Do Exchange Rate Shocks Affect Firms' Production Capacity? The Working Capital Channel *

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Abstract

I provide a novel channel through which real exchange rate (RER) shocks affect sales and short-term investment of U.S. firms with international activities. Using a novel identification strategy that compares how a similar firm responds to firm-specific shocks differently when they are initiated in their most profitable quarter ("main quarter"), I show that RER shocks are amplified by funding constraints that limit working capital financing. Specifically, a positive RER shock (RER depreciation) initiated in the main quarter increases production costs and decreases internal funds allocated to short-term investments of constrained importing firms, reducing firms' sales and production capacity. While the working capital channel is relevant for importing firms, it is not present for exporting firms since those firms are not exposed to changes in production cost after an RER shock.

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1 Introduction

Researchers and policymakers agree that real exchange rate (henceforth, RER) movements have significant effects on firm outcomes such as sales and profits but can also influence their investment decisions (Dao, Minoiu, and Ostry, 2021). According to Bartov and Bodnar (1994), " it is a widely held view that exchange rate movement should affect the value of a firm". Moreover, standard economic analysis implies that cash flows and the value of most U.S. firms with international activities should increase (decrease) with an unexpected dollar depreciation (appreciation).

Economic shocks are both amplified and propagated over time by financing frictions because they lead to changes in firms' balance sheets (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). For instance, an RER shock associated with an RER depreciation can reduce importing firms' cash flows, limiting their ability to borrow and thereby further reducing their profitability over time. The focus of existing literature is primarily on the effect of RER on long-term investment (capital expenditures) of financially constrained firms because, in principle, short-term assets may be easier to finance.

However, recent work by Almeida, Carvalho, and Kim (2023) has shown that financing frictions that affect short-term investment can limit firms' production capacity since lower inventories or receivables translate into lower sales. Despite the importance of this idea, there is no evidence on how RER shocks affect sales and short-term investment of firms that face funding constraints that limit working capital financing or the economic channel through which it works in practice.

The main contribution of this paper is to provide a novel channel through which RER shocks affect the production capacity (sales) and short-term investment (receivables and inventories) of cash-constrained firms. I call this the *working capital channel*. After a positive RER shock (RER depreciation), importing firms face higher input prices and, hence, higher production costs. If the importing firm is financially constrained, less internal funds are allocated to short-term investment. This decrease in short-term investment translates into immediate reductions in firm sales and production capacity. Firms with higher import exposure suffer larger decreases in internal funds allocated to short-term investment, and consequently, sales and production capacity drop by more.

I show that the working capital channel consequences of an RER shock are amplified during a firm's most profitable quarter (main quarter). If a firm is hit in its main quarter, the share of the investment in inputs that firms can finance on credit from suppliers is higher due to higher profits to repay the suppliers, and as a result, the drop in short-term investment is larger. This larger drop in investments translates to larger decreases in sales and production capacity.

I also provide novel evidence that foreign exposure affects the transmission of the RER shock to firms. While the working capital channel is relevant for importing firms, it is not present for exporting firms. The key is that RER shocks must change input prices (production costs) and hence affect the internal funds allocated to short-term investment. Although RER shocks also affect exporting firms and their cash flows, such shocks comprise sales shock and, as a result, do not affect the amount of short-term assets (inputs) they can finance on credit.

The theoretical framework follows Kiyotaki and Moore (1997) and Almeida, Carvalho, and Kim (2023). I consider a firm with international activities that require short-term investments in accounts receivable and inventories to operate and need working capital financing. The firm relies on funding from suppliers (accounts payable) to cover this financing need and uses all of the credit available from suppliers, and these frictions limit the available credit. The idea that credit from suppliers addresses this working capital need among international firms has been supported by the literature on trade credit (Engemann, Eck, and Schnitzer, 2014; Auboin, 2009; IMF, 2009).

In this setting, RER shocks that change input prices (production costs) affect internal funds allocated to short-term investment, sales, and, consequently, the firm's production capacity. This happens because firms rely on short-term investments to complete their sales. Further, RER shocks during the firm's main quarter are amplified because the firm can leverage its short-term investment more aggressively with short-term funding from suppliers during this period.[1]

This paper uses data from three main sources: COMPUSTAT's Fundamentals Quarterly (balance sheet information), IMF (quarterly data of nominal exchange rates and consumer price indexes), and Hoberg-Moon Offshoring Repository (international activities

[1]For more details on the theoretical framework, see Section 2.

of publicly traded U.S firms that file 10-Ks international activities). After merging these datasets and applying typical filters, my main sample covers 7,795 firms and 197,300 firm-quarter observations from 2000 to 2017.

I document four facts from the data. First, the strong predictability in firms' cash flows, that is, firms have main quarters where their cash flows are predicted to be higher. Second, leverage seasonality, that is, top supplier financing firms (top tercile of supplier financing distribution) borrow more aggressively from suppliers during their main quarter. Third, the random assignment of treated and control firms. In other words, firms hit by shocks inside versus outside the main quarter (treated versus control firms) are very similar. Fourth, RER shocks have a significant effect on firms' cash flows. For instance, an RER shock associated with RER depreciation significantly reduces importing firms' cash flows. Facts 1, 2, and 3 are directly from Almeida, Carvalho, and Kim (2023). However, observing those facts in a new sample that focuses on U.S. firms with international activities (exporting and importing firms) is an interesting result on its own and helps me to obtain a clear identification strategy.

To empirically test the working capital channel, I start by constructing firm-specific RER shocks. In my main analysis, I focus on importing firms to ensure that the shocks are associated with significant changes in production costs, as suggested by the theoretical motivation.[2] As firms import from different countries of origin, they are exposed to exchange rates with different foreign currencies. Shocks to these firm-specific exchange rates have a significant effect on importers' input prices. In fact, in Subsection 4.4, I show that RER shocks significantly decrease importing firms' cash flows.

I then by show that firms have main quarters where their cash flows are predicted to be higher. Since the borrowing from suppliers is very short-term, firms have more cash flows to repay suppliers in their main quarter, and the share of the investment in inputs that firms can finance on credit from suppliers is higher during these periods. This step is important because RER shocks endogenously trigger financial problems, which then amplify and propagate the shocks. Therefore, analyzing how an RER shock affects firms differently when the financial amplification mechanism is more important (i.e., during the

[2]In Section 8, I present the results for exporting firms and show that the working capital channel is not present for those firms.

main quarter) helps to fully isolate the financial constraint channel.

Finally, I contrast how a firm responds over time to an RER shock when this shock hits the firm (say firm i, the treated firm) inside its main quarter with a similar firm's (say firm j, the control firm) response to an RER shock that hits outside of the main quarter. The random assignment of treated and control firms discussed in Subsection 4.3 guarantees that the characteristics of firms inside versus outside the main quarter should be very similar. Therefore, the two firms I contrast (treated versus control) are similar and only differ in the timing of their main quarter.

The estimated effects in my baseline analysis are both statistically and economically significant for firms that strongly rely on credit from suppliers (top supplier financing firms). They indicate that a typical positive RER shock (RER depreciation) immediately reduces firms' sales by 2.7% more when firms are initially hit in their main quarter. This effect propagates over time. After five quarters, firms initially hit by the shock inside its main quarter reduces their sales by approximately 4% more. I do the same exercise using short-term investment as an outcome. Consistent with previous analysis for firms' sales, a typical RER shock immediately reduces the short-term investment of firms by 6% more when firms are initially hit in their main quarter. After five quarters, the differential effect is 12%, indicating a strong propagation effect. Those results are neither economically nor statistically significant for mid and bottom supplier financing firms.[3]

I also show that the effect of RER shocks is bigger for short-term investment than for long-term investment. After a positive RER shock initiated in the main quarter, I find a differential effect of 4% for short-term investment relative to long-term investment (stronger drop in short-term investment) in the quarter of the shock.

I address concerns about several potentially confounding factors. For instance, one could argue that if RER shocks take place more often during quarter Q1 or if there are more Q1-type firms (firms with the main quarter in calendar quarter Q1), my results would be capturing the differential sensitivity of Q1-type firms to shocks. I overcome this challenge by showing that firms have main quarters well distributed throughout the year. I also include several fixed effects, such as firm-type fixed effects (see Subsection 4.1), and the

[3]Top, mid, and bottom supplier financing firms are firms in the top, middle, and bottom tercile of Supplier Financing (sorted by year), respectively. For more details, see Subsection 3.2.

interactions between each of these indicators and the RER shock. Those controls guarantee that the empirical specification estimates how a same firm responds to an RER shock when the shock happens inside versus outside the main quarter.

Another potential concern is that, in principle, Q1-type firms (firms with the main quarter in calendar quarter Q1) may be different from Q2-type firms (firms with the main quarter in calendar quarter Q2) in a way that could contaminate the identification strategy. For example, Q1-type firms are smaller in my data, and shocks could have a different persistence for smaller firms. However, the assumption that RER shocks are unpredictable and the fact that they occur frequently eliminates differences between firms hit by the shock inside their main quarter (treated firms) and firms hit outside their main quarter (control firms).

I subject my baseline results to several robustness tests. First, I show that the working capital channel is not present for exporting firms. As described in Section 2, exporting firms should not be exposed to the working capital channel since RER shocks do not affect internal funds allocated to short-term investment. Using a new RER shock that considers the export exposure of each U.S. publicly-listed firm, I do not find significant effects of RER shocks for those firms during the main quarter. A positive RER shock (RER depreciation) does not lead to a significantly larger increase in sales and short-term investment of firms when they are hit inside their main quarter.

Second, I show that RER shocks do not affect firms' long-term investment differently when they hit firms in their main quarter. This is important because it ensures that the channel I propose is driven by working capital and not alternative mechanisms. Third, I analyze the response of accounts payable. Firms that rely on the working capital channel finance much of their investment in inputs on credit and changes in this short-term investment should be matched with comparable effects on customers' credit from suppliers (accounts payable). This is exactly what I observe when defining accounts payable as the outcome variable.

Fourth, I show that results are robust to alternative cutoffs for the importance of supplier financing. By dividing the main sample into two groups using Supplier Financing (sorted by year), top 50% and bottom 50% supplier financing firms, I find that only firms in the top supplier financing group (top 50%) are significantly more affected when the

RER shock initially hits them inside their main quarter.

This paper relates to several strands of literature in the corporate and international finance areas. A large empirical literature in corporate finance studies the effect of financing frictions on the real economy and the idea that the effect of economic shocks on long-term investment is amplified if the firm faces financing constraints (Fazzari, Hubbard, and Petersen, 1987; Duchin, Ozbas, and Sensoy, 2010; Almeida et al., 2012; Carvalho, 2015). Recent literature also shows that funding frictions can matter for short-term investments in assets such as account receivables and inventories (Almeida, Carvalho, and Kim, 2023). I contribute to this literature by providing novel evidence that when firms face financing constraints that limit working capital financing, the effect of RER shocks on firms' production capacity is amplified and propagated over time.

My study relates most closely with Almeida, Carvalho, and Kim (2023) in the sense that I follow their empirical approach, and we both use funding constraints on short-term investment to study the effect of economic shocks on firms' production capacity. In fact, their paper is the first to provide micro-level evidence that an important subset of firms faces funding frictions limiting their ability to finance short-term investments in inventories and receivables and reducing their production capacity. However, my work differs along several dimensions.

First, while their focus is to show that funding frictions matter for short-term investment, I focus on understanding the economic channel through which RER shocks affect firms' outcomes and the role of financing constraints that limit working capital financing in amplifying those shocks. Therefore, real exchange movements, which are key in my investigation, are left out of their analysis. Second, my sample focuses on U.S. firms with international activities (importing and exporting firms). As far as I am concerned, my work is the first to provide empirical evidence that financing constraints on short-term investment affect the production capacity of constrained importing firms. Third, I construct a more granular shock measure. That is, while they use oil shocks at the industry level, I construct firm-specific RER shocks. This is important because it lets me better capture firms' reactions to those shocks. Fourth, Almeida, Carvalho, and Kim (2023) only consider small firms with negative oil exposure in their analysis. In contrast, I analyze firms with both import and export exposure and show how foreign exposure affects the

transmission of the RER shock to those firms, an aspect not addressed by the authors.

My study also connects to the macro-finance literature on working capital financing constraints. Paravisini et al. (2015) study the effect of bank credit shocks on the export behavior of Peruvian firms during the 2008 crisis and shows that credit shortages reduce exports through raising the variable cost of production rather than the cost of financing sunk entry investments. This would be the case, for example, if banks financed exporters' working capital. Amiti and Weinstein (2011) also emphasizes that the health of financial institutions is an important determinant of firm-level exports during crises. I add to this literature by providing empirical evidence that RER shocks affect sales and short-term investment of firms that face funding constraints that limit working capital financing, and foreign exposure plays an important role in understanding the transmission of the shock to firms.

A sizable literature on corporate investment examines the behavior of firms during exchange rate movements (Chang and Velasco, 2000; Forbes, 2002; Aguiar, 2005; Bleakley and Cowan, 2008; Dao, Minoiu, and Ostry, 2021). For instance, Aguiar (2005) uses the Mexican peso crisis of 1994 to show that firms with heavy exposure to short-term foreign currency debt before the devaluation experienced relatively low levels of post-devaluation investment. Dao, Minoiu, and Ostry (2021) show that when firms are financially constrained in the sense that the cost of external finance exceeds that of internal finance, internally generated cash flow will play an important role in investment financing. I document a novel channel through which RER shocks affect constrained firms' production capacity (sales) and short-term investment.

I also contribute to the trade credit literature. Petersen and Rajan (1997) argue that credit from suppliers is largely used to finance short-term investments as this allows firms to match the maturity of assets and liabilities. Engemann, Eck, and Schnitzer (2014) find that supplier credits are used intensively by firms active in international trade. I focus on supplier financing to show that firms that strongly rely on credit from suppliers are more exposed to the working capital channel.

The paper is structured as follows. Section 2 discusses the theoretical motivation and explains the working capital channel. Section 3 describes the data sources and variables construction. Section 4 documents four motivating facts from the data. Section 5 presents

my empirical strategy and specification. The main results are presented in Sections 6 and 7. In Section 8, I discuss the results for exporting firms. The robustness exercises are in Section 9. Section 10 concludes.

2 The Working Capital Channel

The theoretical motivation closely follows Kiyotaki and Moore (1997) and Almeida, Carvalho, and Kim (2023). Consider a firm with international activities. The firm can be an importer or an exporter and is allowed to trade with many different countries. As a result, this firm may be exposed to changes in the bilateral RER.[4] For instance, suppose two firms (say firms A and B) trade with a foreign country (say Canada). Firm A purchases inputs (importing firm) from Canada, while Firm B sells goods (exporting firm) to Canada. Then, after an RER depreciation of the U.S. dollar, firm A may be negatively affected by higher input prices, but firm B may have positive effects on its cash flow due to higher sales.

In order to operate, firms require short-term investments in accounts receivable and inventories, which creates a need for working capital financing. In each period (e.g., quarter), firms need to cover operating costs prior to the collection of cash from sales and need working capital financing to fund this gap. I consider a firm that relies on funding from suppliers (accounts payable) to cover this financing need. Suppliers provide short-term credit at the beginning of each period and get paid at the end of the period when the firm generates cash from sales. Previous literature has shown that constrained firms may be financed by their suppliers (Petersen and Rajan, 1997) and trade credit has a short maturity (Klapper, Laeven, and Rajan, 2012).

Trade credits are an important financing tool for firms engaged in international activities. Supplier credits are used intensively by firms active in international trade (Engemann, Eck, and Schnitzer, 2014), and about 40 percent of international transactions are financed via supplier credits (IMF, 2009). Those trade credits are also economically important. Auboin (2009) estimates that the global market for trade credit and insurance is $10–12 trillion, which was roughly 80% of 2008 trade flows valued at $15 trillion.

[4] Please see Subsection 3.5 for the definition of RER.

I study a constrained firm that would like to expand its short-term investment by using additional working capital financing but faces frictions. The firm uses all the credit available from suppliers, and these frictions limit the available credit. I rely on two assumptions. First, suppliers finance a share of new short-term investments the firm makes. Second, more profitable firms receive more credit from suppliers.[5] As in Chang et al. (2017) and Almeida, Carvalho, and Kim (2023), I show in Subsection 4.1 that firms have main quarters where their cash flows are predicted to be higher. Since the borrowing from suppliers is very short-term, firms have more cash flows to repay suppliers in their main quarter, and the share of the investment in inputs that firms can finance on credit from suppliers is higher during these periods.

Since the firm is active in international trade, RER shocks (see Subsection 3.5) may impact firms' cash flows.[6] In fact, I show in Subsection 4.4 that RER shocks have an economically significant effect on firms' profitability. If the RER shock changes input prices (production costs), this affects the internal funds allocated to short-term investment, sales, and, consequently, the firm's production capacity. This happens because firms rely on short-term investments to complete their sales. Moreover, RER shocks during the firms' main quarter will be amplified because the firm can leverage its short-term investment more aggressively with short-term funding from suppliers during this period.

Consider the following numerical example. Suppose an importing firm (say firm A) decides to buy \$1.0 in inputs from suppliers, and the firm can borrow 30% of the value of inputs outside of the main quarter. This means that firm A can raise \$0.3 in financing and internally fund \$0.7. Since the firm is financially constrained and uses all the credit available, the response of the firm's short-term investment to RER shocks will be levered. For instance, after an RER depreciation, firms face higher input prices and, consequently, higher production costs. This reduces firms' internal funds allocated to buy inputs by \$1.0. Then, the short-term investment will drop by \$(1.0)/ (0.7) = \$1.43.[7]

Now, suppose firm A is inside its main quarter and can borrow 35% of the value of

[5] This is supported by Petersen and Rajan (1997).

[6] The effect on cash flow depends on whether the firm is an exporter or importer and if the change in RER is a depreciation or appreciation of the U.S. dollar against the foreign currency.

[7] $CM = \frac{1}{1-\left(\frac{B_m}{p_t}\right)}$, where CM is the credit multiplier, B_m is the share of inputs that customers can finance on credit, and p_t is the input price.

inputs. Firms have more cash flows to repay suppliers in their main quarter and can leverage their short-term investment more aggressively with short-term funding from suppliers during these periods. An RER shock that reduces internal funds allocated to buy inputs by the same amount of $1.0 is associated with a higher drop in short-term investment. The short-term change in investment is $(1.0)/ (0.65) = $1.54 inside the main quarter, which is greater than $1.43, the change outside of the main quarter.

This leads to a new channel through which RER shocks affect production capacity (sales) and short-term investment of firms facing funding constraint that limits working capital financing. I call this the *Working Capital Channel*. Consider an importing firm. After a positive RER shock (RER depreciation), the firm faces higher input prices, which implies higher production costs. If the firm is financially constrained, lower internal funds are allocated to short-term investment. This decrease in short-term investment translates into immediate reductions in firm sales and production capacity. Firms with higher import exposure suffer larger decreases in internal funds allocated to short-term investment and, consequently, larger sales and production capacity drops.

This working capital channel is amplified during the firms' main quarter. Suppose the firm is hit inside its most profitable quarter (main quarter). In this quarter, the share of the investment in inputs that firms can finance on credit from suppliers is higher due to higher profits to repay the suppliers, and therefore, the drop in short-term investment is larger. This larger investment drop translates to larger decreases in sales and production capacity. Firms significantly relying on supplier financing are more exposed to the working capital channel since they use more leverage from suppliers during their main quarter.

The effect of RER shocks via the working capital channel propagates over time. In other words, it affects firms not only in the period of the shock but also in subsequent periods. A decrease in investment in inputs during this period leads to lower production capacity and profitability, reducing internal funds available to fund operations in the future. Reduced internal funds in subsequent periods then lead to further reductions in firms' short-term investments and sales, propagating the effects of RER shocks on constrained firms over time.

Exporting firms, in contrast to importing firms, should not be exposed to the working capital channel. RER shocks need to change input prices to have an effect on the internal

funds allocated to short-term investments. Although RER shocks may affect the cash flows of exporting firms, this would be a sales shock and not a shock on production costs. For instance, after an RER depreciation (the U.S. dollar's value decreases relative to a foreign currency), the affordability of goods exported from the United States to foreign markets increases, resulting in higher exports. Since there is no change in production costs, exporting firms should not change their investment in inputs. In fact, I provide empirical evidence in Section 8 that the working capital channel is muted for exporting firms.

The working capital channel is economically important for multiple reasons. My analysis reveals that it is a novel channel by which RER shocks affect firms. That is, the effect of RER movements is not only via changes in capital expenditures (Dao, Minoiu, and Ostry, 2021) but also by affecting firms' short-term investment and production capacity. This is significant because it shows how RER shocks can impact the economy via the supply side. Second, it connects RER movements in a developed country and the working capital credit multiplier proposed by Almeida, Carvalho, and Kim (2023). I provide evidence that the effect of RER shocks is amplified by funding constraints on working capital. Third, I show how firms' foreign exposure is crucial for understanding how RER Shocks can affect U.S. firms with international activities.

3 Data

I use three main sources of data: COMPUSTAT's Fundamentals Quarterly, Hoberg-Moon Offshoring Repository (Hoberg and Moon, 2017; Hoberg and Moon, 2019), and the International Financial Statistics (IMF). The first data set provides balance sheet information of listed firms. The second contains international activities of publicly traded U.S. firms that file 10-K international activities. The third holds information on quarterly data of nominal exchange rates and consumer price indexes (CPI).

The baseline sample period covers 2000 to 2017. Following standard practice in the corporate finance literature, I exclude financial firms (SIC codes 6000 - 6999), regulated utilities (SIC codes 4900 - 4999), and firms with a missing SIC. I also drop firms with missing or negative assets and missing capital expenditures. My analysis requires drop-

ping firms with missing quarterly data on cash flows for all the past five years (twenty quarters).[8] Those restrictions leave my main sample with 7,795 firms and 197,300 firm-quarter observations.

3.1 Firm-level Variables

Cash Flow is defined as the ratio of operating income before depreciation ($oibdpq$) to the lag of total assets (atq). *Sales* is quarterly sales ($salesq$). *Inventories* is quarterly inventories ($invtq$). STI is the sum of quarterly receivables and quarterly inventories. *LTI* is the ratio of capital expenditures ($capxy$) to lagged total assets.[9] *Payables* is quarterly accounts payables (apq). *Size* is given by the logarithm of total assets. *Cash holdings* are measured as the ratio of cash and short-term investments ($cheq$) to total assets. *Total debt* is long-term debt ($dlttq$) plus debt in Current Liabilities ($dlcq$). *Book leverage* denotes the ratio of total debt to total assets. *Q* is defined as the ratio of total assets plus market capitalization minus common equity minus deferred taxes and investment tax credit (atq + $prccq \times cshoq$ - $ceqq$ - $txditcq$) to total assets. Age is the number of years since the IPO date. *Net PPE/Assets* is the ratio of net property, plant, and equipment ($ppentq$) to total assets. Table 1 provides the summary statistics for the overall sample, which covers 197,300 firm-quarter observations over the period 2000-2017.

I refer to LTI_{ijt} as long-term investments and STI_{ijt} as short-term investments. Intuitively, one can think of long-term investment as capital expenditures and short-term investment as working capital. For instance, consider a construction company paying for costs before billing (receivables) and a manufacturing firm completing an order before delivery (inventories). These short-term investments are economically important. Table 1 shows that receivables and inventories represent approximately 25% of total assets. This magnitude is similar to the ratio of net property, plant, and equipment (Net PPE) over total assets (29% of total assets in the main sample).

[8] Please see Subsection 3.3.

[9] The variable capxy represents "year-to-date" capital expenditures. I adjust this variable to reflect quarterly values.

3.2 Measuring supplier financing

I construct the variable *Supplier Financing* to measure suppliers' importance in financing working capital using the one-quarter lag of the ratio of accounts payable to sales (annualized). This ratio captures the importance of these liabilities as a share of firms' overall production. I divide the sample into terciles using *Supplier Financing* (sorted by year) to separately analyze the three groups of firms. *Topsupfin* is an indicator variable that equals one for top supplier financing firms (top tercile). *Midsupfin* is an indicator variable that equals one for mid supplier financing firms (mid tercile). *Bottomsupfin* is an indicator variable that equals one for bottom supplier financing firms (bottom tercile).

Table 2 presents the summary statistics for firms in the top tercile of Supplier Financing (sorted by year). Consistent with the data construction, top supplier financing firms rely much more on payables than other firms. While the average ratio of payables to sales is 0.47 for firms relying most on suppliers, Table 1 shows that the average ratio of payables to sales is 0.19 in the overall sample.

3.3 Measuring seasonality in firms' profitability

My empirical analysis exploits seasonal patterns in the cash flows of U.S. firms. In other words, firms have main quarters where their cash flows are predicted to be significantly larger (Chang et al., 2017; Almeida, Carvalho, and Kim, 2023). To capture this pattern, I construct the variable Main quarter (*mquarter*), which is an indicator variable that equals one in the firm's most profitable quarter. First, for each year, I use data on the previous twenty quarters and rank those quarters in terms of their *Cash Flow*. Then, I calculate the average rank for each quarter and define the main quarter as the quarter with the lowest average rank (highest average position). Table 3 shows the distribution of main quarters among firms. I find that firms have main quarters well distributed throughout the year.

3.4 Offshoring Data

One challenge in estimating the effect of RER shocks on U.S. firms with international activities is to obtain data on each U.S. publicly traded firm's foreign exposure. I over-

come this challenge by using the Hoberg-Moon Offshoring Repository (Hoberg and Moon, 2017; Hoberg and Moon, 2019) data, which is a dynamic firm-nation-year network summarizing the international activities of publicly-traded U.S. firms that file 10-Ks. This data is indexed by Compustat gvkey, nation, and year, so they can be merged into existing databases easily.

I capture the import and export exposure of each firm i at time t by defining the following variables:

$$importexposure_{ijt} = \frac{\text{Total Import}_{ijt}}{\text{Total Import}_{ijt} + \text{Total Export}_{ijt}} \tag{1}$$

$$exportexposure_{ijt} = \frac{\text{Total Export}_{ijt}}{\text{Total Import}_{ijt} + \text{Total Export}_{ijt}} \tag{2}$$

$\text{Total Import}_{ijt}$ is the number of total mentions of the firm purchasing inputs in a given year (*Offshore Input*), and $\text{Total Export}_{ijt}$ is the total number of mentions of the firm selling goods in a given year (*Offshore Output*).

3.5 Firm-Specific RER shocks

Firm-level RER shocks are defined as

$$RERshock_{ijt} = \Delta \ln REERI_{it} \times importexposure_{ijt-1} \tag{3}$$

The construction of these shocks is a three-step process. First, I construct bilateral real exchange rates, defined as nominal foreign exchange rates (average period) against the U.S. dollar scaled by CPI. I label this variable RER_{ct}, where c is the country and t is the quarter. Higher values of RER_{ct} mean depreciation, while lower values mean appreciation of the U.S. dollar. Second, I construct $REERI_{it} = \Sigma_{c=1}^{N_i} \lambda_{ict} \times RER_{ct}$, where λ_{ict} is the share of imports of the firm i from country c during year t, and N_i is the number of countries of origin for the importer during this period. For instance, if firm A purchases 50% of its input from Canada and 50% from Brazil in year t, then $REERI_{At} = 50\% \times RER_{Canada,t} + 50\% \times RER_{Brazil,t}$. Then I obtain $\Delta \ln REERI_{it}$, which is the change in

the log of $REERI_{it}$ between quarters t and $t-1$. The last step is to interact $\Delta \ln REERI_{it}$ with $importexposure_{ijt}$, defined in Subsection 4.3.

I focus on importing firms to ensure that the shocks are associated with significant changes in production costs as suggested by the theoretical motivation[10]. As firms import from different countries of origin, they are exposed to exchange rates with different foreign currencies. Shocks to these firm-specific exchange rates have a significant effect on importers' input prices. In fact, in Subsection 4.4, I show that RER shocks significantly decrease firms' cash flows.

This measure of RER shock has several advantages. First, this is a firm-level shock and is a more granular measure than the shock at the industry level used by Almeida, Carvalho, and Kim (2023). Second, previous research has shown that a change in the real exchange rate (RER) affects a firm through firms' export sales and firms' purchases of imported inputs (Ekholm, Moxnes, and Ulltveit-Moe, 2012). Therefore, the shock I construct allows me to study heterogeneity across exporting and importing firms and the role of foreign exposure in understanding how RER movements affect U.S. firms. Finally, since most short-term RER movements are due to the nominal exchange rate, and that's almost entirely unpredictable, it is reasonable to assume that RER shocks are unpredictable. The unpredictability of RER movements has been discussed in previous literature (Meese and Rogoff, 1983a; Meese and Rogoff, 1983b; Meese and Rogoff, 1988; Obstfeld and Rogoff, 2000; Rossi, 2013).

4 Data Facts

In this section, I present four motivating facts. First, the strong predictability in firms' cash flows. Second, the presence of leverage seasonality, that is, top supplier financing firms borrow more aggressively from suppliers during their main quarter. Third, I discuss why the research design used in my analysis leads to a random assignment. Fourth, the effect of RER shocks on firms' cash flow.

[10] In Section 9, I show that the working capital channel is not present for exporting firms using export exposure to construct the firm-specific RER shocks.

4.1 Main Quarter Effect

I show that the main quarter variable ($mquarter_{ijt}$) predicts firms' profitability by estimating the following equation:

$$CashFlow_{ijt} = \theta_{jt} + \beta_1 mquarter_{ijt} + \epsilon_{ijt} \tag{4}$$

$CashFlow_{ijt}$ is the ratio of operating income before depreciation ($oibdpq$) to the lag of total assets, where i is the firm, j is the industry, and t is time. θ_{jt} are industry-quarter fixed effects. I also include firm-type fixed effects, which are indicator variables for firms with their predicted main quarter in each quarter of the calendar year (Q1, Q2, Q3, or Q4). I label firms with a main quarter in Q1, Q2, Q3, and Q4 as Q1- , Q2-, Q3, and Q4-type firms, respectively. Standard errors are heteroskedasticity robust and clustered at the firm level. Table 4 provides strong evidence that the main quarter variable predicts firms' cash flows. Cash flows are predicted to be 76-80% higher (relative to its mean) inside of the main quarter than outside. This magnitude is both economically and statistically significant.

4.2 Leverage Seasonality

I present evidence that top supplier financing firms borrow more aggressively from suppliers during their main quarter by estimating the following specification:

$$Y_{ijt} = \theta_{jt} + \beta_1 mquarter_{ijt} + \beta_2 topsupfin_{ijt} + \beta_3 mquarter_{ijt} \times topsupfin_{ijt} + \epsilon_{ijt} \tag{5}$$

Y_{ijt} is the outcome variable and θ_{jt} are industry-quarter fixed effects. I also include firm-type fixed effects (see Subsection 4.1). In some regressions, I add Industry $\times$ Quarter $\times$ TopSupFin FE, which includes interactions of Industry $\times$ Quarter fixed effects with $topsupfin_{ijt}$, an indicator that equals one if the firm is in top tercile in terms of *Supplier Financing*.

I first define the outcome variable as $\log AP(t) - \log STI(t)$. AP and STI denote firms' payables and short-term investments, respectively. Table 5 provides strong evidence that leverage seasonality is present for top supplier financing firms. In particular, their

payables increase relative to their short-term investment during the main quarter. I then use $\log AP(t) - \log Sales(t)$ as the outcome variable. Sales denote firms' quarterly sales. Consistent with previous analysis for short-term investments, Table 6 shows that firms' payables increase relative to their sales during the firms' most profitable quarter.

Leverage seasonality and the main quarter effect analyzed in Subsection 4.1 provides an important fact. Firms' higher profitability during the main quarter allows them to borrow more from suppliers in this period, and top supplier firms use more leverage from suppliers during their main quarter. Therefore, firms that rely significantly on supplier financing are potentially more exposed to the working capital channel.

4.3 Random Assignment

One important part of the empirical analysis is to contrast similar firms hit by RER shocks inside versus outside the main quarter. In principle, it is possible that Q1-type firms (firms with the main quarter in calendar quarter Q1) are different from Q2-type firms (firms with the main quarter in calendar quarter Q2) in a way that could contaminate the identification strategy. For instance, Q1-type firms are smaller, and shocks could have a different persistence for smaller firms.

However, the assumption that RER shocks are unpredictable and the fact that they occur frequently eliminates differences between firms hit inside their main quarter (treated firms) and firms hit outside their main quarter (control firms). In a sample with quarterly firm data, the characteristics of firms inside versus outside the main quarter should be very similar since all firms alternate between these two sub-samples. If the probability of being hit by an RER shock is the same in each of these two sub-samples, then firms hit by shocks inside versus outside the main quarter (treated versus control firms) should also be very similar. Table 7 confirms the random assignment of treated and control firms by showing that these two sub-samples are very similar across multiple basic firm characteristics.

4.4 Effect of RER shocks on firms' profitability

I show that RER shocks have a significant negative effect on firms' cash flows by estimating the following equation:

$$\Delta CashFlow_{ijt} = \alpha_i + \theta_{jt} + \beta_1 RERshock_{ijt} + \gamma' X_{ijt} + \epsilon_{ijt} \quad (6)$$

$CashFlow_{ijt}$ is the ratio of operating income before depreciation ($oibdpq$) to the lag of total assets, where i is the firm, j is the industry, and t is time. α_i are firm fixed effects, θ_{jt} are industry-quarter fixed effects, $RERshock_{ijt}$ is the RER shock defined in Subsection 3.5 and X_{ijt} is a vector of controls, which includes one-quarter lag of Q, one-quarter lag of $Size$, $\Delta \ln REERI_{it}$, and $importexposure_{ijt-1}$. I also control for $\Delta \ln REERE_{it}$ and its interaction with $exportexposure_{ijt-1}$ (see Section 8). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels.

Table 8 shows that the effect of RER shocks on firms' profitability is economically and statistically significant. I scale the estimated coefficient $RERshock$ by multiplying it by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). After a typical RER shock (depreciation of RER), the cash flows of importing firms decrease significantly by approximately 1.5-2.5%. Intuitively, after an RER depreciation, firms will face higher input prices. This implies higher production costs and, as a result, lower internal funds. Moreover, firms with higher import exposure suffer from a larger decrease in internal funds.

5 Empirical Strategy and Specification

5.1 Empirical Strategy

I follow the empirical approach proposed by Almeida, Carvalho, and Kim (2023) to test the working capital channel described in Section 2. The main idea of this empirical strategy is to contrast how a firm responds over time to an RER shock when this shock hits the firm (say firm i, the treated firm) inside its main quarter with a similar firm's (say firm j, the control firm) response to an RER shock that hits outside of the main quarter. The random assignment of treated and control firms discussed in Subsection 4.3 guarantees that the characteristics of firms inside versus outside the main quarter should be very similar.

It is a two-step process to test the working capital channel. First, I study the firm's im-

mediate response to RER shocks. Then, I examine subsequent responses to RER shocks, that is, the propagation effect. Intuitively, consider firm i and j above, and suppose that an RER shock is initiated in quarter t. The two firms are similar and only differ in terms of the timing of their main quarter. If firm j is outside its main quarter, it will eventually move into its main quarter in a subsequent period (say quarter t+1). Therefore, the effect of the RER shock should be stronger for firm i in quarter t and stronger for firm j in quarter t+1. But suppose I find that firm i also shows a greater response to the shock in quarter t+1, relative to firm j. Such a result must indicate the propagation of the shock over time.

As discussed in Subsection 4.2, firms' higher profitability during the main quarter allows them to borrow more from suppliers in this period, and top supplier firms use more leverage from suppliers during their main quarter. Therefore, firms that rely significantly on supplier financing are potentially more exposed to the working capital channel. One could argue that RER shocks can affect firms' short-term investment and sales due to changes in the conditions faced by firms' competitors, suppliers, and customers. However, these alternative mechanisms should not lead to stronger propagation effects when shocks hit in the main quarter and that are concentrated on firms that strongly rely on credit from suppliers.

5.2 Empirical Specification

Motivated by the data facts discussed in Section 4, for each of the three groups (top, mid, and bottom suppliers), I estimate the following specification:

$$\begin{aligned}\Delta Y_{ijt} = \alpha_i + \theta_{jt} + \beta_1 mquarter_{ijt} + \beta_2 RERshock_{ijt} + \beta_3 mquarter_{ijt} \times RERshock_{ijt} \\ + \gamma' X_{ijt} + \epsilon_{ijt}\end{aligned} \tag{7}$$

Y_{ijt} is the outcome variable for firm i at quarter t, α_i are firm fixed effects, θ_{jt} are industry-quarter fixed effects, $mquarter_{ijt}$ is the main quarter variable defined in Subsection 3.3, $RERshock_{ijt}$ is the RER shock defined in Subsection 3.5, and X_{ijt} is a vector of controls, which includes one-quarter lag of Q, one-quarter lag of $Size$, one-quarter lag of

$Book\ Leverage$, and the interaction of those firm characteristics with $mquarter_{ijt}$. I also include $\Delta \ln REERI_{it}$, $importexposure_{ijt-1}$ and the interaction of those variables with $mquarter_{ijt}$. Finally, ϵ_{ijt} is the error term. Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels.

One potential concern with this specification is that it could be capturing differences across types of firms in their sensitivity to RER shocks, as opposed to differences in how a same type of firm responds at different points of its cycle. I control for this concern by including firm-type fixed effects (see Subsection 4.1) and the interactions between each of these indicators and the RER shock. Those controls guarantee that the empirical specification estimates how a same type of firm responds to an RER shock when the shock happens inside versus outside the main quarter.

I analyze the three outcome variables: $\log Sales$, $\log Inventories$, and $\log STI$. Sales, Inventories, and STI denote firms' quarterly sales, quarterly inventories, and short-term investments, respectively.[11] Consistent with the working capital channel described in Section 2, I expect a positive RER shock to increase production costs (via higher input prices) and reduce the internal funds allocated to short-term investment. This decrease in short-term investment should translate into immediate reductions in firm sales and production capacity. I expect top supplier financing firms to be more exposed to the working capital channel since they leverage more aggressively from suppliers during their main quarter. In other words, I anticipate a significant $\beta_3 < 0$ for the three outcomes for the top supplier group. The effect for the Mid and Bottom supplier groups is expected to be less economically and statistically significant (or even insignificant) because they leverage less aggressively from suppliers during their main quarter than top supplier firms.

6 Main Results

This section uses the main specification described in Subsection 5.2 (Equation (7)) to analyze how firms respond to RER shocks when these shocks are initiated in the main quarter. First, I show the effect of RER shocks on firms' sales and short-term investment.

[11] For details on variables construction, see Subsection 3.1.

Then, I provide evidence that impacts are greater on firms' short-term investments than on their long-term investments.

6.1 Effect of RER shocks: Sales and Short-term Investment

I show the effect of RER shocks separately for firms in each of the terciles of supplier financing. I scale the main coefficient to better capture its magnitude. I multiply the estimated coefficient of $mquarter_{ijt} \times RERshock_{ijt}$ by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Therefore, I interpret the results as capturing the effect of a typical RER shock on importing firms.

Table 9 presents the results for firms' sales. I start by analyzing the effect on top supplier financing firms (column Top). A positive RER shock (RER depreciation) leads to a significantly larger drop in firms' sales when they are hit inside their main quarter. In particular, a typical RER shock immediately reduces a firm's sales by approximately 2.7% more when firms are initially hit in their main quarter. Given the average sales growth of approximately 1%, this effect is economically important and consistent with the working capital channel described in Section 2. Table 9 also presents the results for mid (column Mid) and bottom (column $Bottom$) supplier financing firms. I do not find a statistically significant effect for these groups.

Table 10 presents the results for firms' short-term investments. Consistent with previous analyses for firms' sales, depreciation in the RER reduces a firm's short-term investment, and this effect is amplified if the firm is hit inside its main quarter. For top supplier financing firms, a typical RER shock reduces the short-term investment of firms by approximately 3-6% more when firms are initially hit in their main quarter. The effect on mid supplier financing firms is almost half the magnitude of the effect on top supplier financing firms. A typical RER shock reduces mid supplier financing firms' short-term investment by 1.4-3.8% more when firms are initially hit in their main quarter. The effect is not economically or statistically significant for bottom supplier financing firms.

The above results provide strong empirical evidence of the working capital channel. After a positive RER shock (RER depreciation), if the firm is financially constrained, lower internal funds are allocated to short-term investments. This decrease in short-term

investment translates into immediate reductions in firm sales. This effect is amplified during a firm's main quarter since the share of the investment in inputs that firms can finance on credit from suppliers is higher, and therefore, the drop in short-term investment is larger. This larger investment drop translates to larger decreases in sales and production capacity.

6.2 Effect of RER shocks: Short-term versus Long-term Investment

I show that the effect of RER shocks is stronger for firms' short-term investment relative to their long-term investment using Equation (7). The outcome variables are defined as $\Delta \log STI(t) - \Delta LTI(t)$, and $\Delta \log Inventories(t) - \Delta LTI(t)$, where STI and LTI denote firms' short-term and long-term investments, respectively (see Subsection 3.1).

Table 11 shows the results, which go hand-in-hand with previous analyses for sales and short-term investment. After a positive RER shock, there is an immediate differential effect of 2.6-4% for short-term investment relative to long-term investment (stronger drop in short-term investment) for top supplier financing firms (column Top). The effect on mid supplier financing firms is almost half the magnitude of the effect on top supplier financing firms (column Mid). The effect is not economically or statistically significant for bottom supplier financing firms (column $Bottom$).

As described in Section 2, firms' ability to finance short-term investment should change within its cycle as the firm becomes more profitable. That is, the share of investments in inputs that a firm can finance on credit from suppliers is higher during a firm's main quarter. This is why the effect of RER shocks on a firm's sales and short-term investment is amplified if the firm is hit by the shock inside its most profitable quarter. However, the share of long-term investments financed on credit from suppliers should not be significantly larger during a firm's main quarter since long-term investments are usually financed using long-term financing (Petersen and Rajan, 1997), and long-term debt is paid over future periods.

According to Bernanke, Gertler, and Gilchrist (1999), firms' cash flow drops negatively affect borrowing terms. For instance, if a positive RER shock reduces a borrower's internal funds, lenders might charge higher spreads or impose stricter borrowing limits on new credit. Therefore, a firm's ability to finance short-term investment (inputs) on credit

from suppliers is exposed to changes in refinancing terms for this short-term credit. Of note, firms need to refinance short-term funding every period.

In contrast, firms rely on long-term debt to finance long-term investments on credit, and due to issuance costs, firms do not raise long-term debt in every period that they make long-term investments. Therefore, after drops in a firm's internal funds, short-term investments are more exposed to changes in refinancing terms than long-term investments. As a result, the drop in short-term investment should be larger due to a positive RER shock. This result confirms that when firms are hit by RER shocks inside their most profitable quarter, the effect is stronger for short-term than long-term investment, underscoring the presence and impact of the working capital channel.

7 Dynamics and Propagation Effects

As discussed in Section 5, it is a two-step process to test the working capital channel. First, I study the immediate response of the firm to RER shocks (Subsection 5.2). Then, I examine subsequent responses to RER shocks, that is, the propagation effect. Intuitively, consider firm i and j above, and suppose that an RER shock is initiated in quarter t. The two firms are similar and only differ in terms of the timing of their main quarter. If firm j is outside its main quarter, it will eventually move into its main quarter in a subsequent period (say quarter t+1). Therefore, the effect of the RER shock should be stronger for firm i in quarter t and stronger for firm j in quarter t+1. But suppose I find that firm i also shows a greater response to the shock in quarter t+1, relative to firm j. Such a result must indicate the propagation of the shock over time.

To empirically investigate the propagation effects, I apply the local projection approach pioneered by Jordà (2005) and estimate the following dynamic OLS equations separately for top and bottom supplier firms for each horizon h:

$$\begin{aligned} y_{ij,t+h} - y_{ij,t} = {} & \beta_1^h mquarter_{ijt} + \beta_2^h RERshock_{ijt} + \beta_3^h mquarter_{ijt} \times RERshock_{ijt} \\ & + \alpha_i^h + \theta_{jt}^h + \gamma^h X_{ijt} + \epsilon_{ijt} \end{aligned} \tag{8}$$

where $y_{ij,t}$ are three different outcomes of firm i in industry j: $\log Sales$, $\log STI$, and $\log Inventories$. Sales, Inventories, and STI denote firms' quarterly sales, quarterly inventories, and short-term investments, respectively.[12] α_i^h are firm fixed effects, θ_{jt}^h are industry-quarter fixed effects, $mquarter_{ijt}$ is the main quarter variable defined in Subsection 3.3, $RERshock_{ijt}$ is the RER shock defined in Subsection 3.5, and X_{ijt} is a vector of controls, which includes one-quarter lag of Q, one-quarter lag of $Size$, one-quarter lag of $Book\ Leverage$, and the interaction of those firm characteristics with $mquarter_{ijt}$. I also include $\Delta \ln REERI_{it}$, $importexposure_{ijt-1}$ and the interaction of those variables with $mquarter_{ijt}$, lagged $RERshock_{ijt}$, and firm-type fixed effects (see Subsection 4.1) and the interactions between each of these indicators and the RER shock.

Figure 1 presents estimated Impulse Response Functions (IRFs) for the response of sales to RER shocks that are initiated in the main quarter using Equation (8). I use a confidence interval of 90%. Figure 1 shows that, after five quarters, a typical RER shock significantly reduces the sales of top supplier financing firms by approximately 4% more when firms are initially hit in their main quarter, indicating a strong propagation effect. The effect is not statistically significant for bottom supplier financing firms.

Figures 2 and 3 present estimated Impulse Response Functions (IRFs) for the response of short-term investment to RER shocks that are initiated in the main quarter using Equation (8). I use a confidence interval of 90%. Figures 2 and 3 show that, after five quarters, a typical RER shock significantly reduces the short-term investment of top supplier financing firms by approximately 7-12% more when firms are initially hit in their main quarter, indicating a strong propagation effect. The effect is not statistically significant for bottom supplier financing firms.

8 RER shocks and exporting firms

I test the presence of the working capital channel on exporting firms as follows. First, I closely follow Subsection 3.5 to construct the shock. Firm-level RER shocks are defined

[12] For details on variables construction, see Subsection 3.1.

as

$$RERE shock_{ijt} = \Delta \ln REERE_{it} \times exportexposure_{ijt-1} \tag{9}$$

where $exportexposure_{ijt}$ is defined as in Subsection 3.4 and $REERE_{it} = \Sigma_{c=1}^{M_i} \theta_{ict} \times RER_{ct}$, where θ_{ict} is the share of exports of the firm i from country c during year t, and M_i is the number of countries of destination for the exporter during this period. For instance, if firm A sells 50% of its goods to Canada and 50% to Brazil in year t, then $REERE_{At} = 50\% \times RER_{Canada,t} + 50\% \times RER_{Brazil,t}$. I then estimate the differential effect for top supplier financing firms using the following equation:

$$\begin{aligned} \Delta Y_{ijt} = \alpha_i + \theta_{jt} + \beta_1 mquarter_{ijt} \times RERE shock_{ijt} \times topsupfin_{ijt} + \\ \beta_2 mquarter_{ijt} \times RERE shock_{ijt} + \beta_3 mquarter_{ijt} \times topsupfin_{ijt} + \\ \beta_4 RERE shock_{ijt} \times topsupfin_{ijt} + \beta_5 mquarter_{ijt} + \beta_6 RERE shock_{ijt} + \\ \beta_7 topsupfin_{ijt} + \gamma' X_{ijt} + \epsilon_{ijt} \end{aligned} \tag{10}$$

Y_{ijt} is the outcome variable for firm i at quarter t, α_i are firm fixed effects, θ_{jt} are industry-quarter fixed effects, $mquarter_{ijt}$ is the main quarter variable defined in Subsection 3.3, $RERE shock_{ijt}$ is the shock defined in Equation (9), and X_{ijt} is a vector of controls, which includes $exportexposure_{ijt-1} \times mquarter_{ijt} \times topsupfin_{ijt}$, $\Delta \ln REERE_{it} \times mquarter_{ijt} \times topsupfin_{ijt}$, the interaction of $\Delta \ln REERE_{it}$ with $topsupfin_{ijt}$, and the interaction of $exportexposure_{ijt-1}$ with $topsupfin_{ijt}$. I also include one-quarter lag of Q, one-quarter lag of $Size$, one-quarter lag of $Book\ \ Leverage$, and the interaction of those firm characteristics with $mquarter_{ijt}$, $\Delta \ln REERE_{it}$, $exportexposure_{ijt-1}$ and the interaction of those shock variables with $mquarter_{ijt}$, and firm-type fixed effects (see Subsection 4.1) and the interactions between each of these indicators and the shock.

The main coefficient of interest is β_1, which captures the differential effect of RER shocks initiated in the main quarter for top supplier financing firms. Consistent with the theoretical framework, I anticipate an insignificant coefficient. As Section 2 explains, exporting firms should not be exposed to the working capital channel. For the working capital channel effect to be present, RER shocks must change input prices (production

costs) so that there is an effect on the internal funds allocated to short-term investment. Although RER shocks may affect exporting firms and their cash flows, this comprises a sales shock, which should minimally affect the short-term production of a cash-constrained firm.

Table 12 presents the results for firms' sales. I don't find a differential effect of RER shocks for exporting firms that strongly rely on credit from suppliers when those firms are hit by the shock inside their main quarter. Table 12 also presents the results for firms' short-term investments. Consistent with the previous analysis for firms' sales, depreciation in the RER does not increase firms' short-term investment more when firms are initially hit in their main quarter.

Overall, these results support the working capital channel. A positive RER shock (RER depreciation) does not change the input prices (production costs) of exporting firms, and, as a result, there is no effect on the internal funds allocated to short-term investment. Since there is no change in short-term investment, firm sales should not be affected after the shock.

9 Robustness

This section reports several robustness tests to which I subject my main specification. More specifically, I verify that results are robust to alternative outcome measures and different percentiles of supplier financing distribution.

9.1 Response of long-term investment

I provide evidence that RER shocks might not affect firms' long-term investment differently when they hit firms in their main quarter. Investors have a longer horizon to evaluate the returns when financing long-term assets. As a result, temporary cash flow differences do not significantly affect long-term investment borrowing terms. Intuitively, I do not observe seasonality in long-term investments. Cash flows also matter for those investments, but it is cash flows that happen over a long time period that matter. The fact that cash flow is higher this quarter (a temporary difference) should not affect funding constraints

on capital expenditures.

I use Equation (7) to analyze $\Delta LTI(t)$, where LTI denotes firms' long-term investment. Table 13 summarizes the result. For all groups of firms, RER shocks do not affect firms' long-term investment differently when they hit firms in their main quarter instead of another quarter. Those results strongly support the presence of the working capital channel.

9.2 Response of Payables

In the working capital channel, firms finance a share of their investment in inputs on credit, and changes in this short-term investment should be matched with comparable effects on customers' credit from suppliers (accounts payable). I empirically investigate this fact by estimating Equation (7), but using a firm's payables as the outcome variable, i.e., using $\Delta log(Payables)(t)$.

Table 14 presents the results. I find that a positive RER shock (RER depreciation) leads to a significantly larger drop in the payables of top supplier financing firms when the shock is initiated in their main quarter. A typical RER shock reduces the payables of firms by approximately 1.6% more when firms are initially hit in their main quarter. This effect is consistent with previous short-term investment and sales results and with the working capital channel described in Section 2.

9.3 Top vs. Bottom 50% Supplier Financing firms

I test the presence of the working capital channel using alternative cutoffs for the importance of supplier financing. First, I divide the sample into two groups using *Supplier Financing* (sorted by year): top 50% and bottom 50% supplier financing firms. Then, for each group separately, I estimate the effect of RER shocks on a firm's sales and short-term investment using Equation 7. I analyze three outcome variables: $\log Sales$, $\log STI$, and $\log Inventories$. Sales, STI, and Inventories denote firms' quarterly sales, short-term investments, and quarterly inventories, respectively.

Table 15 shows the results for a firm's sales. For the top 50% supplier financing group, a positive RER shock (RER depreciation) leads to a significantly larger drop in firms'

sales of 2% when they are hit inside their main quarter. This effect is not economically and statistically significant for the bottom 50% supplier financing firms. Table 16 shows the results of a firm's short-term investment. Consistent with previous analysis for firms' sales, a typical RER shock reduces the short-term investment of firms by approximately 2-3.3% more when firms are initially hit in their main quarter. This effect is economically and statistically significant only for the top 50% supplier financing firms.

This exercise confirms that results are robust to alternative cutoffs for the importance of supplier financing. Consistent with the working capital channel described in Section 2, firms in the top supplier financing group (top 33% or top 50%) are more affected when the shock initially hits them inside their main quarter.

10 Conclusion

The corporate finance literature has emphasized how economic shocks and financing constraints impact a firm's investment. However, there is no micro-level empirical evidence on how RER shocks affect sales and short-term investment of firms that face funding constraints that limit working capital financing or the economic channel through which it works in practice for two reasons. First, existing research focuses on the idea that financing problems matter primarily for longer-term investments. Second, it is challenging to find data on each U.S. publicly traded firm's foreign exposure.

In this paper, I use a novel identification strategy that compares how a similar firm responds to shocks differently when they are initiated in their most profitable quarter ("main quarter") to provide novel empirical evidence for a "working capital channel" through which RER shocks affect firms' short-term investment and sales. I use two U.S. firm-level datasets to show that firm-specific RER shocks associated with an RER depreciation reduce the production capacity of importing firms that strongly rely on credit from suppliers to finance working capital, and the effect of the shock is amplified if the firm is hit by the shock inside its main quarter. I also provide evidence that foreign exposure affects the transmission of the RER shock to firms. While the working capital channel is relevant for importing firms, it is not present for exporting firms since those firms are not exposed to changes in input prices and production costs after an RER shock.

My findings indicate that RER shocks propagate through the economy over time in ways that interact with firm characteristics and seasonality in firms' profitability. The effect of the shock is economically significant, heterogeneous across firms, and amplified by financing constraints. The working capital channel highlights the importance of the relationship between exchange rate movements, financing constraints on short-term investment, and firms' production capacity.

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Tables

Table 1: Summary Statistics: Main Sample

This table presents summary statistics for the main sample in my analysis. The sample covers 197,300 firm-quarter observations over the period 2000-2017. For details on variables construction, see Section 3.

	Observations	Mean	Median	Standard Deviation
Log of Sales	197,069	4.17	4.34	2.47
Δ log(Sales) (t)	188,628	0.01	0.005	0.25
Log of Inventories	146,172	3.53	3.68	2.55
Δ log(Inventories) (t)	139,127	0.008	0.006	0.23
Log of Receivables	193,891	3.54	3.56	2.31
Δ log(Receivables) (t)	184,928	0.009	0.001	0.27
Log of Payables	196,893	3.17	2.94	2.19
Payables/Assets	196,853	0.11	0.06	0.21
Payables/Sales	183,964	0.19	0.07	0.66
Inventories/Assets	193,078	0.11	0.06	0.14
Receivables/Assets	193,851	0.14	0.11	0.12
Cash Holdings	197,190	0.19	0.09	0.22
Size	197,260	5.64	5.83	2.62
Age	96,682	13.7	13	6.29
Q	176,637	2.75	1.47	5.34
Cash Flow	195,877	-0.007	0.025	0.14
Book leverage	192,273	0.29	0.18	0.50
CAPX/Assets	188,854	0.01	0.007	0.02
Net PPE/Assets	197,067	0.29	0.20	0.26

Table 2: Summary Statistics: Top Supplier Financing Firms

This table presents summary statistics for top supplier financing firms: firms in the top tercile of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of payables to sales (annualized). For details on variables construction, see Subsection 3.2.

	Observations	Mean	Median	Standard Deviation
Log of Sales	61,316	3.91	3.81	2.64
Δ log(Sales) (t)	58,253	-0.01	0.001	0.30
Log of Inventories	46,415	3.35	3.50	2.88
Δ log(Inventories) (t)	43,705	0.02	0.01	0.28
Log of Receivables	60,167	3.49	3.31	2.51
Δ log(Receivables) (t)	56,937	0.005	0.00	0.28
Log of Payables	61,316	3.66	3.43	2.41
Payables/Assets	61,314	0.18	0.12	0.25
Payables/Sales	61,316	0.47	0.15	1.09
Inventories/Assets	59,863	0.12	0.06	0.15
Receivables/Assets	60,165	0.14	0.11	0.13
Cash Holdings	61,304	0.18	0.08	0.23
Size	61,314	5.56	5.63	2.84
Age	29,049	13.47	12	6.35
Q	55,300	3.00	1.40	5.94
Cash Flow	60,855	-0.03	0.01	0.16
Book leverage	59,957	0.34	0.21	0.59
CAPX/Assets	58,262	0.01	0.007	0.02
Net PPE/Assets	61,244	0.31	0.21	0.28

Table 3: Share of Firms with Main Quarter in Each Quarter

This table reports the distributions of main quarters in different samples of firms: all firms and top supplier financing firms. In each sample, the shares of firms with the main quarter equal to Q1, Q2, Q3, and Q4 are listed.

	All firms	Top Supplier Firms
Main Quarter = Q1	18.4%	20.9%
Main Quarter = Q2	25.8%	24.7%
Main Quarter = Q3	27.6%	27.9%
Main Quarter = Q4	28.2%	26.5%

Table 4: Seasonality in Firm Profitability: Main Quarter Effect

This table documents seasonality on firms' cash flows using Equation (4). The dependent variable is $CashFlow(t)$, the ratio of operating income before depreciation to lagged total assets in quarter t. I report scaled coefficients, where estimated coefficients are divided by the average absolute value of the outcome variable in the sample. Standard errors are heteroskedasticity robust and clustered at the firm level. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$Cashflow(t)$	$Cashflow(t)$
mquarter	0.7671***	0.8033***
	(12.51)	(13.16)
Observations	191,939	191,939
R^2	0.18	0.1832
Industry × Quarter FE	Yes	Yes
Firm type FE	No	Yes

Table 5: Supplier Financing During the Main Quarter: Payables and Short-term Investment

This table documents the presence of leverage seasonality in top supplier financing firms using Equation (5). The dependent variable is $\log AP(t) - \log STI(t)$ (see Subsection 4.2). I include firm-type fixed effects (see Subsection 4.1) and Industry × Quarter × TopSupFin FE, which includes interactions of Industry × Quarter fixed effects with TopSupFin, an indicator that equals one if the firm is in top tercile in terms of Supplier Financing. Standard errors are heteroskedasticity robust and clustered at the firm level. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\log AP(t) - \log STI(t)$	$\log AP(t) - \log STI(t)$
mquarter× topsupfin	0.0203***	0.0178***
	(3.23)	(2.79)
Observations	185,802	178,043
R^2	0.4686	0.5149
Industry×Quarter FE	Yes	No
Firm type FE	Yes	Yes
Industry × Quarter × TopSupFin FE	No	Yes

Table 6: Supplier Financing During the Main Quarter: Payables and Sales

This table documents the presence of leverage seasonality in top supplier financing firms using Equation (5). The dependent variable is $\log AP(t) - \log Sales(t)$ (see Subsection 4.2). I include firm-type fixed effects (see Subsection 4.1) and Industry × Quarter × TopSupFin FE, which includes interactions of Industry × Quarter fixed effects with TopSupFin, an indicator that equals one if the firm is in top tercile in terms of Supplier Financing. Standard errors are heteroskedasticity robust and clustered at the firm level. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\log AP(t) - \log Sales(t)$	$\log AP(t) - \log Sales(t)$
mquarter× topsupfin	0.0219***	0.0304***
	(3.88)	(5.33)
Observations	192,730	184,981
R^2	0.5206	0.5697
Industry×Quarter FE	Yes	No
Firm type FE	Yes	Yes
Industry × Quarter × TopSupFin FE	No	Yes

Table 7: Firms hit by RER shocks inside vs outside of the main quarter

This table reports the distribution of basic firm characteristics for firms hit by RER shocks inside versus outside their main quarter. I include all firm-quarter observations where $|\Delta \ln REERI_{it}|$ is above its median value in the sample. $REERI_{it} = \Sigma_{c=1}^{N_i} \lambda_{ict} \times RER_{ct}$, where λ_{ict} is the share of imports of the firm i from country c during year t, and N_i is the number of countries of origin for the importer during this period (see Subsection 3.5). Firm characteristics are all measured in quarter t-1.

	Inside ($mainquarter = 1$)			**Outside** ($mainquarter = 0$)		
	Mean	Median	STD	Mean	Median	STD
Size (t-1)	5.65	5.84	2.62	5.66	5.85	2.61
Age (t-1)	13.6	13.0	6.30	13.7	13.0	6.25
Q (t-1)	2.73	1.47	5.28	2.72	1.47	5.27
Cash Flow (t-1)	-0.00	0.02	0.14	-0.00	0.03	0.14
Cash Holdings (t-1)	0.18	0.09	0.22	0.19	0.10	0.22
Book Leverage (t-1)	0.29	0.18	0.49	0.28	0.18	0.49
Payables/Assets (t-1)	0.11	0.06	0.20	0.11	0.06	0.20
Receivables/Assets (t-1)	0.14	0.11	0.12	0.14	0.11	0.13
Inventories/Assets (t-1)	0.12	0.06	0.14	0.11	0.06	0.14
Net PPE/Assets (t-1)	0.29	0.20	0.26	0.29	0.20	0.26

Table 8: The effect of RER shocks on Firms' Cash Flows

This table reports evidence that RER shocks have significant and persistent effects on firms' cash flows using Equation (6). The dependent variable is $CashFlow(t)$ (see Subsection 4.4). I scale the estimated coefficient $RERshock$ by multiplying it by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta Cashflow(t)$	$\Delta Cashflow(t)$
RERshock	-0.015*	-0.025**
	(-1.71)	(-2.16)
Observations	82,815	76,790
R^2	0.2611	0.3640
Controls	Yes	Yes
Firm FE	Yes	Yes
Industry × Quarter FE	No	Yes

Table 9: Effect of RER shocks on Sales

This table analyzes the effect of RER shocks on firms' sales using Equation (7). The dependent variable is $\Delta \log Sales(t)$ (see Subsection 5.2). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log Sales(t)$		
	Top	Mid	Bottom
mquarter × RERshock	-0.027***	0.002	0.006
	(-2.79)	(0.33)	(0.94)
Observations	17,339	25,470	23,451
R^2	0.3603	0.4956	0.4565
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry×Quarter FE	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes

Table 10: Effect of RER shocks on Short-term Investment

This table analyzes the effect of RER shocks on firms' short-term investments using Equation (7). The dependent variables are $\Delta \log STI(t)$ and $\Delta \log Inventories(t)$ (see Subsection 5.2). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log STI(t)$			$\Delta \log Inventories(t)$		
	Top	Mid	Bottom	Top	Mid	Bottom
mquarter × RERshock	-0.060*	-0.038	-0.002	-0.033**	-0.014*	-0.005
	(-1.88)	(-1.61)	(-0.27)	(-2.37)	(-1.94)	(-0.94)
Observations	12,755	22,606	16,151	12,858	22,837	16,253
R^2	0.3882	0.4446	0.4395	0.3699	0.4309	0.4288
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry×Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 11: Effect of RER shocks: Short-versus Long-Term Investment

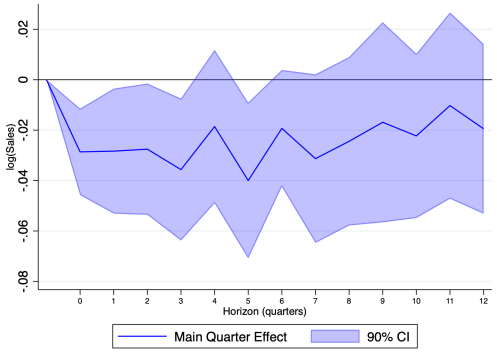
This table shows that the effect of RER shocks is stronger for firms' short-term investment relative to their long-term investment using Equation (7). The dependent variables are $\Delta \log STI(t) - \Delta LTI(t)$ and $\Delta \log Inventories(t) - \Delta LTI(t)$ (see Subsection 5.2). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log STI(t) - \Delta LTI(t)$			$\Delta \log Inventories(t) - \Delta LTI(t)$		
	Top	Mid	Bottom	Top	Mid	Bottom
mquarter × RERshock	-0.04*	-0.02*	0.0002	-0.026**	-0.013*	-0.001
	(-1.69)	(-1.69)	(0.04)	(-2.13)	(-1.87)	(-0.26)
Observations	12,117	21,677	15,539	12,221	21,891	15,638
R^2	0.4159	0.4582	0.4351	0.4119	0.4493	0.4269
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry×Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes	Yes	Yes	Yes

Figure 1: Dynamic Response of Sales to RER Shocks.

This figure shows Impulse Response Functions (IRFs) for the response of sales to a typical RER shock (β_3^h in Equation (8)). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). Panel (A) refers to top supplier financing firms, while Panel (B) refers to bottom supplier financing firms. The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). I use a confidence interval of 90%.

(A) Top Supplier Financing Firms



(B) Bottom Supplier Financing firms

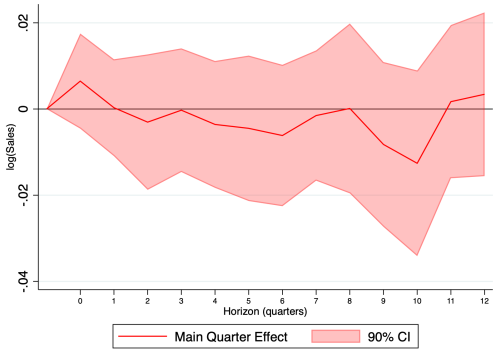
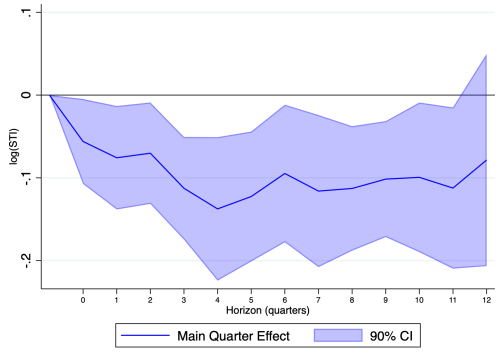


Figure 2: Dynamic Response of Short-term Investment to RER Shocks.

This figure shows Impulse Response Functions (IRFs) for the response of short-term investment to a typical RER shock (β_3^h in Equation (8)). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). Panel (A) refers to top supplier financing firms, while Panel (B) refers to bottom supplier financing firms. The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). I use a confidence interval of 90%.

(A) Top Supplier Financing Firms



(B) Bottom Supplier Financing firms

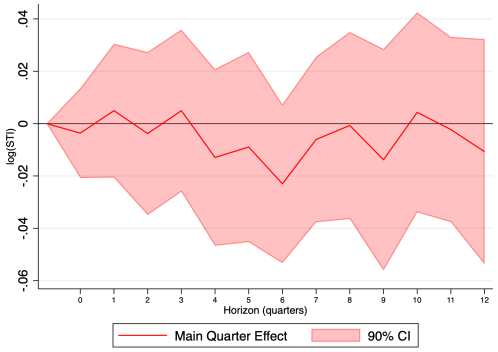
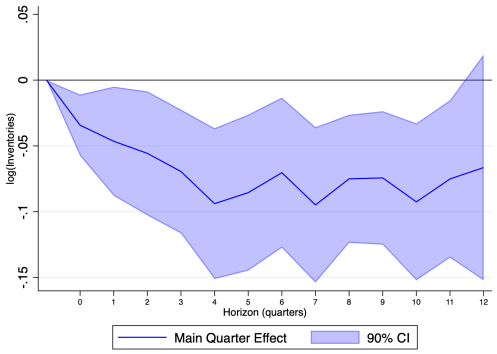


Figure 3: Dynamic Response of Inventories to RER Shocks.

This figure shows Impulse Response Functions (IRFs) for the response of inventories to a typical RER shock (β_3^h in Equation (8)). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). Panel (A) refers to top supplier financing firms, while Panel (B) refers to bottom supplier financing firms. The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). I use a confidence interval of 90%.

(A) Top Supplier Financing Firms



(B) Bottom Supplier Financing firms

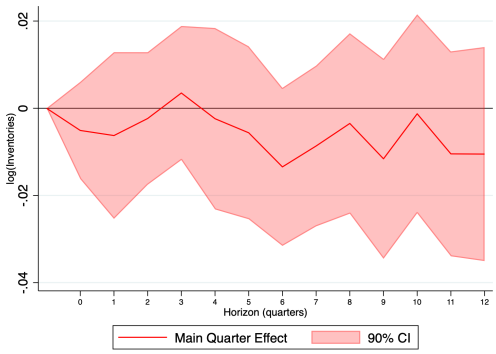


Table 12: Effect of RER shocks on Exporting Firms

This table analyzes the effect of RERE shocks on exporting firms using Equation (10). The dependent variables are $\Delta \log Sales(t)$, $\Delta \log STI(t)$ and $\Delta \log Inventories(t)$ (see Subsection 5.2). I include Industry × Quarter × TopSupFin FE, which includes interactions of Industry × Quarter fixed effects with Topsupfin, an indicator that equals one if the firm is in top tercile in terms of Supplier Financing. Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERE_{it}$ and 0.54 (average export exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log Sales(t)$	$\Delta \log STI(t)$	$\Delta \log Inventories(t)$
RERE shock × mquarter × topsupfin	0.004	-0.006	-0.003
	(0.36)	(-0.28)	(-0.32)
Observations	82,172	62,526	63,020
R^2	0.2950	0.3256	0.3055
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes
Industry × Quarter × Topsupfin FE	Yes	Yes	Yes

Table 13: Effect of RER shocks on Long-term Investment

This table analyzes the effect of RER shocks on firms' long-term investments using Equation (7). The dependent variable is $\Delta LTI(t)$ (see Subsection 5.2). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta LTI(t)$		
	Top	Mid	Bottom
mquarter × RERshock	-0.0003	-0.0003	0.00005
	(-0.88)	(-0.71)	(0.23)
Observations	16,444	24,393	22,552
R^2	0.2410	0.3413	0.3197
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry×Quarter FE	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes

Table 14: Effect of RER shocks on Accounts Payable

This table analyzes the effect of RER shocks on firms' payables using Equation (7). The dependent variable is $\Delta \log Payables(t)$ (see Subsection 5.2). I estimate this specification in three subsamples: the terciles of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log Payables(t)$		
	Top	Mid	Bottom
mquarter × RERshock	-0.016***	-0.003	0.010
	(-2.93)	(-0.35)	(1.10)
Observations	17,341	25,462	23,464
R^2	0.4321	0.5118	0.5161
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry×Quarter FE	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes

Table 15: Effect of RER shocks on Sales: Top vs. Bottom 50% Supplier Financing Firms

This table analyzes the effect of RER shocks on firms' sales using Equation (7). The dependent variable is $\Delta \log Sales(t)$ (see Subsection 5.2). I estimate this specification in two subsamples: the top and bottom 50% of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log Sales(t)$	
	Top 50%	Bottom 50%
mquarter × RERshock	-0.020***	0.009
	(-3.03)	(1.56)
Observations	32,612	39,807
R^2	0.3364	0.4179
Controls	Yes	Yes
Firm FE	Yes	Yes
Industry×Quarter FE	Yes	Yes
Shock × Firm type FE	Yes	Yes

Table 16: Effect of RER shocks on Short-term Investment: Top vs. Bottom 50% Supplier Financing Firms

This table analyzes the effect of RER shocks on firms' short-term investments using Equation (7). The dependent variables are $\Delta \log STI(t)$ and $\Delta \log Inventories(t)$ (see Subsection 5.2). I estimate this specification in two subsamples: the top and bottom 50% of Supplier Financing (sorted by year). Supplier Financing is the one-quarter lag of the ratio of accounts payable to sales (annualized). The reported coefficients are scaled to better capture their magnitude: they are multiplied by the product of the standard deviation of $\Delta \ln REERI_{it}$ and 0.45 (average import exposure in the main sample). Standard errors are heteroskedasticity robust and two-way clustered at the firm and quarter levels. I report the respective t-statistics in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$\Delta \log STI(t)$		$\Delta \log Inventories(t)$	
	Top 50%	Bottom 50%	Top 50%	Bottom 50%
mquarter × RERshock	-0.033**	-0.010	-0.021**	-0.001
	(-2.10)	(-0.68)	(-2.38)	(-0.20)
Observations	26,431	30,566	26,659	30,812
R^2	0.3482	0.3970	0.3195	0.3787
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry×Quarter FE	Yes	Yes	Yes	Yes
Shock × Firm type FE	Yes	Yes	Yes	Yes