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Tariffs and the Exchange Rate: Evidence from Twitter

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Abstract

This paper examines the conjecture that an increase in tariffs in a flexible exchange rate regime leads to the appreciation of the local currency. We focus on the reaction of the exchange rate market to tweets by US President Donald Trump regarding possible tariff increases on Canadian and Mexican goods. The anticipation of trade restrictions leads to the US dollar appreciating by 0.023% and 0.051% vis-à-vis the Canadian dollar and Mexican peso within five minutes of the tweet, and comparable percentages for forward rates up to five years ahead. Exchange rate appreciation may mitigate the expenditure-switching intended by the protectionist policy.

Topics: Exchange rates; Trade integration
JEL codes: F13, F31

1. Introduction

This paper examines the conjecture that an increase in tariffs on foreign goods in a flexible exchange rate regime leads to the appreciation of the local currency. The focus is on government communication in the form of tweets issued by U.S. President Donald Trump regarding actual and possible tariffs on Canadian and Mexican goods. The president has extensive statutory powers on international trade matters and his tweets are informative and potentially consequential.[1] Canada and Mexico are respectively the second and third largest U.S. trade partners; and the effects of trade restrictions, even if just as a possibility or a threat, may be large and elicit a response in foreign exchange markets. The facts that the data are well-measured, relatively abundant, available at high frequencies, and concern countries that jointly account for one-third of U.S. trade means that we are able to identify the effects of trade restrictions on the exchange rate.

Our work is empirical in nature, but it sheds light on the theoretical literature that asks whether an increase in tariffs on foreign goods is expansionary. If the local currency appreciates following the imposition of tariffs, then relative prices may be left unchanged and the intended expenditure-switching from foreign to local goods will not take place.[2] A classical paper by Robert Mundell (Mundell, 1961) suggests that in a flexible exchange rate regime, an increase in tariffs causes the appreciation of the local currency and, contrary to the possible intention of the policy, domestic output may fall because the improvement in the terms of trade increases savings via the Laursen-Metzler effect and reduces aggregate demand (Laursen and Metzler, 1950). Similar results are reported by Chan (1978), Eichengreen (1981), Krugman (1982), and Ostry (1991).

Recent work that studies the effects of commercial policy includes Barattieri, Cacciatore, and Ghironi (2020), Erceg, Prestipino, and Raffo (2018), and Caldara, Iacoviello, Molligo, Prestipino, and Raffo (2021). Barattieri et al. (2020) extend the general equilibrium model in Ghironi and Melitz (2005) with a non-tradable sector and examine the effect of an increase in protectionism by a small open economy under a flexible exchange rate. They find that expenditure-switching towards local goods is partly mitigated by the appreciation of the exchange rate and that the overall effect of the policy is contractionary. In contrast, Erceg et al. (2018) find that in a New Keynesian open-economy model, a combination of import tariffs and export subsidies may be expansionary. Caldara et al. (2021) report that uncertainty about higher future tariffs reduces investment and economic activity. These theoretical results have attracted attention in light of the recent application

[1] For example, the Trump administration brought about the imposition of 25% and 10% duties on steel and aluminum imports from Canada and Mexico in June 2018 (see *The New York Times*, May 31, 2018).

[2] For instance, see Erceg, Prestipino, and Raffo (2018). Other important considerations include the expected duration of the new tariffs, whether trade partners retaliate with tariffs of their own, and possible general equilibrium effects.

by the United States of a commercial policy whereby tariffs and other restrictions on international trade attempt to influence exports, imports, and the resulting trade balance.

As the literature above indicates, a key issue is the behavior of the exchange rate following the increase in tariffs. A challenge to study this behavior empirically is that changes in U.S. tariffs were relatively infrequent until recently, and when they occurred, they covered narrowly defined product categories. Hence, it may be hard to detect aggregate effects based on historical data and to identify a causal relation between tariff changes and exchange rate movements. Ostry and Rose (1992) and, more recently, Barattieri et al. (2020) and Furceri, Hannan, Ostry, and Rose (2019) use vector autoregressions to examine the effect of tariff changes on several macroeconomic variables, including the exchange rate. Jeanne and Son (2020) examine recent instances where the U.S. imposed tariffs on Chinese goods and find that U.S. tariffs lead to the appreciation of the U.S. dollar but that Chinese tariffs do not have a statistically significant effect on the renminbi.[3] We complement their work by focusing on the exchange rate market's reaction to the possible tariff increases that would have taken place if the United States had withdrawn from the North American Free Trade Agreement (NAFTA) or if the negotiations for a new trade agreement would have failed. Trade with the other NAFTA members accounted in 2016 for 68%, 66%, and 29% of all international trade by Canada, Mexico, and the U.S., respectively.[4] Hence, the aggregate implications of NAFTA's collapse are likely to be large and the foreign exchange market would react to even the possibility of such outcome.[5]

The uncertainty regarding NAFTA was driven by U.S. commercial policy and, more specifically, by the "America First" policy during the presidency of Donald Trump. Although the U.S. Congress has competency over trade policy, the powers of the president have been considerably expanded through the Trade Expansion Act of 1962 and the Trade Act of 1974. The United States Trade Representative is part of the Executive Office of the President and is the agency responsible for developing and recommending trade policy to the president, conducting trade negotiations, and coordinating trade policy with other government agencies. During the considered period, a key source of news regarding trade policy and, in particular, tariffs were public communications by the U.S. president, frequently in the form of tweets.

We quantify the causal effect on the bilateral exchange rates of the possible and actual imposition

[3] A key difference between their dataset and ours is that China retaliated immediately and proportionally to U.S. tariffs, while Canada and Mexico's response was considerably more muted and delayed. This means that retaliation is less likely to impinge on our empirical results.

[4] Authors' calculations are based on data from the World Bank available at https://wits.worldbank.org/. The figures are the sum of imports from and exports to the other two NAFTA members over the sum of total exports and imports.

[5] For an analysis of the macroeconomic effects of NAFTA's termination, see Steinberg (2020).

of tariffs on Canada and Mexico as gleaned from presidential tweets. Identification is based on a high-frequency strategy that computes the change in the nominal exchange rate between two points in a narrow time window around the Twitter feed. Other news could induce movements in the exchange rate during the day, and the identifying assumption is that the Twitter feed was the only source of new information arriving during the brief time interval around it. Our exchange rate data correspond to the nominal rate, but it is safe to assume that the price level is unchanged over the time window around the tweet, so that a high-frequency movement in the nominal exchange rate translates one-to-one into a high-frequency movement in the real exchange rate.

This high-frequency identification strategy is used by previous literature that studies the effect of monetary policy announcements on long-term interest rates (Cochrane and Piazzesi, 2002; and Gürkaynak, Sack, and Swanson, 2005), on the volatility of the stock returns of individual firms (Gorodnichenko and Weber, 2016), and on expected inflation and output growth (Nakamura and Steinsson, 2018). The strategy is also used by a recent literature that examines the effect of tweets on the Chinese and U.S. stock markets (Blanchard and Collins, 2019) and on the federal funds futures market (Bianchi, Kung, and Kind, 2019; and Camous and Matveev, 2021).[6] In the context of fiscal policy, the literature also includes Romer and Romer (2010), who use government publications and presidential speeches to construct a time series of tax changes and quantify their effect on aggregate output, and Ramey (2011), who examines the effects of news regarding military spending as reported by *Business Week*. Breinlich, Leromain, Novy, Sampson, and Usman (2018) study the effect on stock returns of Brexit-related speeches by Theresa May. In the same spirit, our paper is concerned with the effects of government communication on economic variables and uses social media postings to shed light on the response of the exchange rate to changes in tariffs.

Our results show that the anticipation of trade restrictions leads to the appreciation of the U.S. dollar by 0.0228% and 0.0508% with respect to the Canadian dollar and Mexican peso, respectively, within five minutes of the tweet. Forward rates up to five years ahead respond in a quantitatively similar manner. These figures are economically and statistically significant and robust to including additional regressors. Placebo tests show that exchange rates react systematically only to tweets concerning commercial policy, but not to tweets concerning immigration, U.S. politics, or other matters. Hence, our results suggest that the conjecture that exchange rate appreciation may mitigate expenditure-switching towards local goods after a tariff increase is empirically plausible.

This paper is organized as follows. Section 2 describes the data used, section 3 presents case studies that document the effects of presidential tweets on exchange rates, section 4 reports empirical

[6] See also Gholampour and van Wincoop (2019), who use private tweets about the euro/U.S. dollar exchange rate to evaluate to what extent it is driven by fundamentals or by private information.

results, and section 5 concludes and discusses caveats to our analysis.

2. Data

The raw data for this study consists of 336 tweets by Donald Trump, first as candidate and then as president, between January 1, 2016, and November 29, 2019. We selected these tweets from more than 40,000 tweets available at the publicly available repository, www.thetrumparchive.com, using the keywords: Canada, Mexico, Canadian, Mexican, NAFTA, USMCA, and CUSMA. We disregard re-tweets, which by definition contain no new information, and weekend tweets, when foreign exchange markets are closed. We consider tweets from the same thread jointly if they fall within the same identification window and as separate tweets otherwise. The identification window is six minutes long. The window starts one minute before and ends five minutes after the publication of the tweet. To verify that our identification strategy is not tainted by any public or private data release that may fall within the window, we collected data on the release of major economic indicators from www.tradingeconomics.com and verified their timestamp. We found 11 instances where the timestamp was within the identification window; and, hence, we abstained from using the associated tweets in our empirical analysis. The final sample consists of 177 tweets for Canada and 180 for Mexico.

The information content of a tweet is classified into one of five possible categories, $c \in C = \{1, 2, 3, 4, 5\}$. The first category ($c = 1$) consists of tweets that announce or threaten new tariffs, openly criticize NAFTA, or threaten to end NAFTA or the negotiations for a new treaty. These tweets signal a potential increase in tariffs and trade restrictions on Mexican and/or Canadian goods coming into the U.S.[7] An example is:

> We are in the NAFTA (worst trade deal ever made) renegotiation process with Mexico and Canada. Both being very difficult. May have to terminate?

published on August 27, 2017, at 13:51. As a convention, all timestamps are on Greenwich Mean Time or GMT. Our sample contains 83 of these tweets, of which 51 were published when foreign exchange markets were open.

At the time there was some discussion in the economic press as to whether the president could unilaterally withdraw the U.S. from NAFTA and what tariff regime would take place in that case. Article 2205 of NAFTA states that "a Party may withdraw from this Agreement six

[7] We include in this category tweets where trade issues are explicitly linked to immigration, border control, or the construction of a wall along the Mexico-U.S. border

months after it provides written notice of withdrawal to the other Parties," so clearly the U.S. could have withdrawn unilaterally from NAFTA. As to whether the president could have initiated the process without Congress approval, Murrill (2016) notes in a legal opinion for the non-partisan Congressional Research Service (CRS) that the president possesses exclusive constitutional authority to communicate with foreign powers and, if characterized under that authority, the president's delivery of a notice of withdrawal to other free trade agreement (FTA) partners "appears sufficient to terminate the agreements as a matter of international law." For most trade agreements, such a notice initiates a six-month period until the actual termination of, or withdrawal of a party from, the agreement. Under the Vienna Convention, withdrawing under the provisions of the agreement would have released the U.S. from its obligations under NAFTA from the date that withdrawal or termination became effective (Murrill, 2016, p. 10).

Murrill suggests that section 125 of the Trade Act of 1974, which Congress has made applicable to most free trade agreements signed by the U.S., authorizes the president to proclaim the restoration of tariff rates to what they would be without the agreement. The president shall recommend to Congress the appropriate rates of duty for affected imports within 60 days after termination of, or withdrawal from, an agreement. It is reasonable to assume that President Trump would have proposed tariffs no lower than those under NAFTA for a wide array of Canadian and Mexican goods entering the U.S. Hufbauer (2017) argues that the president could have invoked the call for "reciprocal and mutually advantageous concessions" in the North American Free Trade Agreement Implementation Act of 1993 to raise U.S. tariffs applicable to Canada, Mexico, or both to the most-favored-nation (MFN) levels that apply to countries that have no free trade agreement with the U.S. Without any presidential action, the section allows the same duties or other import restrictions under the FTA to remain in place for up to a year.[8]

Compared with Mexico, the case of Canada is more complicated because the Canada-U.S. Free Trade Agreement (CUSFTA) was suspended, rather than terminated, when NAFTA entered into force in 1994. Thus, should NAFTA be terminated, the CUSFTA may ensure continuation of free trade between Canada and the United States unless separately terminated. However, the discussion above suggests that the president could unilaterally withdraw the U.S. from CUSFTA as well. Still, the immediate consequences of the U.S. withdrawing from NAFTA would be larger for Mexico than for Canada and, hence, we would expect the exchange rate effects of presidential tweets to be quantitatively larger for the former than for the latter.

[8]This is not to say that Congress is powerless. The Constitution grants Congress the power to impose tariffs on imports, and the presidential power to proclaim modifications to tariff rates derives from a statutory delegation of this power. Presumably, Congress could alter the language of the legislation or repeal the relevant statues, but this may require bipartisan support.

Even without leaving NAFTA, the U.S. president was allowed to impose tariffs on Canadian and Mexican steel and aluminum starting in June 2018 under section 232 of the Trade Expansion Act of 1962. This section permits the president to impose tariffs when "an article is being imported into the United States in such quantities or under such circumstances as to threaten or impair the national security." The section was upheld by the Supreme Court in 1976, and the Court refused to hear a new challenge to its constitutionality in June 2019. The president also instructed the Secretary of Commerce to investigate the effect of imports of automobiles, trucks, and automotive parts on national security under section 232 in May 2018.[9]

The above discussion motivates our coding strategy because it indicates that presidential tweets criticizing NAFTA or threatening to impose new tariffs, to withdraw the U.S. from NAFTA, or to end the negotiations for a free-trade agreement were potentially consequential and unambiguously signalled the possible increase in tariffs on Canadian and Mexican goods.

The second category ($c = 2$) consists of tweets that indicate progress in the trade negotiations or that signal the continuation of the status quo and potentially a decrease in tariffs. An example is:

> Our relationship with Mexico is getting closer by the hour. Some really good people within both the new and old government and all working closely together . . . A big Trade Agreement with Mexico could be happening soon!

published on August 25, 2018, at 4:58. There are only 16 of these tweets in our sample, of which 9 were published when foreign exchange markets were open. We include in this category a tweet announcing a new sugar deal with Mexico published on June 29, 2017, at 12:27 and a tweet calling for more open trade with Canada published on June 1, 2018, at 13:18.

The third category ($c = 3$) consists of tweets concerning border issues alone. These tweets were identified using the keywords: wall, immigration, border, caravan, migrants, and drugs. An example is:

> Mexico will pay for the wall!

published on September 1, 2016, at 13:22. There are 107 of these tweets, of which 79 were published when foreign exchange markets were open.

[9]Section 232 was also used to justify tariffs on solar panels and washing machines in January 2018, on steel and aluminum in March 2018, and on products made of steel and aluminum (e.g., staples, nails, car bumpers, etc.) in January 2020. These tariffs targeted countries other than Canada and Mexico, although, as discussed in the text, tariffs on steel and aluminum were extended to both countries in June 2018.

The fourth category ($c = 4$) consists of tweets about economic and political issues only marginally related to trade. We include in this category tweets demanding that Congress approves the new USMCA treaty or extolling the benefits of this new treaty. These tweets contain no new information about tariffs or trade and primarily reflect internal U.S. politics. An example is:

> Great reviews on the USMCA - sooo much better than NAFTA!

published on November 30, 2018, at 20:23, two months after the successful ending of negotiations with Canada had been announced. There are 103 of these tweets, of which 75 were published when foreign exchange markets were open.

Finally, the fifth category ($c = 5$) consists of tweets with no relevance for trade, immigration, or politics and includes, for example:

> Happy Canada Day to all of the great people of Canada and to your Prime Minister and my new found friend @JustinTrudeau

published on July 1, 2017, at 12:44. There are 27 of these tweets, of which 13 were published when foreign exchange markets were open. These tweets are used in section 4 to carry out placebo tests.

The exchange rate data were obtained from Refinitiv (formerly part of Thompson Reuters) and consist of U.S. dollar/Canadian dollar and U.S. dollar/Mexican peso spot and forward rates. The data are sourced from Refinitiv FX Matching platform, which is a primary inter-dealer electronic trading venue based on the central limit order book, or "CLOB." We use spot market data at the level of individual executed trades and forward market data on individual quotes for outright forward contracts with tenors ranging from one month to five years. Transaction-level (tick-by-tick) data are essential to implement the high-frequency identification of the effects of presidential tweets on the exchange rates.

3. Case Studies

This section explores the effects of presidential tweets on the U.S. dollar/Canadian dollar and the U.S. dollar/Mexican peso spot exchange rates by focusing on three specific instances.

3.1 Trade Deficit with Mexico (January 26 and 27, 2017)

In the week following his inauguration on January 20, 2017, the U.S. president expressed dissatisfaction with the existing trade arrangement with Mexico as follows:

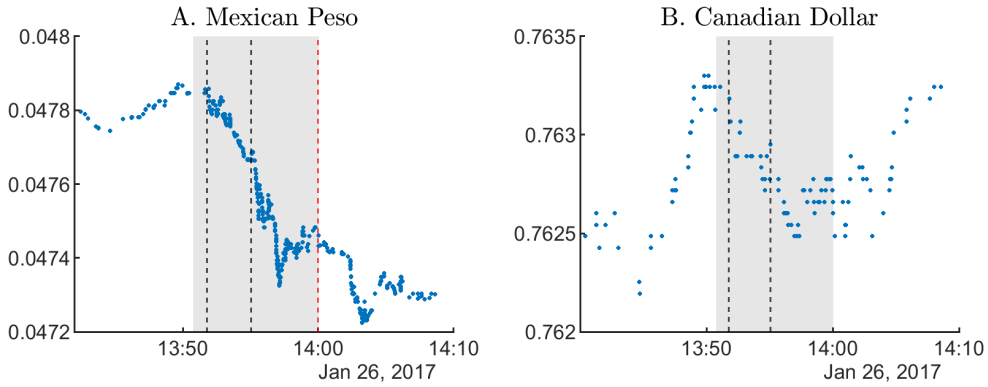

Figure 1: The figure plots the price of the foreign currency in U.S. dollars around the time tweets were published at 13:51 and 13:55 GMT.

> The U.S. has a 60 billion dollar trade deficit with Mexico. It has been a one-sided deal from the beginning of NAFTA with massive numbers of jobs and companies lost. If Mexico is unwilling to pay for the badly needed wall then it would be better to cancel the upcoming meeting...

This thread published on January 26 was the first trade-related comment by the president and combined the criticism of NAFTA with immigration issues. Figure 1 plots the U.S. dollar/Mexican peso and U.S. dollar/Canadian dollar exchange rates with the tweet marked in a black dotted line, a data release marked with a red dotted line, and the identification window marked as a shaded grey area. The vertical axis is the price of the Mexican peso in U.S. dollars (panel A) and the Canadian dollar in U.S. dollars (panel B), and the horizontal axis is time. The figure shows an appreciation of the U.S. dollar by 0.871% with respect to the Mexican peso. The tweet does not mention Canada explicitly, but the negative depiction of NAFTA led to an appreciation of the U.S. dollar by 0.084% with respect to the Canadian dollar.

A follow-up tweet on January 27 leads to an appreciation of the U.S. dollar with respect to the Mexican peso, albeit of a smaller magnitude (see Figure 2):

> Mexico has taken advantage of the U.S. for long enough. Massive trade deficits & little help on the very weak border must change NOW!

The first thread was published shortly before the release of economic data on the Mexican trade balance. One can readily compare their effects and conclude that a U.S. president's tweet on trade can potentially affect the exchange rate by more than the release of actual trade data. Similarly, the

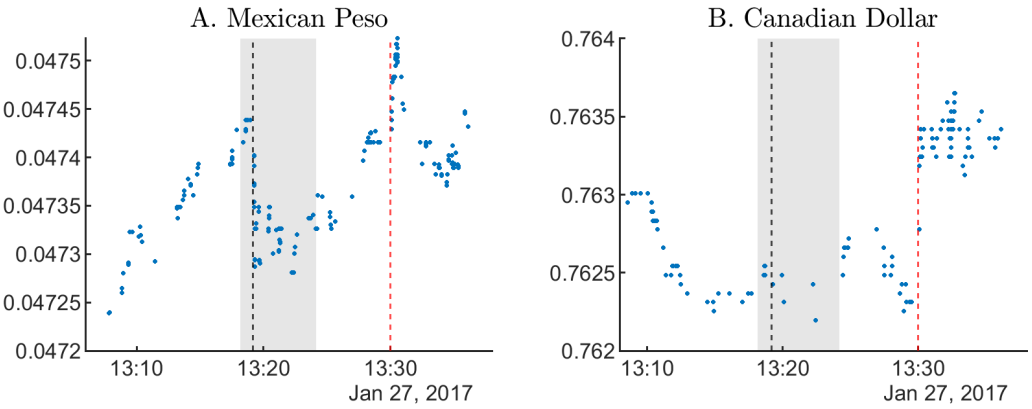

Figure 2: The figure plots the price of the foreign currency in U.S. dollars around the time a tweet was published at 13:19 GMT.

follow-up tweet was published not long before the release of data on durable goods orders and the personal consumption expenditures price index in the U.S. One can see that the effects of the tweet and the data release on the U.S. dollar/Mexican peso exchange rate are of comparable magnitude.

3.2 Calls to Renegotiate NAFTA (April 27, 2017)

Approaching the 100th day of his presidency, President Trump was reportedly considering to withdraw the United States from NAFTA. Leaders of both Mexico and Canada reached out to the U.S. president and the withdrawal was averted. These events led to the following tweets:

> I received calls from the President of Mexico and the Prime Minister of Canada asking to renegotiate NAFTA rather than terminate. I agreed..

published on April 27, 2017, at 11:12, followed by:

> ...subject to the fact that if we do not reach a fair deal for all, we will then terminate NAFTA. Relationships are good-deal very possible!

published the same day, a few minutes later, at 11:21. The corresponding exchange rate dynamics are displayed in Figure 3. The first tweet signals that the focus has shifted towards reworking NAFTA. The U.S. exchange rate depreciated by 0.192% and 0.066% with vis-à-vis to the Mexican peso and Canadian dollar, respectively. The follow-up tweet contains a qualifying statement that maintains withdrawal as a contingency and results in a partial reversal of exchange rates, with the U.S. dollar appreciating by 0.079% with respect to the Mexican peso and 0.037% with respect to the Canadian dollar.

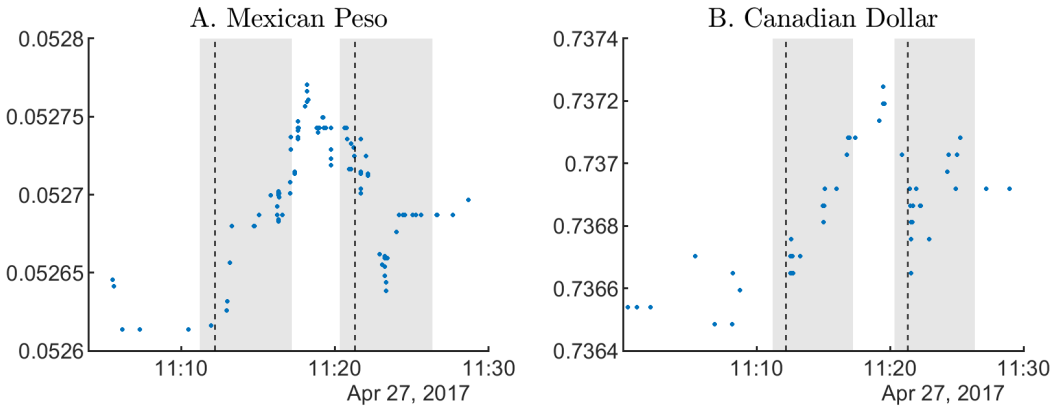

Figure 3: The figure plots the price of the foreign currency in U.S. dollars around the time tweets were published at 11:12 and 11:21 GMT.

3.3 Tariffs and Migration Crisis (May 30, 2019)

As attempts to secure funding for the wall along the border with Mexico had proven unsuccessful, President Trump promised to impose escalating tariffs on Mexican goods over illegal immigration. The announcement was made on Twitter on May 30, 2019 at 23:30 as follows:

> On June 10th, the United States will impose a 5% Tariff on all goods coming into our Country from Mexico, until such time as illegal migrants coming through Mexico, and into our Country, STOP. The Tariff will gradually increase until the Illegal Immigration problem is remedied, at which time the Tariffs will be removed. Details from the White House to follow.

Figure 4 shows that the U.S. dollar/Mexican peso and U.S. dollar/Canadian exchange rates reacted to this announcement. The U.S. dollar appreciated vis-à-vis the Mexican peso by 0.615% and the adjustment persisted beyond our identification time window. Even though the announcement did not directly concern Canada, it put the recently negotiated USMCA trade agreement at risk and led to an appreciation of the U.S. dollar with respect to the Canadian dollar by 0.059%.

These case studies suggest that the possibility of the increase in trade tariffs leads to the appreciation of the local currency or, conversely, to the depreciation of the foreign currency. In the following section, we examine whether this result holds more broadly for the complete set of tweets in our sample.

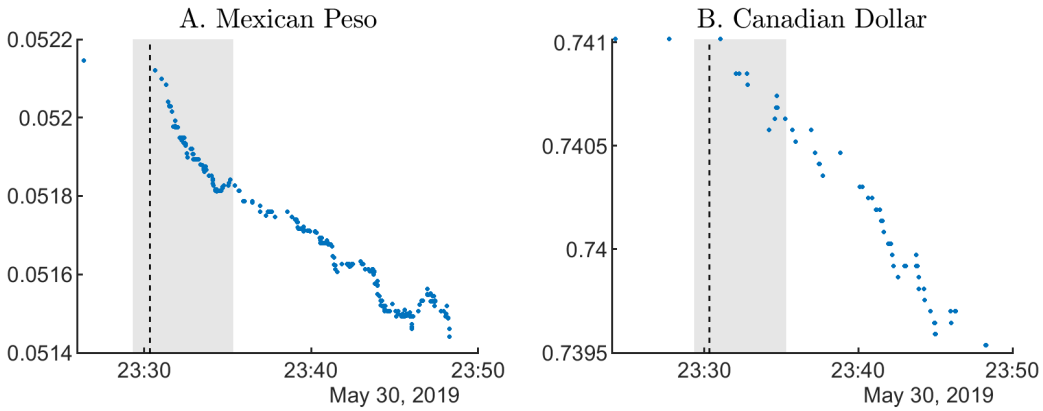

Figure 4: The figure plots the price of the foreign currency in U.S. dollars around the time a tweet was published at 23:30 GMT.

4. Empirical Analysis

4.1 Benchmark Results

Consider the projection

$$\ln(e_{t+\delta}) - \ln(e_{t-\varsigma}) = \alpha + \beta D_t + X_t'\gamma + u_t, \tag{1}$$

where $\ln(e_{t+\delta}) - \ln(e_{t-\varsigma})$ is the change in the nominal bilateral spot exchange rate in a window of $\delta + \varsigma$ minutes around the Twitter feed; α is an intercept term; β is a coefficient; D_t is a dummy variable that takes value 1 if $c = 1$, -1 if $c = 2$, and 0 otherwise; γ is a vector of coefficients; X_t is a vector with additional regressors or controls; and u_t is a disturbance independent of D_t and X_t. Under our high-frequency identification strategy, the Twitter feed is the only source of new information arriving during the window and ordinary least squares delivers a consistent estimate of β, that is, of the effect of presidential tweets on the exchange rate. The specification (1) imposes the restriction that tweets that signal an increase and a decrease in tariffs on Canadian and/or Mexican goods have the same quantitative effect, but this restriction is relaxed below. Note that the identification window is not symmetric around the Twitter feed, and in this paper $\varsigma = 1$ minute and $\delta = 5$ minutes.

Consider first the benchmark results reported in column 1 of Tables 1 and 2 for the U.S. dollar/Canadian dollar and U.S. dollar/Mexican peso exchange rates, respectively. A tweet by the U.S. President signalling a potential increase in tariffs on Canadian goods leads to a 0.0228% appreciation of the U.S. dollar with respect to the Canadian dollar in the five minutes following its publication. The effect is even larger in the case of the U.S. dollar/Mexican peso exchange rate where such a tweet leads to a 0.0508% appreciation of the U.S. dollar. Both effects are

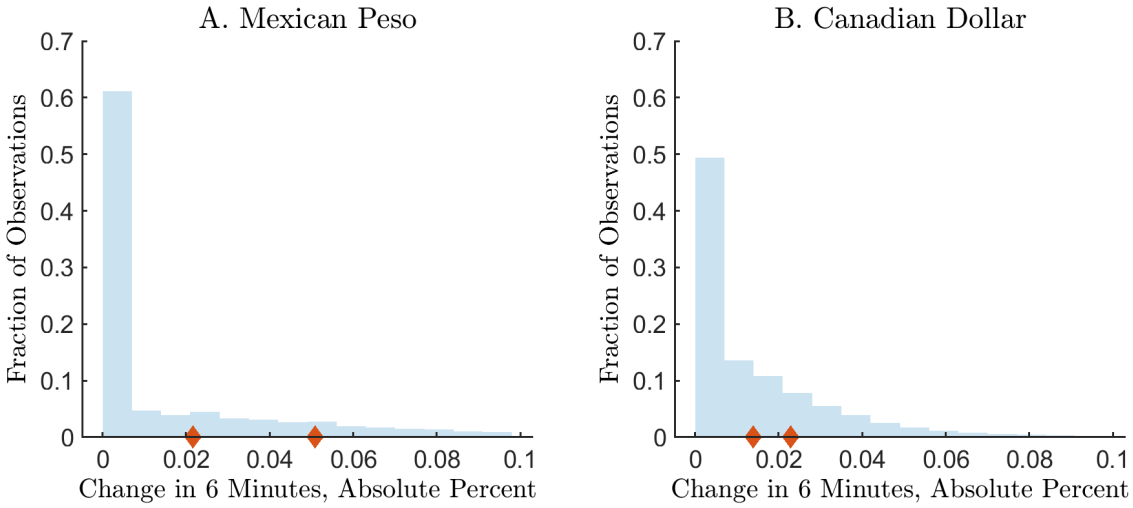

Figure 5: The figure plots the distributions of absolute values of change for each exchange rate in all six-minute time intervals from January 1, 2016 to November 29, 2019.

statistically significant at the five percent significance level. When compounded for a trading day, these estimates imply a U.S. dollar appreciation of 1.84% and 4.15% with respect to the Canadian dollar and Mexican peso, respectively. To put these figures in perspective, consider Figure 5, which plots the distribution of changes (in absolute value) for each exchange rate in all six-minute time intervals of the full sample from January 1, 2016, to November 29, 2019. Red diamonds mark the average of the distribution, which is 0.014% and 0.022% for the U.S. dollar/Canadian dollar and U.S. dollar/Mexican peso exchange rates, respectively, and the average change associated with a presidential tweet, which is roughly speaking, twice the magnitude of the average change. Hence, the quantitative effect of a presidential tweet is not only statistically significant, but it is economically significant as well.

The fact that the effect is much larger on the U.S. dollar/Mexican peso than on the U.S. dollar/Canadian dollar exchange rate may be due to the fact that Canada could continue to trade freely with the U.S. after NAFTA's termination under the previous Canada-U.S. Free Trade Agreement, which was suspended, but not terminated, in 1994. Also, Steinberg (2020) finds that the aggregate effects of NAFTA's termination would be larger for Mexico than for Canada. For instance, the decrease in consumption would be 0.26% in Mexico versus 0.13% in Canada, and the decrease in investment would be 0.66% in Mexico versus 0.56% in Canada (see Table 5 in Steinberg, 2020, p. 846). The decrease in welfare in the short- and long-run would be larger in Mexico than in Canada as well (see Table 6 in Steinberg, 2020, p. 850).

While the estimates above concern the nominal exchange rate, it is safe to assume that the price

level is unchanged over the time window around the tweet. Hence, the high-frequency movement in the nominal exchange rate translates one-to-one into a high-frequency movement in the real exchange rate in the same direction.

Overall, these results provide empirical support for the conjecture that in a flexible exchange rate regime, an increase in tariffs on foreign goods leads to the appreciation of the local currency (in this case, the U.S. dollar) or, conversely, to the real depreciation of the foreign currency (the Canadian dollar or Mexican peso), as, for example, in the theoretical models in Mundell (1961), Krugman (1982), and Barattieri et al. (2020). This exchange rate appreciation may mitigate the expenditure-switching from foreign to local goods intended by the protectionist policy.

Finally, our results are in line with recent work by Furceri et al. (2019) and Jeanne and Son (2020). Furceri et al. construct a tariff series based on trade tariff rate data at the product level for 16 sectors in 39 countries and compute the response of several variables to an increase in tariffs. Their VAR results show that an increase of one standard deviation in the tariff rate (about 3.6 percentage points) leads to a statistically significant real appreciation of the local currency in the short run. Jeanne and Son find that the imposition of tariffs on Chinese goods leads to the appreciation of the U.S. dollar by 0.2% after five hours of the announcement. This appreciation may offset the potential benefits of the tariff increase leading to a small effect on the trade balance and a decrease in output and productivity.[10]

4.2 Robustness

Column 2 in both tables examines the robustness of the results to using only data from the two most liquid exchange rate markets, namely, New York and London. This reduces the number of observations by 50 for both Canada and Mexico. Results for U.S. dollar/Canadian dollar exchange rate are unchanged, while for U.S. dollar/Mexican peso the estimated appreciation is lower at 0.0311%. The latter estimate is not statistically significant at the five percent level, but it is significant at the ten percent level. Moreover, the benchmark estimate of 0.0508% is contained in the 95% confidence interval around 0.0311%. Hence, conclusions do not appear to be driven by the lower liquidity in the other markets in our sample.

Column 3 considers separately tweets involving only the other NAFTA partner (i.e., Mexico in the case of Canada and vice-versa). In the case of Canada, tweets mentioning Mexico alone have the same effect on the U.S. dollar/Canadian dollar exchange rate as tweets mentioning both countries, NAFTA, or Canada alone. In contrast, in the case of Mexico, tweets mentioning only

[10] An earlier paper by Ostry and Rose (1992) uses tariff revenues divided by the value of dutiable imports as a measure of the tariff rate and finds that one cannot reject the hypothesis that tariffs are statistically insignificant determinants of the real exchange rate, output, and the trade balance for the U.S.

Canada have basically no effect on the U.S. dollar/Mexican peso exchange rate. There are two possible explanations for this result. First, the number of tweets mentioning only Canada is smaller (11) than the number mentioning only Mexico (19). Second, the language in the latter tweets is considerably more aggressive than that in the former and more likely to receive the attention of traders.

Column 4 considers separately tweets before and after Donald Trump's election as president. Pre-election tweets have no effect on exchanges rates, possibly because markets may have assigned a relatively low probability to his winning the election. These estimates suggest that results are driven by tweets following the election on November 8, 2016. This finding underscores the importance of government communication (tweets by a U.S. president or president elect) over private communication (tweets by a presidential candidate) in the foreign exchange rate market. More broadly, however, private communication that reveals private information may be an important driver of exchange rate fluctuations (see Gholampour and van Wincoop, 2019).

Columns 5 and 6 separately consider additional tweets that concern only border issues (e.g., immigration, the construction of a wall along the Mexico-U.S. border, etc.) or economic and political issues that are only marginally related to trade and mostly reflect internal U.S. politics. In terms of the projection (1), results in column 5 correspond to the case where X_t is a dummy variable that takes value 1 if $c = 3$ and 0 otherwise. Results in column 6 corresponds to the case where X_t takes value 1 if $c = 4$ and 0 otherwise. In all cases, the coefficients of those tweets are quantitatively small and statistically insignificant. These results indicate that the information content of tweets regarding tariffs is different from that of tweets concerning immigration or U.S. politics, and that while the former tweets have explanatory power over changes in bilateral exchange rates, the latter do not.

Columns 7 and 8 control for instances where there was a public or private data release in the 60 minutes before or after the identification window. In all cases, the coefficient of the tariff tweets is similar to the one in the benchmark regression and the coefficient of the control variable is not statistically significant.

Finally, column 9 performs a regression that allows the effect of tweets signalling a possible increase in tariffs—criticizing NAFTA, threatening new tariffs, or threatening to end NAFTA or the negotiations for a new treaty—to be different from the effect of tweets signalling progress in the negotiations or the reduction of tariffs. The OLS regression in this case is

$$\ln(e_{t+\delta}) - \ln(e_{t-\varsigma}) = \alpha + \beta D_t^+ + \rho D_t^- + u_t,$$

where ρ is a coefficient, D_t^+ is a dummy variable that takes value 1 if $c = 1$ and 0 otherwise, D_t^-

is a dummy variable that takes value -1 if $c = 2$ and 0 otherwise, and the remaining notation is as previously defined. In the case of Canada, tweets that signal a potential increase in tariffs lead on average to a 0.0195% appreciation of the U.S. dollar, while tweets that signal a potential decrease lead to a 0.0353% depreciation. Both coefficients are statistically significant, but in the later case only at the ten percent significance level. In the case of Mexico, tweets that signal a potential increase in tariffs lead to a 0.0563% appreciation of the U.S. dollar, while tweets that signal a potential decrease lead to a 0.0296% depreciation, but the latter effect is not statistically different from 0. For both countries, the hypothesis that both coefficients are same in absolute value cannot be rejected at the five percent level, but this result should be interpreted with caution because the number of tweets that signal a potential decrease in tariffs is small.

4.3 Longer-term Effects

Consider now the projection

$$\ln(f^h_{t+\delta}) - \ln(f^h_{t-\varsigma}) = \alpha + \beta D_t + X_t'\gamma + u_t, \tag{2}$$

where $\ln(f^h_{t+\delta}) - \ln(f^h_{t-\varsigma})$ is the change in the forward exchange rate in the window around the Twitter feed, h is the contract horizon, and the remaining notation is as previously defined. The contract horizons are 1-month, 2-months, 3-months, 6-months, 9-months, 1-year, 2-years, and 5-years ahead. This projection allows us to gauge the extent to which the protectionist policy signalled by presidential tweets is expected by the foreign exchange market to persist into the future.

Estimates for Canada and Mexico are respectively reported in Tables 3 and 4, and in Figure 6, which plots the estimates of β (filled squares) and their 95% confidence intervals for all contracts for both countries. In the case of the U.S. dollar/Canadian dollar, results using forward rates are quantitatively similar to those obtained using the spot rates for all contracts, even as far as 5-years ahead. For example, Table 3 shows that the exchange rate decreases (i.e., the U.S. dollar appreciates) by 0.0234%, 0.0220%, 0.0277% in the 1-month-, 1-year- and 5-year-forward markets, compared with the 0.0228% appreciation of the U.S. dollar in the spot market. The table and Figure 6 also show that the U.S. dollar appreciation in the forward market due to the presidential tweet is statistically significant in all cases.

In the case of U.S. dollar/Mexican peso, Table 4 and Figure 6 show that the effect of presidential tweets on the forward rates decreases mildly with the horizon. While the U.S. dollar appreciates by 0.0508% in the spot market, it appreciates, for example, by 0.0426%, 0.0415%, and 0.0335% in the 1-month-, 1-year- and 5-year-forward markets. These estimates are overall larger than for the U.S. dollar/Canadian dollar exchange rate and significant at standard significance levels at all horizons,

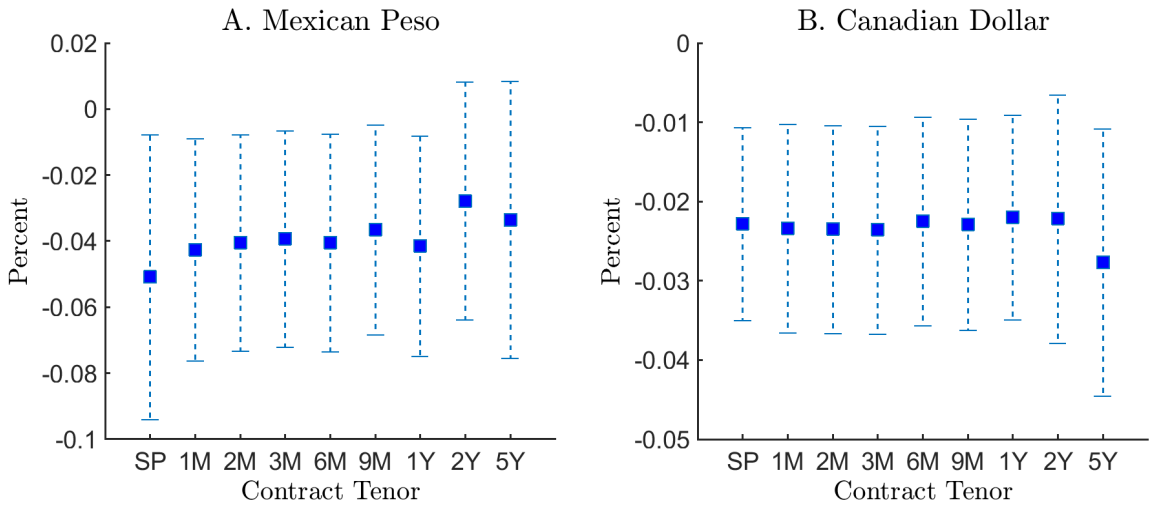

Figure 6: The figure plots the estimates of the effect of tweets on exchange rates at various horizons and their associated 95% confidence interval.

except for 2-year- and 5-year-ahead contracts.

4.4 Placebo Tests

We carried out placebo tests to verify that the effect of presidential tweets on the exchange rate is indeed the result of their content about the U.S. commercial policy and not of an extraneous reason (for instance, who the author of the tweet is). Placebo tests repeat the analysis using a different part of the dataset where no intervention occurred and ask whether the conjectured effect on the exchange rate is present or not.

Results in tables 1 and 2 already show that tweets regarding immigration and U.S. politics have no explanatory power over the exchange rate. Thus, the natural placebo are tweets by the U.S. president that concern Canada and Mexico but are unrelated to trade, immigration, or U.S. politics. In addition to the example reported in section 2, another example is

> Congratulations to all of our Mexican friends on National Independence Day. We will be doing great things together!

published on September 16, 2018, at 21:28. As described in section 2, these tweets were coded as $c = 5$ and so the dummy variable D_t in (1) and (2) takes value 1 if $c = 5$ and 0 otherwise. Given the uninformative nature of these tweets (from the policy perspective), one would not expect them to have a systematic effect on the bilateral exchange rate, and evidence of the contrary would call into question our interpretation of the results above.

Results are reported in Tables 5 and 6 for Canada and Mexico, respectively. Notice that the coefficient of the presidential tweets is not statistically significant at standard levels for either the spot exchange rate or the forward contracts. The only exception is the case of the 2-year-forward contract for the Mexican peso for which the coefficient of the tweet is significant at the ten percent level. These results and those in columns 4 and 5 in Tables 1 and 2 lead us to conclude that only tweets related to trade have an effect on the U.S. dollar/Canadian dollar and U.S. dollar/Mexican peso exchange rates. Hence, the benchmark results reported in section 4.1 are only due to the information content about U.S. commercial policy contained in the presidential tweets.

4.5 Other Currencies

Finally, we examine whether tweets concerning U.S. commercial policy with respect to Canada and Mexico may have an effect on other bilateral exchange rates. We focus on U.S. dollar/Australian dollar, U.S. dollar/euro, U.S. dollar/Japanese yen, U.S. dollar/New Zealand dollar, U.S. dollar/Norwegian krone, U.S. dollar/British pound, and U.S. dollar/Swedish krone. Point estimates reported in Table 7 suggest that the U.S. dollar generally depreciates with respect to these currencies, but the effect is quantitatively small and generally not significant at the five percent level. An exception is the Australia dollar, with respect to which the U.S. dollar depreciates by 0.0108%.

A possible explanation for this result is that Australia, like Canada, is a large producer of raw materials, and, hence, an increase in tariffs on Canadian goods would make Australian goods relatively cheaper in the U.S. market. It is interesting to note, for instance, that beef and aluminum are respectively the United States' first and fifth largest import categories from Australia (respectively, $2.4 billion and $596 million in 2019) and that the tweets

> We have large trade deficits with Mexico and Canada. NAFTA which is under renegotiation right now has been a bad deal for U.S.A. Massive relocation of companies &; jobs. Tariffs on Steel and Aluminum will only come off if new &; fair NAFTA agreement is signed. Also Canada must ...
>
> ...treat our farmers much better. Highly restrictive. Mexico must do much more on stopping drugs from pouring into the U.S. They have not done what needs to be done. Millions of people addicted and dying.

published on March 5, 2018, at 11:47 and 11:53, led to a depreciation of the U.S. dollar with respect to the Australian dollar by -0.0516%, which is one of the largest responses in our sample.

5. Conclusions and Caveats

Both reduced-form models (e.g., Mundell, 1961, and Eichengreen, 1981) and dynamic general equilibrium models (e.g., Barattieri et al, 2020) generally predict an appreciation of the local currency vis-à-vis the foreign currency after an increase in tariffs. Such an appreciation would limit the effect of tariffs on relative prices and mitigate the expenditure-switching from foreign to local goods intended by the protectionist policy. Evaluating this prediction empirically is difficult because previous tariff changes were infrequent and affected a limited set of goods, and identification can be problematic (see, however, Barattieri et al., 2020; and Furceri et al., 2019). For these reasons, we use a high-frequency identification strategy that focuses on the reaction of the exchange rate market to news about the possible tariff increases that would have taken place if the United States had withdrawn from the NAFTA or if the negotiations for a new trade agreement would have failed. NAFTA covers a substantial proportion of U.S. international trade, and the aggregate effects of its termination are likely to be large. News regarding trade policy take the form of social media postings (tweets) by the U.S. president.

Our results show that the anticipation of trade restrictions led to the appreciation of the U.S. dollar by 0.0228% and 0.0508% with respect to the Canadian dollar and Mexican peso in the spot market and by similar magnitudes in the forward market up to five years ahead. These estimates are economically and statistically significant and robust to including additional regressors. In particular, we show that exchange rates reacted systematically only to tweets concerning commercial policy, but not to tweets concerning immigration, U.S. politics, or other matters. Thus, our results indicate that the conjecture that exchange rate appreciation may mitigate expenditure-switching towards local goods after a tariff increase is empirically plausible.

However, in interpreting these results it is important to consider that our estimates are based on actual and expected tariff increases and may underestimate the appreciation of the U.S. dollar because the probability of tariff increases as perceived by traders is unobservable by the econometrician. Thus, our estimates are more constructively interpreted as a lower bound. In addition, our results concern high frequencies, but we do find that forward contracts up to five years ahead are similarly affected, suggesting that results may also hold at lower frequencies. Finally, our analysis abstracts from other considerations, such as the possibility of retaliation by trade partners and general equilibrium effects that may be quantitatively important. We leave these important issues for future research.

Table 1. U.S. Dollar/Canadian Dollar: Spot Rate

	Regression								
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	.0013	−.0010	.0014	.0012	.0036	.0014	.0032	.0027	−.0001
	(.0031)	(.0037)	(.0031)	(.0031)	(.0045)	(.0039)	(.0033)	(.0031)	(.0029)
Tariffs	−.0228*	−.0235*	−.0222*	−.0243*	−.0244*	−.0228*	−.0227*	−.0229*	−.0195*
	(.0062)	(.0077)	(.0075)	(.0064)	(.0068)	(.0066)	(.0062)	(.0061)	(.0058)
Tariffs (Mexico)			−.0240*						
			(.0089)						
Pre-election				−.0127					
				(.0152)					
Wall					−.0056				
					(.0059)				
Political						−.0001			
						(.0063)			
Release before							−.0063		
							(.0063)		
Release after								−.0041	
								(.0060)	
Agreement									.0353†
									(.0209)
Number of obs.	177	127	177	177	177	177	177	177	177
F-statistic	2.752	15.661	1.335	1.746	1.836	1.317	1.993	1.662	1.975
p-value	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$
R^2	.106	.111	.106	.110	.111	.106	.112	.109	.112

Note: The dependent variable is the percentage change in the U.S. dollar/Canadian dollar spot exchange rate in a window from one minute before to five minutes after the tweet timestamp. The figures in parenthesis are Huber-White heteroskedasticity consistent standard errors. The superscripts $*$ and † denote statistical significance at the five and ten percent levels, respectively.

Table 2. U.S. Dollar/Mexican Peso: Spot Rate

	Regression								
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	.0144	−.0112	.0140	.0138	.0093	.0156	.0249	.0242	.0169
	(.0181)	(.0067)	(.0182)	(.0182)	(.0083)	(.0253)	(.0239)	(.0254)	(.0218)
Tariffs	−.0508*	−.0311†	−.0620*	−.0565*	−.0472*	−.0517*	−.0508*	−.0513*	−.0563†
	(.0220)	(.0177)	(.0245)	(.0238)	(.0181)	(.0252)	(.0222)	(.0221)	(.0301)
Tariffs (Canada)			−.0017						
			(.0299)						
Pre-election				−.0118					
				(.0216)					
Wall					.0125				
					(.0435)				
Political						−.0042			
						(.0274)			
Release before							−.0352		
							(.0256)		
Release after								−.0294	
								(.0251)	
Agreement									.0296
									(.0395)
Number of obs.	180	130	180	180	180	180	180	180	180
F-statistic	2.752	4.964	1.731	1.522	1.432	1.374	1.927	1.751	1.413
p-value	.099	.028	.180	.221	.242	.256	.149	.177	.246
R^2	.015	.037	.019	.017	.016	.015	.021	.019	.016

Note: The dependent variable is the percentage change in the U.S dollar/Mexican peso spot exchange rate in a window from one minute before to five minutes after the tweet timestamp. See notes to Table 1.

Table 3. U.S. Dollar/Canadian Dollar: Forward Rates

	Regression							
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	.0034	−.0035	.0033	.0029	.0036	.0035	.0028	.0031
	(.0031)	(.0031)	(.0031)	(.0031)	(.0031)	(.0030)	(.0037)	(.0041)
Tariffs	−.0234*	−.0235*	−.0236*	−.0225*	−.0229*	−.0220*	−.0222*	−.0277*
	(.0067)	(.0067)	(.0067)	(.0067)	(.0068)	(.0066)	(.0080)	(.0086)
Number of obs.	178	178	178	178	178	178	178	177
F-statistic	21.626	22.003	21.923	19.656	20.305	18.915	12.793	16.391
p-value	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$
R^2	.109	.111	.111	.101	.103	.097	.067	.085

Note: The dependent variable is the percentage change in the U.S. dollar/Canadian dollar forward exchange rate in a window from one minute before to five minutes after the tweet timestamp. The columns correspond respectively to rates 1-month, 2-months, 3-months, 6-months, 9-months, 1-year, 2-years, and 5-years ahead. See notes to Table 1.

Table 4. U.S. Dollar/Mexican Peso: Forward Rates

	Regression							
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	−.0011	−.0018	−.0020	−.0013	−.0031	−.0016	.0026	.0032
	(.0054)	(.0053)	(.0053)	(.0054)	(.0051)	(.0052)	(.0055)	(.0094)
Tariffs	−.0426*	−.0405*	−.0393*	−.0405*	−.0365*	−.0415*	−.0278	−.0335
	(.0172)	(.0167)	(.0167)	(.0168)	(.0162)	(.0170)	(.0184)	(.0214)
Number of obs.	180	180	180	180	180	180	180	180
F-statistic	11.467	10.788	10.134	10.720	9.268	11.019	4.082	5.522
p-value	$< .001$	.001	.002	.001	.003	.001	.050	.020
R^2	.061	.057	.054	.057	.050	.058	.022	.030

Note: The dependent variable is the percentage change in the U.S dollar/Mexican peso forward exchange rate in a window from one minute before to five minutes after the tweet timestamp. The columns correspond respectively to rates 1-month, 2-months, 3-months, 6-months, 9-months, 1-year, 2-years, and 5-years ahead. See notes to Table 1.

Table 5. U.S. Dollar/Canadian Dollar: Placebo Tests

	Regression								
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	−.0039	−.0025	−.0024	−.0026	−.0028	−.0023	−.0021	−.0027	−.0038
	(.0028)	(.0028)	(.0028)	(.0028)	(.0028)	(.0029)	(.0028)	(.0034)	(.0038)
Unrelated	−.0006	.0119	.0117	.0120	.0124	.0138	.0123	.0099	.0105
	(.0172)	(.0111)	(.0110)	(.0112)	(.0109)	(.0107)	(.0105)	(.0115)	(.0117)
Number of obs.	177	178	178	178	178	178	178	178	178
F-statistic	.002	.804	.777	.811	.868	1.077	.856	.382	.347
p-value	.962	.371	.379	.369	.353	.301	.356	.537	.557
R^2	$< .001$	.005	.004	.005	.005	.006	.005	.002	.002

Note: The dependent variable is the percentage change in the U.S. dollar/Canadian dollar spot and forward exchange rates in a window from one minute before to five minutes after the tweet timestamp. The columns correspond respectively to spot rates and rates 1-month, 2-months, 3-months, 6-months, 9-months, 1-year, 2-years, and 5-years ahead. See notes to Table 1.

Table 6. U.S. Dollar/Mexican Peso: Placebo Tests

	Regression								
Description	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	.0020	$-.0116^{\dagger}$	$-.0119^{\dagger}$	$-.0117^{\dagger}$	$-.0112^{\dagger}$	$-.0122^{\dagger}$	$-.0119^{\dagger}$	$-.0050$	$-.0049$
	(.0165)	(.0069)	(.0068)	(.0068)	(.0068)	(.0066)	(.0069)	(.0074)	(.0077)
Unrelated	.0162	.0181	.0198	.0166	.0136	.0180	.0198	$.0320^{\dagger}$	.0095
	(.0233)	(.0164)	(.0165)	(.0169)	(.0184)	(.0160)	(.0154)	(.0176)	(.0141)
Number of obs.	180	180	180	180	180	180	180	180	180
F-statistic	.033	.236	.294	.205	.137	.259	.285	.638	.051
p-value	.856	.628	.558	.651	.712	.612	.594	.425	.821
R^2	$< .001$	.001	.002	.001	$< .001$	.002	.002	.004	$< .001$

Note: The dependent variable is the percentage change in the U.S. dollar/Mexican peso spot and forward exchange rates in a window from one minute before to five minutes after the tweet timestamp. The columns correspond respectively to spot rates and rates 1-month, 2-months, 3-months, 6-months, 9-months, 1-year, 2-years, and 5-years ahead. See notes to Table 1.

Table 7. Other Exchange Rates

Description	Regression						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	−.0013	.0008	.0009	−.0035	−.0105	.0061	−.0230
	(.0029)	(.0037)	(.0052)	(.0034)	(.0071)	(.0028)	(.0085)
Tariffs	.0108*	.0118†	−.0048	.0124†	.0218	.0029	.0227
	(.0054)	(.0065)	(.0106)	(.0074)	(.0137)	(.0054)	(.0188)
Number of obs.	191	191	191	191	191	191	191
F-statistic	4.099	2.993	.219	3.546	3.215	.283	2.025
p-value	.044	.085	.640	.061	.075	.596	.156
R^2	.021	.016	.001	.018	.017	.002	.011

Note: The dependent variable is the percentage change in the spot exchange rate in a window from one minute before to five minutes after the tweet timestamp. The columns correspond respectively to the (1) U.S. dollar/Australian dollar, (2) U.S. dollar/euro, (3) U.S. dollar/Japanese yen, (4) U.S. dollar/New Zealand dollar, (5) U.S. dollar/Norwegian krone, (6) U.S. dollar/British pound, and (7) U.S. dollar/Swedish krone. See notes to Table 1.

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