dummy is significant for a revaluation but not for devaluation, suggesting that the bias continued after the end of the exchange rate band scheme. Second, the content of the news is closely linked to the words "exporters", "revaluation", "central bank", "government" and "assistance", showing that in a high proportion news are not only

published during revaluation of the exchange rate, but that news report the claims of help from an interest group to public institutions. And third, Colombia's central bank intervenes in the exchange market buying US dollars responding to the number of news (the bias) and not volatility of the NER.

The econometric results only settle down the proposed bias for revaluation news to a testable level, but tell us nothing regarding why it happens. A principle of journalism is unbiasedness, if this principle were in action in this particular economic event, the number of news discussing the behavior of the NER should be the same when a devaluation or a revaluation happens, however this is precisely not the case. Economic journalism in Colombia is biased. The remaining question is why?

The Corneo (2006) model suggests that there is media bias after the media has made a coalition with an interest group. For the case studied in this paper, that interest group can be the exporting industries which are directly affected by revaluation of the exchange rate. Journalists, editors and commentators become the public reflection of exporting industries. Exporting industries using newsletters, press releases, public announcements and their own associations and conferences, disseminate their discontent with the economic environment and revaluation episodes. This discontent is received by the press and becomes a source of news, editorials and op-eds. There are more news discussing revaluation because the exporting industries are complaining about it, and there are less news discussing devaluation because the exporting industries benefits from it.

Furthermore the complaints and the news are not an end by themselves, the industry complains in search for government assistance. And in fact this is the case, fiscal authorities subsidize "affected" industries and central bank intervenes in the exchange rate market. The third finding shows that the central bank responds to the number of news and not volatility to intervene in the exchange rate market (completing the mechanics of the Corneo model). This result is in clear contrast to the idea of an independent central bank. In the Corneo model, policy makers respond to the media bias in order to keep incumbency in office, or face the challenge of the public. Colombia's central bank board is not subject to public elections but they do face scrutiny and take the blame for the behavior of the NER. This shows that the board of the central bank is quite aware of the media highlights and reacts to them as well as to economic variables.

If the number of news is taken as a proxy for the pressure of local exporting industries to magnify the effects of a revaluation and seek government assistance, this behavior speaks ill of the industry. The determination of the NER in Colombia has been set by market mechanisms for almost 20 years and there are still complaints about adverse the results of the market. How long can it take for the exporting industry to adjust and learn from the market? Why exporters do not engage in the use of financial tools such as

futures and derivatives to edge against adverse events?[12] In spite of the result reported here of a lower news bias during the free market period, this seems to be a case of a slow learning, if not unlearning, by exporting.

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[12]Financial tools have been available in Colombia for at least a decade, as reported in El Tiempo (1997) and El Tiempo (2004), even the head of the exporters association guild declared "[exporters] seem to continue their business as if the Act Nr. 444 of 1967 were still in place, [under such scheme] with a guaranteed and continuous devaluation" ([los exportadores] todavía manejan sus negocios como si existiera el Decreto 444 de 1967 que garantizaba una devaluación gota a gota) González (2009).

# Appendices

Appendix 0.A Acronyms

NBRM   Negative Binomial Regression Model

NER   Nominal Exchange Rate

PRM   Poisson Regression Model

RER   Real Exchange Rate

VAR   Vector Auto Regression

Appendix 0.B   Additional figures and tables

This appendix shows several figures with the purpose to validate the use of the data and results shown in the main text. First, it is argued that an interest group might react strongly to the behavior of the Real Exchange Rate (RER) instead of the NER and its volatility. Figures 12 and 13 show that there is no difference in the $m = 30$ and $m = 60$ days percentage change between the NER and RER; and how volatility and the percentage change of the NER are not very different either. Secondly, figure 14 shows the number of news as defined in the text and the time series of the RER for $m = 30$ and $m = 60$, accordingly to the previous two figures, considering using the RER would not make any difference. As argued in the text, these figures confirm that using the NER percentage change instead of the RER is appropriate. Finally a Vector Auto Regression (VAR) estimation is undertaken for the central bank decision to intervene (equation 5) with 1 and 2 lags structure and $m = 30$ and $m = 60$. This estimation, confirms there is no feedback effect from the central bank intervention upon the number of news, although collinearity between then number of news, volatility and inflation does exist, this has been addressed in the estimation included in the text using robust standard errors.
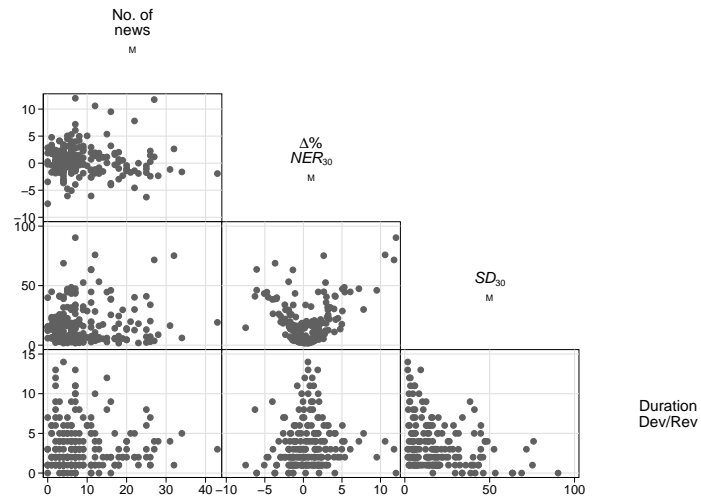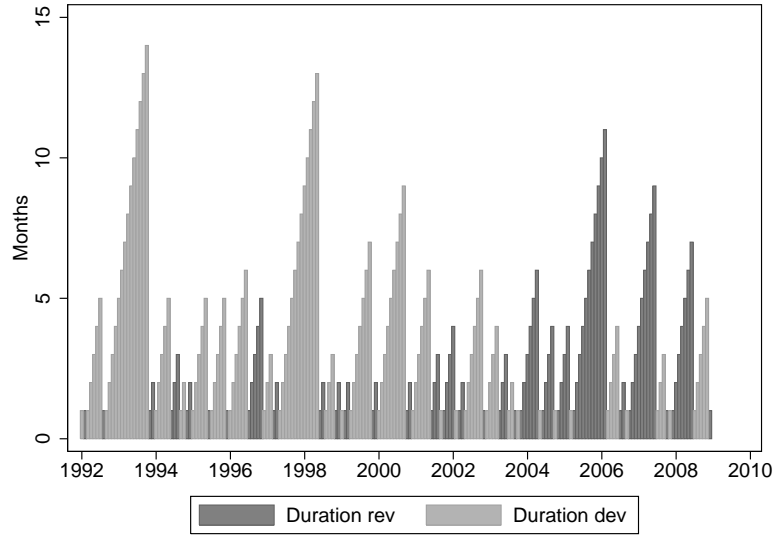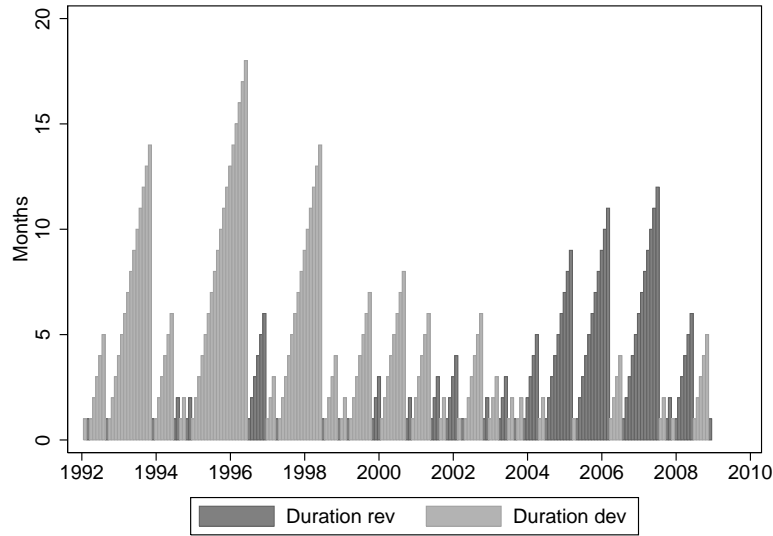
a. For $m = 30$
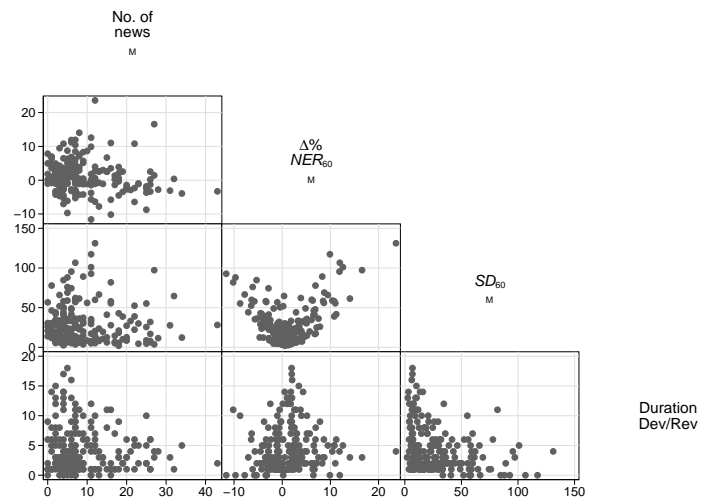
b. For $m = 60$

Figure 9. Scatter plot dependent and explanatory variables for $m = 30, 60$.

Source: NER behavior from Banco de la República (2010); Nr. of news from Casa Editorial El Tiempo (2010).

a. For $m = 30$

b. For $m = 60$

**Figure 10.** Cumulative count of time period with devaluation / revaluation.

Note: Count variable of the number of days of devaluation/revaluation for $m = 30, 60$. The variable takes a value of 1 if the devaluation/revaluation period lasts one time period (a month), 1 the first time period and 2 the second time period if the devaluation/revaluation period lasts two time periods, and so forth.

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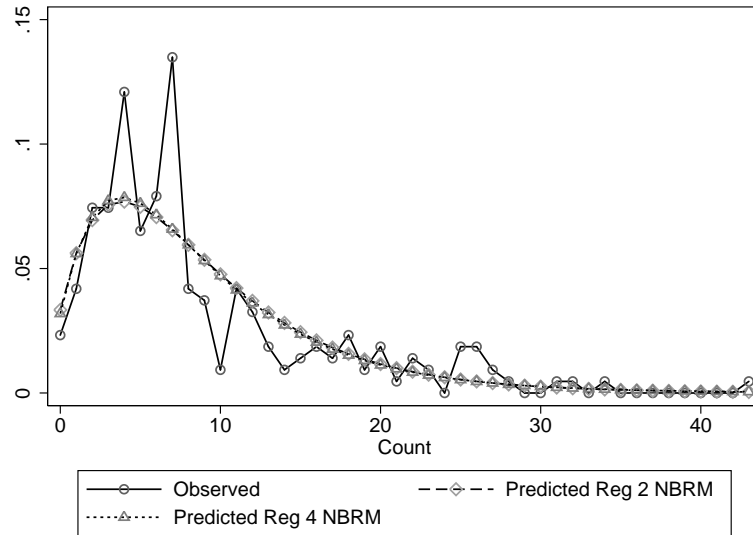
a. Estimation with $m = 30$
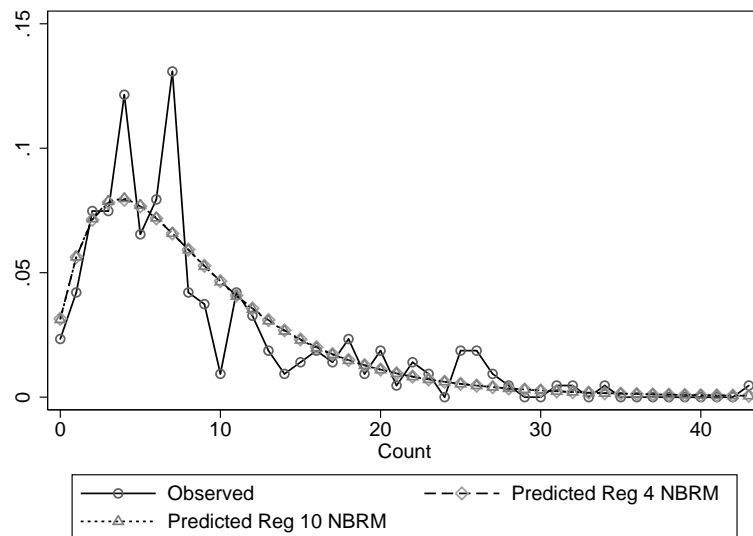
b. Estimation with $m = 60$

Figure 11. Predicted probability of the count variable.
Note: The figure shows the Mean predicted probability and the observed probability, regressions 2 and 4 for the $m = 30$ estimation and regressions 4 and 10 for the $m = 60$ estimation.

a. 30 days percentage change

b. 60 days percentage change
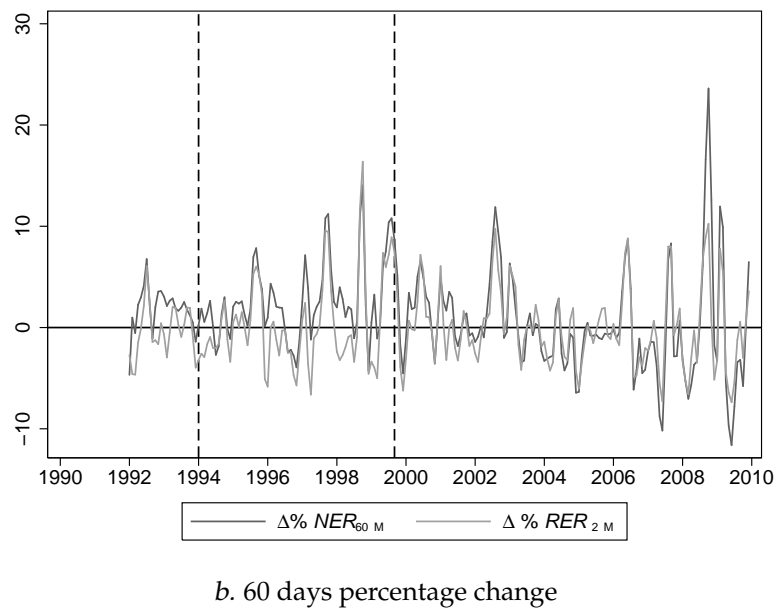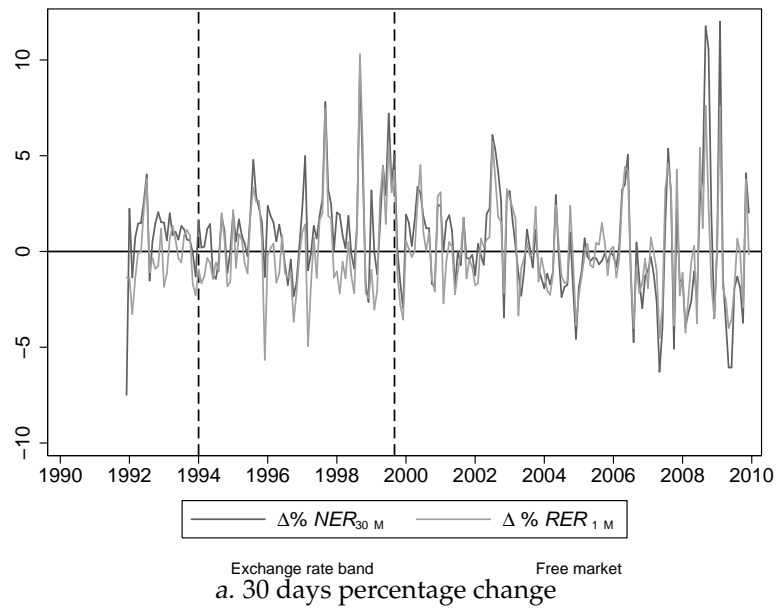
Figure 12. Percentage change of the NER and RER.
Note: The figure shows the percentage change of the NER and RER for $m = 30$ and $m = 60$ days window.
Source: NER behavior from Banco de la República (2010)
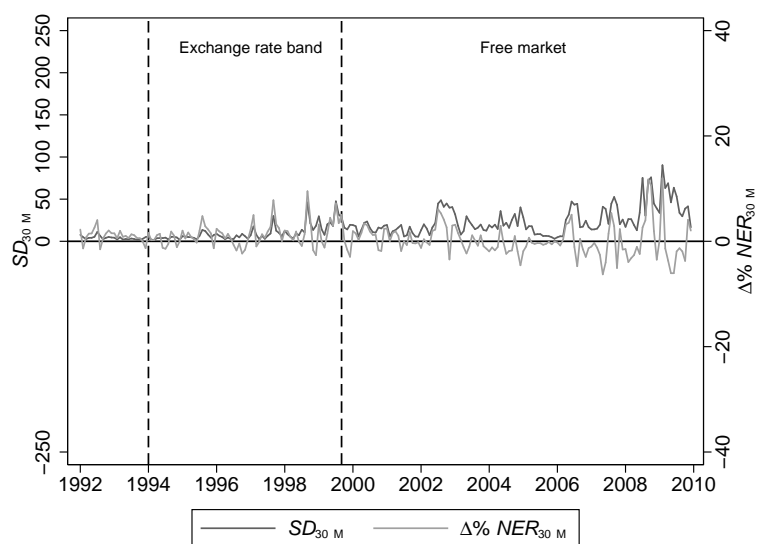
a. 30 days percentage change
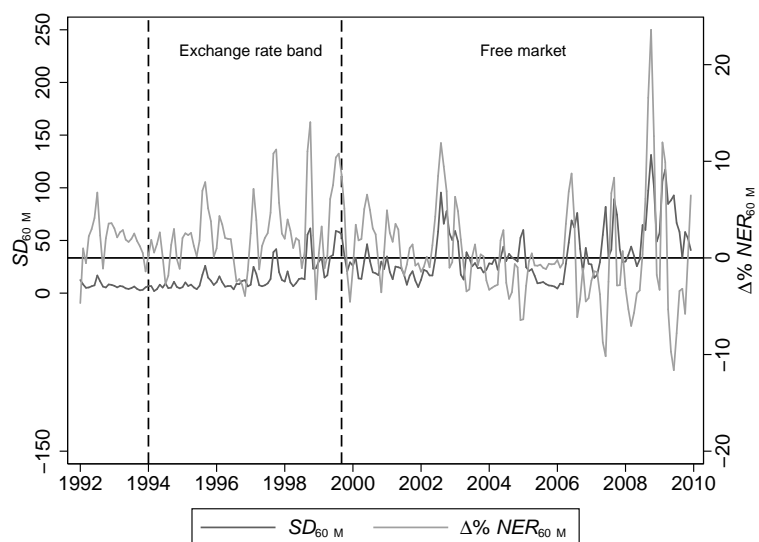
b. 60 days percentage change

Figure 13. Volatility and percentage variation of the NER.
Note: The figure shows the volatility, measured as the standard deviation (SD) and the devaluation / revaluation of the NER for $m = 30$ and $m = 60$.
Source: NER behavior from Banco de la República (2010).

Figure 14. RER behavior, news, editorials and op-eds.
Note: Left axis, Number of news, editorials and op-eds (monthly) published by the *El Tiempo*, *Portafolio* and *Cambio*. Right axis RER.
Source: NER behavior from Banco de la República (2010); Nr. of news from Casa Editorial El Tiempo (2010).

Table 10. VAR estimation for variables in central bank intervention (equation 5) for $m = 30$.

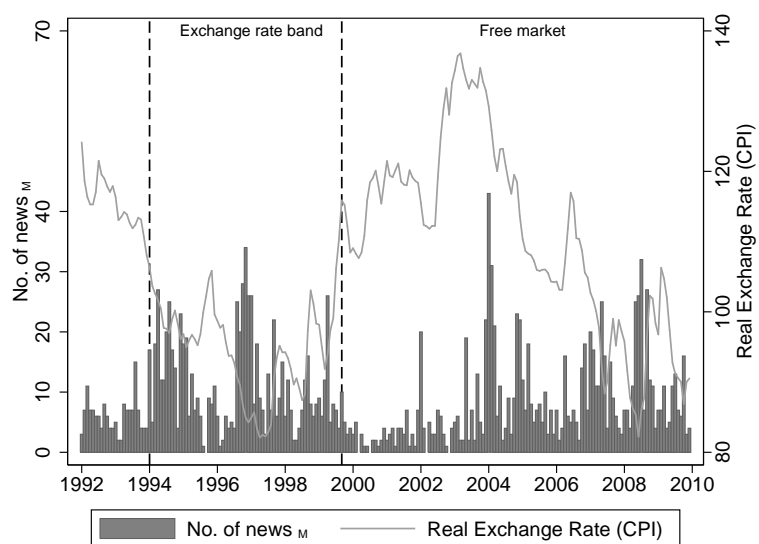|	$CB\,buy_M$	$No.\,News_M$	SD_{SM}	π - $Target$	$INT.\,RES_{SM}$	$CB\,buy_M$	$No.\,News_M$	SD_{SM}	π - $Target$	$INT.\,RES_{SM}$
$CB\,buy_M(t-1)$	0.266^a	0.718	-3.065	-0.0389	0.130	0.290^a	0.689	-3.874^c	-0.000692	0.379
	(0.0907)	(1.264)	(2.203)	(0.106)	(0.737)	(0.0892)	(1.243)	(2.247)	(0.106)	(0.719)
$CB\,buy_M(t-2)$	0.0866	-0.00463	-2.856	0.134	0.957					
	(0.0929)	(1.296)	(2.258)	(0.109)	(0.756)					
$No.\,News_M(t-1)$	-0.00171	0.520^a	0.357^b	0.00948	-0.0289	0.00294	0.491^a	0.134	0.00819	0.00371
	(0.00693)	(0.0966)	(0.168)	(0.00811)	(0.0563)	(0.00588)	(0.0820)	(0.148)	(0.00697)	(0.0474)
$No.\,News_M(t-2)$	0.00228	0.0344	-0.174	-0.00823	0.0359					
	(0.00661)	(0.0922)	(0.161)	(0.00774)	(0.0538)					
$SD_{SM}(t-1)$	0.00169	-0.146^a	0.412^a	-0.000387	-0.00334	-0.00350	-0.0705^c	0.624^a	-0.00359	-0.0200
	(0.00390)	(0.0543)	(0.0946)	(0.00456)	(0.0317)	(0.00259)	(0.0360)	(0.0652)	(0.00306)	(0.0208)
$SD_{SM}(t-2)$	-0.00627^c	0.0995^c	0.261^a	-0.00302	-0.0156					
	(0.00367)	(0.0512)	(0.0893)	(0.00430)	(0.0299)					
π - $Target(t-1)$	0.0995	0.363	-1.562	1.031^a	0.470	0.0356	0.670^c	1.388^b	0.907^a	0.195
	(0.0763)	(1.064)	(1.853)	(0.0893)	(0.620)	(0.0253)	(0.353)	(0.638)	(0.0300)	(0.204)
π - $Target(t-2)$	-0.0675	0.240	3.114^c	-0.128	-0.337					
	(0.0731)	(1.019)	(1.775)	(0.0855)	(0.594)					
$INT.\,RES_{SM}(t-1)$	-0.00558	0.0204	0.903^a	0.0115	0.0355	$6.14\text{e-}05$	-0.0416	0.677^b	0.0180	0.0596
	(0.0112)	(0.157)	(0.273)	(0.0131)	(0.0913)	(0.0111)	(0.155)	(0.281)	(0.0132)	(0.0898)
$INT.\,RES_{SM}(t-2)$	0.00707	-0.0421	-0.266	0.0206	0.0288					
	(0.0113)	(0.158)	(0.276)	(0.0133)	(0.0922)					
Constant	0.467^a	4.214^a	8.881^a	0.0339	0.704	0.459^a	5.340^a	9.260^a	0.0544	1.160
	(0.110)	(1.537)	(2.678)	(0.129)	(0.896)	(0.0964)	(1.344)	(2.430)	(0.114)	(0.777)
Observations	124	124	124	124	124	124	124	124	124	124
N	124	124	124	124	124	124	124	124	124	124
AIC	22.98	22.98	22.98	22.98	22.98	22.86	22.86	22.86	22.86	22.86
HQIC	23.49	23.49	23.49	23.49	23.49	23.13	23.13	23.13	23.13	23.13
SBIC	24.23	24.23	24.23	24.23	24.23	23.54	23.54	23.54	23.54	23.54

Note: Standard errors in parenthesis. a. $p<0.01$, b. $p<0.05$, c. $p<0.1$

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Table 11. VAR estimation for variables in central bank intervention (equation 5) for $m = 60$.

	$CB\,buy_M$	$No.\,News_M$	SD_{SM}	π - $Target$	$INT.\,RES_{SM}$	$CB\,buy_M$	$No.\,News_M$	SD_{SM}	π - $Target$	$INT.\,RES_{SM}$
$CB\,buy_M(t-1)$	0.248^a	1.506	-5.780^c	-0.0374	0.0431	0.289^a	0.780	-7.125^b	0.00340	-0.0839
	(0.0914)	(1.251)	(2.963)	(0.107)	(0.838)	(0.0877)	(1.235)	(2.903)	(0.103)	(0.876)
$CB\,buy_M(t-2)$	0.0817	-0.511	-3.339	0.131	1.265					
	(0.0934)	(1.278)	(3.028)	(0.110)	(0.856)					
$No.\,News_M(t-1)$	-0.000670	0.477^a	0.514^b	0.00938	-0.0239	0.00254	0.473^a	0.407^b	0.00788	0.0322
	(0.00661)	(0.0905)	(0.214)	(0.00776)	(0.0606)	(0.00572)	(0.0806)	(0.189)	(0.00675)	(0.0571)
$No.\,News_M(t-2)$	0.00126	0.0746	-0.293	-0.00876	0.0159					
	(0.00640)	(0.0876)	(0.207)	(0.00752)	(0.0587)					
$SD_{SM}(t-1)$	0.000398	-0.118^a	0.724^a	-0.000316	-0.0159	-0.00336^b	-0.0391^c	0.695^a	-0.00319	-0.0372^b
	(0.00292)	(0.0399)	(0.0946)	(0.00343)	(0.0268)	(0.00167)	(0.0236)	(0.0554)	(0.00198)	(0.0167)
$SD_{SM}(t-1)$	-0.00422	0.103^a	-0.0279	-0.00172	0.00468					
	(0.00279)	(0.0382)	(0.0904)	(0.00328)	(0.0256)					
π - $Target(t-1)$	0.0889	0.630	-1.279	1.032^a	0.812	0.0358	0.668^c	1.521^c	0.904^a	0.233
	(0.0766)	(1.049)	(2.485)	(0.0900)	(0.703)	(0.0251)	(0.354)	(0.832)	(0.0296)	(0.251)
π - $Target(t-2)$	-0.0558	-0.00167	3.293	-0.129	-0.539					
	(0.0730)	(0.999)	(2.366)	(0.0857)	(0.669)					
$INT.\,RES_{SM}(t-1)$	-0.00244	0.158	0.835^a	0.0156	0.762^a	0.00513	-0.0613	0.570^b	0.0192^b	0.564^a
	(0.00937)	(0.128)	(0.304)	(0.0110)	(0.0859)	(0.00757)	(0.107)	(0.251)	(0.00893)	(0.0756)
$INT.\,RES_{SM}(t-2)$	0.00514	-0.243^c	-0.464	-0.000769	-0.406^a					
	(0.00919)	(0.126)	(0.298)	(0.0108)	(0.0843)					
Constant	0.507^a	3.639^b	13.53^a	0.0349	0.973	0.492^a	5.256^a	10.54^a	0.0651	2.016^b
	(0.112)	(1.530)	(3.625)	(0.131)	(1.026)	(0.0967)	(1.362)	(3.202)	(0.114)	(0.966)
Observations	124	124	124	124	124	124	124	124	124	124
N	124	124	124	124	124	124	124	124	124	124
AIC	23.73	23.73	23.73	23.73	23.73	23.78	23.78	23.78	23.78	23.78
HQIC	24.23	24.23	24.23	24.23	24.23	24.06	24.06	24.06	24.06	24.06
SBIC	24.98	24.98	24.98	24.98	24.98	24.46	24.46	24.46	24.46	24.46

Note: Standard errors in parenthesis, a. p<0.01, b. p<0.05, c. p<0.1

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