# The Causal Effects of Expected Depreciations

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WAIFS

[1]The views expressed in this presentation are those of the authors and do not necessarily represent those of the Inter-American Development Bank. The randomized control trial is registered at the AEA RCT Registry (# AEARCTR-0005700).

# Motivation

- Exchange rate (USD/peso) is a crucial price for open economies
- Direct and indirect effects on firms, households, and fiscal and monetary authorities
- Qualitative understanding of mechanisms at play
  - Policy objectives
  - Future expected revenues and costs
  - Valuation of debt and wealth
- Three main challenges preventing empirical assessment
  - Path of NER and unobserved fundamentals potentially correlated
  - Not readily available datasets about $\mathbb{E}_t S_{t+1}$ of price-setters
  - Difficult to separate direct effects from time-varying policy reactions or GE effects

# Our Approach

Estimate the elasticity of firm-outcomes to exogenous future expected depreciations

1. Measure NER perceptions and expectations for a panel of firm managers in a SOE
2. RCT to induce exogenous variation in firm exchange rate expectations
3. Measure the size and persistence of expectation formation effects
4. Measure the effects of the treatment on the distribution of trade outcomes
5. Compute the elasticity of imports to expected depreciations

Results are a PE elasticity of firm-outcomes to expected future depreciations.

# Empirical Challenges

- OVB and reverse causality concerns: path of potentially unobserved shocks
- Two main approaches
  - Large Depreciations: Burstein et al (2005), Cravino and Levchenko (2017)
  - Changes in exchange rate regimes: Candia and Pedemonte (2022), Bouscasse (2022), Fukui et al (2023)
- Difficult to separate direct effects from GE effects and policy reaction functions
- Strong identifying assumptions
- This paper: information shock to firms exploiting deviations from full information
  - Treat a subset of firms with public information
  - Isolate other aggregate effects

# Related Literature

- Endogeneity of exchange rates and economic conditions widely acknowledged
  - Auer, Burstein, Lein (2012), Fukui, Nakamura, Steinsson (2023)
  - Eichengreen and Sachs (1985), Bouscasse (2022), Candia and Pedemonte (2022)
  - Focus on expectations. Induce variation using an RCT
- Formation of inflation expectations and its effects on decisions
  - Theory: Afrouzi (2023), Sung (2022), Werning (2022)
  - Empirics: Coibion, Gorodnichenko, Kumar (2018), Coibion, Gorodnichenko, Ropele (2020), Frache et al. (2023)
  - Contribute by measuring belief formation about future exchange rates
- Emerging market economies characterized by Dominant Currency Pricing
  - Gopinath et al. (2020), Egorov and Mukhin (2023), Boz et al. (2022), Casas (2020)
- Dynamic trade models and strategic decisions when trade is lumpy
  - Alessandria et al. (2010), Alessandria et al. (2024), Khan and Khederlarian (2021)
  - Mostly focus on tariff, we introduce issues with uncertainty about exchange rate

# Context: Colombia

- Emerging economy with a floating exchange rate
- Inflation targeting, low and stable inflation
- 98% of exports invoicing in USD Gopinath et al. (2020)
- *[...] de jure managed floating exchange rate regime* Ilzetski, Reinhart, Rogoff (2010)

⏩ Relative Volatility of the NER ⏩ Correlation with the Inflation Rate ⏩ Correlation with Oil Prices

# Survey, Randomization, and Research Design

# Survey

- We create new measure of firm expectations and beliefs for the USD exchange rate and local CPI inflation
- Using the leading business sentiment survey of the country as a starting point
- Roughly 500 firms per month
- Unbalanced panel
- Nationally representative for manufacturing and retail sectors

# Experiment Structure

1. Measure Priors: Not always ideal to ask the exact prior, we use proxy
2. Give information to a randomly selected group: Publicly available information, but not necessarily incorporated by everybody
3. Measure the effect on posterior: Compare reaction to treated versus control group
4. Use that effect on decision variables: IV approach to measure causal effect on decisions

Challenges

- Not many surveys allowing this structure
- Hard to get answers from decision makers

# Questions

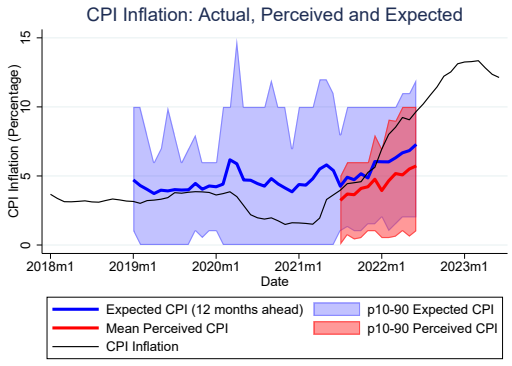
**Pre-Treatment Questions**

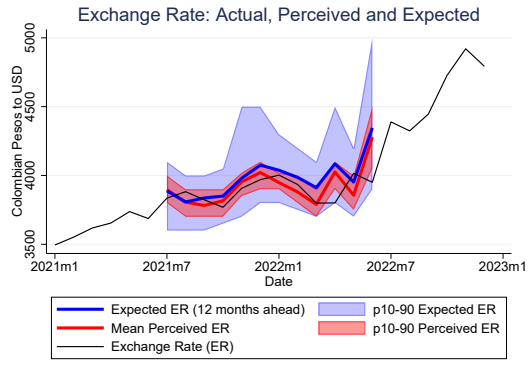
1. *If you were to buy US Dollars this week, What is the exchange rate at which you would be able to do so?*
2. *What is your perception of the percentage change of the CPI that occurred in the last 12 months?*

**Post-Treatment Questions**

1. *If you were to buy US Dollars in the financial sector in 12 months, what is the exchange rate at which you could buy them?*
2. *At what percentage value do you think that the prices in the economy, measured by the Consumer Price Index (CPI), will increase or decrease in the following 12 months?*

# CPI Inflation: Expectations and Perceptions



# Firm Managers vs. Professional Forecasters

| | Average | Standard Deviation | Forecast Error |
|---|---|---|---|
| Nowcast Exchange Rate | | | |
| Firms | \$3921 | \$204.9 | \$45.43 |
| Forecast Exchange Rate | | | |
| Professional Forecasters | \$3734 | \$133.2 | \$854.4 |
| Firms | \$3980 | \$329.4 | \$634.4 |
| Nowcast Inflation | | | |
| Firms | 4.48% | 4.23% | 2.18% |
| Forecast Inflation | | | |
| Professional Forecasters | 4.10% | 0.55% | 8.19% |
| Firms | 5.76% | 4.60% | 6.54% |

Less disagreement and lower forecasting errors the exchange rate. Inflation in line with German data (Link, Peichl, Roth, Wohlfart, 2023)

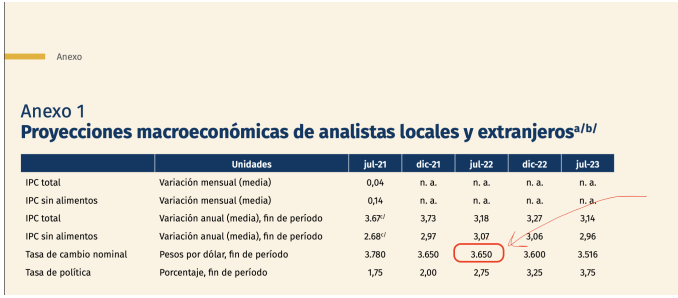
# Research Design

- We randomly assign firms into Treatment and Control groups ⏩ Balance
- Stratified randomization to ensure balance in three dimensions
  1. Prioritized firms
  2. Main Sector: Industry vs. Retail
  3. Exporter vs. Non-Exporter
- Elicit perceptions of CPI inflation and USD exchange rate
- For firms in $T$, provide the information treatment
  - Average NER forecast printed in the monetary policy report
- Elicit forecasts of CPI inflation and USD exchange rate

# Treatment

Firms in the treatment group receive a piece of public information contained in an annex of the monetary policy report:

*According to the last Survey of Analyst Expectations conducted by the Central Bank, the exchange rate in July 2022 is expected to be 3650.*



Anexo

**Anexo 1**

**Proyecciones macroeconómicas de analistas locales y extranjeros[a/b/]**

| | Unidades | jul-21 | dic-21 | jul-22 | dic-22 | jul-23 |
|---|---|---|---|---|---|---|
| IPC total | Variación mensual (media) | 0,04 | n. a. | n. a. | n. a. | n. a. |
| IPC sin alimentos | Variación mensual (media) | 0,14 | n. a. | n. a. | n. a. | n. a. |
| IPC total | Variación anual (media), fin de período | 3.67[c/] | 3,73 | 3,18 | 3,27 | 3,14 |
| IPC sin alimentos | Variación anual (media), fin de período | 2.68[c/] | 2,97 | 3,07 | 3,06 | 2,96 |
| Tasa de cambio nominal | Pesos por dólar, fin de período | 3.780 | 3.650 | 3.650 | 3.600 | 3.516 |
| Tasa de política | Porcentaje, fin de período | 1,75 | 2,00 | 2,75 | 3,25 | 3,75 |

Statistical Properties of the Forecast

# Treatment Effects on Expectation Formation

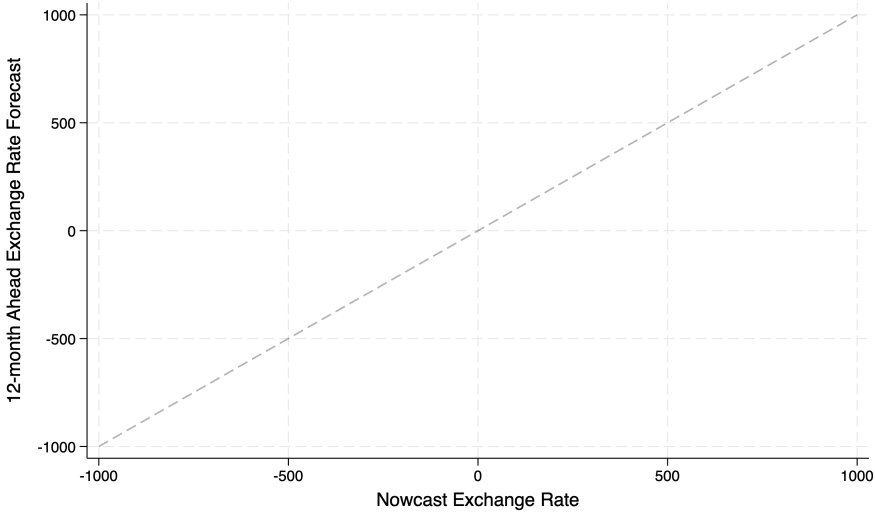
# Notation

- We estimate the following regressions

$$S^e_{i,t} = \beta_t + \beta_1 T_{i,t} + \beta_2 S_{i,t} + \beta_3 T_{i,t} \times S_{i,t} + \epsilon_{i,t}$$

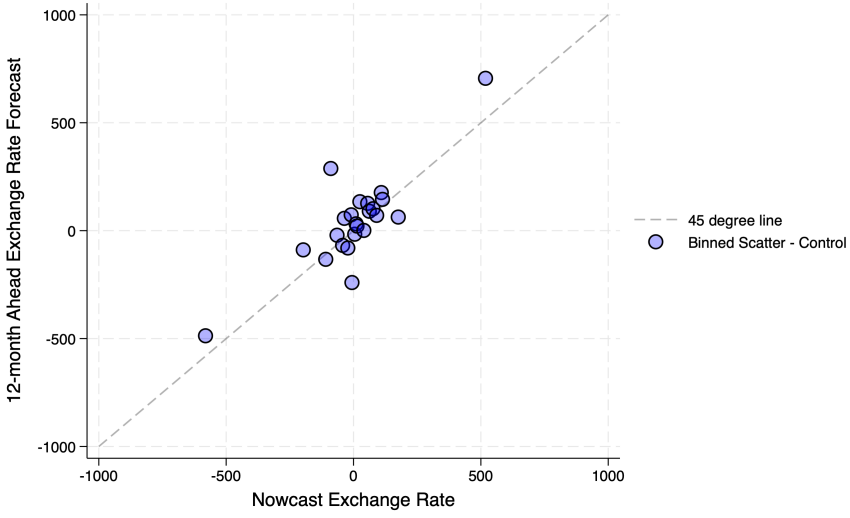
- $S^e$ denote forecasts about the realization of variable $S$
- $\beta_3$ the decrease in weights of priors
- Estimations using both OLS and Huber robust regressions

# Exchange Rate Nowcasts and Expectations




Inflation

# Exchange Rate Nowcasts and Expectations




Inflation

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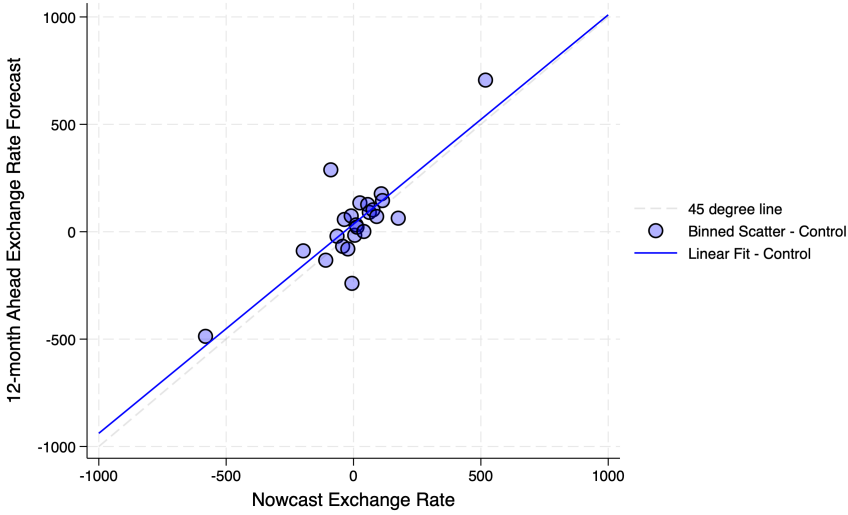


Inflation

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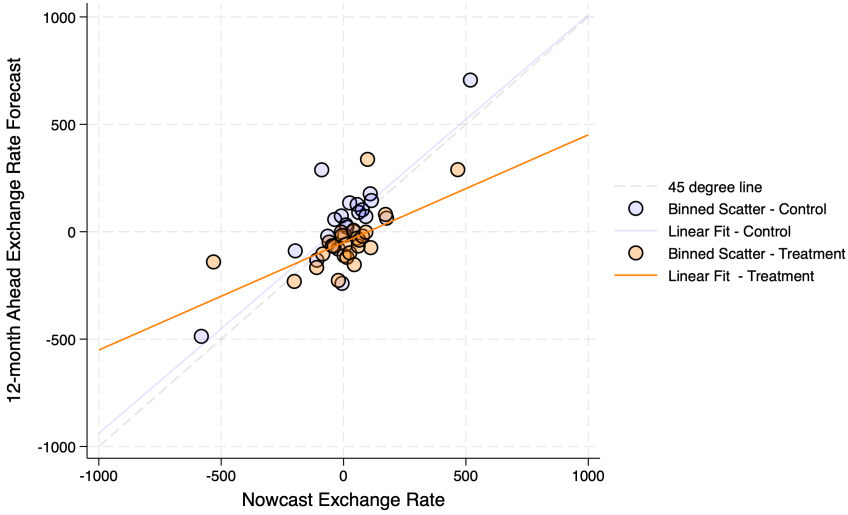


Inflation

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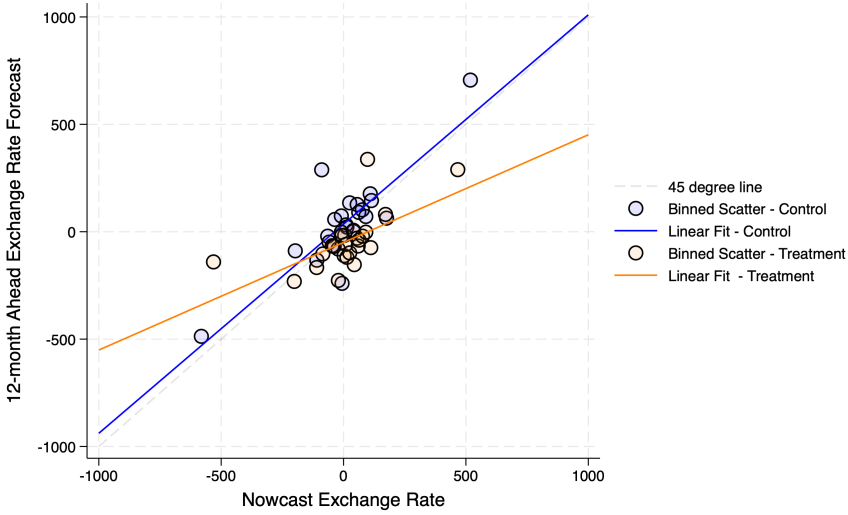
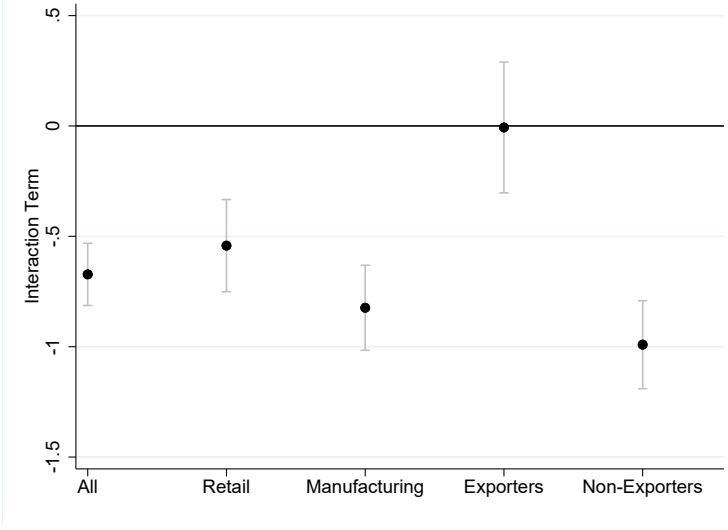



Inflation

# Treatment effect on Exchange and Inflation Expectations

| | 12-Month Ahead Exchange Rate Forecasts | |
|---|---|---|
| | (1) | (2) |
| NER Nowcast | 0.978*** | 0.958*** |
| | (0.115) | (0.053) |
| NER Nowcast x Treatment | -0.601*** | -0.672*** |
| | (0.157) | (0.143) |
| Treatment | 2,208*** | 2,496*** |
| | (597.9) | (273.7) |
| Constant | 143.2 | 196.1 |
| | (439.1) | (200.6) |
| Regression | OLS | Huber |
| Time FE | Yes | Yes |
| Observations | 681 | 659 |

# Heterogeneity: Exchange Rates

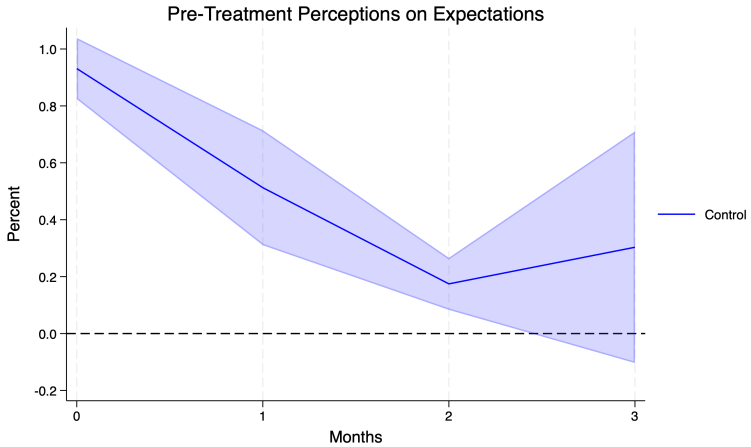



Inflation

# Dynamic Causal Effects

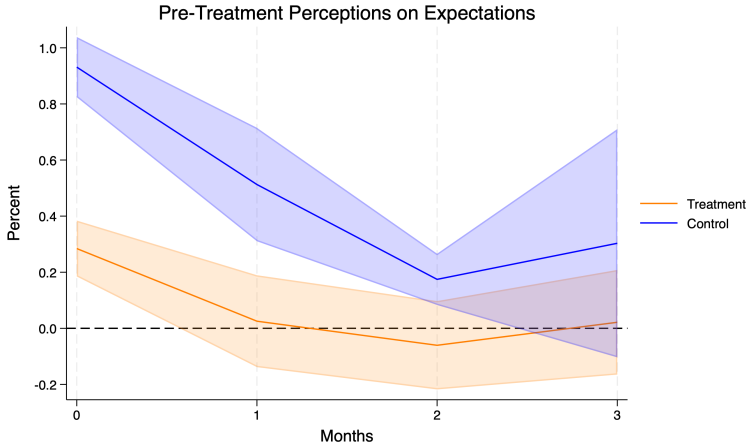
- Estimate the persistence of treatment effects
  1. For the formation of expectations
  2. For the formation of beliefs of current states
- Usually the macro literature on informational treatment finds very transient effects
- So far we estimated effects on $S^e_{i,t+h}$ for $h = 0$
- Now repeat for expectations and perceptions forward in time ($h \geq 1$)

# Dynamic Expectation Effects: Exchange Rate Forecasts




$$S^e_{i,t+h} = \beta_t + \beta^h_1 T_{i,t} + \beta^h_2 S_{i,t} + \beta^h_3 T_{i,t} \times S_{i,t} + \epsilon^h_{i,t}$$

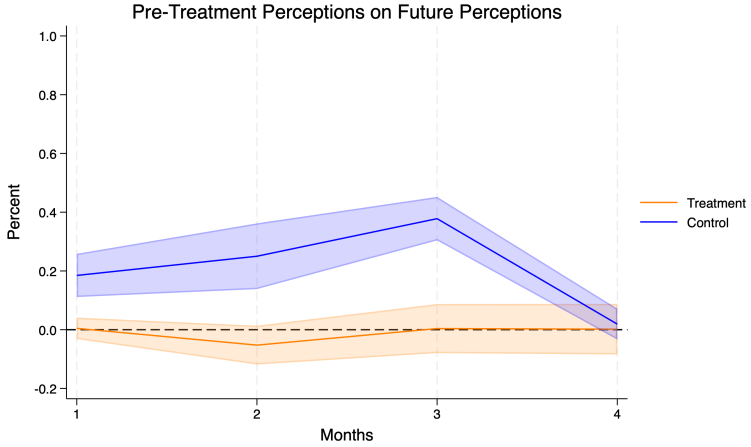
# Dynamic Expectation Effects: Exchange Rate Forecasts




$$S^e_{i,t+h} = \beta_t + \beta^h_1 T_{i,t} + \beta^h_2 S_{i,t} + \beta^h_3 T_{i,t} \times S_{i,t} + \epsilon^h_{i,t}$$

⏩ Forecasts Inflation ⏩ Nowcasts Inflation

# Dynamic Perception Effects: Exchange Rate Nowcasts




$$S^e_{i,t+h,t+h} = \beta_t + \beta^h_1 T_{i,t} + \beta^h_2 S^e_{i,t,t} + \beta^h_3 T_{i,t} \times S^e_{i,t,t} + \epsilon^h_{i,t}$$

# Treatment Effects on Firm Decisions

# Effects of Expected Depreciation

Measure the elasticity of current imports to future expected depreciations

- Link survey with administrative data of exports and imports » Distribution Sample vs Whole Economy
- Estimate effects on the average effects of firm-level outcomes

$$\log Y_{i,1} = \alpha_t + \beta \log Y_{i,0} + \gamma \log S^e_{i,0,1} + \varepsilon_i \tag{1}$$

- $Y_{i,t}$: yearly exports or imports before treatment ($t = 0$) or after treatment ($t = 0$)
- Instrumenting $\log S_{i,0,1}$ with $T_i$ and $\log S^e_{i,0,0} \times T_i$ (Coibion et al. 2023)
- Idea: use variation in exchange rate expectations induced by the treatment

# Effects of Expected Depreciation on Exports and Imports

| | First Stage | | IV Estimates | | | |
|---|---|---|---|---|---|---|
| | $\log \text{Imports}_{0,1}$ | $\log \text{Exports}_{0,1}$ | $\log \text{Imports}_{0,1}$ | $\log \text{Imports}_{0,1}$ | $\log \text{Imports}_{0,1}$ | $\log \text{Exports}_{0,1}$ |
| $T_i$ | -1.976*** | -1.218 | | | | |
| | (0.458) | (0.859) | | | | |
| $\log S^e_{i,t,t} \times T_i$ | 0.237*** | 0.146 | | | | |
| | (0.056) | (0.104) | | | | |
| $\log S^e_{i,t,t+12}$ | | | 6.444** | 9.738** | 1.510 | 6.863 |
| | | | (2.776) | (4.064) | (2.464) | (6.822) |
| $\log \text{Imports}_{i,t-12,t}$ | | | 0.977*** | 0.927*** | 0.997*** | |
| | | | (0.024) | (0.032) | (0.030) | |
| $\log \text{Exports}_{i,t-12,t}$ | | | | | | 0.960*** |
| | | | | | | (0.047) |
| Sample | All | All | All | Non-Exporters | Exporters | All |
| N | 452.0 | 237.0 | 452.0 | 221.0 | 231.0 | 237.0 |
| F-Test | | | 15.90 | 14.33 | 5.84 | 2.18 |

▸▸ Inference under weak instruments

# Interpretation

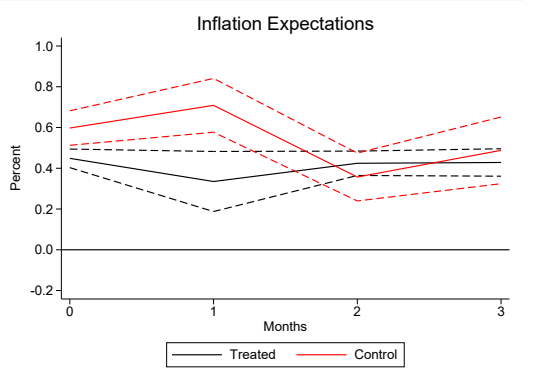
- Elasticity of imports to future expected depreciations $\approx 6$
- Larger for for non-exporters. Less informed $\rightarrow$ more affected by $T$
- Estimates combine:
  1. Intertemporal substitution in the timing of imports within and across products and origins
     - Positive
     - Studied in the trade/durable literature (Alessandria, Kaboski and Midrigan, 2011)
  2. Elasticity of import usage to costs
     - Substitution away from imported goods
     - Reduction in optimal firm scale
     - Both effects are negative
  3. Future expected Keynesian effects
     - Ambiguous sign of GE effects
- Relevant for effects of depreciations in the aggregate:
  - Expected depreciation important to understand reaction of net exports and to calibrate macro models

# Conclusions

- Firms react to public, easy to find information on the exchange rate
- They adjust forecasts and beliefs
- Act on those beliefs resetting prices, and exports
- Differential effects to destinations that use the USD
- We estimate a positive elasticity of current import expenditures to future expected depreciations

Thank you!

# Dynamic Expectation Effects: CPI Inflation




$$\pi^e_{i,t+h,t+h+12} = \beta_t + \beta^h_1 T_{i,t} + \beta^h_2 \pi^e_{i,t,t} + \beta^h_3 T_{i,t} \times \pi^e_{i,t,t} + \epsilon^h_{i,t}$$

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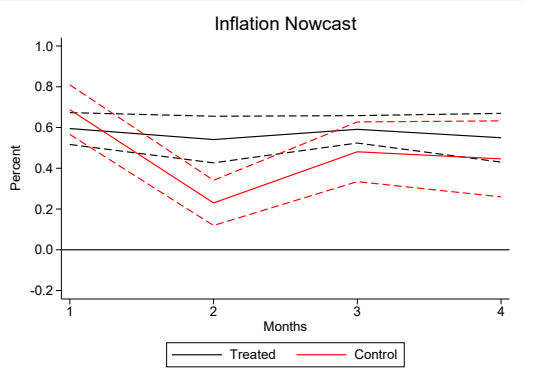
# Dynamic Perception Effects: CPI Inflation




$$\pi^e_{i,t+h,t+h} = \beta_t + \beta^h_1 T_{i,t} + \beta^\tau_2 \pi^e_{i,t,t} + \beta^h_3 T_{i,t} \times \pi^e_{i,t,t} + \epsilon^h_{i,t}$$

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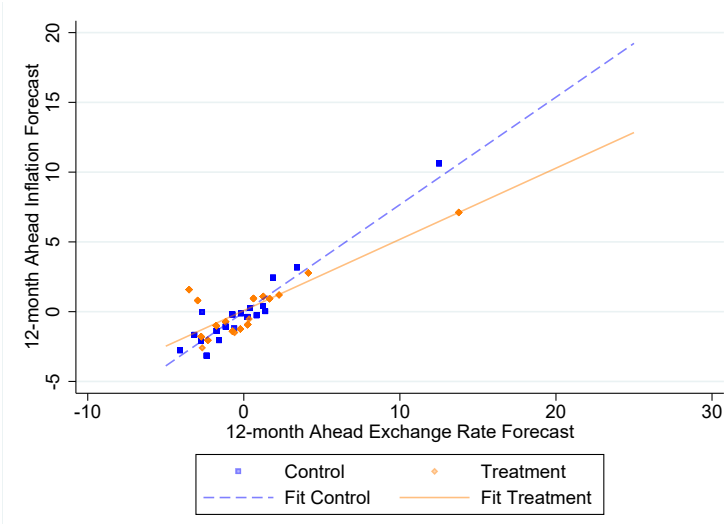
# Inflation Nowcasts and Expectations

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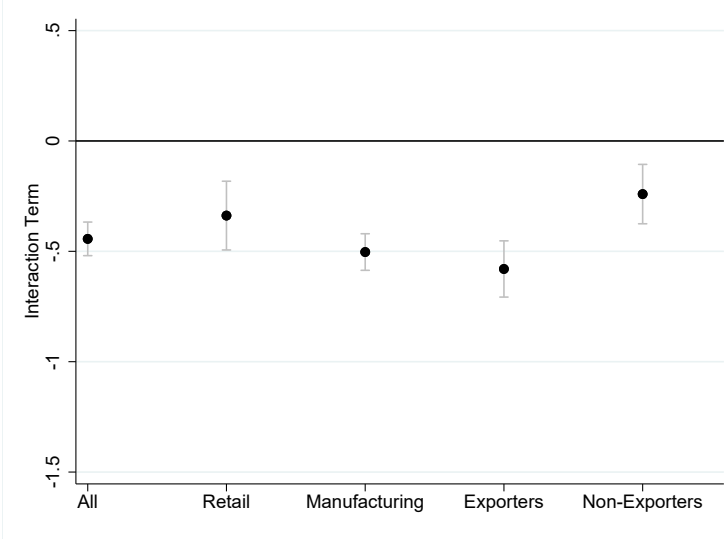
# Heterogeneity: Inflation Rates

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# Treatment Effects on the Distribution of Export Unit Prices

| | All Exports | Exports (USD) | Exports (Others) |
|---|---|---|---|
| | (1) | (3) | (2) |
| $P_{i,pre}$ | 0.877*** | 1.035*** | 0.889*** |
| | (0.009) | (0.000) | (0.006) |
| $P_{i,pre} \times T_i$ | -0.739*** | -0.068*** | -0.510*** |
| | (0.009) | (0.019) | (0.006) |
| $T_i$ | 34.212*** | 3.276 | 12.355*** |
| | (5.782) | (2.180) | (3.773) |
| Huber Regression | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |
| Observations | 183 | 153 | 140 |

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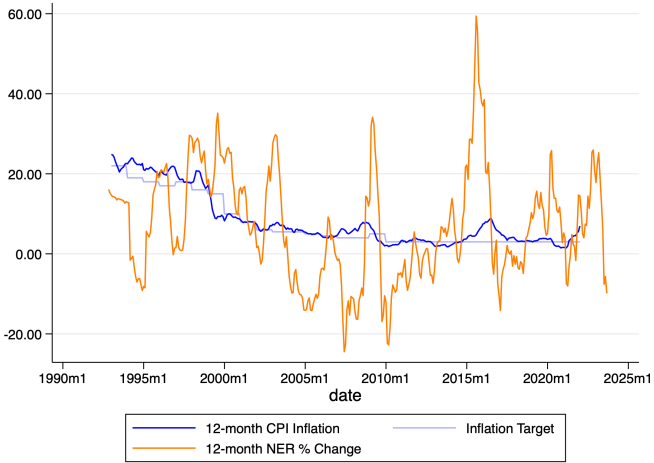
# Relative Volatility of the Exchange Rate

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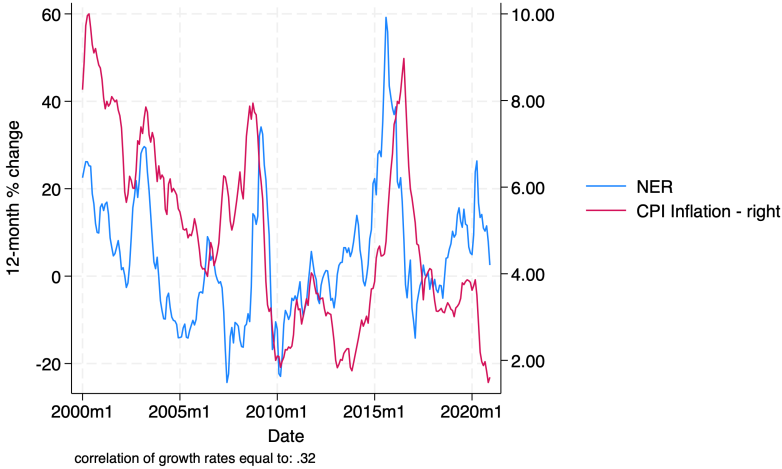
# Correlation with CPI Inflation

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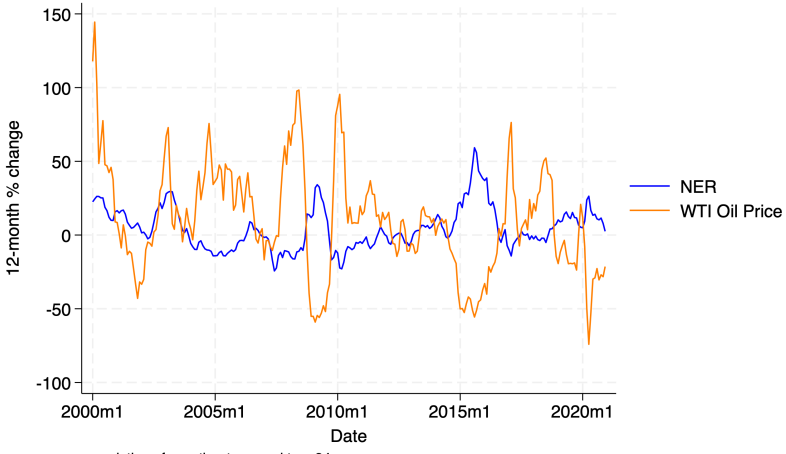
# Correlation with the Price of Oil

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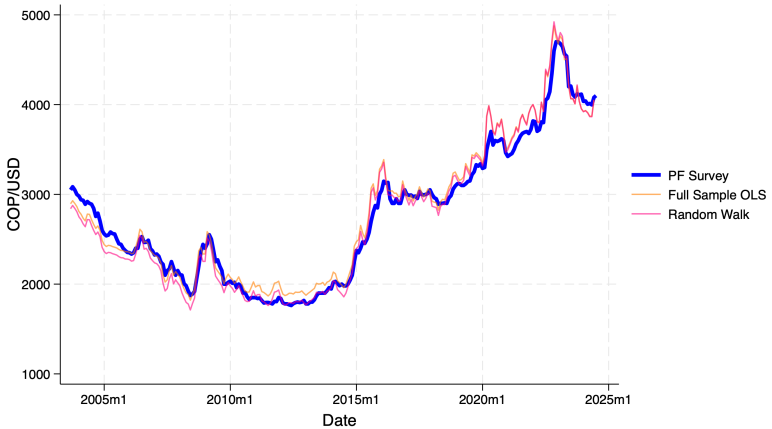
# Statistical Properties of the Forecast




Avg(Forecast Error / NER): Professional Forecasters: 0.12, Full Sample OLS: 0.11, Random Walk Forecast: 0.11

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# Weak Instruments

- For imports
  - Montiel-Olea and Pflueger (2013) weak instrument test
    - Effective F Stat: 14.7
    - Critical value for a worst-case bias of 10%: 11.81
  - AR Confidence Intervals: Reject elasticities lower than 0.83
- For Exports:
  - Montiel-Olea and Pflueger (2013) weak instrument test
    - Effective F Stat: 2.57
    - Critical value for a worst-case bias of 10%: 6.39
  - AR Confidence Intervals: $(-\infty, \infty)$

Results for exports a good smell test. The treatment does not change move exchange rate expectations for that sub-group Back

# Weighted Product Regressions

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | log Imports | log Imports | log Imports | log Imports | log Imports | log Imports |
| $S^e_{i,t,t+12}$ | 2.557 | -1.879** | 3.210 | -2.530*** | 4.698 | -2.681*** |
| | (2.416) | (0.911) | (2.519) | (0.687) | (4.352) | (0.666) |
| $\log \text{Imports}_{i,t-1}$ | 0.982*** | 0.880*** | 0.997*** | 0.881*** | 0.989*** | 0.878*** |
| | (0.018) | (0.007) | (0.016) | (0.005) | (0.016) | (0.004) |
| Observations | 8543 | 8543 | 13941 | 13941 | 18804 | 18804 |
| $R^2$ | 0.794 | 0.755 | 0.811 | 0.757 | 0.789 | 0.767 |
| Product Digits | 2 | 2 | 4 | 4 | 6 | 6 |
| Level of Variation | Product x Origin | Product x Origin | Product x Origin | Product x Origin | Product x Origin | Product x Origin |
| Method | Weighted | Unweighted | Weighted | Unweighted | Weighted | Unweighted |

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# Balance

| | Observations | | Average (SD) | | | |
|---|---|---|---|---|---|---|
| Variable | Treated | Control | Treated | Control | Diff | P-Value ($\neq 0$) |
| $S^e_{0,0}$ (July 2021) | 133 | 147 | 3876.6 | 3912.6 | 35.992 | 0.191 |
| | | | (12.485) | (23.572) | | |
| $S^e_{0,1}$ (July 2021) | 133 | 147 | 3886.4 | 3899.1 | 12.711 | 0.679 |
| | | | (22.165) | (21.261) | | |
| $\pi^e_{0,0}$ (July 2021) | 133 | 147 | 3.412 | 3.243 | -0.169 | 0.693 |
| | | | (0.310) | (0.296) | | |
| $\pi^e_{0,1}$ (July 2021) | 133 | 147 | 4.634 | 3.964 | -0.670 | 0.106 |
| | | | (0.327) | (0.246) | | |
| All Exports | 298 | 382 | 206,740 | 276,432 | 69,692 | 0.667 |
| | | | (107,642 ) | (113,339) | (159,710) | |
| Exports to USD | 298 | 382 | 56,239 | 80,971 | 24,731 | 0.534 |
| | | | (17,348) | (32,384) | (39,742) | |
| Exports to Others | 298 | 382 | 150,501 | 195,461 | 44,960 | 0.732 |
| | | | (91,180) | (91,365) | (131,099) | |
| All Imports | 298 | 382 | 526,482 | 406,159 | -120,323 | 0.395 |
| | | | (105,476) | (93,763) | ( 141,239) | |

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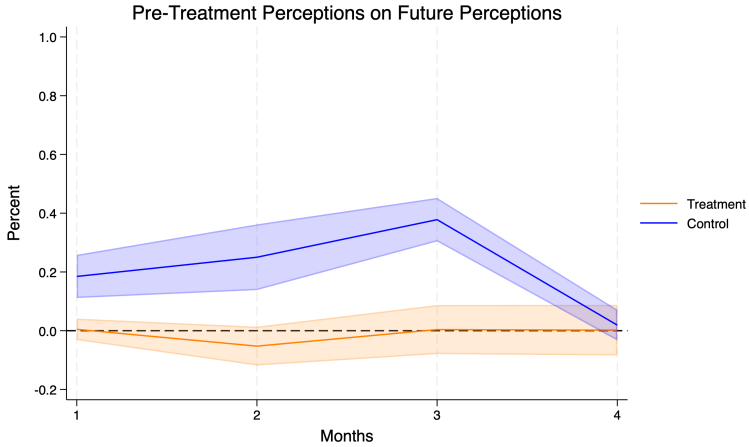
# Dynamic Perception Effects: Exchange Rate Nowcasts




$$S^e_{i,t+h,t+h} = \beta_t + \beta^h_1 T_{i,t} + \beta^h_2 S^e_{i,t,t} + \beta^h_3 T_{i,t} \times S^e_{i,t,t} + \epsilon^h_{i,t}$$

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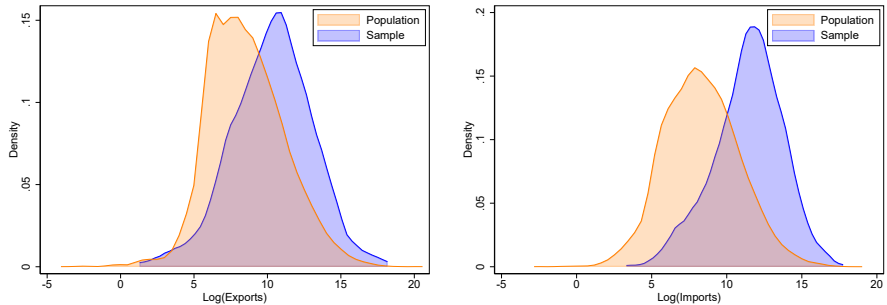
# Distribution of Exports and Imports




Distribution of Exports and Imports

*Note*: The figure shows the distribution of the total exports (left panel, in logs) and total imports (right panel, in logs) for the firms in our survey (Sample) and for all Colombian firms (Population), for the baseline period. Exports and imports are in US dollars.

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