How Do Financing Frictions Shape Export Activity? The Firm Balance-Sheet Channel

Heitor Almeida, Daniel Carvalho, and Yongseok Kim*

ABSTRACT

We study how financing frictions amplify and prolong the effect of economic shocks on export activity (e.g., export demand shocks) through a firm balance-sheet channel. In the presence of funding frictions, shocks to export performance can shape firms' ability to finance new export transactions. To analyze the importance of this effect, we estimate how exporters propagate temporary shocks across their export destinations over time. Using transaction-level data on firm exports, we show that temporary exchange rate shocks to some export destinations have strong positive spillovers on firms' subsequent level of exports to other destinations. These effects are not driven by economic links across firms' export markets in different countries, captured using detailed product data, or export entry decisions. These spillovers are persistent and match the detailed predictions of the balance-sheet mechanism we propose. Our results suggest that this mechanism is significant for a broad range of firms and can help explain the volatility of export activity, which is significantly higher than the volatility of output.

* Heitor Almeida is from the University of Illinois at Urbana-Champaign, Daniel Carvalho is from Indiana University, and Yongseok Kim is from Tulane University.

Firms engaging in international trade typically require significant funding to complete their transactions. Exporters not only need to finance their entry into new markets but also need to continuously fund their production in the markets in which they already operate. As exporting firms frequently receive the cash from their export sales with some delay after their production costs are incurred, they rely on internal funds and different external financing arrangements to finance operating costs and deliver the goods, i.e., to finance these working capital requirements. Therefore, financing frictions can directly reduce the level of firms' exports by limiting their ability to fund this activity, an idea supported by a growing body of research.[1]

In this paper, we study how financing frictions amplify and propagate the effect of economic shocks (e.g., demand shocks) on export activity. We propose and test the importance of a new mechanism leading to these effects, the firm balance-sheet channel. The key idea behind this mechanism is that when financing frictions bind, the availability of internal resources (firms' net worth) becomes an essential determinant of how much firms can export (their export capacity). Since a firm's net worth is directly shaped by its recent export activity, shocks to exports can lead to a significant financial multiplier effect. For example, suppose a drop in demand significantly reduces the export activity of a given firm. As the shock reduces the firm's sales, the firm has less internal funds to finance new export transactions. If the firm faces funding constraints, the decrease in internal funds further reduces sales and internal funds, inducing a multiplier effect that amplifies the effect of the initial shock on export capacity. Importantly, while exports represent only a share of firms' total sales, this multiplier also affects the firm's ability to finance its domestic production and to refinance its short-term funding, increasing the economic significance of the firm balance-sheet channel.[2]

We present a theoretical framework that illustrates why this mechanism can be economically important and builds on previous research analyzing the role of firm balance sheets in the amplification of economic shocks (e.g., Bernanke and Gertler (1989), Kiyotaki and Moore (1997),

[1] For example, see Amiti and Weinstein (2011), Manova (2013), Feenstra, Li, and Yu (2014), Paravisini et al. (2015), Bruno and Shin (2023), and the references therein for evidence on the importance of this effect.

[2] The idea that funding frictions in export markets have significant effects on firms' total sales is consistent with previous research (Matray et al. (2024)). Since firms often need to cover production costs prior to collecting cash from domestic sales, funding frictions associated with domestic production can also be important (Almeida, Carvalho, and Kim (2024), Drechsler, Savov, and Schnabl (2024)). At the same time, export transactions can be especially affected by these funding issues because of their increased financing needs and their greater exposure to sectors where these issues are more relevant (e.g., manufacturing and retail, as opposed to services).

Almeida, Carvalho, and Kim (2024)). Guided by our framework, we develop an empirical approach to isolate the importance of this mechanism from other factors that could also shape how firms' exports respond to shocks. We implement our approach using transaction-level data on exports and provide evidence that this financial multiplier can significantly amplify and propagate (over time and across destinations) product-market shocks to export activity.

Our results help explain the volatility of export activity. Across broad periods of time and many countries, export activity is significantly more volatile than GDP (two to four times more volatile than GDP). Figure 1 illustrates this pattern in the context of Brazil (our empirical setting) as well as the U.S., but these patterns are similar for a broad range of countries.[3] Previous research linking this volatility to financial factors has focused on a credit supply channel, where disruptions to the supply of credit (e.g., due to banking crises) reduce export activity. Empirically, the literature has found that export volatility seems to be mostly explained by changes in export demand, as opposed to shifts in credit supply or trade frictions. This finding has been interpreted as implying a limited contribution of finance to export volatility.[4] Our results contrast with this interpretation and suggest that financing frictions can help explain export volatility through a different economic mechanism: a firm balance-sheet channel. Our paper also shows that the firm balance-sheet channel has implications for the persistence of shocks to export activity, the buildup of these shocks over time, and their propagation across different destinations. Finally, our analysis suggests that financing frictions matter for export activity even when firms have significant access to finance.

We start our analysis by outlining this firm balance-sheet effect and its predictions. We consider an exporter that needs to finance its operating costs prior to the collection of cash from sales and is financially constrained. Because of financing frictions, the firm faces limits on its ability to raise external funds and expand its level of exports in the markets in which it operates, i.e., the firm has a limited export capacity. We then consider how these constraints shape the firm's

[3] As in our mechanism, intensive-margin changes in the volume of exports (within a product-destination) significantly contribute to these time-series fluctuations (see Bernard et al. (2009) and Section 5). The fact that export activity is volatile relative to GDP has been documented by previous research, e.g. see Ahn, Amiti, and Weinstein (2011), Alessandria, Kaboski, and Midrigan (2011), Engel and Wang (2011), and the references therein.

[4] For example, see Eaton et al. (2016), Engel and Wang (2011), Bems, Johnson, and Yi (2013), Paravisini et al. (2015), and the references therein for the role of economic shocks such as demand shocks in shaping export volatility. See the text below for the literature debating the role of finance in international trade.

responses to shocks to their product markets, e.g., changes in the demand for their products. As discussed above, the literature has suggested that these product-market shocks are a primary source of export volatility. We illustrate how these shocks can propagate over time through firms' balance sheets. This captures the intuition above: shocks to firm exports today affect the firm's net worth tomorrow (available internal funds), shaping the firm's subsequent export capacity and sales. A central point from our framework is that these propagation effects lead to a firm balance-sheet channel that amplifies and propagates the effect of economic shocks over time and across export markets.[5]

Our framework also illustrates how changes in short-term funding and domestic sales can significantly contribute to the importance of these effects. When funding working capital requirements, firms often rely on short-term funding that needs to be refinanced (see Section 1). After negative (positive) export shocks to their net worth, firms reduced (increased) ability to refinance their short-term funding and fund their domestic production further affects subsequent export capacity. Moreover, this refinancing effect illustrates why the firm balance-sheet channel can remain significant or become stronger as firms have greater access to credit.

Providing empirical evidence for this financial multiplier is challenging for the following reasons. First, to analyze how shocks in period t propagate over time into period $t + k$, one needs to disentangle the propagation effect of the shock at period t from the direct effect of the same shock or other correlated shocks in period $t + k$. One way to estimate such propagation effects is to isolate the effect of temporary shocks. Suppose that two similar firms are hit by economic shocks that only differ during period t (the shocks converge after this period). Then, any gaps in the response of these firms to the shocks after period t must capture the propagation of the initial shocks (during period t) by the firms over time. Second, even if one can isolate the propagation of shocks by firms over time, this propagation can still be driven by different economic mechanisms, e.g., adjustment costs.

We develop an approach to address these issues by estimating how shocks propagate across firms' export markets over time. To isolate a temporary shock to product-market conditions, we

[5] For example, suppose that a drop in export demand leads a direct drop (in the absence of our mechanism) in export sales of 5% over two semesters (that have similar sales). Suppose now that each 1% drop in export sales in the first semester reduces these sales by 0.5% in the second semester (propagation effect). The total effect of the shock in the second semester is now 7.5% = 1.5 × 5%, and the total drop in exports over the year is multiplied by 1.25.

focus on exchange rate shocks. Previous evidence suggests that future changes in exchange rates are hard to forecast. This lack of predictability implies that temporary differences in exchange rates across different destinations should not forecast the subsequent values of these exchange rates (see Section 2). For example, consider two export destinations, with currencies A and B, that both appreciated by 2 percent (relative to the domestic currency) during a semester. While A appreciated by 7% in the first three months and depreciated by 5% in the next three months, B had the opposite pattern (5% depreciation followed by 7% appreciation). Exporters exposed to currency A experienced a more positive exchange-rate shock during the semester than exporters exposed to currency B. However, this temporary difference should not forecast future gaps between the two currencies after the end of the semester. Using transaction-level data on exports, we analyze how differences in exports within the same product × destination × time are shaped by *temporary* shocks to *other* destinations from the same firm (we include product × destination × time fixed effects). This methodology allows us to identify how shocks to certain destinations (in period t) propagate over time into other destinations (after period t).[6]

This analysis of propagation across export destinations also helps us isolate the role of firms' balance sheets from other economic channels that could propagate shocks over time. We build on the point that, in our mechanism, exports in one market affect firms' ability to finance their export transactions in other markets, independently of any economic link between these decisions. We implement this approach using customs data on the universe of Brazilian exporters between 1996 and 2006. An important advantage of this empirical setting is the availability of detailed transaction-level data for a large sample of firms (approximately 50,000) exporting across a broad range of destinations, with information on the month of each transaction. When constructing exchange rate shocks to firms' other markets, we use a weighted average of firms' exchange rates across export destinations. Our setting allows us to build a large dataset of firm-specific exchange rates, which helps isolate the temporary differences in exchange rates described above. As a first step in our analysis, we document that these temporary shocks to firm exchange rates are important and have a significant immediate effect on firms' export sales (in their local currency).

[6] When implementing this analysis, we abstract away from entry effects as we examine only export markets (product × destinations) where firms operate prior to the shocks. This is motivated by the mechanism we analyze.

Using our empirical approach, we estimate that temporary shocks to firms' exports in a set of destinations has a strong positive spillover on their subsequent level of exports to other locations. This finding captures changes in the level of exports by firms within markets (product × destinations), as opposed to entry effects. These results show that exporters significantly propagate shocks to their product markets over time and across destinations. Moreover, the timing of these effects matches the one predicted by our mechanism. One should expect balance-sheet propagation effects to have a delay of at least one quarter or semester (not much longer) as firms need to collect the cash from initial export sales before they finance new transactions.[7] As we analyze temporary shocks that take place over short periods (less than one semester), our mechanism should lead to positive spillovers across export markets only *after* the shocks have ended. The spillover effects we document match this precise timing.

We then provide evidence that these positive spillover effects are not driven by economic links across firms' export decisions in different destinations, a central prediction from our mechanism. To capture such potential links, we use detailed information regarding the specific products firms sell. The idea is that economic connections across firms' decisions in different export markets should be stronger when firms sell closer products in these markets. Intuitively, these connections could capture factors such as the use of common inputs (e.g., same workforce) and technology by firms when selling to different destinations. Recall that we analyze firm export decisions at the product × destination level, which we label as a market. In our results, we examine how temporary shocks to some markets shape firms' subsequent export decisions in markets located at different destinations. In principle, these propagation effects could capture spillovers across markets with close or distant products. We show that our main findings can be estimated using only spillovers across markets with distant products. Crucially, we then show that the positive propagation effects we document become weaker (less positive) when markets have products with greater similarity (economic links are stronger). These findings are robust across a range of measures of product similarity based on product codes from the global harmonized system.

These findings suggest that economic propagation effects do not lead to the specific *positive* spillover effects we document. In principle, economic propagation effects could explain our basic

[7] This delay has been highlighted by previous research and is implied by simple facts on the time associated with the delivery of goods and the payment from importers, which typically pay with delay after the arrival of goods.

results under two conditions. First, firms must make decisions during these temporary shocks that are costly to reverse (once the shock is over). Second, these decisions must lead to positive economic spillover effects across markets after the temporary shock is over. For example, suppose a firm cuts its workforce during a temporary drop in demand in one destination and keeps a reduced workforce after the shock because of adjustment costs. If workers can be used to export across different destinations (economic link across markets), the firm might use less labor and export less across destinations after the shock.[8] Our analysis suggests that these economic spillover effects across markets are negative, limited, or that firms might not make significant adjustments that are costly to reverse during the short-lived economic shocks we study.

Another central prediction from our mechanism is that propagation effects should be stronger when shocks initiate in markets that are initially more important for firms' exports: these shocks lead to stronger changes in firms' balance sheets. The results directly support this prediction. We also refine our evidence in multiple ways to provide additional support for the detailed predictions from the firm balance-sheet channel and further address the concern that economic propagation effects could drive our results. For example, our mechanism can lead to propagation effects that have significant persistence over time. These propagation effects can become stronger or remain stable over time (after the shock) because of the interaction between firms' export sales and balance sheet conditions. In time horizons of two to three years, we find support for this idea and estimate that propagation effects are persistent and do not become weaker over time. It is also challenging for economic propagation mechanisms to explain this pattern. Even if economic decisions made during temporary economic shocks are costly to reverse, it is natural to expect these effects to become less significant over time, especially after multiple periods.

Overall, the analysis suggests that firms' balance sheets are an important mechanism in amplifying and propagating shocks to export markets. Our main contribution is to provide micro-level evidence on the significance of these effects. In terms of economic magnitudes, we estimate that an initial drop in firm exports by 10 percent leads to a subsequent drop in the level of exports between 3-6 percent (due to these balance sheet effects). These estimates imply that a shock to firms' exports can be amplified by 15-30 percent and 25-45 percent during its first year and first

[8] Since these shocks do not affect the economic conditions faced by firms after the shock, alternative mechanisms must capture the fact that some decisions made during the shock are costly to reverse afterwards.

two years, because of this financial multiplier effect. Consistent with our mechanism, we also show that our results remain important among larger firms (within the universe of exporters) and export transactions to neighboring countries (closer to domestic sales). These findings illustrate why this mechanism can have significant aggregate implications and can be relevant for a broad set of firms.[9]

This paper relates to several strands of the literature. Our findings complement previous research debating the role of finance in international trade. Many studies examine how access to finance shape static patterns of trade and comparative advantages across different countries, types of industries, or firm characteristics (e.g., Beck (2002), Manova (2013), Muûls (2015)). The potential role of financial factors in shaping the volatility of trade has received significant attention since the collapse in international trade around the global recession of 2008-2009. While some research has provided evidence that shocks to the supply of credit can help shape fluctuations in export activity (e.g., Amiti and Weinstein (2011), Chor and Manova (2012)), other studies have argued that these fluctuations are mostly explained by economic shocks and shifts in export demand (e.g., Bems, Johnson, and Yi (2013), Paravisini et al. (2015), Eaton et al. (2016)). As discussed above, we contribute to this literature by proposing and analyzing a new role for financial frictions in shaping broad patterns in export volatility. Namely, these frictions can amplify the effect of economic shocks (e.g., export demand shocks) that have been highlighted as key sources of volatility in the volume of international trade.

Our analysis also relates to previous research studying the persistence of temporary shocks to firms' export decisions. One idea analyzed by the literature, both theoretically and empirically, is that sunk costs can lead firms' entry decisions into export markets to become persistent over time (e.g., Baldwin and Krugman (1989), Roberts and Tybout (1997)). Relatedly, Xu (2022) provides evidence that temporary disruptions to the banking sector can have very persistent effects on trade by leading importers to build relationships with different exporters. Our paper adds to these studies by suggesting a new balance sheet mechanism through which temporary economic shocks to the level of exports (intensive margin) can persist for a few years. Our evidence on the financial propagation of shocks to the level of exports across destinations also relates to previous research

[9] This finding is also consistent with previous research. Almeida, Carvalho, and Kim (2024) and Matray et al (2024) provide evidence that these frictions associated with the financing of production are relevant and binding for many publicly listed firms in the U.S.

analyzing how existing export destinations shape export entry decisions in new markets through economic complementarities (Chaney (2014), Morales, Sheu, and Zahler (2019)).

Finally, we contribute to previous research on the real effects of shocks to firms' balance sheets, which typically study firms' long-term investment decisions. The focus on financing frictions that relate to firms' production decisions links our paper to Almeida, Carvalho, and Kim (2024, hereafter ACK). We complement ACK by studying the role of these effects in shaping export activity, where frictions associated with the financing of production can be especially relevant, and by showing that these effects can have multiple implications for international trade. Additionally, we develop and implement a new empirical approach to study how firms' balance sheets propagate temporary shocks to their product markets.[10]

1. Theoretical Framework

We begin by discussing the theoretical framework that we use to motivate our empirical tests. We present the main intuitions here and provide a simple model formalizing them in the Appendix. The starting point for our analysis is the notion that exporters face a delay between the time they pay for production costs and the time they collect the cash from sales. This time gap is driven by multiple factors. The shipment and arrival of goods can take time. The payment for the goods often happens with a delay after their arrival. Additionally, in activities associated with trade (e.g., manufacturing and retail), firms often rely on inventories or take time to complete orders. This leads to short-term investments in production that need to be financed, i.e., the firm needs to finance these working capital requirements. We note that the funding of this short-term investment associated with export sales can come from different sources and reflect a combination of internal and external funds.

We consider a financially constrained firm that would like to expand its level of exports but cannot or finds it expensive to raise the required additional funding. Previous research across a range of empirical settings has supported the idea that these working capital constraints on the level of firm exports are important. We examine how the firm's balance sheet can amplify and

[10] Previous studies on these real effects of balance sheet shocks include Almeida and Campello (2007), Chaney, Sraer, and Thesmar (2012), and Carvalho (2015). These changes in longer-term investment do not have immediate effects on firms' production capacity and do not lead to the multiplier effects here studied. ACK examine effects on firms' total sales and, for methodological reasons, focus on firms' responses to shocks to input prices. As discussed above, the literature argues that shocks to product market conditions are key to understand fluctuations in export activity.

propagate shocks to its product markets (e.g. shifts in export demand). A fundamental point is that the export activity of this firm will be shaped by the availability of internal funds (its net worth).[11] When economic shocks hit the firm's exports, they change the firm's net worth and its ability to fund future export transactions (firm balance sheet effect). A central point from our framework is that these propagation effects lead to a financial multiplier that amplifies and propagates the effect of economic shocks. For example, consider an initial drop in export demand that reduces the firm's exports. This will reduce the firm's subsequent net worth and export capacity, inducing further drops in the firm's exports, net worth, and so on. We label this mechanism amplifying and propagating economic shocks as the firm balance-sheet channel.

Our framework illustrates how different factors can lead this multiplier to become economically important and persistent over time. A first factor is the refinancing of firms' short-term funding. When firms need to cover operating costs prior to the collection of cash from sales, it is natural for them to rely on short-term financing. While data on the funding of export activity is limited, previous research and anecdotal evidence support this idea that firms frequently finance short-term investments with short-term funding (e.g., Petersen and Rajan (1997)).[12] To illustrate the role of refinancing effects, we build on previous work analyzing the implications of financing frictions (Bernanke, Gertler, and Gilchrist (1999)), and further assume that decreases in firms' internal resources adversely affect new borrowing terms. This effect is implied by standard models of lending with frictions as the divergence of interests between lenders and borrowers is greater when borrowers have lower net worth. Gertler and Gilchrist (2018) discuss how this effect is consistent with the data. This leads to the following key point. Negative (positive) shocks to a firms' net worth not only affect their internal funds but also limit (improve) their ability to raise new funding for their operations, increasing the magnitude and persistence of the previous multiplier. These refinancing effects directly shape the firm's ability to fund its exports. A related factor is leverage. Because of fixed operating and financial obligations (e.g., wages and debt

[11] This point only comes from the fact that, since the firm is financially constrained, external funds are more expensive than internal funds or limited. For example, see Amiti and Weinstein (2011), Manova (2013), Feenstra, Li, and Yu (2014), Paravisini et al. (2015), Bruno and Shin (2023), and the references therein for evidence on the importance of such funding constraints on the level of exports.

[12] Antras and Foley (2015) provide an analysis of contracting arrangements used to finance export activity. For example, exporters can rely on cash in advance from importers or letters of credit to finance these transactions. Alternatively, they could also rely on credit from their suppliers or lines of credit. All these short-term funding arrangements are exposed to the risk of default by the exporter and subject to the financing frictions that we highlight.

repayments), shocks to firms' exports can have a levered effect on their net worth, further increasing the previous multiplier. Note that the internal funds available for the firm are determined after these potential fixed obligations have been paid. These effects also illustrate why, as long as funding frictions remain important, the firm balance-sheet channel can become stronger when firms have greater access to credit or can fund a larger share of working capital needs with credit.

Another important consideration is the role of firm's domestic sales. While exports represent only a share of firms' total sales, this multiplier can also spillover into firms' domestic sales.[13] Intuitively, when domestic sales are indirectly affected by these shocks to firms' exports, subsequent changes in firms' net worth and the previous multiplier effect become more significant, i.e., these effects do not become limited to a portion of firms' operations (export activity). A natural reason for these spillover effects is the point that funding frictions associated with domestic production can also be important (Almeida, Carvalho, and Kim (2024), Drechsler, Savov, and Schnabl (2024)). Therefore, changes in firm's net worth can directly affect both export and domestic production decisions. When analyzing this idea, we allow domestic production to require less financing than export transactions. We illustrate that, if funding frictions are still binding for domestic production decisions, the firm balance-sheet channel can become significantly stronger because of spillover effects between exports and domestic production. We also note that, even if this spillover effect from exports into domestic sales is driven by other non-financial effects, this spillover can still contribute to the magnitude of this financial multiplier. The idea that funding frictions in export markets have significant effects on firms' total sales is consistent with our findings below as well as previous research (Matray et al. (2024)).

To guide our empirical analysis, we examine how these propagation effects shape firms' responses to temporary shocks in some of their export destinations. Suppose the exporter described above sells to two foreign destinations (A and B) and faces binding working capital constraints in both markets. For simplicity, production decisions in one market do not shape costs in other markets, i.e., production decisions are separable. This assumption is common in models of firm-level trade with multiple export markets (e.g., Bernard, Redding, and Schott (2011)), and allows us to isolate the role of firms' balance sheets in creating links across markets. We then analyze

[13] We estimate that, on average, exports represent 15-20 percent of the sales from manufacturing exporters in our sample. This fraction is comparable to one estimated in another setting (e.g., Alessandria, Arkolakis, and Ruhl (2021)).

how a temporary shock to demand conditions during period *t* (e.g., semester *t*) in market B shapes the firm's exports to market A over time. The shock is unexpected and only lasts during period *t*.

We first note that that immediate effect of the shock (during period *t*) on the firm's exports to market A should be negative or limited. Given the scarce internal funds available for investments in both markets, the firm has an incentive to reallocate resources across their opportunities in the two markets during the shock. When the return to investing in market B improves (deteriorates), the firm reallocates resources away from (into) market A, leading to a negative spillover effect in market A. Frictions (e.g., adjustment costs) could limit this immediate reallocation of resources during the short-term shock, leading to a muted negative spillover effect.[14]

The central prediction we highlight is that there should be a strong positive spillover effect on the exports to market A from period *t*+1 on (after the temporary shock has ended). The direct effect of the shock on the firm's exports during period *t* leads to a change in the firm's net worth from period *t*+1 on (after the firm has been paid on export transactions from period *t*). This changed net worth then affects the ability of the firm to fund its exports across all markets from period *t*+1 and captures the key ideas described above (balance sheet effect). Temporary increases (decreases) in firms' exports allow the firm to finance significantly more (less) exports in subsequent periods. Crucially, this effect does not depend on the existence of economic links between the two markets and should be stronger when the shock hits more important export markets (i.e., when the share of exports from market B is larger). Shocks to more important markets have stronger effects on firms' balance sheets. Additionally, the previous substitution effect is not present from period *t* +1 on since the shock has ended. Finally, these balance sheet effects can also lead to persistent positive spillovers in the firm's exports to market A, including many periods after the end of the shock.

2. Empirical Strategy

2.1. Basic Approach

We build on the predictions discussed in Section 1 to develop our empirical approach. Using transaction-level data on firm exports, we analyze how differences in exports within the same

[14] An additional possibility is that improved (deteriorated) demand conditions in market B could allow the firm to borrow more (less) during period *t* and invest more (less) in both markets in this period. The net spillover effect would then combine both this positive spillover effect and the negative substitution effect above. These effects in opposite directions should limit the net spillover across the two markets during period *t*.

product × destination × time are shaped by *temporary* shocks to *other* destinations from the same firm. This methodology allows us to identify how shocks to certain destinations (in period t) are propagated over time by firms into other destinations (after period t). Our approach to isolate the firm balance-sheet channel is to examine if temporary shocks to some destinations have strong positive spillovers on firms' subsequent export activity in other destinations that are unrelated to potential economic links across these export markets.

We focus on temporary shocks to isolate their propagation over time. We want to analyze the indirect effect that the shock at period t has during period $t + k$ (propagation effect). The key identification challenge is disentangling this propagation effect of the shock at period t from the direct effect of the same shock or other correlated shocks in period $t + k$. Our approach to address this challenge builds on the following idea. Suppose that two similar firms are hit by economic shocks that only differ during period t (the shocks converge after this period). Then, any gaps in the response of these firms to the shocks after period t must capture the propagation of the initial shocks (during period t) by the firms over time. As explained below, we implement this idea using exchange rate shocks. This allows us to construct product-market shocks to specific destinations that are both temporary and unrelated to firms' characteristics prior to the shock.

Our analysis of propagation effects across destinations (as opposed to within a same destination over time) addresses another important identification challenge. In principle, firms could propagate shocks to export markets over time through alternative mechanisms, e.g., adjustment costs or investment sunk costs. We build on the point that, in our mechanism, exports in one market affect firms' ability to finance their export transactions in other markets, independently of any economic link between these decisions. We first examine if temporary shocks to firms' exports in a set of destinations have strong positive spillover effects on their subsequent level of exports to other locations, and if this effect matches the timing from our mechanism. We then check if these positive spillover effects are unrelated to potential economic links across firms' decisions in different export markets. We capture such potential economic links using detailed information on the products associated with export transactions. The basic idea is that economic links across firms' export decisions in different destinations should be stronger when firms sell closer products (i.e., products with greater similarity) across these markets. Intuitively, these economic links should capture factors such as the use of common inputs or technologies by firms when selling to different

markets. This analysis allows us to examine if economic propagation effects (as opposed to balance-sheet propagation effects) contribute to the spillover effects across export destinations that we estimate.

We further refine our approach to provide additional support for the detailed predictions from the financial multiplier effect we propose and further address the concern that economic propagation effects could drive our results. Another central prediction from our mechanism is that these positive spillover effects should be stronger when shocks initiate in markets that are initially more important for firms' exports. These shocks lead to stronger changes in firms' balance sheets. We also analyze the persistence of these propagation effects.

2.2. Temporary Shocks to Firm-Specific Exchange Rates

We rely on exchange rates to construct temporary shocks to firms' export destinations. The key motivation for this focus is the fact that it is very challenging to predict future changes to exchange rates using past information, a pattern that has been documented by a large body of evidence (e.g., see Rossi (2013) and the references therein). To illustrate the basic idea from our approach, consider the following example. Suppose there are two export destinations with foreign currencies A and B, that both depreciated by 2 percent during a semester (relative to the domestic currency). While A appreciated by 7% in the first three months and depreciated by 5% in the next three months, B had the opposite pattern (5% depreciation followed by 7% appreciation). Exporters exposed to currency A (selling to the destination with this currency) experienced a more positive exchange-rate shock during the semester than exporters exposed to currency B, i.e., during the average month of the semester.[15] However, this temporary difference should not forecast future gaps between the two currencies after the end of the semester. What matters for forecasting future values of the exchange rates is their latest value at the end of the semester.

In our analysis, we consider how differences across firm exports within a same product and destination are shaped by temporary shocks to *other* export destinations from these firms. Going back to the previous example, suppose two firms export a product to the same destination with

[15] For each month in the semester, consider the appreciation of these exchange rates since the start of the semester. The average value of this appreciation will be higher for foreign currency A. While both currencies experienced the same total change during the semester, this temporary difference comes from the timing of the shock across the two currencies.

foreign currency C. At the same time, one of the firms also exports to the country with currency A and the other firm also exports to the destination with currency B. We can analyze how the temporary shock to currency A versus B shapes the subsequent exports of these firms in the same market (with currency C). This will isolate a spillover effect of temporary shocks to certain export destinations.

We implement this idea using firm-specific exchange rates. For each exporter and period, we calculate an initial share of exports for the firm from each destination. We then construct shocks to firm-specific exchange rates as the weighted average of log changes to the exchange rates for each destination. Our analysis focuses on the effect of temporary shocks to these firm-level exchange rates along the lines of the example above. These firm-level shocks capture the overall impact of exchange rates on firms' exports and balance sheets, and this overall effect is what matters in our mechanism. Importantly, recall that we use product × destination × time fixed effects in our analysis. Differences in firm-specific exchange rates within a same product × destination × time must capture shocks to exchange rates in *other* export destinations from the firm. Therefore, our approach estimates how export decisions are shaped by temporary shocks in other destinations while ensuring that we weight these shocks based on their overall importance for firms' exports. Additionally, we refine this approach to construct firm exchange rate shocks originating only from products in other destinations that are close or distant from the product being analyzed.

The key assumption from our approach is that these temporary shocks to firm-specific exchange rates do not forecast future shocks to these exchange rates and are unrelated to initial firm characteristics (before the shocks). This assumption follows from the lack of exchange rate predictability discussed above. Firm initial characteristics should not forecast subsequent shocks to their exchange rates unless there is some link between the characteristics of firms' export destinations and shocks to the exchange rates from these destinations. Importantly, as illustrated above, we rely on the timing of these shocks (not their cumulative value over time), what would further mitigate any potential link driven by exchange rate predictability. Additionally, when implementing this approach, we use continuous shocks to exchange rates which are not related to their volatility (as opposed to discrete shocks capturing tail events).[16] To provide direct support

[16] More formally, the point is that $E(e^c_{t+k} - e^c_t | I_{tc})$ should not be significantly related to country characteristics in the information set I_{tc}, where e_t is the log exchange rate for country c during period t. However, our approach only requires that the timing of these shocks is unrelated to I_{tc} (conditional on the average shock during a period).

for this assumption, we show that the temporary shocks to firm-specific exchange rates used in our analysis are unrelated to important initial firm characteristics in our data (see Section 3.3).

3. Data, Variables, and Initial Evidence

3.1. Data and Sample Construction

The main data source used in the paper is the administrative record of every legally recorded export transaction by Brazilian firms. This transaction-level customs data (*SECEX*) covers the period between 1996 and 2006. This data includes the following information for each export transaction: the value of the transaction, the exporter (unique firm identifier), the month of the transaction, the country of destination, and a product code for the product being exported. The product code includes the 6-digit code from the global Harmonized System (HS). In some analyses, we combine this export data with information on firms and their workforce. This information comes from the labor force record RAIS (*Relação Anual de Informações Sociais*) from the Brazilian labor ministry. For example, this data allows us to measure the total number of workers and the number of high-skilled workers for firms in the data in each month. We also rely on exchange rate data to construct firm-specific exchange rates. Daily exchange rates for different currencies relative to the U.S. dollar are obtained from Datastream and linked to daily exchange rates for the Brazilian real relative to the U.S. dollar from the Brazilian central bank.

The main sample used in our analysis tracks firms' exports at the firm × product × destination × semester level. Our choice of semesters as the period is motivated by the mechanism we propose. Recall that, in this mechanism, shocks to one export destination in period t only have significant positive spillovers in other destinations at period t+1. This gap captures the time that it takes for exporters to collect the cash from initial transactions (with updated prices after the shock) and to complete a new production cycle with updated financial resources (recording new transactions). Previous research and anecdotal evidence suggest that it should take at least one quarter-semester for the positive effects above to become important (and not much longer). For example, this gap includes the time that it takes to deliver the goods and the fact that importers are typically not obliged to pay until 90 days after the goods arrival (e.g., Djankov et al. (2010), Amiti and Weinstein (2011)). Also motivated by our mechanism, we abstract away from entry decisions and focus only on markets (product × destinations) where firms already operate. We start our sample construction by including all observations where there is some export transaction for the firm ×

product × destination in the previous semester. We then restrict this sample to all cases where we can find exchange rate data for the export destination. Finally, since we track firms export responses until semester $t + 2$ in our baseline results and rely on data from semester t -1, this sample covers the period between the second semester of 1996 and the second semester of 2005. This sample includes 2,492,806 observations covering 42,465 firms that export 5,155 products (6-digit HS codes) to 57 destinations.

3.2. Main Variables and Summary Statistics

The primary outcome variables in our analysis measure firms' export growth at the product × destination level, that we label as a market. We measure this growth between semesters t - 1 and $t + k$, where $k \geq 0$. Recall that we abstract away from entry effects and only include observations where the firm has some export activity in the market during semester t -1. We focus on growth measures that incorporate both intensive-margin changes to the level of exports in a market and exit decisions from that market. This is important as we want growth measures that capture the potential effects of firms' balance sheets on these two margins, since they could both be economically relevant. Additionally, estimating the effects of shocks only in the intensive margin is challenging because of selection issues. Firms endogenously decide to operate or not in a market during semester $t + k$ and this decision might be shaped by the shock. Hence, the subset of firms that continue operating in a market at semester $t + k$ should be shaped by the shocks we study. In contrast, our approach ensures that we are tracking all firms initially exposed to the shocks over time.

Our main measure of export growth is $ProdExpGrowth1(t + k)$, the difference in firm × product × destination exports between semesters $t + k$ and t - 1, scaled by the average value of these exports across the two periods. The main advantage of this measure is that it is symmetric for expansions and contractions, and it leads to a bounded growth measure (this growth rate is always between -2 and 2), limiting the influence of growth outliers. For these reasons, this measure has been proposed and used by previous research when combining both intensive- and extensive-margin effects into growth rates (e.g., Davis and Haltiwanger (1992), Alfaro, Bloom, and Lin (2024)). As an alternative approach, we also use a simple growth rate $ProdExpGrowth2(t + k)$, the difference in firm × product × destination exports between semesters $t + k$ and t - 1, scaled by the value of these exports in the initial semester (t - 1). We winsorize this simple growth rate to

limit the potential influence of a few extremely high growth rates (as firms can have small initial values for exports in certain markets).[17] We construct measures of export growth at the firm level in the same way. $FExpGrowth1(t)$ is the difference in firm total exports between semesters *t* and *t* - 1, scaled by the average value of these exports across the two periods. $FExpGrowth2(t)$ is the difference in firm total exports between semesters *t* and *t* - 1, scaled by the value of these exports in the initial semester (*t* -1).

We construct shocks to firm-specific exchange rates following the approach outlined in Section 2.2. For each exporter and semester, we calculate the firm's initial share of exports from each destination using values from semester *t* - 1. Using these shares as weights, we then measure the weighted log changes to exchange rates across the firm's initial destinations. $FERShock\ (t+k)$ implements this approach using log changes in exchange rates for each destination country between semesters *t* – 1 and *t* + *k*, where $k \geq 0$. We first calculate average values for exchange rates in each semester using daily data and then calculate log changes for these values across semesters. We also define $FERShockStart\ (t+1)$ as the shock to firm-specific exchange rates between semesters *t* – 1 and the first month of semester *t* + 1. Here, we follow the same steps as before but use log changes in exchange rates between semester *t* – 1 and the first month of semester *t* + 1. We also construct shocks to firm-specific exchange rates that only incorporate shocks to products that are close or distant to the product being analyzed (see Section 4.4).

Table 1 provides summary statistics. Panel A shows statistics for the main sample used in our analysis. Panel B shows basic firm characteristics available in our data. The unit of observation here is a firm × semester and we include all firm observations in the main sample from Panel A. On average, exporters in our sample have 298 employees, operate 2.85 plants, and export 5.50 products (six-digit HS code) to 4.36 destinations.

3.3. Initial Evidence on Firm-Specific Exchange Rate Shocks

We describe the construction of firm-specific exchange rate shocks used in our analysis and provide evidence that these shocks are not associated with differences in firm initial characteristics. To construct temporary shocks to firm-specific exchange rates during semester t, we rely on

[17] Note that, in this simple growth measure, growth rates are bounded by -1 on the left tail but unbounded on the right tail. In the results presented in the paper, we remove the top five percent of the distribution of *ProdGrowth2*. In the Internet Appendix, we show that our results are robust to a range of alternative approaches.

differences in $FERShock\ (t)$ after controlling for $FERShock\ (t+1)$. This formalizes the idea described in Section 2.2. Conditional on the cumulative change in exchange rates between period t - 1 and t + 1 ($FERShock\ (t+1)$), gaps in $FERShock\ (t)$ across firms capture temporary changes in the exchange rates during semester t. As we implement our analysis, we also consider variations of this baseline specification. For example, we consider specifications with non-linear controls for $FERShock\ (t+1)$ to address potential measurement error issues.

We provide direct evidence that these temporary shocks to firm-specific exchange rates are not related to differences in firms' initial characteristics. In this analysis, we use firm-level data, and the unit of observation is a firm × semester. We estimate linear regressions predicting different initial firm characteristics (measured in semester t – 1) using $FERShock\ (t)$ and controlling for $FERShock\ (t+1)$. Panel C of Table 1 shows the results that focus on characteristics we can measure in our data: total employment, high skilled employment share, number of plants, number of export destinations, and the number of export products. The results show that there is not an economically or statistically significant link between temporary shocks and these firm characteristics. For example, a one-standard-deviation increase in $FERShock\ (t)$ (0.14 from table 1) leads to a difference of approximately 0.1 pp (= 0.14 × 0.009) in the number of products exported by firms. This provides a check on our arguments in Section 2.2 that we should not expect a link between these temporary shocks and initial firm characteristics or fundamentals.

4. Results

4.1. Empirical Specification

We implement the empirical approach described in Sections 2 and 3 by estimating:

$$ProdExpGrowth_{ipdt+k} = \alpha_{pdt} + \beta \times FERShock_{it} + \gamma_0 \times FERShock_{it+1} + \gamma_1{}' X_{ipdt} + \varepsilon_{ipdt}, \quad (1)$$

where $ProdExpGrowth_{ipd}(\,t+k)$ is the export growth of product p by firm i to destination d between semesters t - 1 and t + k, α_{pdt} is a product × destination × semester fixed effect, $FERShock\ (t+k)$ is the firm-specific exchange rate shock between semesters t - 1 and t + k, and X_{ipdt} is a vector with control variables (see Section 3.2 for variable definitions). As discussed in Section 2.2, conditional on these fixed effects, differences in shocks to firm-specific exchange rates must be driven by shocks to other destinations from the exporter. We focus on these firm-

level exchange rates because they capture the overall importance of these shocks for firms' exports and balance sheets. Recall that we construct temporary shocks to firm-specific exchange rates during semester *t* by analyzing differences in $FERShock\ (t)$ while controlling for $FERShock\ (t+1)$ (Section 3.3).

The coefficient of interest is β and captures how firms' export growth in a market (product × destination) during semester $t + k$ responds to temporary shocks to other export destinations during semester *t.* In our baseline results, we do not include additional controls (Model 1). In an alternative specification, we control for a third-degree polynomial function of $FERShock\ (t+1)$ to address a potential concern that $FERShock\ (t)$ might capture a non-linear function of $FERShock\ (t+1)$ (Model 2). We also consider additional functional forms for this control in the Internet Appendix. Importantly, as we estimate equation (1), we weight the observations using the initial shares of exports from the firm in each product × destination (measured in semester t - 1). Note that we analyze firm-level shocks, and this allows us to capture firm-level responses to these shocks. This approach ensures that we are giving the same weight to each firm, independently of their number of products and destinations in our data. At the same time, we can use the granularity of the data (in contrast with firm-level data) to control for shocks to each market and trace the propagation of shocks across different markets within a firm.

4.2. Temporary Shocks to Firm-Specific Exchange Rates

We start by providing evidence that the temporary shocks to firm-specific exchange rates we analyze have economically strong immediate effects on firms' total exports. This is the key building block of our mechanism, where temporary shocks to other destinations during semester *t* matter by affecting firms' total exports in that period. Table 2 shows the results, which are based on the estimation of equation (1) using measures of firms' total export growth in semester *t* as the outcome ($FExpGrowth1(t)$ and $FExpGrowth2(t)$). The results show that temporary shocks to firm exchanges during a semester have immediate effects on firms' total exports during that semester that are both economically and statistically significant. For example, column (1) implies that firms' total exports expand by 6.5 pp (= 0.14 × 0.465) during semester *t* in response to a one-standard-deviation increase in $FERShock(t)$ (0.14 from Table 1). This finding is robust across a range of specifications. Since these results are based on the estimation of equation (1), the same

specification used to estimate our main results, they capture the effect of shocks to other export destinations on firms' total exports.

4.3. Firms' Propagation of Shocks Across Export Markets

We then study how firms propagate temporary exchange-rate shocks across export destinations over time. The results are based on the estimation of equation (1). Table 3 shows the results. We first consider the immediate spillover effects of these shocks into other export destinations (within the same semester). Columns (1) and (2) in both panels show these results. Consistent with our mechanism, we estimate that these immediate spillover effects are negative and have limited importance. Recall that our mechanism predicts that we should not find significant immediate *positive* spillover effects and that these immediate spillover effects should be negative or limited (Section 1). Intuitively, in our mechanism, these positive spillover effects capture the fact that increases in firm exports facilitate the financing of subsequent export transactions and we should not expect this effect to appear in the initial semester of the shock (Section 3.1). Our mechanism predicts that, if present, these positive spillover effects should appear in subsequent semesters (from semester $t + 1$ on).

Motivated by these points, we then estimate the spillover effects of these temporary shocks into other export destinations during semesters $t + 1$ and $t + 2$ (the shocks take place in semester t). Columns (3) to (6) in both panels show the results, which show the presence of economically and statistically positive spillover effects during these two semesters. The economic magnitude of these effects is significant. For example, column (5) of Panel A implies that firms expand their exports in a market by 3.7 pp (= 0.14 × 0.261) during semester $t + 2$ in response to a one-standard-deviation increase in $FERShock(t)$ (0.14 from Table 1) in other destinations. This finding is also robust across a range of specifications. Overall, these results show that temporary shocks to firms' exports in a set of destinations have strong positive spillover on their subsequent level of exports to other locations. These results do not capture entry effects into new markets (product × destinations) and match the timing from our mechanism.

4.4. Firms' Propagation of Shocks Across Export Markets: The Role of Economic Links

We refine our findings to test if the positive spillover effects we document above are unrelated to potential economic links across firms' decisions in different export markets. The motivation for

our analysis is that economic links across exporters' decisions in different destinations might not lead to the specific *positive* spillover effects across export destinations that we document.

In principle, economic links across export destinations could lead to the positive spillover effects predicted by our mechanism under two conditions. First, it must be the case that, during the temporary shocks we study, firms make significant adjustments that are costly to reverse after the shock is gone. Note that these shocks do not affect the economic conditions faced by firms after the shock. Second, the adjustments made during the shocks to some destinations must have positive spillovers on firms' subsequent exports to other destinations (after the shock). For example, suppose a firm expands its workforce during a temporary increase in export demand at one destination. Because of adjustment costs, the firm might keep an increased workforce after the shock. If workers can be used to export to different destinations (economic link across markets), the firm could then use more labor and expand its exports to other destinations after the shock.[18]

In theory, these conditions might not hold, and economic links might not lead to the positive spillover effects we analyze. Instead, these spillovers might be negative or limited. An important point is that, because of funding frictions or adjustment costs, firms might have a limited ability to quickly scale up their overall production during temporary shocks. Therefore, shocks in one market might lead them to significantly reallocate their internal resources across the markets in which they operate. Going back to the example above, the exporter might not be able (or find it costly) to quickly expand its overall workforce during the increase in demand. Instead, the exporter might reallocate its existing workforce to sell more to the destination faced with higher demand and away from other destinations (negative spillover effect). This internal reallocation of resources could have effects that persist after the temporary shock.[19] Another important point is that firms might not make significant adjustments that are costly to reverse during these short-lived shocks.

To analyze the potential role of economic links in our previous results, we use detailed information on the products associated with export transactions. The starting point is the notion that economic links across firms' export decisions in different destinations should be stronger

[18] In this example, the value of increasing production in the market directly affected by the shock returns to its initial level after the shock. Therefore, once the shock is gone, the firm could have incentives to use the additional workforce across all destinations.

[19] The idea that firms respond in this way to shocks in one market is consistent with previous research analyzing the allocation of resources inside the firm across regions or industries (e.g., see Giroud and Mueller (2015)). This literature documents these negative spillovers even in responses to persistent shocks to one market.

when firms sell closer products (i.e., products with greater similarity) across these markets. Intuitively, these links could capture factors such as the use of common inputs (e.g., same workforce) and technology by firms when selling to different destinations. Note that we study firm export decisions at the product × destination level, which we label as a market. Our results analyze how temporary shocks to some markets shape firms' subsequent export decisions in markets located at different destinations. In principle, these propagation effects could capture spillovers across markets with close or distant products. The basic idea of our approach is to check if the positive propagation effects we document become weaker (less positive) or stronger (more positive) when markets have products with greater similarity, i.e., economic links are stronger. If our results become weaker or remain similar when shocks originate in markets that are economically closer, economic connections must lead to spillover effects that are negative or limited (as discussed above).

The data allows us to measure firms' export transactions at the product level using six-digit product codes from the global Harmonized System (HS). This detailed classification system for traded products was developed by the World Customs Organization (WCO), covers more than 5,000 products, and is used to classify most international trade. Using these product codes, we construct three measures of product distance or similarity: two products are defined as close if they belong to the same two-, four-, or six-digit product code. To give a concrete example, two two-digit product codes (61-62) capture most apparel and clothing products (excluding footwear). Within one of these two groups (61), one four-digit code (61.10) includes sweaters, pullovers, sweatshirts, or similar items knitted or crocheted. Different six-digit codes in this subgroup then include sweaters made of wool (6110.11), cashmere (6110.12), or cotton (6110.20). As this example illustrates, our different definitions of close versus distant products capture a range of distances across two products.

As a first strategy to implement this idea, we decompose our variable capturing firm-specific exchange rate shocks. Intuitively, these shocks can initiate in products that are close or distant to the product being analyzed and we decompose firms' overall shocks into two components that capture these possibilities. More formally, note that this variable can be written as $FERShock_{it+k} = \sum_{j \in M_{it-1}} w_{ijt-1} \Delta \log \left(e_{d(j)t+k}\right)$, where M_{it-1} is a set including all markets $j = p \times d$ (product × destinations) that firm i exported to during semester $t-1$, w_{ijt-1} is the initial

share of exports from the firm coming from market j during semester $t-1$, and $\Delta\log\left(e_{d(j)t+k}\right)$ is the log change of the exchange rate from destination $d(j)$ between semesters $t-1$ and $t+k$. This variable can be expressed as the sum of $CloseShock_{ipt+k}$ and $DistantShock_{ipt+k}$, which include all terms in the previous expression from close or distant products, respectively. In other words, we have that $CloseShock_{ipt+k} \equiv \sum_{j\in Close_{ipt-1}} w_{ijt-1}\Delta\log\left(e_{d(j)t+k}\right)$ and $DistantShock_{ipt+k} \equiv \sum_{j\in Distant_{ipt-1}} w_{ijt-1}\Delta\log\left(e_{d(j)t+k}\right)$, where $Close_{ipt-1}$ and $Distant_{ipt-1}$ are the subsets of markets with close or distant products from product p (being analyzed).[20]

Differences across firms in their exchange rate shocks must be driven by one of these two components and we separately estimate their effects using the specification:

$$ProdExpGrowth_{ipdt+k} = \alpha_{pdt} + \beta_1 \times CloseShock_{ipt} + \beta_2 \times DistantShock_{ipt} + \gamma_0 \times CloseShock_{ipt+1} + \gamma_1 \times DistantShock_{ipt+1} + \gamma_2{}'X_{ipdt} + \varepsilon_{ipdt}, \quad (2)$$

where $CloseShock_{ipt+k}$ and $DistantShock_{ipt+k}$ are explained above and all other variables are defined in the same way as equation (1). Recall that, since we include product × destination × time fixed effects, we are estimating the effect of exchange rate shocks on other export destinations from the same firm. Moreover, we are using the controls $CloseShock_{ipt+1}$ and $DistantShock_{ipt+1}$ to ensure that we capture temporary shocks to other destinations. Importantly, we are now isolating the effects of temporary shocks to other export destinations that originate in close or distant products. The two coefficients of interest are β_1 and β_2 and capture these effects.

Panel A of Table 4 reports the results. We find that the previous positive spillover effects across firms' export destinations are important in both cases: when temporary shocks to other destinations originate in close or distant products. The results for distant shocks show that our previous findings become stronger and can be estimated using only spillovers from distant products and associated with weaker economic links. Crucially, we formally analyze the difference between the effects for close versus distant shocks and find that close shocks lead to weaker (less positive) spillover effects. These key findings are robust across the three measures of product distance or similarity that we analyze.

[20] Note that the weights w_{ijt-1} used to calculate close and distant shocks capture the relevance of each market for the firm's overall exports (and balance sheet) and do not necessarily add up to one in the subgroups of close or distant markets. Depending on the importance of the affected markets for the firm, shocks to close or distant products can have different implications for the firm's overall balance sheet and these measures capture this point.

We then consider an alternative strategy to implement our approach, based on the analysis of product-specific shocks to firms. We now construct product-specific exchange rate shocks for each firm, which are analogous to firm-specific exchange rates but focus only on the specific product being analyzed. We define $ProdERShock_{ipt+k} = \sum_{d \in D_{ipt-1}} w_{ipdt-1} \Delta \log (e_{dt+k})$, where D_{ipt-1} is set of destinations that the firm sells product p to during semester $t-1$, w_{ipdt-1} is the share of exports from firm i's product p that comes from destination d during semester $t-1$, and $\Delta \log (e_{dt+k})$ is the log change of the exchange rate for the destination between semesters $t-1$ and $t+k$. We construct these product-specific shocks using the three alternative definitions of products considered in the previous analysis (Panel A of Table 4).

We estimate two sets of results using these product shocks. We first replicate our baseline results in Table 3 controlling for product shocks, i.e., we add $ProdERShock\ (t)$ as a control variable to the previous results. After we include this control, we are estimating our main results using only temporary changes in $FirmERShock\ (t)$ that come from distant products (as opposed to close products). We then estimate the effect of temporary product shocks while controlling for the firm-level shocks used in our main results (the opposite of the previous result), i.e., the effect of $ProdERShock\ (t)$ while controlling for $ProdERShock\ (t+1)$ and $FERShock\ (t)$. Once we condition on the importance of firm-level shocks, stronger (more positive) product shocks must capture instances where firm-level shocks hit products closer to the one being analyzed. Therefore, if economic links lead to the positive spillover effects we document, we should find similar patterns when we analyze product shocks in this specification. On other hand, if economic links lead to negative or limited spillover effects across export destinations, we should estimate limited or negative effects of product shocks in this specification, respectively.

Panels B and C of Table 4 report the results, which confirm our findings in Panel A. Panel B confirms that our results remain qualitatively similar and become quantitively stronger when estimated using only temporary shocks that originate in distant products. Panel C then shows that economic links lead to negative spillover effects across export destinations. As in the case of Panel A, these findings are robust across the different measures of product similarity.

Overall, this analysis suggests that economic links cannot explain our main finding that temporary shocks to some destinations have positive spillover effects on firms' subsequent export activity in other destinations. We note that this conclusion is unlikely to be driven by measurement error in economic

links across export destinations or non-linear effects of these links. This result holds as we consider small and large differences in economic links across export destinations (using different measures of product similarity). Additionally, we capture the importance of economic links across export destinations using detailed product data. Taken together, these findings support the predictions from our mechanism that positive spillover effects we document should be tied to the importance of shocks for firms and not driven by economic links across firms' activities in different export destinations. In the analysis that follows, we further refine this evidence.

4.5. Firm-Level Employment Adjustments During Temporary Shocks

We analyze how firms adjust their overall employment during the temporary shocks to their exchange rates. This analysis further addresses a concern that our results could capture economic propagation effects and is motivated by our discussion in Section 4.4. In principle, firms could expand their overall employment during temporary shocks, and this could potentially contribute to the positive spillovers across export destinations that we document. Alternatively, firms might have a limited ability (or might find it costly) to quickly expand their overall employment during temporary shocks, e.g., because of funding frictions or adjustment costs. Instead, firms might reallocate their workforce across opportunities during these shocks to specific destinations, i.e., use the same workers to sell more to certain destinations. This muted immediate effect of shocks on total employment could help rationalize our findings from Section 4.4 that economic links across export destinations lead to negative spillover effects.

Table 5 shows the results, which are based on a specification analogous to equation (1) at the firm level. We estimate linear regressions linking firm-level employment outcomes to $FERShock(t)$, industry × semester fixed effects, and $FERShock(t+1)$. We measure changes in firm total employment, high skilled employment, and low skilled employment between the last month of semester t - 1 and the last month of semester t. This allows to capture the adjustment to firm employment during a shock in semester t. Columns (1) to (3) show that firms make economically and statistically insignificant adjustments to their total employment during temporary shocks. We contrast these effects with the one for firms' total exports in column (4), which is both economically and statistically significant and an order of magnitude stronger. This analysis helps rationalize the negative spillover effects we estimate in Section 4.4.

4.6. Results Using Longer Time Horizons

We examine our previous results using longer time horizons to analyze the persistence of positive spillover effects across export destinations. Our mechanism predicts that these spillover effects can have significant persistence, including many periods after the end of the shock. This comes from the fact that, in this mechanism, there is a feedback loop between firms' balance sheet conditions and export activity. For example, even after a drop in demand on one export destination is gone, the reduction in firms' export capacity limits the funding available to finance new export transactions and further reduces their export capacity. Moreover, over longer time horizons, these balance sheet effects could also persist due to spillovers on longer-term investments. As positive (negative) shocks to firms' balance sheets increase (limit) their ability to make longer-term investments, this can further expand (reduce) their export capacity. This effect should not be significant in the period immediately after the shock (analyzed in our previous results) but could become important over longer horizons. Relatedly, these effects could persist over longer horizons by shaping exit decisions. As firms stop exporting over multiple periods due to liquidity issues, it can become more difficult for them to start exporting again. We interpret these additional longer-term effects from changes in firms' balances as also part of the mechanism we propose.

This analysis also helps us further address the concern that we might capture economic propagation effects, as opposed to the balance sheet propagation effects in our mechanism. If the spillover effects we document capture adjustment costs, we should expect these effects to become weaker over time after the shock is gone. In contrast, as discussed above, our mechanism can lead to spillover effects that are highly persistent over time.

We estimate the same specifications as in Tables 3 and 4 using alternative outcome variables that capture longer-term responses. We extend our time horizon to include a three-year period after the start of the shock. In other words, we track firms' responses between semesters t and $t + 5$ to a temporary shock during semester t. Building on our previous analysis, we estimate average effects during three periods: immediate effect (semester t), subsequent effect (semesters $t + 1$ to $t + 2$), and longer-term effect (semesters $t + 3$ to $t + 5$). The comparison between the subsequent effect (previously analyzed) and longer-term effect allows us to test the persistence from the spillovers we document. We also show estimates by semester using figures.

Table 6 shows our baseline results (Table 3) using these longer time horizons. The results show that the previous positive spillover effects are highly persistent over time. Across a range of specifications, our estimates remain similar over longer time horizons. Figure 2 further documents this persistence by showing the effects for each semester between t and $t + 5$. Table 7 then considers the role of economic links across export destinations in shaping these longer-term effects. Here, we estimate the results from Table 4 using these longer time horizons. This analysis suggests that economic links across export destinations cannot explain the persistent positive spillover effects across export destinations that we document. Our results can be estimated using only temporary shocks that originate in distant products. Importantly, as in our previous analyses, spillover effects across export destinations become weaker (less positive) when there are stronger economic links across these markets.

These findings support the idea that the positive spillover effects across export destinations that we document are highly persistent over time. Moreover, as in our previous analysis, these persistent positive spillovers are unrelated to economic links across export markets.

4.7. Positive versus Negative Adjustments to Exports

We examine the contribution of export contractions and expansions to our previous findings. In principle, increases in firm export growth to a given destination could be explained by larger export expansions or smaller export contractions. Similarly, decreases in this growth could reflect smaller export expansions or larger export contractions. In our mechanism, export contractions (expansions) should contribute to propagation effects only if firms reducing (expanding) their exports are exposed to binding funding frictions. In principle, our mechanism could be relevant in both cases. Firms expanding their exports might need significant funding to meet their export demand. However, intuitively, these effects might be especially relevant for firms cutting their exports, which are more likely to be exposed to significant liquidity issues. This analysis helps further address concerns about economic propagation effects. One potential reason for economic propagation effects is the presence of investments with sunk costs. Firms might make investments associated with such costs during temporary shocks and this could lead to persistent positive spillovers across export markets after the shocks. If this is the case, we should expect our results to be driven by firms expanding their exports, in contrast with our mechanism. In other words, while investments with sunk costs could potentially rationalize effects that are highly persistent

over time, it is challenging to explain effects that are both highly persistent and mostly driven by firms cutting exports with this alternative mechanism.[21]

To analyze these possibilities, we use the following decomposition: $ProdExpGrowth_{ipt+k} = Positive_PExpGrowth_{ipt+k} + Negative_PExpGrowth_{ipt+k}$. $Positive_PExpGrowth_{ipt+k}$ is a variable that equals $ProdExpGrowth_{ipt+k}$ if $ProdExpGrowth_{ipt+k} \geq 0$ and zero otherwise. Relatedly, $Negative_PExpGrowth_{ipt+k}$ is a variable that equals $ProdExpGrowth_{ipt+k}$ if $ProdExpGrowth_{ipt+k} < 0$ and zero otherwise. We then decompose our results (Tables 3 and 6) into two margins by estimating them with each of these two variables as outcomes. Note that, in each case, the sum of these two margins equals our total original effect.

Table 8 shows the results. We find that positive spillover effects across export destinations are relevant in both cases. At the same time, consistent with our mechanism, we find that the effects are mostly driven by changes in export contractions (negative margin). As discussed above, this supports our mechanism as firms cutting their exports are more likely to be ones facing liquidity issues. This finding also provides additional evidence against the idea that economic propagation effects driven by sunk costs could explain our findings.

4.8. IV Results and Economic Magnitudes

To better analyze the economic magnitudes implied by our previous effects, we now estimate our results using an instrumental-variable (IV) approach. The basic idea of this approach is to use the temporary shocks to firm exchange rates as an instrument for the initial shock to firms' total exports ($FExpGrowth(t)$). This approach builds on the assumption that the previous results are driven by the balance-sheet propagation effects we propose. Note that, under this assumption, the effects of temporary shocks on $ProdExpGrowth(t+k)$ are driven by the initial effect of the shocks on firms' total exports and balance sheets, as captured by $FExpGrowth(t)$. We also highlight that this approach is motivated by our theoretical framework (see Section 1 and the Appendix).

While completely ruling out alternative explanations for our findings is challenging, our previous analyses suggest that our results are driven by these balance-sheet propagation effects.

[21] Note that sunk costs associated with export entry decisions cannot explain our results as we abstract away from entry decisions. These sunk costs here discussed would be associated with firm-level investment decisions.

The main potential identification concern with our analysis is that economic propagation effects, as opposed to balance-sheet propagation effects, could explain our basic findings (Section 2). Our different findings do not support the role of this alternative mechanism in driving our results. The positive spillover effects across export destinations that we document match the precise timing of this mechanism, i.e., these propagation effects become important only after the temporary shocks (Section 4.3). Crucially, these positive spillover effects are not related to the presence of economic links across export destinations, measured using detailed product data, and become stronger when shocks have a greater effect on firms' total exports and their balance sheets (Section 4.4). Additionally, also consistent with our mechanism and in contrast with economic propagation effects, these effects are highly persistent over time and mostly driven by firms cutting their exports (Sections 4.6 and 4.7).

We implement this IV approach by estimating the following specification:

$$ProdExpGrowth_{ipdt+k} = \alpha_{pdt} + \beta \times FExpGrowth_{it} + \gamma' X_{ipdt} + \varepsilon_{ipdt}, \quad (3)$$

where $FExpGrowth_{it}$ is the firm-level export growth of firm i between semesters $t-1$ and t and all other terms are defined in the same way as in equation (1). The coefficient of interest is β and measures an elasticity of exports in semester $t+k$ with respect to firm exports during semester t. We estimate this elasticity using an IV approach where the first stage is given by specifications in Table 2. Specifically, we use $FERShock\ (t)$ as an instrument for $FExpGrowth\ (t)$, while controlling for $FERShock\ (t+1)$ (Model 1) or controlling for a third-degree polynomial function of $FERShock\ (t+1)$ (Model 2). As we implement this approach, we are estimating an elasticity of firm exports in semester $t+k$ with respect to temporary shocks to firms' total exports during semester t. As before, to ensure that we capture firm-level effects, we weight the observations using the initial share of the product × destination for the firm's total exports during semester $t-1$.

Table 9 reports the results. Panel A shows the estimated elasticities for the two semesters after the shock (t + 1 and t + 2) and match our results in Table 3. Panel B then considers a longer-term horizon that matches our analysis in Table 6 and presents elasticities for the subsequent effect (semesters t + 1 to t + 2) and the longer-term effect (semesters t + 3 to t + 5). Across a range of specifications, we estimate elasticities that are mostly between 0.3 and 0.6. For example, the result in column (1) of Panel A implies that firms expand their exports by 3.5 percent (in existing markets) during semester t + 1 in response to a temporary increase of 10 percent in their exports during semester *t.* The results show that

the estimated elasticities have comparable magnitudes across a range of specifications and do not become weaker over longer time horizons up to two-three years after the temporary shock. We also highlight that this range of estimated values for these elasticities is consistent with the predictions from our theoretical framework (see the Appendix).

We can build on these estimated elasticities to quantify the implied economic importance of the financial multiplier effect we analyze. Suppose that a drop in export demand leads to a direct drop (in the absence of our mechanism) in export sales of 5% over two years (that have similar sales). Suppose now that each 1% drop in export sales in the first semester reduces these sales by 0.5% in the subsequent semesters (propagation effect as in our analysis). The total effect of the shock in the subsequent semesters (from the second semester on) is now 7.5% = 1.5 × 5%. Therefore, the total drop in exports over the first year is multiplied by 1.25 (= 1 + 0.5 ×0.5). Similarly, the overall drop in exports over the two years is multiplied by 1.38 (= 1 + 0.5 ×0.75). Based on the estimated elasticities in the 0.3-0.6 range, this exercise implies that a shock to firms' exports can be amplified by 15-30 percent and 25-45 percent during its first year and the first two years, because of the firm balance-sheet channel. This quantification exercise implies that the financial multiplier effect we analyze is economically important and can significantly contribute to the volatility of export activity.

4.9. Additional Evidence

We provide additional sources of evidence that represent important additional checks on our findings. First, in the Internet Appendix, we show that our results remain significant and similar across smaller and larger firms. This addresses a potential concern that our mechanism might not matter for aggregate export volatility as it could be concentrated among small firms. Importantly, this finding is consistent both with our theoretical framework and previous research. In our framework, as long as funding frictions are still binding, our mechanism can remain similar and become even stronger among larger firms. If larger firms have greater access to credit, this can lead them to respond more aggressively to shocks to their balance sheets and become more exposed to these shocks due to higher leverage. The idea that these funding frictions can still be binding for larger firms in our data is consistent with previous research suggesting the importance of such frictions for many listed firms in the U.S. (Almeida, Carvalho, and Kim (2024), Matray et al.

(2024)). Recall that our analysis covers all exporters in Brazil, and only a small portion of these exporters are listed firms.

Second, also in the Internet Appendix, we show that our main findings remain economically and statistically important when estimated using only exports to neighboring countries, that capture a significant portion of transactions in our data. Since these transactions are closer to domestic sales, this result supports an important element of the mechanism we propose. Recall that our mechanism can have a significantly stronger economic magnitude if it leads to effects on firms' domestic sales (Section 1).

We also show that our main findings remain similar when estimated using a broader product definition. In this analysis, we construct our firm × product × destination × semester data using four-digit harmonized product codes (as opposed to the full six-digit product codes). We implement all the other steps in our analysis in the same way with this alternative product definition. Table 10 reports the results, which remain qualitatively and quantitatively similar with this alternative broader product definition.

5. Broad Implications

We discuss in greater detail the broad implications from our findings. One main implication is that our results can help explain the volatility of export activity. Across broad periods of time and many countries, export activity is significantly (two to four times) more volatile than GDP. We show this pattern for the cases of Brazil and the U.S. in Figure 1, but this pattern is similar for a broader range of countries, as we illustrate in the Internet Appendix.[22] We highlight two points about this volatility that connects it to our analysis. First, a significant portion of these fluctuations in the volume of export activity over a few years is driven by intensive-margin changes in the level of exports (as opposed to entry into new export markets). For example, this point is documented in the context of the U.S. by Bernard et al. (2009), who argue that this is natural given the small size of new entrants relative to incumbents. In the Internet Appendix, we document this point in the context of Brazil and discuss evidence from other settings. Recall that our mechanism focuses on these fluctuations in the volume of exports by firms that already entered export markets. Second, the literature has argued that shocks to export demand conditions are a key driver of this

[22] This empirical fact has been documented by previous research, e.g. see Ahn, Amiti, and Weinstein (2011), Alessandria, Kaboski, and Midrigan (2011), Engel and Wang (2011), and the references therein.

volatility in export activity and the gap between the volatility of exports and output.[23] This literature highlights that the asymmetric volatility of trade comes from shifts in the composition of expenditures. For example, trade might disproportionally drop in a global recession because of large declines in spending on durable goods (associated with trade). We take this importance of shocks to export demand conditions as given when considering the implications of our mechanism for export volatility. Our focus on firm-specific and temporary shocks to exchange rates is intended to capture such shifts in the export demand conditions faced by individual firms. More broadly, aggregate, persistent changes in exchange rates could have other effects on exporters. For example, firms can have debt denominated in a foreign currency. Our goal is not to analyze the overall implications of exchange rates for exporters.[24]

Our analysis suggests how funding frictions can significantly amplify the effect of these shocks to demand conditions on export activity. This amplification should further increase the asymmetry between the volatility of export activity and output due to their different exposure to economic shocks.[25] Our quantification analysis in Section 4.8 suggests that this amplification of the volatility of export activity can be economically significant. While our empirical results focus on temporary shocks for identification purposes, this quantification analysis considers a broad range of shocks, motivated by our theoretical framework. Moreover, our finding in Section 4.9 that these effects matter for a broad range of firms (including large firms) also suggests that this amplification can be important for aggregate export activity. These findings illustrate how funding frictions can play an important role in shaping export volatility in the absence of shocks of the supply of credit and outside of periods with disruptions in this supply.

Another fact suggested by Figure 1, and present for other countries (see the Internet Appendix), is that fluctuations in export activity frequently build up over time. A typical expansion (contraction) in exports is associated with a sequence of expansions (contractions) over multiple

[23] For example, see Eaton et al. (2011), Engel and Wang (2011), Bems, Johnson, and Yi (2013), Paravisini et al. (2015).

[24] In our setting, this type of foreign currency debt is typically tied to the U.S. dollar and should not be affected by differences in firm-specific exchange rates within the same period (the dollar exchange rate is fixed within a period). Moreover, firms' exposure to such debt should not predict these exchange rate shocks. For example, see Kohn, Leibovici, and Szkup (2020) for an analysis of the overall implications of exchange rates for exporters.

[25] Export transactions could also be especially affected by funding frictions because of their increased financing needs and their greater exposure to sectors where these issues are more relevant (e.g., manufacturing and retail, as opposed to services). This is another reason why our mechanism could increase this volatility gap.

years. Our mechanism can also help rationalize why exporters' responses to export demand shocks (or related economic shocks) would build up over time. As economic shocks (directly) affect firms' export performance over multiple periods, the propagation effects that we study should become more important. For example, suppose there is an increase in export demand that expands firm exports by 5 percent each semester during a two-year period, from semester t to $t + 3$ (direct effect without our mechanism). Our empirical analysis analyzes the propagation of the shock from semester t to subsequent periods. Suppose that this propagation effect leads to an additional increase of 2 percent in exports between semesters $t + 1$ and $t + 3$. This effect does not incorporate the fact that the direct 5 percent shock to period $t + 1$ should also be propagated over time. Therefore, there is only one propagation effect in semester $t + 1$ (from semester t), but there are two propagation effects in semester $t + 2$ (from semesters t and $t + 1$). While it is unclear how these different propagation effects should be aggregated, the point is that these effects build up over time. Our theoretical framework illustrates how the effects we document can lead to this pattern.[26]

Our findings also have implications for the persistence of export performance. In the Internet Appendix, we document that, in our setting, there are persistent differences in firms' export performance conditional on entry into a specific market (product × destination). Our analysis suggests a mechanism that can contribute to this persistence of the level of exports and lead short-term conditions in export markets to have longer-term effects (over time horizons of two-three years). We note that this balance-sheet mechanism for the persistence of export performance is different from the idea analyzed in the literature that sunk costs can lead firms' entry decisions into export markets to become persistent over time (e.g., Baldwin and Krugman (1989), Roberts and Tybout (1997)). Relatedly, our findings suggest why policies providing existing exporters with temporary access to liquidity could potentially have longer-term effects on export activity.

6. Conclusion

In this paper, we study how funding frictions amplify and prolong the effect of economic shocks on export activity (e.g., export demand shocks) through a firm balance-sheet channel. We present a theoretical framework to illustrate the potential importance of this effect and guide our empirical analysis. The key idea of this channel is that, when funding frictions are important,

[26] In this analysis, we are taking the shocks to export demand conditions as exogenous. Export expansions (contractions) are eventually reversed because of negative (positive) subsequent exogenous shocks.

shocks to firms' export performance should affect their subsequent balance-sheet conditions and ability to fund new export transactions. We develop an empirical approach to study this mechanism by analyzing how firms propagate temporary shocks across their export destinations over time. Using transaction-level data on exports, we estimate how differences in export activity within a same product × destination × period are shaped by temporary shocks to firms' other export destinations (constructed using exchange rates). We estimate that shocks to firms' export destinations have a significant positive spillover on their subsequent export activity to other destinations, and the timing of this effect matches the one predicted by our mechanism. This effect cannot be explained by economic links across firms' export destinations, captured using detailed product data, and matches the detailed predictions from the firm balance-sheet effects we propose.

Overall, our analysis suggests that firms' balance sheets are an important mechanism in amplifying and propagating shocks to export markets. In terms of economic magnitudes, we estimate that an initial drop in firm exports by 10 percent leads to a subsequent drop in the level of exports between 3-6 percent (through the firm balance-sheet channel). Our results imply that a shock to firms' exports can be amplified by 15-30 percent and 25-45 percent during its first year and first two years, because of this mechanism. Consistent with the predictions from our framework, we find that these effects are important for a broad range of firms, including large firms in our sample covering all exporters in Brazil.

These findings help explain the volatility of export activity. Across broad periods of time and many countries, export activity is significantly more volatile than GDP (two to four times more volatile than GDP). Previous research has argued that shocks to export demand conditions are a key driver of this volatility in export activity and the gap between the volatility of exports and output. Our analysis shows how funding frictions can amplify the asymmetry between the volatility of export activity and output due to this different exposure to economic shocks. These findings illustrate how funding frictions can play an important role in shaping export volatility in the absence of shocks to the supply of credit and outside of periods with disruptions in this supply. The firm balance-sheet channel also has implications for the persistence of shocks to export activity, the buildup of these shocks over time, and their propagation across different destinations. Analyzing in greater detail some of these aggregate implications of our micro-level evidence is an interesting area for future research. Another interesting direction for research is studying in greater

detail the implications of these effects for policies designed to support the financing of export activity (which are frequently implemented in many countries).

References

Ahn, JaeBin, Mary Amiti, and David E. Weinstein. 2011. "Trade Finance and the Great Trade Collapse." *American Economic Review: Papers & Proceedings* 101 (3): 298-302.

Alessandria, George, Costas Arkolakis, and Kim J. Ruhl. 2021. "Firm Dynamics and Trade." *Annual Review of Economics* 13 (1): 1-28.

Alessandria, George, Joseph P. Kaboski, and Virgiliu Midrigan. 2011. "US Trade and Inventory Dynamics." *American Economic Review: Papers & Proceeding* 101 (3): 303-307.

Alfaro, Ivan, Nicholas Bloom, and Xiaoji Lin. 2024. "The Finance Uncertainty Multiplier." *Journal of Political Economy* 132 (2): 577-615.

Almeida, Heitor, and Murillo Campello. 2007. "Financial Constraints, Asset Tangibility, and Corporate Investment." *Review of Financial Studies* 20 (5): 1429-1460.

Almeida, Heitor, Daniel Carvalho, and Taehyun Kim. 2024. "The Working Capital Credit Multiplier." *Journal of Finance* Forthcoming.

Amiti, Mary, and David E. Weinstein. 2011. "Exports and Financial Shocks." *Quarterly Journal of Economics* 126 (4): 1841-1877.

Antras, Pol, and Fritz C. Foley. 2015. "Poultry in Motion: A Study of International Trade Finance Practices." *Journal of Political Economy* 123 (4): 853-901.

Baldwin, Richard, and Paul Krugman. 1989. "Persistent Trade Effects of Large Exchange Rate Shocks." *Quarterly Journal of Economics* 104 (4): 635-654.

Beck, Thorsten. 2002. "Financial Development and International Trade: Is There a Link?" *Journal of International Economic* 57 (1): 107-131.

Bems, Rudolfs, Robert C. Johnson, and Kei-Mu Yi. 2013. "The Great Trade Collapse." *Annual Review of Economics* 5 (1): 375-400.

Bernanke, Ben, and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review* 79 (1): 14-31.

Bernanke, Ben, Mark Gertler, and Simon Gilchrist. 1999. "Chapter 21 The Financial Accelerator in a Quantitative Business Cycle Framework." *Handbook of Macroeconomics* 1: 1341-1393.

Bernard, Andrew B., Bradford Jensen, Stephen J. Redding, and Peter K. Schott. 2009. "The Margins of US Trade." *American Economic Review: Papers & Proceedings* 99 (2): 487-493.

Bernard, Andrew B., Stephen J. Redding, and Peter K. Schott. 2011. "Multiproduct Firms and Trade Liberalization." *Quarterly Journal of Economics* 126 (3): 1271-1318.

Bruno, Valentina, and Hyun Song Shin. 2023. "Dollar and Exports." *Review of Financial Studies* 36 (8): 2963-2996.

Carvalho, Daniel. 2015. "Financing Constraints and the Amplification of Aggregate Downturns." *Review of Financial Studies* 28 (9): 2463-2501.

Chaney, Thomas. 2014. "The Network Structure of International Trade." *American Economic Review* 104 (11): 3600-3634.

Chaney, Thomas, David Sraer, and David Thesmar. 2012. "The Collateral Channel: How Real Estate Shocks Affect Corporate Investment." *American Economic Review* 102 (6): 2381-2409.

Chor, David, and Kalina Manova. 2012. "Off the Cliff and Back? Credit Conditions and International Trade During the Global Financial Crisis." *Journal of International Economics* 87 (1): 117-133.

Davis, Steven J., and John Haltiwanger. 1992. "Gross Job Creation, Gross Job Destruction, and Employment Reallocation." *Quarterly Journal of Economics* 107 (3): 819-863.

Djankov, Simeon, Caroline Freund, and Cong S. Pham. 2010. "Trading on Time." *Review of Economics and Statistics* 92 (1): 166-173.

Drechsler, Itamar, Alexi Savov, and Philipp Schnabl. 2024. "Credit Crunches and the Great Stagflation." Working Paper, New York University.

Eaton, Jonathan, Samuel Kortum, Brent Neiman, and John Romalis. 2016. "Trade and the Global Recession." *American Economic Review* 106 (11): 3401-3438.

Engel, Charles, and Jian Wang. 2011. "International Trade in Durable Goods: Understanding Volatility, Cyclicality, and Elasticities." *Journal of International Economics* 83 (1): 37-52.

Feenstra, Robert C., Zhiyuan Li, and Miaojie Yu. 2014. "Exports and Credit Constraints under Incomplete Information: Theory and Evidence from China." *Review of Economics and Statistics* 96 (4): 729-744.

Gertler, Mark, and Simon Gilchrist. 2018. "What Happened: Financial Factors in the Great Recession." *Journal of Economic Perspectives* 32 (3): 3-30.

Giroud, Xavier, and Holger, M. Mueller. 2015. "Capital and Labor Reallocation within Firms." *Journal of Finance* 70 (4): 1767-1804.

Kiyotaki, Nobuhiro, and John Moore. 1997. "Credit Cycles." *Journal of Political Economy* 105 (2): 211-248.

Kohn, David, Fernando Leibovici, and Michal Szkup. 2020. "Financial Frictions and Export Dynamics in Large Devaluations." *Journal of International Economics* 122: 1-13.

Manova, Kalina. 2013. "Credit Constraints, Heterogeneous Firms, and International Trade." *Review of Economic Studies* 80 (2): 711-744.

Matray, Adrien, Karsten Müller, Chenzi Xu, and Poorya Kabir. 2024. "Exim's Exit: The Real Effects of Trade Financing by Export Credit Agencies." NBER Working Paper No. 32019.

Morales, Eduardo, Gloria Sheu, and Andrés Zahler. 2019. "Extended Gravity." *Review of Economic Studies* 86 (6): 2668-2712.

Muûls, Mirabelle. 2015. "Exporters, Importers and Credit Constraints." *Journal of International Economics* 95 (2): 333-343.

Paravisini, Daniel, Veronica Rappoport, Philipp Schnabl, and Daniel Wolfenzon. 2015. "Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data." *Review of Economic Studies* 82 (1): 333-359.

Petersen, Mitchell A., and Raghuram G. Rajan. 1997. "Trade Credit: Theories and Evidence." *Review of Financial Studies* 10 (3): 661-691.

Roberts, Mark J., and James R. Tybout. 1997. "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs." *American Economic Review* 87 (4): 545-564.

Rossi, Barbara. 2013. "Exchange Rate Predictability." *Journal of Economic Literature* 51 (4): 1063-1119.

Xu, Chenzi. 2022. "Reshaping Global Trade: The Immediate and Long-Run Effects of Bank Failures." *Quarterly Journal of Economics* 137 (4): 2107-2161.

Appendix: Model of the Firm Balance-Sheet Channel

We provide a simple model of the firm balance-sheet channel which formalizes the intuitions discussed in the text. We first consider a firm that sells to one foreign and a domestic market and then extend our analysis to the case where the firm sells to multiple foreign markets.

Model Set Up

The model is a partial equilibrium model where some inputs are fixed (e.g., capital) and a firm that already entered the export market makes choices of variable inputs. As motivated in Section 1, the firm covers operating costs prior to the collection of cash from sales and need working capital financing to fund this gap. We consider a firm that produces two different products: one sold in the domestic market (H), and the other exported to the foreign market (F). At the beginning of each period t, the firm purchases the inputs m_t^H and m_t^F for its production in the domestic and foreign markets, respectively. The net revenue (after other costs) from each product is given by: $y_t^H = A^H(\varphi_t)(m_t^H)^\theta$ and $y_t^F = A^F(\varphi_t)(m_t^F)^\theta$, where y_t^H (y_t^F) is the revenue in the domestic (foreign) market, and φ_t is a parameter capturing economic conditions. The firm only collects the cash from its sales at the end of the period and needs to finance upfront these costs in both markets. We relax below this assumption of symmetry on the funding requirements across the two markets. We model the firm's production decisions across the markets as separable to isolate the role of

firms' balance sheets in creating links across markets. This assumption is common in models of firm-level trade with multiple export markets (e.g., Bernard, Redding, and Schott (2011)). The firm relies on short-term funding from banks, suppliers, or other sources to cover its financing need. In each period t, the firm can borrow l_t, promising to repay $b_t = Rl_t$ at the end of the period with an interest rate of R (exogenously fixed).

Firms maximize their value. In each period *t*, the firm starts with net worth w_t, decides how much to borrow l_t and invest (m_t^H, m_t^F), and collects the cash from sales at the end of the period. We follow Kiyotaki and Moore (1997, hereafter KM) in assuming that, at the end of each period, the firm must pay out at least a share γ of the income generated during that period. This assumption avoids a scenario in which firms save in perpetuity and never pays dividends.

We examine a constrained firm that would like to expand its short-term investment in both markets (foreign and domestic) using additional financing but faces frictions. Specifically, the firm faces a borrowing limit given by $b_t \leq \overline{b_t} = \alpha(m_t^H + m_t^F)$, where $0 < \alpha < 1$. As firms expand their investment in inputs, they generate more assets and cash flows to repay their lenders, allowing them to credibly repay and borrow more. Intuitively, this captures the idea that the firm can finance on credit a share of its inputs (as in models of financial multiplier effects such as KM). We normalize the (fixed) price of both inputs as one. The firm faces the following binding budget constraint (BC): $m_t = w_t + \frac{\alpha}{R} m_t$, where $m_t \equiv m_t^H + m_t^F$ is the total short-term investment made by the firm, and $w_t + \frac{\alpha}{R} m_t$ is the value of the total funds available (internal and borrowed) to finance this investment.

The net worth in period t shapes its short-term investment and production in this same period. This is captured by (BC), which can be written as $m_t = \left(\frac{1}{1-\alpha/R}\right) w_t$. Importantly, the product-market conditions faced by firms at time t also shape their investment and sales at period $t+1$ through changes in firms' net worth. The firm's net worth at period $t+1$ is given by condition (NW): $w_{t+1} = (1-\gamma)(y_t - b_t)$, where $y_t \equiv y_t^H + y_t^F$ is the total net revenue of the firm. This leads to an amplification and propagation of shocks to product-market conditions over time. An increase in y_t^H or y_t^F leads to a higher value for w_{t+1}, which then translates into increases in (m_{t+1}^H, m_{t+1}^F), (y_{t+1}^H, y_{t+1}^F), and so on.

In each period, the firm allocates its scarce internal resources across the two investments (m_t^H, m_t^F) and this determines its sales in each market (domestic and foreign). There is no dynamic trade-off in the model, and the firm's problem is to maximize y_t by choosing (m_t^H, m_t^F) subject to (BC). Note that, conditional on (BC), we have that $b_t = \overline{b_t}$ is fixed, and maximizing y_t is equivalent to maximizing dividends $d_t = \gamma\,(y_t - b_t)$. From the first-order conditions of the firm's problem and (BC), we can derive the optimal decisions: $m_t^H = \lambda \left(\frac{1}{1-\alpha/R}\right) w_t$ and $m_t^F = (1-\lambda)\left(\frac{1}{1-\alpha/R}\right) w_t$, where $\lambda = \frac{\widetilde{A_t^H}}{\widetilde{A_t^H} + \widetilde{A_t^F}}$ and $\widetilde{A_t^i} = \left(A_t^i\right)^{\left(\frac{1}{1-\theta}\right)}$ for $i = H, F$. Intuitively, the firm allocates its short-term investment between the two markets (domestic and foreign) based on their relative profitability.

To illustrate our predictions, we analyze how the firm responds to an unexpected shock at $t = 0$, captured as a change in the current and future values of economic conditions φ. We assume that a constrained firm is initially in a steady state at $t = -1$. In the initial steady state, the value of economic conditions φ_t is constant and all variables $(A_t^H, y_t^H, m_t^H, A_t^F, y_t^F, m_t^F)$ are constant. For

any variable x, we denote its value in this steady state as x_I. The firm is affected at the start of $t = 0$ by an unexpected (marginal) shock to φ that they do not anticipate (in an analogous way to KM). For expositional simplicity, we first assume that the value of φ_t changes into a new constant value after the shock. We then show our analysis without any restrictions on this shock. Specifically, we use the following notation to denote elasticities: $\epsilon(Y, X) \equiv \frac{\partial Y}{\partial X} \times \frac{X}{Y}$. We first assume that $\epsilon(A_t^H, \varphi) = \delta^H$ and $\epsilon(A_t^F, \varphi) = \delta^F$ for all $t \geq 0$ (shock leads to new permanent value for φ). We interpret this as a shock to demand conditions (product-market conditions) and highlight that the revenue functions (y_t^H, y_t^F) can be the outcome of production functions and demand functions.[27] Note that this shock can be a shock only to export demand conditions (A_t^F). More broadly, this shock can have any effect on domestic and foreign product markets.

Firms' Responses to Shocks

We examine how the shock affects the firm's exports over time. This is captured by the firm's response in period $t = k \geq 0$: $\epsilon(y_k^F, \varphi)$. A key point for our analysis is that $\epsilon(y_k^F, \varphi) = \epsilon(y_k^F, A_k^F) \times \epsilon(A_k^F, \varphi) + \epsilon(y_k^F, A_k^H) \times \epsilon(A_k^H, \varphi) + \epsilon(y_k^F, w_k) \times \epsilon(w_k, \varphi)$. We label the terms in this expression as $Direct_k^F \equiv \epsilon(y_k^F, A_k^F) \times \epsilon(A_k^F, \varphi) + \epsilon(y_k^F, A_k^H) \times \epsilon(A_k^H, \varphi)$ and $Indirect_k^F \equiv \epsilon(y_k^F, w_k) \times \epsilon(w_k, \varphi)$. Intuitively, $Direct_k^F$ captures the immediate effect of the changes in conditions during period $t = k$ (the shock affects all periods) on the firm's exports during this same period. On the other hand, $Indirect_k^F$ captures the propagation of the shock over time through the firm's balance sheet (the firm balance-sheet channel). As the shock affects the firm's sales in previous periods ($k < 1$), it shapes exports in period k by changing the internal funds available for the firm in that period, i.e., by changing the firm's net worth w_k.

Firms' exports y_k^F are immediately affected by (A_k^H, A_k^F) for two reasons that determine $Direct_k^F$. First, changes in demand conditions A_k^F directly affect y_k^F conditional on m_k^F (the firm can charge higher prices). Second, the firm will adjust m_k^F in response to changes in demand conditions across its two markets (A_k^H, A_k^F). Note that there is not an *immediate* effect of the shock on (BC), i.e., (BC) in period k is not shaped by (A_k^H, A_k^F). Therefore, this immediate effect on m_k^F will capture an internal reallocation of scarce resources by the firm across the two markets. When conditions improve in the foreign (domestic) market, the firm reallocates resources to expand its foreign (domestic) production and reduce its domestic (foreign) production. In other words, shocks in one market have a negative immediate spillover on the sales to the other market because of this reallocation effect. The expressions above for y_t^F and m_t^F imply that $Direct_k^F = \delta^F + \theta\varepsilon^R(\delta^F - \delta^H)$, where $\varepsilon^R > 0$ captures the importance of this reallocation effect. The first and second terms in this expression capture the first and second effects described above, respectively.

The propagation effect $Indirect_k^F$ captures the importance of the firm balance-sheet channel and builds on the following ideas. Each change in (A_t^H, A_t^F) has a direct immediate effect on the firm's total sales $y_t = y_t^H + y_t^F$. This immediate effect captures the first term in the analysis above of direct effects, as reallocation effects do not have first-order effects on y_t (the firm maximizes y_t

[27] For example, suppose the production function for exports is $q_t^F = B_t^F(m_t^F)^\alpha$, where q_t^F is the real value of exported goods and B_t^F is a measure of (real) productivity. Suppose now that exporters face a demand function for exported goods given by $Q_t^F = D_t^F(p_t^F)^{-\sigma}$, where D^F captures demand conditions and p_t^F is the price of exported goods (in the domestic currency). We can write the firm's revenue from the exported goods as $y_t^F = q_t^F p_t^F = \widetilde{A_t^F}(m_t^F)^{\tilde{\alpha}}$, where $\tilde{\alpha} = \left(\frac{\sigma-1}{\sigma}\right)\alpha$ and $\widetilde{A_t^F} = (D_t^F)^{1/\sigma}(B_t^F)^{(\sigma-1)/\sigma}$. Note that demand conditions D_t^F directly affect $\widetilde{A_t^F}$.

and this captures an envelope condition). This immediate effect of the shock on total sales is given by $\varepsilon^D(y_t, \varphi) = \left(\frac{y_I^H}{y_I}\right)\delta^H + \left(\frac{y_I^F}{y_I}\right)\delta^F \equiv \delta$, where these weights capture the initial importance of each market (foreign and domestic) for firms' total sales. As discussed above, this initial shock to firm sales is propagated over time through the firm's balance sheet (its net worth). Consider the propagation over time of a change in y_t. This initial change in y_t directly affects the internal funds available in the next period (w_{t+1}). This change in w_{t+1} then shapes (m_{t+1}^H, m_{t+1}^F), (y_{t+1}^H, y_{t+1}^F), and y_{t+1}. This indirect effect on y_{t+1} then affects w_{t+2} and so on. The key point is this feedback between the firm's net worth and its production in both markets. This can lead to propagation effects to persist over multiple periods in the future. As we analyze the indirect effect in period k, we must consider propagation effects of these immediate effects on firm sales during periods $k-1, k-2, \ldots, 0$. Since we examine marginal effects, we can simply add these multiple propagation effects when determining the overall propagation effect during period k.

In the Internet Appendix, we show that this indirect effect can be written as $Indirect_k^F = P_1\delta + P_2\delta + \cdots + P_k\delta$, where $P_j = \theta \times \left(\frac{1}{1-b_I/y_I}\right) \times \eta^{j-1}$, where $\eta < 1$ is defined below. Each term $P_j\delta$ captures the propagation over time of the immediate effect of the shock on sales (δ) during period $k-j$. For example, in period $k=0$ there is no indirect effect and in period $k=1$ there is only the propagation effect from the change in sales during $t=0$. Once we reach $k=2$, there are the propagation effects from the changes in sales during $t=0$ and $t=1$. Intuitively, this captures the idea that these propagation effects build up over time. The term P_j measures an elasticity of the firm's exports in period k with respect to the initial change in firm-level sales during period $t-k$ (propagation effect over $j \geq 1$ periods). This elasticity is shaped by a leverage effect: $\left(\frac{1}{1-b_I/y_I}\right) > 1$. Initial shocks to firm sales have a levered effect on the firm's net worth because of their fixed obligations (debt). The term η captures the importance of the feedback effect above between changes in the firm's production and its net worth. Specifically, this term is given by $\eta = \left(\frac{w_I^H}{w_I}\right) \times \eta^H + \left(\frac{w_I^F}{w_I}\right) \times \eta^F$, where $w_t^i \equiv (1-\gamma)(y_{t-1}^i - \alpha m_{t-1}^i)$ is the component of firm's net worth coming from market $i \in \{H, F\}$, $\left(\frac{w_I^i}{w_I}\right) = \left(\frac{y_I^i - \alpha m_I^i}{y_I - \alpha m_I}\right)$ measures the initial importance of market i for the firm's total net worth, and $\eta^i = \epsilon\left(w_t^i, m_{t-1}^i\right)$ is the elasticity of w_t^i with respect to the investment decision m_{t-1}^i. Note that a 1 percent increase (decrease) in w_t leads to a 1 percent increase (decrease) in both m_t^H and m_t^L. These two changes then translate into an η percent increase in w_{t+1} (the expression for η captures this average elasticity). Therefore, the persistence of these propagation effects over time is determined by $\eta < 1$.

The results above can be extended to a general shock: $\epsilon(A_t^H, \varphi) = \delta_t^H$ and $\epsilon(A_t^F, \varphi) = \delta_t^F$. We are not making any assumption on the persistence or dynamics of the shock. In this case, we can still write $\epsilon(y_k^F, \varphi) = Direct_k^F + Indirect_k^F$, and these two expressions remain similar. We now have that $Direct_k^F = \delta_k^F + \theta\varepsilon^R(\delta_k^F - \delta_k^H)$, where $\varepsilon^R > 0$ still captures the importance of a reallocation effect. The firm balance-sheet channel is now given by $Indirect_k^F = P_1\delta_{k-1} + P_2\delta_{k-2} + \cdots + P_{k-1}\delta_1 + P_k\delta_0$, where $\delta_t = \left(\frac{y_I^H}{y_I}\right)\delta_t^H + \left(\frac{y_I^F}{y_I}\right)\delta_t^F$ and P_j is given by the same expression above. The term $P_j\delta_{k-j}$ now captures the propagation of the shock from period $k-j$ into period k.

This framework illustrates how the firm balance-sheet channel can amplify and prolong the effect of shocks to export markets. For example, suppose a shock to export markets has a direct effect on the firm's total sales given by $\delta_0 = \delta_1 = \delta_2 = 0.04$. Suppose also that $P_1 = 0.5$ and $P_2 = 0.25$. The total effect of the shock will be given by $\epsilon(y_0^F, \varphi) = 0.04$, $\epsilon(y_1^F, \varphi) = 0.06$, and $\epsilon(y_1^F, \varphi) = 0.07$ over these three periods. Therefore, the total effect of the shock will be amplified by 25 percent over the first two periods and by 42 percent over the first three periods.

Crucially, when the propagation effects P_j are significant and persistent over time, the firm balance-sheet channel becomes important and can prolong the effect of shocks. Additionally, these propagation effects P_j can be determined by the effect of temporary shocks to the firm. Suppose we compare the effects two shocks that are only different at $t = 0$, i.e., the values of δ_0 are different but the values of δ_t are the same for $t \geq 1$. The difference in the effects of these two shocks from $k = 1$ on will capture the importance of P_j. More formally, this difference will be given by $P_k \Delta\delta_0$ in period k, where $\Delta\delta_0$ is the gap between the values of δ_0 across the two shocks.[28]

Role of Refinancing Effects

In the previous analysis, the magnitude and persistence of the propagation effects is limited by the fact that $\eta < 1$. An important consideration that increases the magnitude and persistence of these effects is that changes in firms' net worth should shape refinancing terms on the new short-term funding obtained by the firm. To show this point, we build on previous work analyzing the implications of financing frictions (Bernanke, Gertler, and Gilchrist (1999), Almeida, Carvalho, and Kim (2024)), and assume that drops in firms' internal resources adversely affect new borrowing terms, i.e., higher net worth leads to a higher borrowing limit (α increases with w_t), a lower interest rate (R decreases with w_t), or both. In other words, we now have that the firm's binding borrowing constraint is given by $m_t = w_t + \beta(w_t)m_t$, where $\beta'(.) > 0$.[29] In this case, changes in net worth matter more and translate into larger and more persistent values for P_j.

We illustrate this point in the case of the general shock discussed above. We can still write that $\epsilon(y_k^F, \varphi) = Direct_k^F + Indirect_k^F$ and have the same expression above for $Direct_k^F$. Additionally, the indirect effect of the shock is still given by $Indirect_k^F = P_1\delta_{k-1} + P_2\delta_{k-2} + \cdots + P_{k-1}\delta_1 + P_k\delta_0$. The key point is that the propagation effects P_j are now $P_j = \theta \times \mu \times \left(\frac{1}{1-b_I/y_I}\right) \times M^{j-1}$, where $M = \mu \times \eta$, η has the same expression as above, and $\mu = 1 + \frac{\beta_w(w_I) \times w_I}{1-\beta(w_I)} > 1$. This expression for P_j is similar to the previous one but now replaces $\eta < 1$ with $M = \mu \times \eta$ where $\mu > 1$. This difference implies that P_j is stronger (more positive) and has greater persistence over time (P_{j+1}/P_j is larger). This change captures the intuition that shocks to the firm's net worth now also affect the firm's balance sheet through changes in refinancing terms, in addition to the previous effect on the availability of internal funds. More formally, the firm's investment decisions are now given by $m_t^H = \lambda\left(\frac{1}{1-\beta(w_t)}\right) w_t$ and $m_t^F = (1-\lambda)\left(\frac{1}{1-\beta(w_t)}\right) w_t$, where λ is the same as above. This

[28] In this exercise, we are considering how a same firm (firm with the same initial conditions) is affected differently when hit by two shocks that only differ in the initial period. This exercise motivates the empirical analysis we implement.

[29] Bernanke, Gertler, and Gilchrist (1999) argue that this effect is implied by standard models of lending with information asymmetry as the divergence of interests between lenders and borrowers is greater when borrowers have less net worth. Gertler and Gilchrist (2018) discuss how this effect is consistent with the data.

implies that a 1 percent increase (decrease) in w_t now leads to a $\mu > 1$ percent increase (decrease) in both m_t^H and m_t^F (in contrast with the one percent increase in the previous analysis). These two changes then translate into an $\eta \times \mu = M$ percent increase in w_{t+1} (as before, a 1 percent increase in both m_t^H and m_t^F lead to a η percent increase in w_{t+1}). The Internet Appendix provides more details on these results.

Multiple Foreign Markets

In the Internet Appendix, we extend our model to consider the case where the exporter sells to two foreign markets, in addition to the domestic market. We model these markets in the same way as before, assuming separable production decisions that require upfront financing, and are subject to binding funding constraints. Denote the two export markets as A and B. To motivate our empirical analysis, we consider how a temporary shock to market B during period *t* affects the firm's export activity to market A over time. In the Internet Appendix, we show that this extension leads to the predictions discussed in Section 1. First, the immediate effect of the shock (during period *t*) on the firm's exports to market A is negative. This captures the direct (immediate) effect of the shock discussed above. This negative spillover captures a reallocation effect. The key point is that there is a positive spillover effect on the exports to market A from period *t*+1 on (after the temporary shock has ended). This positive spillover effect captures the propagation effects described above. This effect is driven by the immediate effect of the shock on firms' total sales in period *t*. These propagation effects are determined in the same way as in the analysis above: they can be significant and persistent over time. Additionally, this positive spillover effect should be stronger when market B represents a large share of the firm's initial exports. This captures the idea that shocks to more important markets have a stronger initial effect on the firm's total sales and balance sheet (its net worth).

Role of Domestic Production

Another important consideration is the role of funding constraints on firms' domestic production in the previous analysis. In the Internet Appendix, we show that the main results above do not depend on the assumption above that foreign and domestic production have similar funding needs. These funding needs can be less important for domestic production. However, for the balance-sheet propagation effects to remain important and persistent, it is key that the shocks to firms' net worth still play an important role in shaping domestic production. To show these points, we first consider a case where the there are no funding needs associated with the domestic production and the foreign prediction is still exposed to the binding funding constraints. We analyze this possibility by assuming that, only in the domestic market, the firm can pay for the inputs at the same time it collects the cash from sales (no upfront funding requirement). We show that propagation effects become limited in this case. Specifically, we have similar expressions the ones in the previous case but the value of η is now limited, what reduces the importance of M and P_j. This comes from the fact that changes in the firm's net worth w_t now only shapes m_t^F (it has no effect on m_t^H which is not exposed to funding issues). At the same time, we still have that w_{t+1} is shaped by both these decisions (the internal funds available for the firm capture profits in both markets). Consequently, changes in w_t now have a more limited effect on w_{t+1} which is bounded by the share of the firm's net worth that is determined by export transactions. We then consider a case where the domestic production can have smaller financing requirements but is still exposed to binding funding constraints. We consider this case by assuming that only a fraction (which is fixed and could be small) of each unit of domestic inputs need to be purchased prior to the

collection of the cash from sales (at the start of the period). At the same time, we assume that funding constraints on the domestic production are still binding. We show that, in this case, propagation effects remain similar to the ones in our baseline analysis with symmetric funding needs across both markets (domestic and foreign). The key idea is that, as in our baseline model, changes in the firm's net worth directly affect its sales to both markets. Hence, changes in w_t directly shape all sources of profits determining w_{t+1} and the previous mechanism limiting the magnitude of propagation effects is no longer present.

Table 1
Summary Statistics and Initial Evidence

This table presents summary statistics and provides some initial evidence motivating our empirical approach. Panel A shows summary statistics on the main sample used in the analysis. The unit of observation is a firm × product × destination × semester. The sample covers all export transactions in Brazil with exchange rate data for the destination country and includes all instances where the firm × product × destination has some export transaction in the previous semester (see Section 3.1). The sample period is from the second semester of 1996 to the end of 2005. *FExpGrowth1* (t) is the difference in firm-level exports between semesters t and t-1, scaled by the average value of the firm-level exports across these two periods. *FExpGrowth2* (t) is the difference in firm-level exports between semesters t and t-1, scaled by the value of firm-level exports in t-1. *ProdExpGrowth1* (t) and *ProdExpGrowth2* (t) are product-level measures of export growth constructed in the same way using the value of exports at the firm × product × destination level (product is a six-digit harmonized product code). *ProdExpGrowth1* $(t+k)$ and *ProdExpGrowth2* $(t+k)$ are the firm × product × destination-level export growth measures from semester t-1 to $t+k$. *FERShock* $(t+k)$ is the firm-specific exchange rate shock from semester t-1 to $t+k$, defined as the weighted average of the log changes in exchange rates across destinations, where the weights are the export shares in the previous semester. *CloseShock* (t) and *DistantShock* (t) decompose *FERShock* (t) into exchange rate shocks from close products and from distant products, respectively (see Section 4.4). Close and distant products are defined as products in the same harmonized 6-, 4-, or 2-digit product code. Panel B shows summary statistics for firm characteristics in the sample from Panel A. The unit of observation here is a firm × semester. Panel C checks if temporary shocks to firm-specific exchange rates are correlated with different firm characteristics. We estimate linear regressions predicting different initial firm characteristics (measured in semester t – 1) using *FERShock* (t) and controlling for *FERShock* $(t+1)$. Standard errors are heteroskedasticity robust and clustered at the firm level. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Main Sample

	Nobs	Mean	Median	SD
ProdExpGrowth1 (t)	2,492,806	-0.878	-1.422	1.250
ProdExpGrowth2 (t)	2,367,812	-0.312	-0.932	1.082
ProdExpGrowth1 $(t+1)$	2,492,806	-0.974	-1.997	1.248
ProdExpGrowth2 $(t+1)$	2,368,318	-0.372	-1.000	1.084
ProdExpGrowth1 $(t+2)$	2,492,806	-1.052	-2.000	1.255
ProdExpGrowth2 $(t+2)$	2,367,784	-0.402	-1.000	1.139
FExpGrowth1 (t)	2,492,806	-0.131	0.015	0.816
FExpGrowth2 (t)	2,359,770	-0.011	-0.013	0.592
FERShock (t)	2,492,806	0.004	-0.005	0.144
FERShock $(t+1)$	2,492,806	0.000	-0.021	0.199
CloseShock (t) *(6-digit code)*	2,492,806	0.002	-0.000	0.064
CloseShock (t) *(4-digit code)*	2,492,806	0.003	-0.000	0.078
CloseShock (t) *(2-digit code)*	2,492,806	0.003	-0.000	0.099
DistantShock (t) *(6-digit code)*	2,492,806	0.002	0.000	0.120
DistantShock (t) *(4-digit code)*	2,492,806	0.001	0.000	0.110
DistantShock (t) *(2-digit code)*	2,492,806	0.001	0.000	0.091

Panel B: Firm Characteristics

	Nobs	Mean	Median	SD
Firm Employment (t - 1)	200,202	298	53	2,094
High Skilled Employment Share (t - 1)	200,202	0.460	0.423	0.309
Number of Plants (t - 1)	200,202	2.85	1.00	48.29
Number of Export Destinations (t - 1)	200,202	4.36	2.00	6.74
Number of Export Products (t - 1)	200,202	5.50	2.00	18.68

Panel C: Initial Evidence - Firm-Specific Exchange Rate Shocks

	Firm Characteristics - Measured at Semester t - 1				
	Log of Firm Employment	HS Employment Share	Log Number of Plants	Log Number of Destinations	Log Number of Products
	(1)	(2)	(3)	(4)	(5)
FERShock (t)	-0.039	0.013	-0.016	-0.007	0.009
	(-0.82)	(1.50)	(-1.01)	(-0.31)	(0.32)
Observations	200,202	200,202	200,202	200,202	200,202
R^2	0.01	0.01	0.01	0.01	0.01
Industry × Time FE	Yes	Yes	Yes	Yes	Yes
FERShock (t + 1) Control	Yes	Yes	Yes	Yes	Yes

Table 2
Temporary Shocks to Firm-Specific Exchange Rates

This table analyzes the immediate responses of firms' total exports to temporary shocks to firm-level exchange rates. The results are based on the estimation of equation (1) using measures of firms' total export growth as the outcome variable. The unit of observation is a firm × product × destination × semester. *FExpGrowth1* (t) is the difference in firm-level exports between semesters t-1 and t, scaled by the average value of the firm-level exports across these two periods. *FExpGrowth2* (t) is the difference in firm-level exports between semesters t and t-1, scaled by the value of the firm-level exports in t-1. *FERShock* (t) is the firm-specific exchange rate shock from semester t-1 to t, defined as the weighted average of the log changes in exchange rates across destinations, where the weights are the firm's export shares in the previous semester. The sample only includes observations where the firm × product × destination has some export transaction in the previous semester. Model 1 controls for *FERShock* (t+1), the firm-specific exchange rate shock from semester t-1 to t+1. Model 2 uses a third-degree polynomial function of *FERShock* (t+1) to construct the control variables. To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester t-1. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination levels. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	FExpGrowth1 (t)		FExpGrowth2 (t)	
	(1)	(2)	(3)	(4)
FERShock (t)	0.4646***	0.5590***	0.3245***	0.4032***
	(6.94)	(8.10)	(7.48)	(8.78)
Observations	2,492,405	2,492,405	2,133,906	2,133,906
R^2	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2

Table 3
Firms' Propagation of Temporary Shocks Across Export Markets

This table analyzes how firms' product-level exports in one market respond to temporary exchange-rate shocks in their other markets. The results are based on the estimation of equation (1). The unit of observation is a firm × product × destination × semester. *ProdExpGrowth1* ($t+k$) is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the average value of these exports across the two periods. *ProdExpGrowth2* ($t+k$) is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the value of these exports in $t-1$. *FERShock* (t) is the firm-specific exchange rate shock from semester $t-1$ to t, defined as the weighted average of the log changes in exchange rates across destinations, where the weights are the export shares in the previous semester. The sample only includes observations where the firm × product × destination has some export transaction in the previous semester. Model 1 controls for *FERShock* ($t+1$), the firm-specific exchange rate shock from semester $t-1$ to $t+1$. Model 2 uses a third-degree polynomial function of *FERShock* ($t+1$) to construct the control variables. To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester $t-1$. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination levels. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Main Growth Measure

	ProdExpGrowth1 (t)		ProdExpGrowth1 (t+1)		ProdExpGrowth1 (t+2)	
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (t)	-0.0729	-0.0194	0.1645***	0.2422***	0.2612***	0.3253***
	(-1.30)	(-0.34)	(3.48)	(4.74)	(5.67)	(6.45)
Observations	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405
R^2	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Panel B: Alternative Growth Measure

	ProdExpGrowth2 (t)		ProdExpGrowth2 (t+1)		ProdExpGrowth2 (t+2)	
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (t)	-0.1008**	-0.0604	0.1371***	0.1950***	0.2185***	0.2807***
	(-2.49)	(-1.43)	(3.73)	(4.95)	(6.01)	(7.01)
Observations	2,133,906	2,133,906	2,133,906	2,133,906	2,133,906	2,133,906
R^2	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Table 4
Firms' Propagation of Shocks Across Export Markets: The Role of Economic Links

This table analyzes how firms' propagation of temporary shocks across export markets is related to the economic links across these markets. In Panel A, we separately estimate the effect of temporary exchnage rate shocks to other markets with close or distant products. The results are based on the estimation of equation (2). *Close Shock* (t) and *Distant Shock* (t) decompose *FERShock* (t) into shocks that originate in close (similar) or distant products. We use three different definitions for close or similar products: products within the same 2-, 4-, or 6-digit harmonized product code. In addition to showing the estimated coefficients for *Close Shock* (t) and *Distant Shock* (t), we also report the estimated difference between these two coefficients. In Panel B, we analyze our results from Table 3 with an additional a control for product-specific exchange rate shocks for each firm (*ProdERShock* (t)). When constructing *ProdERShock* (t), we calculate the weighted average of log changes in export destination for the firm's product between semesters t - 1 and t using firm × product export shares from semester t - 1. This control ensures that the effect of *FERShock* (t) captures shocks to other products. In Panel C, we analyze the effect of temporary product shocks while controlling for the firm-level shocks used in our main results (the opposite of the result in Panel B), i.e., the effect of *ProdERShock* (t) while controlling for *ProdERShock* (t + 1), *FERShock* (t), and product × destination × semester fixed effects. *ProdERShock* (t + 1) is constructed in the same way as *ProdERShock* (t) using the longer time horizon (shock between semesters t - 1 and t + 1). To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester t - 1. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination levels. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Exchange Rate Shocks to Close and Distant Products

Close Product Definition:	Same 6-digit Product Code		Same 4-digit Product Code		Same 2-digit Product Code	
Outcome Variable:	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)
	(1)	(2)	(3)	(4)	(5)	(6)
Close Shock (t)	0.1327***	0.2345***	0.1408***	0.2405***	0.1532***	0.2508***
	(2.80)	(5.07)	(2.98)	(5.21)	(3.24)	(5.45)
Distant Shock (t)	0.3038***	0.3564***	0.3203***	0.3683***	0.3144***	0.3732***
	(5.24)	(6.43)	(5.30)	(6.40)	(4.73)	(5.79)
Observations	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405
R^2	0.00	0.00	0.00	0.00	0.00	0.00
Close Shock (t) - *Distant Shock* (t)	-0.1711***	-0.1218***	-0.1794***	-0.1277***	-0.1612***	-0.1224***
	(-4.77)	(-3.58)	(-4.74)	(-3.57)	(-3.54)	(-2.84)
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
CloseFERShock (t+1) Control	Yes	Yes	Yes	Yes	Yes	Yes
DistantFERShock (t+1) Control	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Results Controlling for Product Shocks						
Product Shock Definition:	6-digit Product Code Shock		4-digit Product Code Shock		2-digit Product Code Shock	
Outcome Variable:	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (*t*)	0.4248***	0.4691***	0.4074***	0.4603***	0.4713***	0.4852***
	(7.22)	(8.22)	(6.37)	(7.39)	(6.08)	(6.41)
Observations	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405
R^2	0.00	0.00	0.00	0.00	0.00	0.00
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
ProdERShock (*t*) Control	Yes	Yes	Yes	Yes	Yes	Yes
FERShock (*t*+1) Control	Yes	Yes	Yes	Yes	Yes	Yes
Panel C: Effects of Temporary Shocks to Firm Products						
Product Shock Definition:	6-digit Product Code Shock		4-digit Product Code Shock		2-digit Product Code Shock	
Outcome Variable:	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)	ProdExpGrowth1 (t+1)	ProdExpGrowth1 (t+2)
	(1)	(2)	(3)	(4)	(5)	(6)
ProdERShock (*t*)	-0.2092***	-0.1640**	-0.1844***	-0.1693**	-0.2644***	-0.1863**
	(-3.18)	(-2.55)	(-2.64)	(-2.50)	(-3.25)	(-2.34)
Observations	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405
R^2	0.00	0.00	0.00	0.00	0.00	0.00
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
FERShock (*t*) Control	Yes	Yes	Yes	Yes	Yes	Yes
ProdERShock (*t*+1) Control	Yes	Yes	Yes	Yes	Yes	Yes

Table 5
Firm-Level Employment Adjustments During Temporary Shocks

This table analyzes how firms adjust their employment during temporary shocks to their firm-specific exchange rates. The unit of observation is a firm × semester. The results are based on linear regressions linking the outcome variables to *FERShock* (t), industry × semester fixed effects, and controls. *Firm Emp Adjustment* (t) is the difference in firm-level employment between the last months of semesters t and t-1, scaled by the average value of this employment across the two periods. *Firm High Skilled Emp Adjustment* (t) and *Firm Low Skilled Emp Adjustment* (t) are defined in the same way using firms' high and low skilled employment in each month, respectively. High (low) skilled employment includes all workers with (without) high school education. We identify a plant as active in a month if it has positive employment in that month. *FExpGrowth1* (t) is the difference in firm-level exports between semesters t and t-1, scaled by the average value of the firm-level exports across these two periods. *FERShock* (t) is the firm-specific exchange rate shock from semester t-1 to t, defined as the weighted average of the log changes in exchange rates across destinations, where the weights are the export shares in the previous semester. The sample only includes observations where the firm has some export transaction in the previous semester. Model 1 controls for *FERShock* (t+1), the firm-specific exchange rate shock from semester t-1 to t+1. Model 2 controls for both *FERShock* (t+1) and *FERShockStart* (t+1), the firm-specific exchange rate shock from semester t-1 to the first month of semester t+1. Industry refers to the firm's main industry (using the share of employment), based on a classification that is similar to a 3-digit SIC code. Standard errors are clustered at the firm level. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Firm Emp Adjustment (t)	Firm High Skilled Emp Adjustment (t)	Firm Low Skilled Emp Adjustment (t)	FExpGrowth1 (t)
	(1)	(2)	(3)	(4)
FERShock (t)	0.023	0.035	0.006	0.407***
	(1.30)	(1.57)	(0.26)	(8.70)
Observations	197,809	187,318	183,444	200,202
R^2	0.01	0.01	0.01	0.01
Industry × Time FE	Yes	Yes	Yes	Yes
Controls	Model 1	Model 1	Model 1	Model 1

Table 6
Firms' Propagation of Temporary Shocks Across Export Markets: Longer Time Horizons

This table analyzes how firms propagate temporary shocks across export markets over longer time horizons. We estimate the same specifications as in Table 3 using alternative outcome variables that capture longer-term responses. *ProdExpGrowth1* ($t+k$) is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the average value of these exports across the two periods. *ProdExpGrowth2* ($t+k$) is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the value of these exports during semester t - *ProdExpGrowth1* ($t+1$, $t+2$) is the simple average of *ProdExpGrowth1* ($t+1$) and *ProdExpGrowth1* ($t+2$). *ProdExpGrowth1* ($t+3$, $t+5$) is the simple average of *ProdExpGrowth1* ($t+3$), *ProdExpGrowth1* ($t+4$), and *ProdExpGrowth1* ($t+5$). *ProdExpGrowth2* ($t+1$, $t+2$) and *ProdExpGrowth2* ($t+3$, $t+5$) are defined in an analogous way using the alternative growth measures. All other variables and controls are defined in the same way as in Table 3. The sample period is now from the second semester of 1996 to the first semester of 2004. To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester $t-1$. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination levels. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Main Growth Measure

	ProdExpGrowth1 (t)		ProdExpGrowth1 (t+1, t+2)		ProdExpGrowth1 (t+3, t+5)	
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (t)	-0.0431	0.0301	0.2377***	0.3298***	0.2780***	0.3311***
	(-0.76)	(0.51)	(5.78)	(7.29)	(6.17)	(6.83)
Observations	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169
R^2	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Panel B: Alternative Growth Measure

	ProdExpGrowth2 (t)		ProdExpGrowth2 (t+1, t+2)		ProdExpGrowth2 (t+3, t+5)	
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (t)	-0.0706*	-0.0211	0.1430***	0.2040***	0.1563***	0.1790***
	(-1.77)	(-0.51)	(4.74)	(6.18)	(4.50)	(4.74)
Observations	1,567,585	1,567,585	1,567,585	1,567,585	1,567,585	1,567,585
R^2	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Table 7
Results Using Longer Time Horizons: The Role of Economic Links

This table analyzes how, over longer time horizons, firms' propagation effects depend on the economic links across export markets. We estimate the same specifications as in Table 4 using alternative outcome variables. *ProdExpGrowth1* ($t+k$) is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the average value of these exports across the two periods. *ProdExpGrowth1* ($t+1$, $t+2$) is the simple average of *ProdExpGrowth1* ($t+1$) and *ProdExpGrowth1* ($t+2$). *ProdExpGrowth1* ($t+3$, $t+5$) is the simple average of *ProdExpGrowth1* ($t+3$), *ProdExpGrowth1* ($t+4$), and *ProdExpGrowth1* ($t+5$). All other variables and controls are defined in the same way as in Table 4. The sample period is now from the second semester of 1996 to the first semester of 2004. To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester $t-1$. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination level. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Exchange Rate Shocks to Close and Distant Products

	Firm-Product Exchange Rate Shock (6-digit)		Firm-Product Exchange Rate Shock (4-digit)		Firm-Product Exchange Rate Shock (2-digit)	
	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)
	(1)	(2)	(3)	(4)	(5)	(6)
Close Shock (t)	0.1946***	0.2431***	0.2031***	0.2487***	0.2191***	0.2625***
	(4.69)	(5.33)	(4.93)	(5.50)	(5.33)	(5.81)
Distant Shock (t)	0.3056***	0.3410***	0.3214***	0.3526***	0.3280***	0.3463***
	(6.14)	(6.91)	(6.24)	(6.89)	(5.77)	(6.23)
Observations	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169
R^2	0.00	0.00	0.00	0.00	0.00	0.00
Close Shock (t) - *Distant Shock* (t)	-0.1111***	-0.0979***	-0.1184***	-0.1039***	-0.1089***	-0.0838**
	(-3.70)	(-3.55)	(-3.75)	(-3.60)	(-2.87)	(-2.45)
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
CloseFERShock ($t+1$) Control	Yes	Yes	Yes	Yes	Yes	Yes
DistantFERShock ($t+1$) Control	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Results Controlling for Product Shocks						
	Firm-Product Exchange Rate Shock (6-digit)		Firm-Product Exchange Rate Shock (4-digit)		Firm-Product Exchange Rate Shock (2-digit)	
	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (*t*)	0.4559***	0.4540***	0.4314***	0.4063***	0.4646***	0.4226***
	(8.72)	(7.66)	(7.54)	(6.32)	(6.58)	(5.44)
Observations	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169
R^2	0.00	0.00	0.00	0.00	0.00	0.00
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
ProdERShock (*t*) Control	Yes	Yes	Yes	Yes	Yes	Yes
FERShock (*t*+1) Control	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: Effects of Temporary Shocks to Firm Products						
	Firm-Product Exchange Rate Shock (6-digit)		Firm-Product Exchange Rate Shock (4-digit)		Firm-Product Exchange Rate Shock (2-digit)	
	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)	ProdExpGrowth1 (t+1, t+2)	ProdExpGrowth1 (t+3, t+5)
	(1)	(2)	(3)	(4)	(5)	(6)
ProdERShock (*t*)	-0.1876***	-0.3021***	-0.1638***	-0.2414***	-0.2044***	-0.2467***
	(-3.18)	(-4.72)	(-2.61)	(-3.54)	(-2.77)	(-3.06)
Observations	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169
R^2	0.00	0.00	0.00	0.00	0.00	0.00
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
FERShock (*t*) Control	Yes	Yes	Yes	Yes	Yes	Yes
ProdERShock (*t*+1) Control	Yes	Yes	Yes	Yes	Yes	Yes

Table 8
Positive versus Negative Adjustments to Exports

This table decomposes the previous firm propagation effects across two margins: changes in positive or negative product-level export growth. These margins capture effects for firms expanding or contracting their exports. Panels A and B estimate the same specifications as in Tables 3 and 6, respectively, using alternative outcome variables. *Positive ProdExpGrowth1* (t+k) equals *ProdExpGrowth1* ($t+k$) if *ProdExpGrowth1* ($t+k$) ≥ 0 and zero otherwise. *Negative ProdExpGrowth1* (t +k) equals *ProdExpGrowth1* ($t+k$) if *ProdExpGrowth1* ($t+k$) < 0 and zero otherwise. The positive and negative product growth variables with longer horizons are defined in the same way using *ProdExpGrowth1* (t+1, t+2) and *ProdExpGrowth1* (t+3, t+5). All other variables and controls are defined in the same way as in Table 3. To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester t-1. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination level. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Main Results

	Positive ProdExpGrowth1 (t+1)		Negative ProdExpGrowth1 (t+1)		Positive ProdExpGrowth1 (t+2)		Negative ProdExpGrowth1 (t+2)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FERShock (t)	0.0631***	0.0868***	0.1014***	0.1553***	0.0914***	0.1109***	0.1699***	0.2143***
	(4.10)	(5.36)	(2.78)	(3.92)	(5.64)	(6.44)	(4.94)	(5.66)
Observations	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405	2,492,405
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Panel B: Longer Time Horizons

	Positive ProdExpGrowth1 (t+1, t+2)		Negative ProdExpGrowth1 (t+1, t+2)		Positive ProdExpGrowth1 (t+3, t+5)		Negative ProdExpGrowth1 (t+3, t+5)	
	(1)	(2)	(5)	(6)	(3)	(4)	(7)	(8)
FERShock (t)	0.0633***	0.0798***	0.1745***	0.2499***	0.0863***	0.1029***	0.1917***	0.2282***
	(4.78)	(5.60)	(5.32)	(6.92)	(6.05)	(6.76)	(5.55)	(6.14)
Observations	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Table 9
Firms' Propagation of Temporary Shocks to Exports Over Time: IV Approach

This table analyzes how firms propagate temporary shocks to export markets over time using an IV approach. In this analysis, we use temporary fluctuations in firm-specific exchange rates as an instrument for temporary windfalls to firms' total exports. The results are based on the estimation of equation (2) using an IV approach, where the first stage is given by the specifications in Table 2. Specifically, we use *FERShock* (t) as an instrument for *FExpGrowth1* (t) or *FExpGrowth2* (t), while controlling for *FERShock* (t +1) (Model 1) or controlling for both *FERShock* (t +1) and *FERShockStart* (t+1) (Model 2). In Panel A, we analyze the same outcome variables and sample as in Table 3. In Panel B, we analyze the same outcome variables and sample as in Table 6. *FExpGrowth1* (t) is the difference in firm-level exports between semesters t and t-1, scaled by the average value of these firm-level exports across the two periods. *FExpGrowth2* (t) is the the difference in firm-level exports between semesters t and t-1, scaled by the value of the firm-level exports in t-1. All other variables and controls are defined in the same way as in Table 3 (Panel A) and Table 6 (Panel B). To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester t-1. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination level. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Main Results

	ProdExpGrowth1 (t+1)		ProdExpGrowth1 (t+2)		ProdExpGrowth2 (t+1)		ProdExpGrowth2 (t+2)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FExpGrowth1 (t)	0.3541***	0.4332***	0.5623***	0.5819***				
	(3.52)	(4.69)	(5.07)	(5.99)				
FExpGrowth2 (t)					0.4224***	0.4835***	0.6734***	0.6960***
					(3.76)	(4.92)	(5.39)	(6.43)
Observations	2,492,405	2,492,405	2,492,405	2,492,405	2,133,906	2,133,906	2,133,906	2,133,906
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Panel B: Longer Time Horizons								
	ProdExpGrowth1 (t+1, t+2)		ProdExpGrowth1 (t+3, t+5)		ProdExpGrowth2 (t+1, t+2)		ProdExpGrowth2 (t+3, t+5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FExpGrowth1 (*t*)	0.5219***	0.8142***	0.6103***	0.8480***				
	(5.22)	(4.59)	(5.65)	(4.68)				
FExpGrowth2 (*t*)					0.4750***	0.6857***	0.5193***	0.6708***
					(4.46)	(4.27)	(4.41)	(4.12)
Observations	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169	1,923,169
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

Table 10
Alternative Product Definition

This table analyzes our main results (Tables 3 and 9) using a different product definition. We aggregate export transactions at the firm × product × destination × semester level using 4-digit product harmonized codes as out product definition, as opposed to the 6-digit harmonized codes used in our main results. In Panel A, we document the reduced-form estimates in Table 3. In Panel B, we examine the IV estimates in Table 9 (Panel A). All other variables and controls are defined in the same way as in Table 3 (Panel A) and Table 9 (Panel B). To capture firm-level effects, all regressions are weighted using the share of firms' exports in each product × destination in semester *t* -1. Standard errors are heteroskedasticity robust and two-way clustered at the firm and product × destination level. We report the respective t-statistics. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Reduced-Form Results

	ProdExpGrowth1 (t)		ProdExpGrowth1 (t+1)		ProdExpGrowth1 (t+2)	
	(1)	(2)	(3)	(4)	(5)	(6)
FERShock (*t*)	-0.0193	0.0441	0.1820***	0.2616***	0.3105***	0.3780***
	(-0.34)	(0.75)	(3.96)	(5.22)	(6.82)	(7.25)
Observations	1,845,022	1,845,022	1,845,022	1,845,022	1,845,022	1,845,022
R^2	0.01	0.01	0.01	0.01	0.01	0.01
Product × Destination × Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2

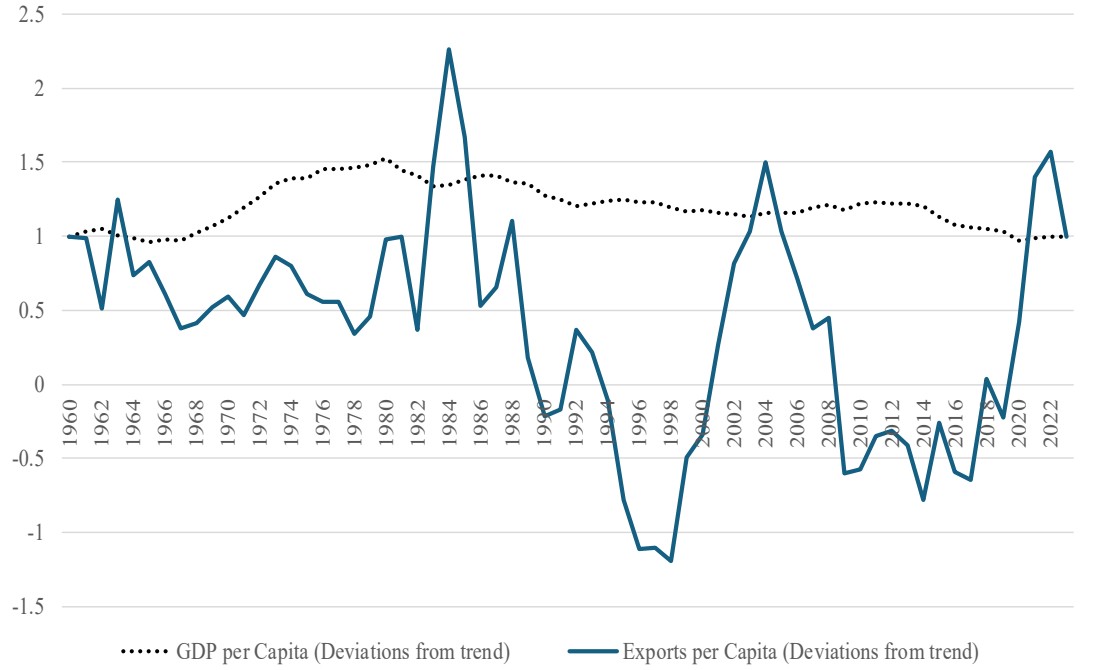
Panel B: IV Approach

	ProdExpGrowth1 (t+1)		ProdExpGrowth1 (t+2)	
	(1)	(2)	(3)	(4)
FExpGrowth1 (*t*)	0.4138***	0.4828***	0.7061***	0.6976***
	(3.89)	(5.07)	(5.35)	(6.29)
Observations	1,845,022	1,845,022	1,845,022	1,845,022
Product × Destination × Time FE	Yes	Yes	Yes	Yes
Controls	Model 1	Model 2	Model 1	Model 2

Figure 1
Export Volatility: Broad Patterns

This figure shows broad patterns for the volatility of exports (per capita) and GDP (per capita) in Brazil and the United States. We use data from the World Bank national accounts to construct the annual time series of exports per capita and GDP per capita for each country. Each time series measures the ratio between the value of the variable in year t and its initial value (at the start of the graph). These values are based on the domestic currency and deflated. In each case, we plot deviations from a simple linear trend. The coefficient for this linear trend is the average growth of the variable over the entire period.

Panel A: Exports and GDP - Brazil



Panel B: Exports and GDP - United States

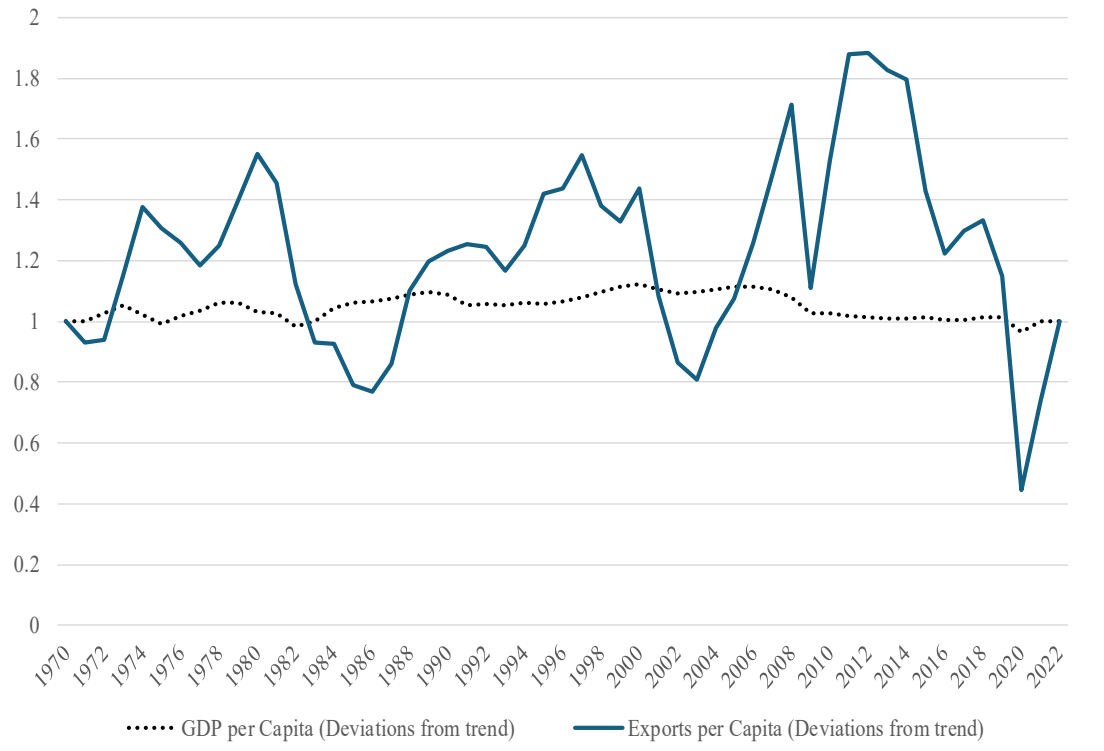


Figure 2
Reduced-Form Estimates by Semester

This figure presents the reduced-form estimates in Table 6 separately for each semester (from semester t to $t+5$). The results are based on the estimation of the same specifications as in Table 6 using different outcome variables. For each semester $t+k$, we show the estimates using *ProdExpGrowth1* $(t+k)$ as the outcome variable. *ProdExpGrowth1* $(t+k)$ is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the average value of these product exports across the two periods. In each case, we plot the estimated coefficient of *FERShock* (t). Model 1 controls for *FERShock* $(t+1)$, while Model 2 uses a third-degree polynomial function of *FERShock* $(t+1)$ to construct the control variables. Blue circles and orange triangles represent point estimates using Model 1 and Model 2, respectively. Vertical bars represent a 95-percent confidence interval for each point estimate.

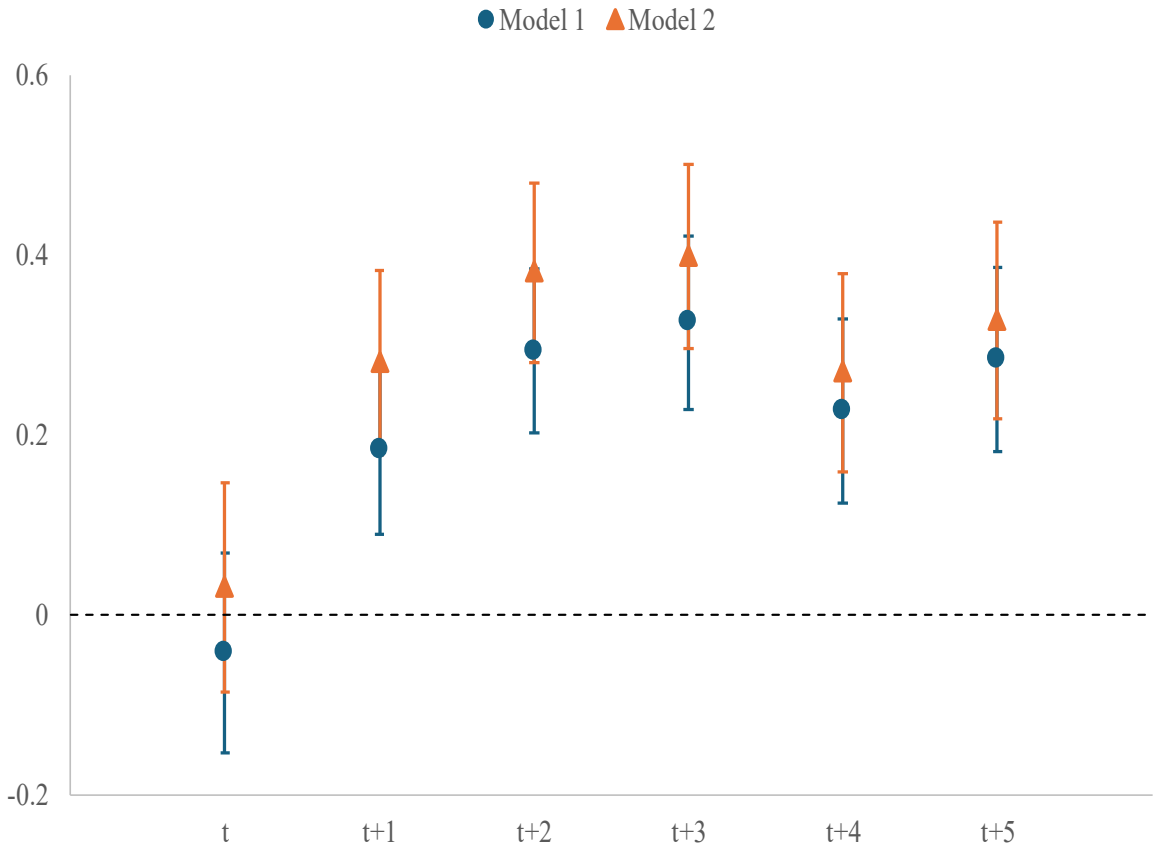


Figure 3
IV Estimates by Semester

This figure presents the IV estimates in Table 9 (Panel B) separately for each semester (from semester $t+1$ to $t+5$). The results are based on the estimation of the same specifications as in Table 9 using different outcome variables. For each semester $t+k$, we show the estimates using *ProdExpGrowth1* $(t+k)$ as the outcome variable. *ProdExpGrowth1* $(t+k)$ is the difference in firm × product × destination exports between semesters $t+k$ and $t-1$, scaled by the average value of these product exports across the two periods. In each case, we plot the estimated coefficient of *FExpGrowth1* (t). Model 1 controls for *FERShock* $(t+1)$, while Model 2 uses a third-degree polynomial function of *FERShock* $(t+1)$ to construct the control variables. Blue circles and orange triangles represent point estimates for Model 1 and Model 2, respectively. Vertical bars represent the 95-percent confidence interval for each point estimate.

