Real Exchange Rate, the Wage Gender Gap and Domestic Violence*

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Abstract. We exploit the natural experiment generated by a strong depreciation of the Uruguayan real exchange rate between 2002 and 2003 followed by an equally strong appreciation between 2004 and 2010 to explore the causes of domestic violence. The real exchange rate is a measure of the relative price between tradable and non-tradable goods. We thus take advantage of the fact that traditionally men are employed in tradable industries (manufacturing) and women are employed in non-tradable industries (services), and therefore a change in the real exchange rate have a different impact in men's and women's potential wages. In line with models of household bargaining, we find that an increase in the real exchange rate, thus generating an increase in the bargaining power of men relative to women within the household, increases domestic violence.

Keywords: Real exchange rate, wage gender gap, domestic violence, assaults.

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I. Introduction

Domestic violence is widespread and common. One out of three women around the world has suffered violent episodes from a partner during their lifetime (WHO 2013). The problem particularly affects women living in developing countries. A report based on data from the Demographic and Health Surveys in nine developing countries (Cambodia, Colombia, Dominican Republic, Egypt, Haiti, India, Nicaragua, Peru, and Zambia) shows that the percentages of women who said an intimate partner had ever abused them ranged from 48 percent in Zambia and 44 percent in Colombia to 18 percent in Cambodia and 19 percent in India (Kishor and Johnson 2004).

In this paper we explore the causes of domestic violence, using data from Uruguay. Uruguay is not an exception in terms of the prevalence of domestic violence: a recent survey from the Ministry of Public Health reveals that one out of four women in Uruguay is a victim of domestic violence. The survey also shows that the incidence of domestic violence is higher for women with low educational attainment.

To study the causes of domestic violence we exploit the natural experiment generated by a strong depreciation of the Uruguayan real exchange rate between 2002 and 2003,[1] followed by an equally significant appreciation of the real exchange rate between 2004 and 2010. As the real exchange rate is a measure of the relative price between tradable and non-tradable goods, we take advantage of the fact that men are traditionally employed in tradable industries (e.g., manufacturing) and women are traditionally employed in non-tradable industries (e.g., services).

[1] Due to the lack of international reserves to sustain the value of the currency in July 2002, the Central Bank of Uruguay was forced to a sudden interruption in the fixed exchange rate regime (crawling peg).

We contribute to the ongoing debate between two alternative theories. On the one hand, socio-cultural models predict that violence against women increases as women's wages increase, mainly because men feel their traditional gender role threatened: "when she brings home the bacon" (Macmillan and Gartner 1999). On the other hand, models of household bargaining predict that an increase in a woman's relative potential wage increases her bargaining power by providing her with an outside option (Farmer and Tiefenthaler 1997; Aizer 2010). Given that it is not the actual wage but the potential wage what determines the outside option, improving relative labor market conditions for women will decrease violence even in those households where women do not work (Pollak 2005). The opposite is also true: the deterioration in women's potential wages relative to men will increase domestic violence.

Most of previous empirical studies (Gelles 1976; Bowlus and Seitz 2006; Tauchen et al. 1991; Farmer and Tiefenthaler 1997) suffer relevant methodological shortcomings given either by omitted variables associated with women's wages (such as education) that could explain the negative relationship with violence, or by the reverse causality given by the fact that domestic violence may reduce woman's productivity and earnings.

A notable exception is Aizer (2010), who presents a household bargaining model that incorporates violence and analyzes the impact of the wage gap as a function of local demand for female and male labor. She provides empirical support in the US for a causal relationship between relative labor market conditions for women and female hospitalizations for assault. Her main finding is that a decrease in the wage gap between men and women reduces violence against women. Here we expand this results by considering not only serious physical but also non-physical abuse against women. Our findings are also consistent with the household bargaining model.

We exploit an exogenous variation in wage gender gap generated by the fluctuation in the real exchange rate. This allows us to estimate the impact effect of better outside options for the woman on domestic violence. Exploiting the variability in the proportion of women and men in tradable and non-tradable sector across the jurisdictions in Montevideo (the capital of Uruguay, 1.5 millions of inhabitants), we find that a reduction in potential wages for women relative to men leads to an increase in domestic violence.

The paper continuous as follows. Section II describes the natural experiment and presents the empirical strategy. Section III reports the results. Section IV concludes.

II. Empirical strategy

We analyze domestic violence in a period where potential gender wage gap suffered an exogenous strong variation. Specifically, we exploit changes in the real exchange rate as a measure of the relative price between tradable (male-work intensive) and non-tradable goods (female-work intensive). This approach accounts for the fact that the theory predicts that are the potential wages, not actual, that affect domestic violence.

The Uruguayan Law defines domestic violence in similar way to the US Department of Justice. Therefore in this paper we consider domestic violence as a pattern of abusive behavior in any relationship that is used by one partner to gain or maintain power and control over another intimate partner. Domestic violence can thus be physical, sexual, emotional, economic, or psychological actions or threats of actions that influence the partner at home.

The real exchange rate adopts alternative definitions in the literature (Hinkle and Montiel 1999). First, the real exchange rate can be defined as the relationship between domestic prices and external prices (trade-weighted multilateral), both expressed in the same currency: $RXR_1 = (E.P^*)/P$, where E is the nominal exchange rate measured in

domestic currency per foreign currency, P* is the level of external prices, and P the level of domestic prices. More importantly for the purpose of this paper, the real exchange rate can also be defined as a price ratio of different categories of goods of the domestic economy: tradable goods and services and non-tradable goods and services. Tradable goods and services are subjected to international trade so arbitrage determines that their internal price tends to equal the international one. This is not true for non-tradable goods and services where the price must be adjusted to close the excess of demand or supply in the domestic market. The real exchange rate is thus alternative defined as follows: $RXR_2 = P_T/P_N$, where P_T refers to the tradable price and P_N for the non-tradable price. It is straightforward to show that both definitions RXR_1 and RXR_2 are closely related.[2] Therefore, changes in the multilateral trade-weighted real exchange rate come hand in hand with changes in the relative prices of tradable and non-tradable goods.

Data from the National Household Survey confirms that wages of men relative to women in Uruguay commoves with the real exchange rate. In fact, between 2002 and 2004, after strong real exchange rate depreciation, the ratio of men's wages to women's wages in Montevideo increased from 1.52 to 1.58; and between 2004 and 2010, after a real exchange rate appreciation (similar in absolute values to the previous depreciation), the wage ratio decreased back to 1.52.

Figure 1 presents a striking pattern of the times series of domestic violence and the trade-weighted multilateral real exchange rate in the period January 2002 to December 2010. Data comes from the Ministry of the Interior and the Central Bank of Uruguay. Between May 2002 and January 2004 the trade-weighted multilateral real exchange rate

[2] $RXR1 = (E.P^*)/P = (E.P^*)/ (P_T^{\alpha} .P_N^{(1-\alpha)}) = E.P^*/(P_T) [P_T / P_N]^{(1-\alpha)} = D.RER2^{(1-\alpha)}$ where P is a geometric price average, D is the tradable goods price deviation with respect to the external prices expressed in the same currency, and α is the share of the tradable goods in the domestic prices basket.

depreciated by 58 percent while at the same time domestic violence increased by 154 percent. That is, in this period violence against women in Uruguay increased as their potential relative earnings have decreased. Interestingly, the reverse dynamics is also true: between January 2004 and February 2009 the trade-weighted multilateral real exchange rate appreciated by 29 percent while at the same time domestic violence decreased by 61 percent.

In this same time window, the behavior of a similar type of crime such as assaults (abusive behavior against another person excluding domestic violence) was different to the one observed in domestic violence.[3] Assaults increased by 40 percent between May 2002 and January 2004 and also increased by 6 percent between January 2004 and February 2009.

A basic regression analysis on monthly data from January 2002 to December 2010 (not reported) confirms these results.[4] The coefficient of regressing domestic violence on the real exchange rate is positive and statistically significant at the 10 percent level. The coefficient is not statistically significant when we consider assaults instead of domestic violence.

To analyze this observed pattern, we use the database of the Police Department of Montevideo, which includes the universe of offenses reported between 2002 and 2010.[5] The database has information on the date and the jurisdiction of the incident (Montevideo has 24 police jurisdictions).

[3] Our database includes 19,276 cases of Domestic Violence (2% of total crime between 2020 and 2010 in Montevideo) and 38,657 cases of Assaults (5% of total crime between 2020 and 2010 in Montevideo).
[4] The Augmented Dickey-Fuller Test (MacKinnon 1996) rejects the null hypothesis that the time series on domestic violence and assaults have a unit root. To deal with potential heteroskedasticity and serial correlation we compute Newey-West robust standard errors with a lag truncation of 4 months. All results mentioned but not shown are available from the authors upon request.
[5] There is no a regular survey on domestic violence victimization.

Additionally, we gather data from the National Household Survey in order to compute labor participation in tradable and non-tradable industries. We identify industries as tradable or non-tradable. We consider the International Standard Industrial Classification (Rev.3) to define a) Agriculture, hunting and forestry, b) Fishing, c) Mining and quarrying, and d) Manufacturing as tradable industries. The remaining industries were considered as non-tradables. This classification is in line with Stockman and Tesar (1995) and Aboal et al. (2005). In Table 2 we present the share of employed agents working in tradable sectors for each police jurisdiction from 2002 to 2010. As observed in that table, there is an important variability both over time and across jurisdiction. As expected, tradable industries are more intensive in male human capital than in female human capital. For every year since 2002 to 2010, the average share of men working in tradable sectors is higher than the share of women. If we consider the total sample period, 20 percent of men are employed in tradable sectors compared to a 14 percent of women. The differences in the employment rate in tradable sectors between men and women are statistically significant according to usual t-tests for each year and in the total sample period.

Figure 2 reports the histogram of the ratio of male to female participation in tradable sectors for the 24 jurisdictions in Montevideo. In line with Table 2, the histogram shows that there is an important variability in the proportion of men to women working in tradable sector across jurisdictions in Montevideo: it ranges from a minimum of 1.0 to a maximum of 2.4.

To identify the effect of potential wage gender gap on domestic violence we exploit the variability in the relative proportion of men to women working in the tradable sector in each police jurisdiction. We assume that unemployed people (including people

who decided not to work) have the same distribution of tradable and non-tradable skills of those currently employed. By doing so, we recognize the potential impact of better options in the job market on unemployed people.

In Figure 3 we introduce our identification strategy. We divide the 24 police jurisdictions in two groups. The first group comprises those jurisdictions where the ratio of men to female participation in tradable sectors is higher than 1.5 and a second group those where this ratio is smaller than 1.5. Then, we track the variation in domestic violence in both groups of jurisdictions in time windows defined by the fluctuations in the real exchange rate. Previous to the real exchange rate depreciation (January 2002 to May 2002), when the real exchange rate was flat, there was a small reduction in domestic violence in both groups of jurisdictions. However, as long as the real exchange rate depreciates (May 2002 to January 2004), domestic violence increases much more in those jurisdictions where the ratio of men to female participation in tradable sectors is more intensive. In other words, the higher the participation rates of men relative to women in tradable sectors the stronger the impact in domestic violence. By the same token, when the real exchange rate appreciates (January 2004 to February 2009), the decrease in domestic violence is stronger in those jurisdictions where the ratio of men to female participation in tradable sectors is higher.

In order to identify the causal effect we follow a difference-in-difference methodology that controls for observable and unobservable characteristics that remain constant along time and also for shocks common to all jurisdictions. We thus run the following equation:

$$Y_{it} = \beta D_i RXR_t + \mu_t + \delta_i + e_{it} \qquad (1)$$

where Y_{it} is domestic violence in jurisdiction i and month t, D_i is the relative proportion of employed men in tradable sectors to employed women in tradable sectors in jurisdiction i in 2002 (the first year of our sample period),[6] RXR_t is the multilateral exchange rate, μ_t is a month fixed effect, δ_i is jurisdiction fixed effect, and e_{it} is the usual error term. In this equation the parameter of interest is β.

The hypothesis is that an increase in the exchange rate should have a stronger effect on domestic violence in those jurisdictions where the relative proportion of men to women in tradable sectors is higher. That is, we expect $\beta > 0$.

III. Results

Table 3 report estimates of Equation (1). In line with our hypothesis, the coefficient on the interaction term is positive and statistically significant, even after considering standard errors clustered at the jurisdiction level (column (1)). That is, an increase in the exchange rate has a stronger effect on domestic violence in those jurisdictions where the relative proportion of men to women in tradable sectors is higher. Indeed, the coefficient is not only statistically significant but also quantitatively substantial. An increase of one standard deviation in the real exchange rate is associated with an increase of 2.7 cases of domestic violence (evaluated at the sample mean of the ratio of men to female participation in tradable sectors). This increase in the number of cases of domestic violence is important since it represents more than 1/3 of the sample mean (7.39).

The result holds after controlling by jurisdiction's per capita income (column (2)), which discards alternative interpretations that connect the variation in domestic violence

[6] We also consider the same data for the period 2003-2010 with no significant differences. In each police jurisdiction, the values of the *coefficient of variation* (the ratio of the standard deviation to the mean) across time from 2002 to 2010 of the share of men and women working in tradable-sector industries are very stable.

with fluctuations in the aggregate level of income of the household instead of the change in women bargaining power.

The result also holds when we use the number of cases of domestic violence normalized by jurisdictions' population (column (3)), and when we use annual data instead of monthly data, with and without controlling for jurisdiction's per capita income (columns (4) and (5)).[7]

We additionally run a false experiment considering the variation in assaults, a similar type of offense but outside the home. That is, we estimate again Equation (1) but using assaults as outcome instead of domestic violence. As shown in Table 4, the coefficient on the interaction term is not significant in all specifications (columns (1), (2), and (3)). These results provide additional confidence that the effect on domestic violence is indeed causal.

IV. Conclusions

In this paper we dig further into the economic causes of domestic violence. We analyze the relationship between income and domestic violence. We extend previous findings in the literature by expanding the coverage of the definition of domestic violence (including any type of non-physical abuse). We found that a reduction in women's potential wages relative to men increase domestic violence, whereas an increase in women's relative potential wages decrease men's incentives for aggression within the home.

Our paper, as most papers in this literature, uses data on reported crime instead of actual crime. In principle, it is possible that reporting is not orthogonal to the changes in the exchange rate potentially biasing our estimates. However, this bias could go in either

[7] Results also hold when we use a regression model for count data (Poisson or Negative Binomial).

direction. For example, the appreciation of the real exchange rate may decrease reporting if women feel sorry for the worsening of men's economic conditions. Alternatively, the availability of better outside options may increase the propensity of women to report domestic violence.

Our findings contribute to the ongoing debate on the causal effect of wage gender gap and domestic violence. We present evidence in line with the hypothesis that an increase in the bargaining power of women relative to men within the household reduces domestic violence. Therefore, policies aimed at reducing wage gender gap would have potential positive impact on domestic violence. At the same time, our results also suggest that the intensity of women-oriented policies should be calibrated according to the fluctuations in the real exchange rate. In fact, macro literature has long recognized potential economic advantages of real exchange depreciations given by exporters' competitiveness gains. Here we unveil a hidden potential social problem associated with the real exchange depreciation: the increase in domestic violence.

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Table 1. Summary statistics

	Mean	St. dev.	Min.	Max.	Obs.
Domestic violence	7.394	6.514	0	44	2,592
Assaults	14.879	9.683	0	56	2,592
Per capita income	7,706	4,133	2,298	22,527	216
Ratio of men to female participation in tradable sectors	2.081	0.564	1	2.4	24
Multilateral exchange rate	121.593	15.079	91	150	108

Table 2. Employment rates in tradable sectors

Jurisdiction	2002		2003		2004		2005		2006		2007		2008		2009		2010	
	Men	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*	*Men*	*Women*
1	13%	15%	7%	9%	10%	13%	12%	11%	11%	10%	15%	7%	18%	12%	9%	8%	11%	9%
2	16%	7%	9%	7%	13%	7%	12%	10%	12%	7%	17%	10%	13%	7%	11%	12%	12%	8%
3	12%	7%	14%	9%	15%	7%	14%	11%	14%	10%	14%	9%	13%	7%	13%	10%	12%	9%
4	14%	9%	12%	9%	15%	12%	17%	13%	15%	13%	18%	13%	15%	11%	12%	10%	14%	10%
5	14%	8%	12%	7%	13%	9%	15%	9%	13%	9%	15%	10%	12%	7%	14%	10%	12%	8%
6	19%	12%	16%	15%	18%	12%	16%	14%	19%	12%	18%	12%	19%	12%	17%	11%	18%	11%
7	17%	12%	21%	14%	18%	11%	17%	12%	20%	12%	18%	11%	21%	13%	17%	12%	21%	12%
8	20%	15%	19%	16%	21%	16%	21%	12%	21%	17%	21%	15%	25%	17%	22%	14%	22%	14%
9	14%	10%	14%	10%	12%	10%	15%	10%	14%	10%	15%	10%	14%	9%	12%	8%	12%	9%
10	18%	10%	12%	11%	15%	9%	14%	10%	13%	8%	16%	11%	13%	7%	12%	9%	13%	9%
11	15%	13%	15%	12%	15%	7%	16%	9%	15%	8%	14%	9%	16%	9%	16%	8%	14%	11%
12	16%	12%	17%	15%	21%	16%	14%	14%	17%	14%	16%	15%	15%	16%	19%	12%	18%	15%
13	15%	11%	15%	13%	19%	17%	15%	12%	17%	10%	19%	13%	18%	11%	18%	11%	16%	12%
14	15%	12%	17%	9%	20%	11%	18%	10%	18%	11%	17%	10%	17%	11%	17%	10%	18%	10%
15	18%	12%	16%	11%	13%	10%	12%	10%	15%	12%	16%	11%	14%	11%	13%	9%	15%	9%
16	19%	14%	19%	16%	19%	13%	22%	16%	21%	16%	21%	14%	20%	15%	21%	15%	20%	15%
17	19%	13%	25%	16%	20%	17%	25%	19%	20%	16%	23%	15%	25%	18%	25%	15%	22%	15%
18	18%	14%	23%	17%	22%	14%	23%	16%	23%	17%	21%	16%	24%	16%	23%	17%	22%	13%
19	24%	13%	23%	16%	27%	18%	20%	17%	24%	17%	24%	16%	24%	15%	26%	14%	23%	16%
20	25%	26%	32%	34%	39%	21%	33%	31%	32%	26%	34%	25%	36%	24%	39%	24%	37%	25%
21	24%	18%	29%	18%	26%	18%	27%	18%	25%	19%	27%	17%	28%	16%	26%	17%	23%	16%
22	35%	19%	31%	28%	48%	27%	38%	26%	33%	21%	41%	22%	40%	21%	35%	17%	33%	17%
23	22%	19%	33%	30%	32%	23%	26%	26%	27%	21%	27%	21%	30%	21%	31%	22%	29%	21%
24	19%	19%	26%	16%	21%	20%	20%	17%	25%	16%	23%	16%	24%	16%	24%	16%	23%	15%
Max.	35%	26%	33%	34%	48%	27%	38%	31%	33%	26%	41%	25%	40%	24%	39%	24%	37%	25%
Min.	12%	7%	7%	7%	10%	7%	12%	9%	11%	7%	14%	7%	12%	7%	9%	8%	11%	8%
Mean	18%	13%	19%	15%	20%	14%	19%	15%	19%	14%	20%	14%	21%	13%	20%	13%	19%	13%
St. Dev.	5%	4%	7%	7%	9%	5%	7%	6%	6%	5%	7%	4%	7%	5%	8%	4%	7%	4%
T-test	p=0,000		p=0,025		p=0,002		p=0,009		p=0,000		p=0,000		p=0,000		p=0,000		p=0,000	

Notes: t-test refers to usual difference of means test. In the total sample period (2002-2010), 20% of men are employed in tradable sectors and 14% of women, and the differences in the employment rate in tradable sectors between men and women are statistically significant according the difference of means t-test.

Table 3. Main results

	Domestic violence	Domestic violence	Domestic violence/Population	Domestic violence	Domestic violence
	(1)	(2)	(3)	(4)	(5)
Ratio * RXR	0.0873	0.0813	0.0010	0.0982	0.0916
	(0.0168) p=0.000	(0.0173) p=0.000	(0.0005) p=0.036	(0.0417) p=0.020	(0.0440) p=0.039
	[0.0439] p=0.059	[0.0439] p=0.092	[0.0006] p=0.111	[0.0539] p=0.082	[0.0574] p=0.124
Per capita income		0.0002			0.0002
		(0.0001) p=0.039			(0.0002) p=0.382
		[0.0002] p=0.430			[0.0002] p=0.505
Observations	2,592	2,592	2,592	216	216

Notes: RXR refers to real exchange rate. Ratio refers to the ratio of men to female participation in tradable sectors. All models are estimated by OLS. Models (1), (2), and (3) use monthly data and include month fixed effects and jurisdiction fixed effects. Model (4) and (5) use yearly data and include year fixed effects and jurisdiction fixed effects. Robust standard errors are in parentheses. Standard errors clustered at the jurisdiction level are in brackets.

Table 4. False experiments

	Assaults	Assaults	Assaults
	(1)	(2)	(3)
Ratio * RXR	0.0218	0.0076	0.0545
	(0.0219) p=0.320	(0.0502) p=0.880	(0.0521) p=0.296
	[0.0409] p=0.599	[0.0406] p=0.854	[0.0504] p=0.290
Per capita income			-0.0011
			(0.0003) p=0.001
			[0.0005] p=0.034
Observations	2,592	216	216

Notes: RXR refers to real exchange rate. Ratio refers to the ratio of men to female participation in tradable sectors. All models are estimated by OLS. Models (1) and (2) use monthly data and include month fixed effects and jurisdiction fixed effects. Model (3) uses yearly data and includes year fixed effects and jurisdiction fixed effects. Robust standard errors are in parentheses. Standard errors clustered at the jurisdiction level are in brackets.

Figure 1. Domestic violence and the real exchange rate

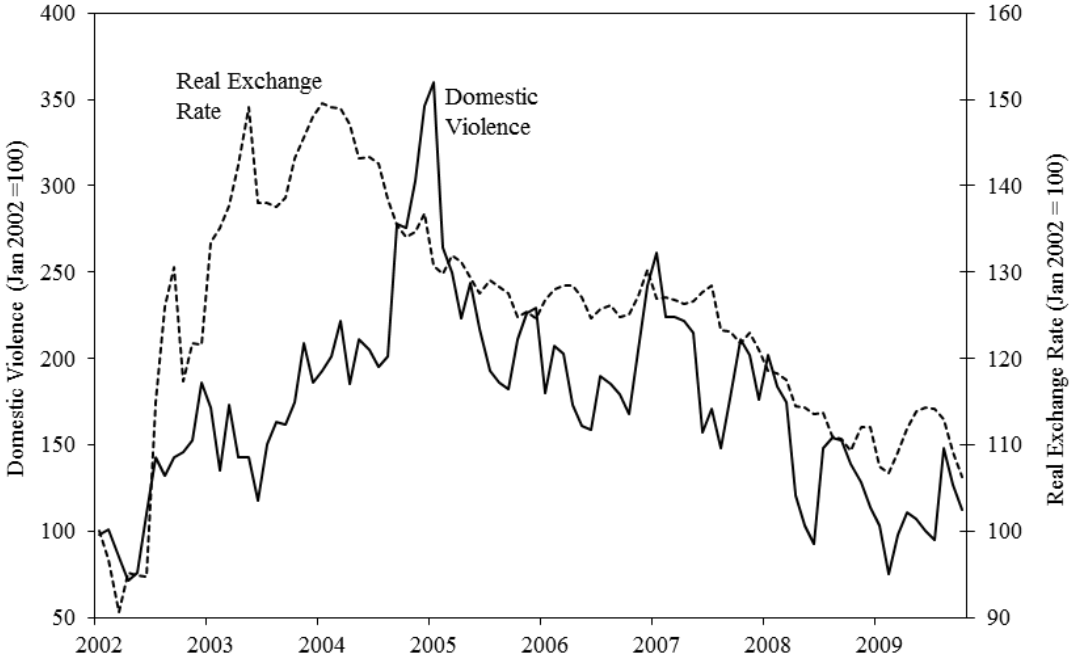
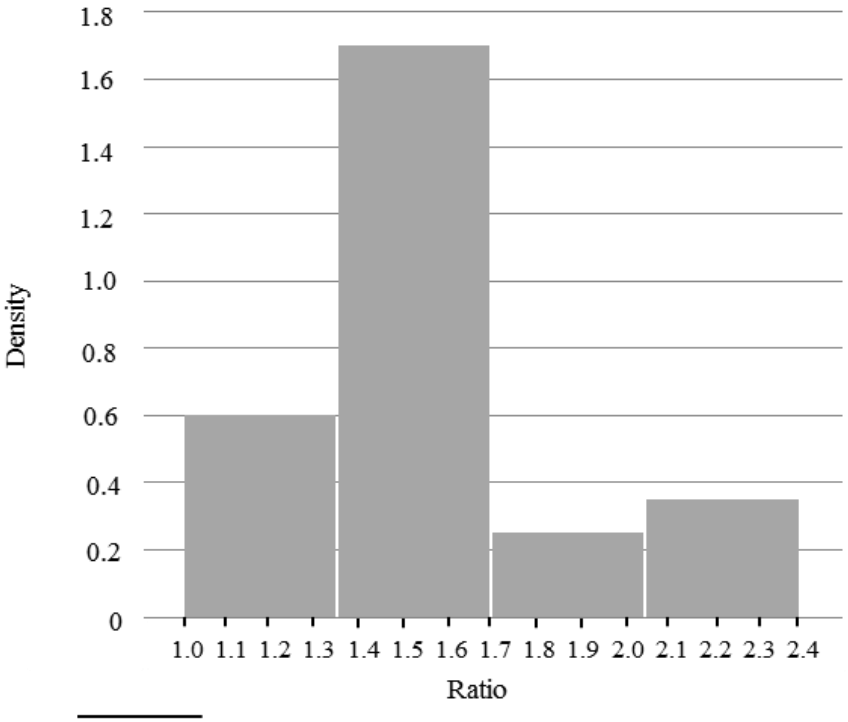
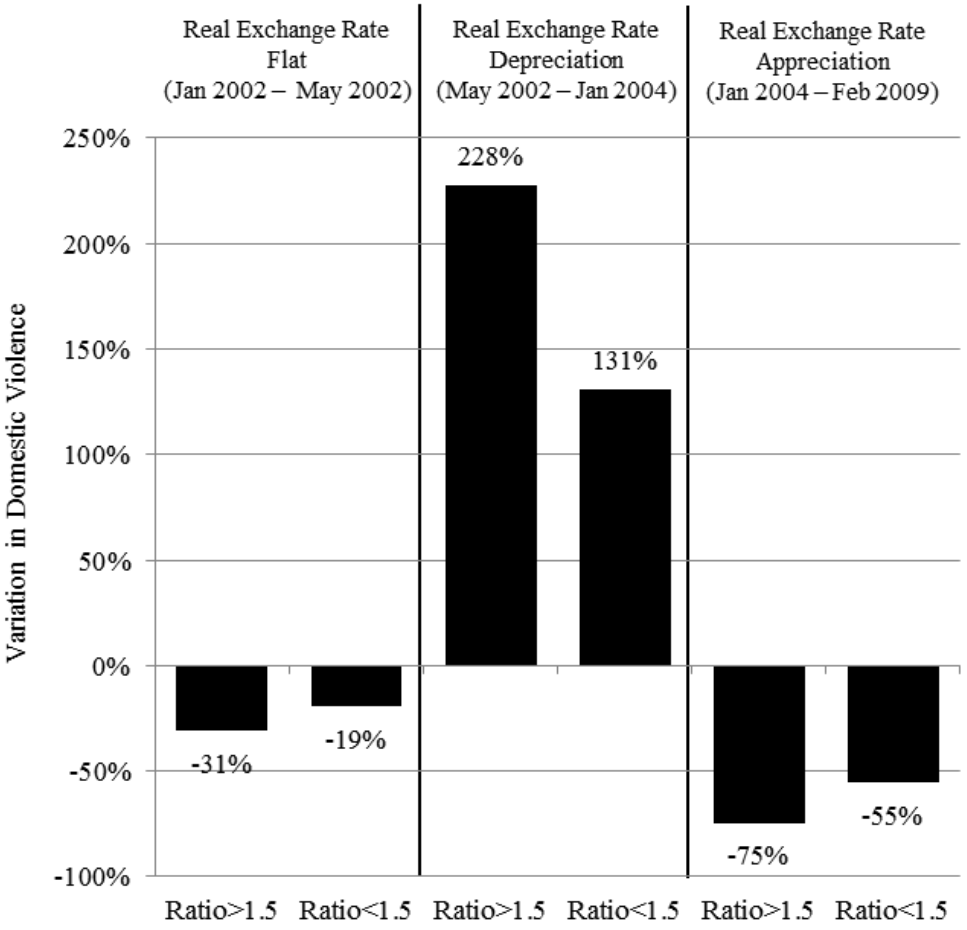


Figure 2. Histogram of the ratio of male to female participation in tradable sectors



Note: Ratio refers to the Ratio of men to female participation in tradable sectors.

Figure 3. Real exchange rate fluctuations, relative participation in tradable sectors, and variation in domestic violence.



Note: Ratio refers to the Ratio of men to female participation in tradable sectors.