Desirability of Competition in Currency of Invoicing*

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Abstract

The current literature documents stickiness in firm-level dollar invoicing, but we show that firms substitute invoicing currency to tide over short-term credit supply shocks. Using a quasi-natural experiment and transaction-level import data, we first show that importers reduce the share of dollar invoiced imports by 10.8% in response to a percentage point decline in dollar credit supply and substitute it with Euro invoicing. We establish a novel *dollar invoicing* shock amplification channel by documenting that firms unable to switch invoicing currencies suffer higher exit rates and lower imports. Global banks shield trade by supporting invoicing in alternate currencies.

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1 Introduction

A key feature that makes the United States dollar (henceforth dollar) dominant is the widespread use of dollar for international trade invoicing, supported by an equally dominant role in the global credit market. Furthermore, dollar invoicing share in the cross-section has been very stable over long periods (Gopinath & Itskhoki, 2022).[1] This equilibrium with a few dominant currencies can aid trade and global financial flows, but a lack of competition in invoicing markets can expose firms to credit shocks in the dominant currencies. While an extensive body of research studies the role of trade credit shocks on trade, whether dependency on a single dominant currency amplifies the adverse effects of such shocks is not well understood.

Invoicing inflexibility can amplify dollar credit shocks for the following reasons. First, while importers might want to obtain credit and invoice in alternate currencies such as the Euro, exporters with pre-determined dollar liabilities may refuse alternate currency invoicing contracts or may offer worse terms to such importers (Bleakley & Cowan (2008)). Second, banks lending in alternate currencies, such as the Euro, are concentrated within the European region (Emter *et al.* (2024)). As a result, firms not connected with banks lending in alternate currencies struggle to raise non-dollar trade credit. Third, even when Euro financing is available, due to invoicing rigidity, the cost of hedging the mismatch between the currency of financing and the currency of invoicing can be prohibitively expensive.

In this paper, we establish these mechanisms causally by combining a quasi-natural event with rich transaction-level data (3.7 million transactions) on Indian imports. We use the plausibly exogenous variation in dollar capital flows across countries following an unexpected change in the US Federal Reserve's monetary policy stance during 2013, widely known as the taper tantrum episode. We utilize this setting to identify how dollar invoicing and trade flows respond for a given importer across countries that are differentially affected in terms of dollar capital flows following the taper tantrum episode. We find that importers, on average, reduce dollar invoicing while trading with countries more affected by the dollar credit shock. However, these effects and resulting real consequences are heterogeneous across importers and countries. Importers trading

[1]For example, 85% of India's imports are dollar-denominated, even though approximately only 10% of Indian imports are sourced from the US. As for dollar credit, according to the Bank of International Settlements (BIS), $13.1 trillion credit is outstanding by non-bank borrowers outside of the US as of September 2022. Typically, importers from emerging markets would raise dollar credit from the exporter or exporter-country banks, backed by letters of credit from their domestic banks (Amiti & Weinstein (2011)).

with highly dollarized countries are unable to substitute away from dollars and suffer higher exit rates and lower trade values, highlighting the amplification due to a lack of competition in the trade invoicing currencies.

We begin by documenting the novel result that firm-level dollar invoicing is not as stable as perceived in the literature – it responds quantitatively meaningfully to fluctuations in cross-border dollar credit supply. In particular, Indian importers, on average, reduced dollar invoicing more while trading with the countries experiencing a greater reduction in cross-border dollar credit around the taper tantrum episode. Our preferred specification suggests that a one percentage point (pp.) reduction in dollar credit originating from exporting country banks reduces the dollar invoicing share of trade with that country by 7.3 pp., which is roughly an 11.9% reduction relative to the sample mean of dollar invoicing share. The result is robust after controlling for potentially confounding covariates, such as currency depreciation and volatility. The reduction in dollar invoicing shares is mainly replaced by Euros, even when the trade partner is a non-Euro country, and by Indian Rupee (INR) to some extent. Further, we find that the decline in dollar invoicing persists until the second quarter of 2014, despite the Federal Reserve reversing its taper announcement in September 2013. We estimate our results using a difference-in-difference (DiD) setting by absorbing firm×product× time fixed effects as in Paravisini *et al.* (2014). These fixed effects imply that we compare how the invoicing responses differ for a given firm when it imports a given product at a given time from two countries differentially affected by the dollar credit shock.

Our results highlight the importance of bank intermediation in the cross-border dollar credit market. Consistent with the fact that international trade credit is primarily intermediated between exporting and importing banks, we find that changes in dollar credit supply to non-financial firms have an insignificant impact on dollar invoicing shares. In the same spirit, changes in non-dollar credit component does not affect the dollar invoicing, highlighting the tight link between credit supply of a particular currency which finances the invoicing of trade in that currency, consistent with the model of Gopinath & Stein (2020).[2]

Next, we turn to document how a lack of competition in the currency of invoicing amplifies the adverse real effects of dollar credit shocks. The amplification is a direct consequence of the inability of some of the firms exposed to dollarization to substitute away from dollars, which limits the volume of trade these firms can support with limited dollar trade credit after the taper

[2]The cross-border assets and liabilities maintained by the BIS also provides information on credit to non-financial firms as well as credit decomposition into major currencies.

tantrum episode. To this end, we measure the dollarization for a given country-product pair in two ways: first, by using the ex-ante dollar invoicing shares for that country-product (*share measure*), and second, by estimating the flexibility in terms of usage of alternate currencies for invoicing the trade within that country-product pair (*flexibility measure*). Subsequently, we construct a firm-level measure of dollarization on these two dimensions by weighting these country-product measures by the ex-ante exposure of a firm to each country-product pair.

We first document the well-known trade credit channel of trade by showing that a given firm-product import declines more if the exporting country experiences a more severe dollar credit shock. A one pp. larger dollar credit shock increases the probability of a firm exiting a firm-product-country next month by 9.9 pp. (or by 23% relative to mean exit probability) after the taper shock. However, what is novel to our results is the finding that this adverse trade impact is largely concentrated within the more dollarized country-product pairs or more dollarized firms. The estimated exit probability rises by more than double for the sub-sample of firms with above-median dollarization relative to the firms with below-median dollarization. We sharpen our findings by conducting a within-country test by additionally absorbing exporting country $\times$ time fixed effects and exploiting within-country variation in terms of firms' exposure to dollarization. In particular, within a given country experiencing a one pp. larger dollar credit shock, firms having one-standard-deviation higher exposure to dollarization suffer exit probabilities that are 34.9 pp. or 18% (relative to the mean exit probability) larger in the post-taper period.

We explain these amplified adverse effects of dollarization on a firm's trade following the dollar credit shock by comparing how dollarization affects firm invoicing patterns. We find that the firms with low dollarization are able to significantly reduce their dollar invoicing post-taper in response to the dollar credit shock, while highly dollarized firms do not exhibit any statistically or economically significant reduction in dollar invoicing. We provide a 'within-country' evidence supporting this finding by saturating our model further by absorbing country$\times$time fixed effects and showing that out of the two firms trading within a given country-product pair, a firm having one-standard-deviation less dollarization (using share measure) reduces the dollar invoicing by 5.3 pp. or 8.5% more in the post-taper period. In terms of real effects, we find that this rigidity and over-reliance on dollars implies that these firms are able to support less trade and even lose trade relationships with a greater likelihood compared to firms with less exposure to dollarization.

In short, our results highlight the potential shock-absorbing role that flexible invoicing regimes can play during times of stress to trade credit originating in a particular dominant currency. From

a policy perspective, this calls for the setting up of funding and invoicing networks in a basket of currencies to reduce the risk of shocks to credit in any single currency.

Finally, we highlight the role played by the global banks in mitigating the adverse trade credit shocks by enabling the firms to substitute the dollar invoicing. We hypothesize that the local/Indian subsidiaries of the global banks can leverage the strength of their internal capital markets by tapping into their parents' multi-currency treasury. In turn, this allows the firms connected to these global banks to maintain the trade volume and trade connections by using alternate currency invoicing more efficiently than those firms connected with purely domestic banks. We provide evidence consistent with this narrative. In particular, we document that the firms trading with the exporting countries whose banks are present in India reduce their dollar invoicing after the taper tantrum, thereby suffering less adverse consequences on the trade.

This paper contributes to the literature on three key dimensions. First, we utilize high-frequency trade invoicing data and shed light on the yet-not-well-documented fact that trade invoicing responds to the trade credit shocks in the *short-run*. Second, by exploiting quasi-random cross-country variation in the dollar credit shock generated by the taper tantrum episode and deploying a robust set of fixed effects, we are able to causally establish the link between dollar credit shocks and trade invoicing. Third, we provide robust evidence in support of what we call the *dollar invoicing channel* by documenting that firms more exposed to various measures of 'dollarization' suffer more severe trade consequences in response to dollar credit shocks.

Related Literature: Our paper contributes to the literature that studies the link between the currency of trade invoicing and cross-border credit. The results are notable in the context of empirical and theoretical literature documenting the long-run stickiness of vehicle currencies such as the dollar in trade invoicing (Gopinath (2005); Gopinath & Itskhoki (2022); Coppola *et al.* (2023)). In addition to documenting the dominance of a few currencies, this set of papers identifies transaction costs (Krugman (1980)), industry-specific features (Goldberg & Tille (2008, 2016)), and inter-linkages between household demand for safe assets, bank funding, and invoicing (Gopinath & Stein (2020)) as important determinants. An important contribution of this paper is to show that dollar invoicing fluctuates to mitigate the impact of credit shocks in particular currencies. To the best of our knowledge, this is the first paper to causally establish the link between cross-border credit and dollar invoicing, which is a key prediction of Gopinath & Stein (2020).

This paper also highlights that shifts in trade invoicing can mitigate the effects of cross-border credit shocks that are not captured in quantitative models such as Boz *et al.* (2019). The quantitative models estimate the pass-through of high-frequency external shocks on domestic outcomes like trade and inflation under different invoicing regimes. By holding invoicing fixed to either producer, local, or a dominant currency, our results imply that they over- or under-estimate the effects depending on the dollarization assumed in these models.

More broadly, our paper is connected to the vast strand of literature linking credit conditions with trade outcomes. For example, firms linked to unhealthy banks (Amiti & Weinstein (2011)) or banks exposed to capital reversals (Paravisini *et al.* (2014)) suffer in terms of exports growth. Manova (2012) documents that credit conditions affect exports over and above the direct effect coming through the contraction of the domestic output.[3] We highlight an entirely new channel through which credit conditions affect trade outcomes, namely the *dollar invoicing* channel. In particular, we show that the firms that can substitute dollar invoicing in times when dollar credit declines globally, can retain trade connections and trade volumes. On the flip side, exposure to highly dollarized exporting country-products pairs, or pairs with very limited flexibility of using alternate currencies to settle the trade makes firms more vulnerable to dollar credit shocks, thereby amplifying the real effects of trade credit shocks on firm outcomes.

The rest of the paper is organized as follows. Section 2 describes the empirical strategy; Section 3 describes the data; Section 4 describes the main results; Section 5 establishes the novel invoicing channel; Section 6 establishes the role of foreign banks; and Section 7 concludes.

2 Empirical Methodology

In this section, we describe our empirical strategy to study the impact of dollar credit on dollar invoicing. We use the taper tantrum episode to construct plausibly exogenous variation in dollar credit and trace its impact on dollar invoicing.

[3] A number of papers also document the importance of trade finance during the great trade collapse of 2008 (see Chor & Manova (2012); Bricongne *et al.* (2012); Levchenko *et al.* (2010)). The dollar's strength as a proxy of credit conditions is shown to affect export performance (Bruno & Shin (2020)).

2.1 Construction: Dollar Credit Shock

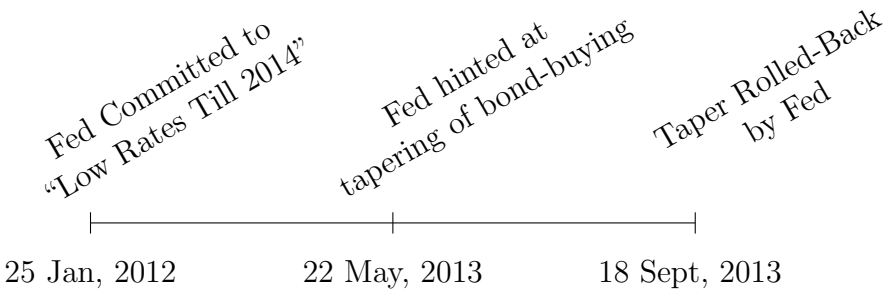
We first motivate why the exporter country banks' external credit is the relevant variable to look at. We then describe the construction of the dollar funding shock, followed by our empirical strategy.

International trade and finance is characterized by two important features. First, there is a prevalence of bank-intermediation (Niepmann & Schmidt-Eisenlohr (2017)) due to longer transportation times and potential custom delays increasing working capital needs for exporters and importers, higher risk of shipment destruction requiring greater coordination with insurers, potential difficulties in cross-border contract enforcement, and associated higher default and settlement risk. Second is the fact that the exporters' bank is the principal entity providing the trade credit. For example, trade credit extended to Indian exporters by India's EXIM bank is 14 times larger than the trade credit extended by the same bank to India's importers, which implies that Indian importers depend predominately on the trade credit originated by the exporter country bank.

It is useful to understand the modus operandi for a standard trade transaction. First, an importer (M) and exporter (X), agree on the terms of contract such as product, quantity, quality, price, and the date of delivery. The firm M then uses the contract to procure a Letter of Credit, or LoC, from its bank (Bank_M) and provides it to X. Importantly, note that the LoC does not result in any disbursal of funds to M, and therefore it is not trade credit. Bank_M only bears the risk of non-payment by M upon X meeting the contract terms. Bank_X purchases the LoC at a discount and disburses funds to X. This is the only time there is a credit made in this transaction. Interestingly, when Bank_X disburses funds to X, it is recorded as a liability, not against X, but against Bank_M (International Monetary Fund (2019)) as the money is disbursed against the LoC provided by Bank_M. In other words, it is recorded as cross-border bank-to-bank credit between X's country and M's country. A large part of this cross-border bank credit is denominated in dollars. Motivated by this modus operandi behind any international trade transaction, we focus on the deterioration in the volume of the cross-border dollar credit extended by the exporting country banks to the banks in other countries around the taper episode.

Figure 1 provides the timeline of events during the taper tantrum episode. On January 25, 2012, the Federal Reserve Bank (Fed) stated that it would maintain low interest rates "at least through late 2014" as part of its forward guidance policy. However, on May 22, 2013, the Fed Chairman reversed this policy and spoke about the possibility of tapering off the bond-buying

Figure 1: Timeline of the Taper Tantrum Episode



Notes: The figure provides the main sequence of events during the taper tantrum episode. The Fed hinted at tapering its bond-buying program in May 2013, while it reversed that stance in September 2013.

program before the earlier-stated deadline. This unanticipated change in the Fed's stance led to a sharp impact on cross-border capital flows, exchange rates, equity prices, and credit default spread in several countries. Most importantly, for the purposes of this paper, the shock had an impact on the supply of wholesale dollar funding for banks in the major international capital markets, which resulted in a lower supply of dollar credit by these banks to the importers.

We construct our dollar credit shock measure for any country as the drop in the aggregate dollar credit extended by the banks of that country to the banks of other countries from pre- to post-taper period. In particular, the dollar credit shock for country c is defined as

$$\text{shock}_c = -1 \times \left\{ \frac{\text{Dollar Credit}_{c,\text{Q2 2013}}}{\text{Dollar Credit}_{c,\text{Q1 2013}}} - 1 \right\} \tag{1}$$

where $\text{Dollar Credit}_{c,\text{Q2 2013}}$ is the stock of cross-border dollar credit by banks in the country c. Because we multiply the quarter-on-quarter credit change by -1, a positive $shock_c$ value indicates a *drop* in the cross-border bank credit by banks of exporting country c from pre- to post-taper. We construct the shock this way to generate a more intuitive negative coefficient on the impact on dollar invoicing when dollar credit falls.

There are several reasons as to why the taper tantrum shock is economically important. First, the taper episode was a result of a completely unexpected monetary policy action that originated in the United States. The expected Fed rates by 2019 (as implied from the overnight index swaps or OIS forward curve) shot up from 2.75% right before the taper announcement to around 4% by the end of June of 2013, and the number of expected fed rate hikes over the next two years

went up from less than 1.5 to more than 3 over the same time. Consequently, the 10-year yield on the US Government bonds spiked from 1.93% on May-21, 2013 to 2.03% on May-22 after the announcement, and kept rising to reach 2.16% by May-28.

Second, the taper announcement had massive spillover effects on global currencies, bond yields, equity prices, and most importantly capital flows (Eichengreen & Gupta (2015)). For example, Brazil, India, Indonesia, Turkey, and South Africa experienced a bond yield spike of 2.5% by August of 2013 (Mishra *et al.* (2014)). Hence, the taper episode allows us to study the effect of shocks to the cross-border credit supply from the exporting country, where the credit supply dropped for the reasons unrelated to the fundamentals of the exporting country. Third, the taper disrupted the ongoing recovery in the cross-border dollar credit market after the slump witnessed during the Global Financial Crises (GFC) of 2008. For example, by the end of 2012, trade-weighted median cross-border dollar loans outstanding were 16% below the pre-GFC levels. Taper was preceded by a sequence of nine straight quarters of positive growth in the trade-weighted median cross-border dollar credit, suggesting that taper-tantrum resulted in a sudden capital flow reversal (Ghosh *et al.* (2016)).

2.2 Summary Statistics for Dollar Credit Shocks

Table 2 provides summary statistics for the shock variable for the countries with which India had positive trade during 2012. We use the 2012 trade-weights for Indian imports using the United Nation's COMTRADE database. In the resulting sample of 125 countries, the trade-weighted median and 75^{th} percentile of dollar credit shock are 2.39% and 11.60%, suggesting that when sorted on the basis of shock, a median (bottom 25%) country trading with India experienced a decline of 2.39% (11.60%) in cross-border dollar credit extended by its banks to banks in other countries. Banks from many of India's top trading partners reduced cross-border dollar lending substantially during the taper episode: China by 17.05%, the USA by 6.11%, Saudi Arabia by 8.28%, Switzerland by 11.59%, South Africa by 6.82%, Malaysia by 9.43%, and Belgium by 3.75%. The taper-tantrum-led drop in cross-border dollar credit was more severe for the emerging markets group, with a trade-weighted median drop in dollar credit of 8.28%.[4]

However, there is a wide variation in the dollar credit shock across the countries, as many

[4]We use the MSCI Classification to tag a country as Emerging (https://www.msci.com/our-solutions/indexes/market-classification)

countries extended more credit during this period, with the 25^{th} percentile of the shock distribution being around -3.85%. Interestingly Euro area banks collectively expanded their cross-border dollar lending by 10.26% during the taper episode. A median EU country also grew cross-border dollar lending by 3.20% during the taper. Combined with our result that firms substitute dollar invoicing with Euro invoicing suggest that European banks not only supported more Euro invoicing by expanding Euro lending, but also supported dollar invoicing by lending more dollars.[5] However, some important non-Euro-Area countries such as Japan, Argentina, Brazil, Jordan, Netherlands, Sweden also extended dollar credit during the taper episode. This rich cross-section of dollar credit shock bodes well for our identification, as a given importer is likely to be trading with countries heterogeneously exposed to the dollar credit shock.

In the last row of Panel A of Table 2, we re-computed our shock measure using a longer window. In particular, we compute the percentage change in cross-border dollar credit between the first and third quarters of 2013 instead of first and second quarters of 2013 as in the baseline shock. Relative to the baseline shock, the shock defined on the longer window has a marginally bigger median (2.67% vs. 2.39%) and a significantly larger 75^{th} percentile (14.75% vs. 11.59%), suggesting that the adverse dollar credit supply shock persists. Figure 3 shows that this persistence is mainly driven by the Emerging economies. In Panel B, we consider alternative definitions of shocks and see if these are correlated with our baseline shock measure. While our baseline shock measures the change in dollar credit from exporting country banks to banks of other countries (bank-to-bank), the alternative shock computes the change in dollar credit between exporting country banks on the one hand and *All the sectors* of other countries, as well as just the *non-financial* sector on the other. The correlation between our baseline shock and shock defined using "All sectors" credit is 0.67. However, it is low at -0.05 for the shock defined using credit to non-financial sector, suggesting that the cross-border dollar credit between banks and the non-financial sector has different dynamics. As our results show, bank-to-bank dollar credit drives our results.

2.3 Identification Strategy

To draw causal inferences about how dollar credit shocks affect dollar invoicing and trade, we exploit the cross-country variation in dollar credit shock ($shock_c$) and estimate the heteroge-

[5]EU banks have been shown to be active in dollar lending market before the Global Financial Crises with roughly 4.5 trillion dollars of outstanding loans in dollars (Baba *et al.* (2009)).

neous invoicing patterns of a given firm across multiple trading partners hit with dollar credit shocks of varying intensity. We utilize a standard difference-in-differences (DiD) setting with a rich set of fixed effects. We aggregate our transaction-level import data at firm×exporting country×product×month level. The sample period covers 9 months before (i.e., from September 2012) and 9 months after (i.e., until February 2014) the Taper episode.

We explain our strategy where our primary dependent variable is the share of dollar invoiced trade (imports), $inv^{\$}_{fcpt}$, where f, c, p, and t indexes the importing firm, exporting country, product (defined at the HS2 level), and month/time respectively. The impact of the dollar credit shock on dollar invoicing is estimated using a following specification on a window of nine months around the taper tantrum event;

$$inv^{\$}_{fcpt} = \beta_0 \text{ shock}_c + \beta_1 \ \mathbb{1}(\text{Post}_t) + \beta_2 \text{ shock}_c \times \mathbb{1}(\text{Post}_t) + \delta_{fpt} + \gamma_{cp} + \theta' \mathbb{X}_{ct} + \varepsilon_{fpct} \qquad (2)$$

where $shock_c$ is the dollar credit shock as defined in Equation 1, and $\mathbb{1}(\text{Post}_t)$ is a dummy variables that takes a value one after May 2013 and zero until May 2013. The main coefficient of interest β_2 estimates the additional change in the share of dollar invoiced trade from country c from pre- to post-taper period, in response to a 1 pp. larger dollar credit shock in that country. β_2 obtains its causal interpretation from the unexpected nature of the dollar credit shock and a rich set of fixed effects this specification employs. In particular, the specification includes firm×product×time fixed effects (δ_{fpt}) which identifies β_2 using the cross-country variation in dollar credit shock within a given firm-product pair. Intuitively, we compare the change in dollar invoicing share from pre- to post-taper period for a given firm importing a given product (e.g leather shoes) from two countries (e.g Italy and Spain) experiencing differential dollar credit shock. In addition, the specification includes exporting country×product fixed effects (γ_{cp}) and a robust set of exporter's country×time controls ($\mathbb{X}_{ct}$) described below. The standard errors are double-clustered at the exporter country and product levels.

The fixed effects δ_{fpt} and γ_{cp} control for several observed and unobserved factors that can jointly affect both the severity of dollar credit shock on one hand and the invoicing choices and the trade for the firms on the other. Our firm×product×time fixed-effects (δ_{fpt}) are similar to Paravisini *et al.* (2014) and account for observed or unobserved, time-varying or invariant factors specific to a i. firm ii. product, and most importantly iii. firm-product combination. A prime example of a firm-specific time-varying unobserved factor would be a change in a firm's preference for dollar

invoicing across all its trading partners in response to a change in its currency risk management policy. Our estimation is robust to a change in the firms' preferences occurring exactly after the taper tantrum, provided it affects all the firms' trading partners similarly. The only threat to our identification comes from the shocks to a firm's preferences that are correlated with the dollar credit shock, and the change in the preferences occurs for reasons unrelated to the taper-induced dollar credit shock, which is very unlikely.

Our fixed effects also control for the unobserved changes to the firm's overall financial position (*demand*) or shocks to the health of its lenders (*supply*), which can affect its invoicing patterns and trade. An example of a product-specific time-varying factor that our fixed effect absorbs is a global decline in trade of a particular product or changing invoicing patterns for a product globally. Controlling for product×time unobserved factors is vital in international trade studies due to the seasonality of the trade, which changes the composition of merchandise traded over the months within a year. To the extent that different merchandise have varying degrees of dollar invoicing, the seasonality can confound the results.

The term γ_{cp} controls for any exporting country×product level time-invariant factors. It includes i. any time-invariant country characteristics (such as ex-ante GDP per capita and credit ratings, among others) or ii. any time-invariant country factors specific to a given product that might confound the impact of the shock on invoicing and trade patterns. For instance, countries can suffer from a product-specific persistent supply crunch for a given product or product-specific trade financing schemes in particular currency.[6] Later, we also extend our model to include exporting country×product×firm fixed effects.

Since our identification depends on cross-country variation generated by the shock, we cannot include time-varying country-fixed effects in our specification. Instead, we include time-varying country-level controls in $\mathbb{X}_{ct}$ grouped into macroeconomic variables (inflation, industrial production growth), external variables (export growth, currency depreciation, and volatility), and financial variables (equity returns, interest rate, and credit/GDP ratio) to filter out the impact of these country-specific dynamic factors. These covariates capturing the economic condition in the exporting country are potentially correlated with the dollar credit shock and the response of dollar invoicing shares, and trade flows can respond to the covariates. Excluding these controls can therefore confound our results by incorrectly ascribing the change in invoicing to the dollar

[6]Since our estimation window is 18 months, any country-product specific factor that is otherwise time-varying but is constant during that short span of 18 months is also controlled for by our country× product fixed effects.

credit shock.

3 Data

Our primary dataset is a random sample from the transaction-level administrative customs data on Indian imports between September 2012 and February 2014. The sample consists of 31.5 million transactions from 224 countries totaling $422 billion, accounting for 59.82% of India's total imports during the sample period. Each transaction provides us with an anonymous firm identifier, customs clearing date, exporting country, HS8 code of the product, the value of the transaction (denominated in dollars), and quantity. However, not all observations provide information on the currency of invoicing. We could obtain the data on the currency of invoicing for a randomly chosen 3.7 million transactions (roughly 7.8% and 11.7% of the imports by value and transaction, respectively) out of the first random sample.

The data on the cross-border loans comes from the Bank of International Settlement (BIS). Table A6.1 of the locational banking statistics provides the data on credit outstanding between each country's reporting banks and "All Other Countries", broken down by currencies and sector (bank, non-bank financial, and non-financial) of the borrowing country at a quarterly frequency. Our baseline dollar credit shock measures the change in the dollar credit outstanding between the exporting country's banks and the banks of borrowing countries. That is, we focus on *bank-to-bank* credit in dollar terms. The data on country characteristics comes from the International Monetary Fund statistics, and from Bloomberg. Finally, we use the data on the presence of foreign banks (as of 2013) in India from Reserve Bank of India.

4 Impact of Dollar Credit Shocks on Dollar Invoicing

In this section, we present the results documenting the fall in dollar invoicing share following a shock to the supply of dollar credit after the taper tantrum.

4.1 Dollar Credit Shocks and Dollar Invoicing

We are now in a position to answer the following question – do Indian importers respond to adverse dollar credit shock by reducing the share of dollar-invoiced imports? As described in Section 2.3, we employ a differences-in-differences estimation as specified in Equation 2 with the share of dollar invoiced firm×exporting country×product×time imports as the dependent variable.

Table 3 reports the results. We begin in column 1 by estimating Equation 2 without any controls but including the firm×product×time and exporting country×product fixed effects so that we compare the pre- to post-taper change in the share of dollar invoiced imports for a given firm-product pair across countries that experience dollar credit shocks of varying intensities after controlling for time-invariant country-product level characteristics. The point estimate of the response of share of dollar invoicing to the credit shock measured by the coefficient on the interaction term, $\mathbb{1}(Post) \times$ Shock is negative (-0.069) and statistically significant at 1% confidence level. The response is large economically, too. A 1 pp. higher dollar credit shock implies that the share of dollar invoiced imports for a given firm-product pair from that country additionally falls by 6.9 pp., which is 10.8% relative to the sample mean of 63.8%.

Columns 2 and 3 progressively add the macroeconomic, external, and financial variables to capture the time-varying economic conditions within the exporting country. The strength of our estimate of the response of dollar invoicing to credit shock is virtually unchanged, both statistically and economically, and, increases slightly compared to column 1. A rich set of controls ameliorates the concern that the change in the intensity dollar invoicing is potentially driven by the correlated change in economic conditions of exporting country around taper tantrum, rather than by the dollar credit shock. Many countries experienced heightened currency volatility as well as sharp depreciation of currencies against the dollar after the taper tantrum. Currency volatility has been shown to affect choice of the invoicing currency (Goldberg & Tille (2016)).[7] In addition, currency fluctuations affect banks' lending capacity through the net currency exposures of these banks (Agarwal (2021)). However, our result is robust even after controlling for currency movement and volatility. We treat the specification in column 3 as our preferred baseline specification. The results in the tables that follow use this specification unless mentioned otherwise.

[7]The rise in currency volatility in exporting country is found to boost the vehicle currency invoicing. If anything, by excluding the currency volatility from controls we would underestimate the response of dollar invoicing to dollar credit shock. Consistent with this logic, we find that the dollar invoicing responds more strongly in columns 2 and 3 when we control for currency variables as compared to column 1.

In columns 4 and 5, we show that the result is robust when using an alternate set of fixed effects. In column 4, we rule out that the endogenous matching of firms with countries or products is driving our results. We achieve this by absorbing the firm×country×product fixed-effects and identifying the response coefficient by estimating within the firm-country-product change in share of dollar invoicing in response to dollar credit shock. A within-tuple comparison rules out compositional changes in firm-country-product groups driving our DiD estimates.[8] Note that we continue to absorb the firm×product×time fixed effects, which control for any time-varying average product demand or firm-wide demand for dollar invoicing. We find that the coefficient on the interaction term continues to be negative and significant (-0.055).

Next, in column 5, we vary the fixed effects to utilize a larger sample of data for identification. The fixed effects in columns 1 through 3 have a strict specification where the coefficient is identified from the set of firm-product pairs having at least two partner countries present in both the pre-taper and post-taper periods. In column 5 instead, we control for time-varying firm-specific factors (firm×month fixed-effects) and time-varying product-specific factors like demand (product×month fixed-effects) and obtain the qualitatively and quantitatively similar result as in the more restrictive specification in column 3.

In column 6, motivated by the fact that the distribution of share of dollar invoicing is bimodal with 98.7% values being either 0 or 1, we alter our dependent variable to a binary variable capturing dollar invoicing. A given firm seldom imports the same product from the same country in two different currencies in a given month. Hence, an adjustment to invoicing currency in response to the dollar credit shock is likely to be either none or complete. To reflect this extensive margin of adjustment, we change our dependent variable to a dummy, which takes a value of one if a firm-country-product-time share of dollar invoicing is positive and takes a value of zero otherwise. We obtain a statistically significant negative coefficient on $\mathbb{1}(Post) \times$ Shock with a magnitude of -0.065. The probability that 100% of firm-country-product-time imports are invoiced in non-dollar currency rises from pre- to post-taper additionally by 6.50 pp. in response to a 1 pp. larger dollar credit shock.

[8] For instance, only larger firms might be able to import from hard-to-access smaller countries and these pairs are more likely to invoice in local currency of the large firm due to higher negotiating power. At the same time, dollar credit shock could hit these smaller exporting countries more severely. Lager firms are more likely to survive the trade connections post taper compared to smaller firms which are likely to invoice in dollars. Such a compositional shift post-taper could explain our results rather than any change in dollar invoicing intensity within a firm-country pair.

Finally, in column 7, we test if the results hold at a higher (firm-country-time) level of aggregation as our shock is defined at the exporting country level. Now the dependent variable is the firm×country×time share of dollar invoiced imports. The coefficient on the interaction term is once again negative and significant and the magnitude (-0.069) and comparable to the baseline estimate.

In a nutshell, Table 3 establishes a novel fact that the importing firms do respond to a decline in cross-border dollar credit from exporting country banks by reducing the share of dollar invoicing after the taper tantrum.

4.2 Type of Cross-Border Credit and Type of Borrowers

In this section, we conduct two tests to highlight the role of the dollar credit relative to alternative currencies and the role of bank-to-bank intermediation relative to bank-to-non-financial-firm credit. The first test explores the role of a shock to cross-border dollar credit relative to the shock to cross-border credit in alternative currencies. As importers attempt to minimize the currency mismatch, the invoicing currency and the currency of trade credit are likely to be the same. Hence, a shock to a particular currency (say, the dollar) is likely to affect invoicing in that currency more prominently.

The second test focuses on the role of bank-to-bank intermediation for international trade. As motivating example discusses, banks are important intermediaries in international trade transactions. Once an exporter (X) and an importer (M) agree to the contract terms, the importer secures a letter of credit (LoC) from her bank (Bank_M). The exporter's bank (Bank_X) discounts the LoC and disburses funds to X. A liability is created on Bank_X, which appears as cross-border *bank-to-bank* credit from X's country to M's country in the BIS dataset. In short, bank-to-bank networks are important channels through which cross-border trade credits operate.

Given these facts, we make two hypotheses about the role of banks and dollars:

1. Since dollar trade credit supports dollar invoicing, shocks to non-dollar credit should have a muted impact on dollar invoicing.

2. Since bank-to-bank dollar credit drives the trade credit, shocks to bank-to-non-financial-firms dollar credit should have a muted impact on dollar invoicing.

Table 4 documents the results. Column 1 reproduces the baseline result (column 3 of table 3), showing that a deterioration of *bank-to-bank* cross-border dollar credit around taper-tantrum leads to a significant fall in the share of dollar invoicing. The first test (column 2) holds the currency of credit as dollars but traces the credit to various types of foreign borrowers. In particular, we use the BIS data to construct a *bank-to-non-financial-firm* dollar credit shock based on the dollar credit outstanding between the exporting country banks and non-financial firms in the rest of the world. Column 2 shows that dollar invoicing does not change from the pre- to the post-taper period in response to the *bank-to-non-financial-firm* dollar credit shock. The coefficient on the interaction term between the shock and post-taper dummy in column 2 is economically small and statistically indistinguishable from zero. This result highlights the special role played by the *bank-to-bank* networks in supporting dollar trade invoicing.

In the second test (column 3), we construct a *bank-to-bank non-dollar* credit shock based on changes in the non-dollar credit lent by the exporting country banks around taper tantrum. Column 3 again shows that dollar invoicing is non-responsive to non-dollar credit shocks. This highlight the role played by the dollar credit in determining the dollar invoicing.

4.3 Substitution to Alternate Currencies

If importers, on average, reduce their share of dollar-invoiced imports in response to dollar credit shock after the taper tantrum, which alternate currencies substitute dollar invoicing? We employ the same estimation strategy as above, with the share of firm×country×product×time imports invoiced in a given currency as the dependent variable. Table 5 documents the results.

Column 1 shows a modest substitution towards the local currency invoicing, namely the Indian Rupee (INR), with the response coefficient to dollar credit shock of 0.0152, which is statistically significant at a 10% confidence level. Economically, this means that INR fills roughly 20% of the void created by the fall in share of dollar invoicing. The limited shift towards local currency pricing is in line with Goldberg & Tille (2016), who document that larger transactions relative to the industry predicts local currency pricing. With Indian import transactions being relatively smaller to the industry averages, the result is consistent with what one would expect. Additionally, we find no evidence for a shift in invoicing towards currencies of other major trade partners of India, namely Yen (column 3) and GBP (column 4), or in invoicing in the producer currency, i.e., the exporters' currency, in column 5.

Next, we explore if importers shift towards the second largest vehicle currency in international trade, namely the Euro. India's imports from European countries are predominantly invoiced in Euros, with 80% pre-taper share of Euro invoicing. However, if the exporter is from a non-European Union country, the share of Euro invoicing in the pre-period is only 3.07%. Column 2 shows that the share of Euro invoicing increases after the shock to dollar credit in the post-taper period. The rise is economically significant. A 1 pp. larger dollar credit shock leads to a 7.30 pp. fall in dollar invoicing (Column 3 of Table 3), out of which the Euro captures 4.86 pp. share. Collectively, INR and Euro capture 6.38 pp. of the fall 7.30 pp. fall in dollar invoicing in a country experiencing a 1 pp. larger dollar credit shock.

Interestingly, we find that the Euro invoicing rises for imports from non-EU countries (column 7). In contrast, imports from the EU region show no change in Euro invoicing post-taper (column 6). This can be explained by the fact that ex-ante trade with European exporters is already predominantly invoiced in Euros, as mentioned above. In summary, the Euro emerges as the primary substitute for dollar invoicing after the dollar credit shock.

4.4 Dynamics of Dollar Invoicing Around Taper-Tantrum

The key identifying assumption behind our differences-in-differences estimation is s parallel trend assumption. The assumption of parallel trends in our set-up means that the firm-country-product dollar invoicing for both the treated (high dollar credit shock countries) and the control (low dollar credit shock countries) groups would have followed parallel trends in the absence of the treatment (taper tantrum). We tackle this concern in two ways. First, following Atanasov & Black (2021), we conduct the pre-treatment balancing tests. We obtain that the GDP per capita and sovereign credit ratings are statistically and economically indistinguishable from each other across the countries experiencing above-median and below-median dollar credit shock. The balanced treatment and control groups are more likely to satisfy the parallel trend assumption.

Second, given that we can not observe the counterfactual of no treatment to test the parallel trend assumption, following Roberts & Whited (2013), we conduct the falsification test to confirm that the dollar invoicing shares of imports were evolving parallelly across the treated and control firm-country-product tuples in the pre-taper period. To this end, we estimate a following differences-in-differences model by interacting time dummies with the country's dollar credit shock

as follows

$$inv_{fcpt} = \beta_0 \left[shock_{\,c}\right] + \sum_t \gamma_t \mathbb{1}(t) + \sum_t \beta_t \left[\mathbb{1}(t) \times shock_c\right] + \delta_{fpt} + \delta_{cp} + \theta' \mathbb{X}_{ct} + \varepsilon_{fpct} \qquad (3)$$

where $\mathbb{1}(t)$ is the dummy taking value of 1 for time t and 0 otherwise. The rest of the variables and fixed effects are as in Equation 2. β_t measures the difference in the share of dollar invoicing at time t for a given firm-product pair across two countries, where one country received 1 pp. larger dollar credit shock than the other. We create nine non-overlapping time groups between the third quarter of 2012 and the second quarter of 2014 and consider the time group of April-May 2013 as the base time group so that $\beta_{\text{Apr-May,2013}} = 0$. That is, we normalize the difference in share of dollar invoicing across treated and control firm-country-product tuples to zero and compare the differences in the other time periods relative to April-May 2013. The results are presented in Figure 2.

We find that the β_t coefficients on the interaction term of time dummies and credit shock for the months before the event are statistically indistinguishable from zero. Therefore, the results are not driven by the possibility that the dollar invoicing share was already evolving differently in the pre-taper period across countries experiencing heterogeneous dollar credit shocks. This result also rules out reverse causality. For example, it could be the case that the drop in cross-border credit by exporting country banks merely reflects the lower demand for dollar invoicing by the importing firms in the pre-period.

In contrast, we obtain statistically significant negative coefficients on the interaction term for the time groups after the taper event for the rest of our sample period, except during the fourth quarter of 2013. The economic magnitude of the response of dollar invoicing to dollar credit shock is comparable to the baseline estimation in column 3 of Table 3. That is, we find that the dollar invoicing falls relatively more in the countries affected by the dollar credit shock after the taper tantrum.

5 The Invoicing Channel of International Trade

The analysis so far provides robust evidence that the dollar invoicing share of Indian imports, on average, drops more with the exporting countries experiencing a more significant fall in dollar

credit. In this section, we accomplish two objectives. First, we explain the cross-section of the response of dollar invoicing to the dollar credit shock. Second, and most importantly, we assess whether these differences in trade invoicing responses explain the cross-section of trade responses around the taper episode.

Mainly, we provide evidence showing that the ability to substitute away from dollar invoicing helps firms mitigate the adverse real effects of the dollar credit shock. However, not all firms can shift invoicing to alternate currencies within a short window after the disruption to the dollar credit. This inability stems from several possible reasons. First, as banks specialize in the currencies they lend, the existing set of banks servicing the firm may be unable to provide trade credit in alternate currencies. Finding a new set of banks lending in alternate currencies, such as the Euros, is difficult in the short run given that these banks are concentrated within the European region (Emter *et al.* (2024)). Second, certain economies and products are more 'dollarized' in the sense that these are highly dependent on dollar invoicing or offer little flexibility in using alternate currencies for invoicing other than dollars. Importing firms exposed to these dollarized exporting countries/products bear the cost of this rigidity/over-reliance on the dollar in terms of trade volume and relationships. In other words, our results establish that 'dollarization' amplifies the adverse real effects of the dollar trade credit shocks.

As highlighted in the introduction, this hypothesis rests on three key channels: reduced supply of dollar trade credit after the taper tantrum, exporter's unwillingness to accept alternate currencies given their pre-determined liabilities denoted in dollars, and difficulty in quickly building new banking connections, especially with the banks that lend in alternate currencies, even if the importer is willing to bear the currency risk or the cost of hedging the risk.

5.1 Measures of Dollarization

To test these ideas, we measure dollarization for a given country-product pair by estimating its ex-ante reliance on dollar invoicing, and the flexibility such a country-product pair offers in terms of invoicing in alternate currencies.

We first define the ex-ante reliance of the country-product pair on the dollar invoicing as the ex-ante share of dollar invoiced country-product trade ($trade_{cp,pre}$) measured over the pre-period of the nine-month window before the taper. We call this the *share measure of dollarization* and

denote it by $\$_{cp}^{pre}$ for a given country c and product p pair. Next, we define the flexibility in invoicing for a country-product pair as the standard deviation of dollar invoicing shares computed over all the firm-country-product triplets within that country-product pair in the pre-period. We call this the *flexibility measure of dollarization* and denote it by $\sigma(\$)_{cp}^{pre}$. The two measures capturing the dollarization are likely negatively related in the data. A country-product pair that is 100% reliant on the dollar has zero invoicing flexibility by construction. However, in the data, the correlation between the two measures is -0.152, suggesting that each measure has meaningful economic content.

The mean and the median share of ex-ante dollar invoicing (share measure) across 2008 unique country-product pairs is 0.62 and 0.96, respectively, with a standard deviation of 0.44, suggesting a significant variation across country-product pairs in terms of usage of dollars for invoicing. Further, as documented in Table 6, a large part of this variation comes from the cross section of countries relative to products.[9] In our data, while Latin American economies exhibit a very high share of dollar-invoiced trade, most European economies have low shares of the trade invoiced in dollars. There are countries other than European economies with low usage of dollars for trade invoicing, such as Australia (65%), Turkey (61%), Ukraine (61%), and Japan (36%). These data features are consistent with Boz *et al.* (2022). Similarly, some product groups have a high share of dollar invoiced trade, such as Ores, Slag, and Ash (95%), Fertilizers (97%), while other products exhibit low dollar invoicing, such as dairy produce (17%), railways/locomotives (47%). The flexibility of invoicing measure has a mean, median, and standard deviation of 0.16, 0, and 0.21, respectively. Country and product fixed effects explain somewhat similar but only a modest share of variation in the flexibility measure.[10]

Having defined these measures at the country-product level, we next translate them into a firm-level measure of dollarization by weighting the country-product dollarization by the firm's pre-period trade weight with that country-product pair. In particular, a firm's share measure of dollarization is

$$\$_{f}^{pre} = \sum_{cp} \left(\frac{trade_{fcp}^{pre}}{trade_{f}^{pre}} \right) \times \$_{cp}^{pre} \tag{4}$$

[9]The R^2 when we estimate the mean of the share of dollar invoicing by absorbing the country, product, and country and product fixed effects together are 51.90%, 6.7%, and 56.5% respectively.

[10]The R^2 when we estimate the flexibility in dollar invoicing by absorbing the country, product, and country and product fixed effects together are 15.30%, 8.6%, and 27%.

where $trade^{pre}_{fcp}$, and $trade^{pre}_{f}$ respectively denote the trade for a given firm-country-product (fcp) triplet and the aggregate trade of the firm over all the country-products during the pre-period. Defined this way, the firm's share measure of dollarization captures a weighted average exposure to the share measure of various country-product pairs in which the firm has active trade in the pre-period. Similarly, firm's exposure to the flexibility measure of dollarization is computed as

$$\sigma(\$)^{pre}_{f} = \sum_{cp} \left(\frac{trade^{pre}_{fcp}}{trade^{pre}_{f}} \right) \times \sigma\left(\$\right)^{pre}_{cp} \tag{5}$$

The mean, median, and the standard deviation of firm's ex-ante dollar-invoiced trade is 0.76, 0.90, and 0.27, while the same statistics for the firm's invoicing flexibility measure are 0.19, 0.16, and 0.10, respectively. The fact that firms trade with multiple partners and products helps create a more continuous distribution of the dollarization measures at the firm level.

One could have defined the share measure of dollarization for a given firm as a share of dollar invoiced trade for that firm in the pre-period, capturing the invoicing choice or experience of that particular firm, which is likely to be correlated with the firm characteristics. However, our firm-level dollarization measure aims to capture the dollarization for an average firm having similar ex-ante trade connections as the firm in question. Our firm-level measures of dollarization are akin to shift-share measures heavily used in the empirical studies.

5.2 Dollarization and Invoicing

First, we estimate the heterogeneous invoicing responses to the dollar credit shock for more dollarized firms relative to less dollarized firms, where we use the share measure of dollarization. Table 7 presents the result. The dependent variable is the share of dollar invoiced imports for a given firm-country-product at time t. We use the dollarization measured both at the country-product pair level (columns 1-2) and at the firm level (columns 3-5). We absorb a standard set of fixed effects, namely country×product and firm×product×time fixed effects. Estimates show that highly dollarized country-product pairs (column 1) or firms with high exposure to dollarized country-product pairs (column 3) experience neither statistically nor economically significant additional reduction in the share of dollar invoiced imports from pre- to post-taper in response to a larger dollar credit shock (with coefficients of 0.016 and 0.002). This is contrary to the average evidence presented so far. On the contrary, columns 2 and 4 highlight that the drop in the share of dollar

invoicing is concentrated within the less dollarized country-product pairs or less dollarized firms. Economically, the drop in the dollar invoicing is larger for this group of country-product pairs and firms. For firms with below-median exposure to the share measure of dollarization, a 1 pp. larger dollar credit shock leads to a 9.60 pp. or a 20% drop (relative to the mean share of dollar invoicing) in the share of dollar invoiced trade.

In column 5, we perform our strongest test, which estimates the dynamics of share of dollar invoicing within a given country for the two firms with varying levels of dollarization. We do so by including a triple interaction between credit shock, firm dollarization, and the post dummy and absorbing country×time fixed effects in addition to our standard set of fixed effects. Estimates from column 5 imply that a firm with one standard deviation less dollarization reduces its share of dollar invoicing by 5.38 pp. or 8.50% (relative to the mean share of the dollar share of invoicing) more from pre- to post-taper in a given country experiencing a 1 pp. higher dollar credit shock.

Table 8 documents a parallel set of results using our flexibility measure of dollarization. The share of dollar invoicing drops in the post-taper period in response to the dollar credit shock only for the country-product pairs or firms having above-median invoicing flexibility (columns 2 and 4). The reduction is statistically significant and economically large. Using estimates from column 4, a firm with above-median invoicing flexibility reduces its share of dollar invoicing by 9.2 pp or 15.9% more for a 1 pp. higher dollar credit shock. Column 5 repeats the 'within-country' test by exploiting the within-country variation across firms in terms of the firm's invoicing flexibility. Column 5 estimates are roughly similar and suggest that a firm with one standard deviation more invoicing flexibility reduces its share of the dollar invoicing by 5.01 pp. or 7.9% (relative to the mean share of dollar share of invoicing) more in a given country experiencing a 1 pp. higher dollar credit shock. It must be noted that the magnitudes of invoicing responses are similar across two sets of measures which gives credence to our estimates.

Overall, Tables 7 and 8 provide strong evidence that less dollarized firms are able to reduce the dependence on dollar invoicing exactly when it is difficult to obtain the cross-border dollar credit. On the other hand, more dollarized firms face rigid invoicing regimes and fail to raise trade credit using alternate currencies. The next section shows that this inability to switch out of the dollar trade settlement hurts these dollarized firms in terms of trade volume and trade relationships.

5.3 Dollarization and Amplification of Real Effects

A growing body of literature documents the adverse effects of trade credit and international bank lending shocks on international trade.[11] Adding to this body of literature, our aim is to highlight how dollarization of international trade interacts with the dollar credit shock to amplify the adverse effects on international trade. In particular, we present compelling evidence that a large part of the decline in the international trade following a drop in the cross-border dollar credit is concentrated within the more dollarized countries, products, or firms. We call this the *dollar invoicing channel* of international trade.

We analyze the effects on both intensive and extensive margin of trade. However, the fact that the dollar and non-dollar credit markets are segmented across the set of banks (Emter *et al.* (2024)), coupled with another observation that banks specialize in lending in certain geographies (Paravisini *et al.* (2020)), tilts our priors towards a strong extensive margin adjustment of the trade in response to dollar credit shocks. To this end, we first define a dummy capturing the exit of a firm from a particular country-product pair during time t (denoted by $\mathbb{1}(Exit)_{fcpt}$) as

$$\mathbb{1}(Exit)_{fcpt} = \begin{cases} 1 & \text{if} \quad trade_{fcpt-1} > 0 \quad \& \quad trade_{fcpt} = 0 \\ 0 & \text{if} \quad trade_{fcpt-1} > 0 \quad \& \quad trade_{fcpt} > 0 \\ . & \text{otherwise} \end{cases} \tag{6}$$

That is our measure of exit for period t is defined only for the firm-country-product triplet which is active during the last time period $t-1$. The intensive margin of international trade is analyzed using the log of the firm-country-product-time imports denoted by $\ln(trade_{fcpt})$.

Tables 9 and 10 document the evidence supporting the dollar invoicing channel. We begin by estimating the standard specification linking the credit shocks and international trade as follows

$$y_{fcpt} = \delta_{fct} + \gamma_{cp} + \beta \, \text{shock}_c \times \mathbb{1}(\text{Post}_t) + \varepsilon_{fcpt} \tag{7}$$

where y_{fcpt} is either $\mathbb{1}(Exit)_{fcpt}$ or $\ln(trade_{fcpt})$, shock_c is the dollar credit shock for country c, and $\mathbb{1}(\text{Post}_t)$ dummy takes the value of 1 for the period after the taper-tantrum episode and 0 otherwise. The model has the same set of fixed effects used so far, namely the firm×product×time fixed effects

[11] See for example Levchenko *et al.* (2010); Ahn *et al.* (2011); Bricongne *et al.* (2012); Chor & Manova (2012); Paravisini *et al.* (2014)

(δ_{fct}) and country×product fixed effects (γ_{cp}). Column 1 of Table 9 with $y_{fcpt} = \mathbb{1}(Exit)_{fcpt}$ reports a β of 0.099, which is statistically significant and economically large. A 1 pp. larger dollar credit shock implies a 9.9 pp. or 23% increase from pre- to post-taper period in the probability of a firm's exit from a given country-product pair. This result corroborates the evidence in the literature documenting the negative effects of trade credit shocks on trade.

Next, we highlight the importance of a firm's exposure to dollarization. In Table 9 we measure the dollarization using our share measure at the firm-level, and estimate the Equation 7 separately on the sample of firms with above- and below-median share measure of dollarization. The firm's exit probability rises additionally by 19.7 pp. or 40.4% from pre- to post-taper period in response to a 1 pp. higher dollar credit shock for the firms with above-median dollarization (column 2). In contrast, the exit probability rises by only about half of that magnitude (by 8.1 pp) for the set of below-median dollarized firms (column 3). Recall that these firms with low dollarization are also able to substitute out the dollar invoicing much more swiftly. Column 3 shows that such a nimble response in terms of using alternative invoicing also allows these firms to mitigate the impact of adverse cross-border dollar credit shocks to the dominant currency on trade more efficiently.

Column 4 conducts a sharp *within-country* test by considering a triple interaction between Post, Shock, and firms' dollarization, which also allows us to absorb country×time fixed effects. Economically, this allows for a comparison in terms of the exit probabilities for two firms operating within the same country at the same time, which are deferentially exposed to trade dollarization. Estimates in column 4 suggest a much bigger rise (34.9 pp.) in the exit probabilities for more dollarized firms in the post-taper period, which is statistically significant. Economically, this is a large relative jump in exit probability for the dollarized firms; within a given country facing 1 pp. larger dollar credit shock, a 1 standard deviation higher exposure to dollarization implies that the exit probability goes up by an additional 18.9% from pre- to post-taper period.

Lastly, in column 5, we conduct a similar within-country test for intensive margin of trade using the natural logarithm of firm-country-product-time trade as the dependent variable. Estimates again a suggests a negative coefficient of -0.759 on the triple interaction. Economically, this implies that within a country experiencing a 1 pp. higher dollar credit shock, a firm with one standard deviation higher exposure to dollarization exhibits a 27.60% additional drop in trade value.

Table 10 documents a parallel set of results where we consider the flexibility measure of dollarization. Note that higher flexibility is interpreted as low dollarization. Again, we obtain the

same conclusions. The exit probabilities jump in response to the trade credit shock primarily for the firms with below-median invoicing flexibility. The coefficients are 19.3 pp. for the firms with below-median invoicing flexibility relative to a substantially smaller increase in the exit probabilities of 7.5 pp for those with above-median flexibility (columns 2 and 3 respectively). Column 4, using country×time fixed effects, confirms a significantly lower increase in the exit probability from the pre to post-taper period for the firms having more invoicing flexibility. The economic magnitudes using the two measures of dollarization are again roughly similar.

In summary, both Tables 9 and 10 provide strong evidence that more dollarized firms suffer worse consequences in terms of international trade in response to a drop in dollar credit. These results quantify how dollarization amplifies the adverse impact of a dollar credit shock on trade. We call this the *dollar invoicing channel* of international trade. This channel operates over and above the usual *trade credit* channel of international trade highlighted in the literature so far.

Firm-Wide Real Effects: The results so far document substantial and amplified trade disruption through the dollar invoicing channel for a given firm within a country-product pair. Still, firms might be able to substitute the export partners and/or products (if the production process allows it) and not face any significant disruptions to international trade when measured at the firm level. However, there could be limits to substituting trade partners. For example, literature documents the stickiness of international trade relationships for a variety of reasons, such as relationship-specific investments, search costs, incompleteness of trade contracts, or institutional quality (Antràs & Chor (2013); Levchenko (2007); Nunn (2007)). Given that banks specialize in specific markets (Paravisini *et al.* (2020)), the decision to shift the exporting country or product is most likely also associated with a search for a new bank specializing in that market, adding to the costs of substitution. In light of this evidence documenting sticky trade relations and their perverse effects on trade, we test the hypothesis that firms may be unable to forge new trade relationships to smooth out the disruptions to their existing relations caused due to taper induced dollar credit shock. This result complements the recent evidence documenting how stickiness amplifies the effects of uncertainty shocks on the trade (Martin *et al.* (2023)).

To this end we estimate if more dollarized firms suffer a bigger fall in the trade aggregated across all its trading partners in response to the drop in cross-border dollar trade credit. We

estimate the following model on the firm×time panel;

$$\ln(trade_{ft}) = \delta_f + \gamma_t + \beta \, \text{shock}_f \times \mathbb{1}(\text{Post}_t) + \varepsilon_{ft} \tag{8}$$

where δ_f , and γ_t denote firm- and time-fixed effects, respectively, and the $\mathbb{1}(\text{Post}_t)$ dummy indicates months after the taper shock of May 2013. shock_f is the dollar credit shock for firm f, defined as a weighted average of dollar credit shock across all the ex-ante trading partner countries of firm f.[12] Hence, our model identifies the trade disruption within a firm and controls the aggregate trade patterns through time fixed effects. Table 11 documents the results. We use both the share and the flexibility measure of dollarization. In column 1, we estimate the model in Equation 8 on the sample of all the firms. The DiD coefficient on the interaction of the Post and the firm's credit shock (-0.36) is statistically and economically significant. This is a classical test of how relationship stickiness can adversely impact the firm trade in response to trade credit shock. Firms lose out on the aggregate trade at the firm-level as they cannot substitute severed relations within the affected geographies with new ones.

We have already documented that the more dollarized firms suffer larger trade relationship losses measured at the country-product level. Using the share measure of dollarization at the firm-level, columns 2 and 4 confirm that the loss of the firm-level trade is mainly concentrated within firms with above-median dollarization. Columns 3 and 5 document no loss to the firm's trade for firms with below-median dollarization. Overall, Table 11 provides a strong empirical estimate of the overall trade costs to the dollarized firms.

6 The Role of Global Banks

Global banks play a vital role in supporting international trade in multiple ways. First, global banks or their subsidiary affiliates can help firms mitigate the impact of the country-specific disruption to the trade credit more efficiently relative to a pure domestic financial institution, as affiliates of global banks can utilize their internal capital markets by tapping into parent's

[12] In particular,

$$\text{shock}_f = \sum_{pc \in PC_f} \left(\frac{trade^{pre}_{fpc}}{trade^{pre}_{f}} \right) \times \text{shock}_c \tag{9}$$

liquid treasury (Cetorelli & Goldberg (2012)). Second, by virtue of being in operation in multiple countries, global banks might be better able to provide liquidity to firms in currencies other than the dollar, allowing firms to substitute dollars in the wake of currency-specific disruptions. Third, global banks are more likely to provide specialized forms of trade finance such as letter of credit.

We explore the role of global banks using the presence of foreign banking affiliates in India as a proxy for global banks. In addition to the role played by the global banks as mentioned above, the geographic proximity of global banks has been documented to boost international trade (Claessens *et al.* (2017)) by resolving asymmetric information problems (Portes & Rey (2005); Michalski & Ors (2012)), or by helping enforce incomplete trade contracts more efficiently (Oslen (2016)).

As of 2012, 23 countries, including both developed and developing nations, had their affiliate banks operating in India.[13] One example of an affiliate of a foreign bank operating in India is "Abu Dhabi Commercial Bank Ltd." Typically, such affiliates specialize in providing trade credit to Indian firms trading with partners from Abu Dhabi. At the same time, these banks are also larger relative to a typical bank in the exporting country and hence, a reasonable proxy for being global. We analyze how invoicing and trade respond to dollar credit shock for these countries deferentially relative to the set of countries without any banking presence in India around the time of the shock.

Country Characteristics Sorted on Presence of Foreign Bank in India Table 12 reports the country characteristics of the countries with and without banking presence in India at the end of 2012. First, the countries having a banking presence in India (Banking Presence Countries) are substantially richer, with median GDP Per Capita almost six times larger at the end of 2012 ($42,372 relative to $7,454, where both numbers are measured in 2012 dollars). However, both sets of countries suffered a significant reduction in dollar credit origination. The 75^{th} percentile of dollar credit shock is 6.82% and 10.41% for countries with and without a banking presence in India, respectively. Having said this, the countries with a banking presence in India experienced a lesser reduction in dollar credit supplied by their banks globally. In terms of other characteristics, both sets of countries experienced similar a currency depreciation and similar spikes in inter-bank lending rates around the taper timeline. In conclusion, summary statistics show that the two set of

[13]These includes Belgium, Canada, France, Germany, Hong Kong, Indonesia, Japan, Mauritius, Netherlands, Oman, Russia, Singapore, South Africa, South Korea, Sri Lanka, Switzerland, Thailand, United Arab Emirates, United Kingdom, and the United States Of America.

countries share similar movements in important macro and financial variables during taper shock, but these also differ in terms of ex-ante per capita income level and the severity of dollar credit shock. We tackle these differences in country characteristics in our estimation by using propensity matching techniques.

6.1 Global Banks and Invoicing Responses

We begin by documenting a deferential invoicing response to the dollar credit shock by firms with and without proximate access to global banks within India. We conjecture the following hypothesis: global banks, leveraging their presence across multiple countries, are more likely to extend trade credit in alternative currencies when access to dollar credit is restricted or its cost increase. Indian affiliates of global banks achieve this as they effectively tap into their parent banks' global treasuries, consistent with the evidence from Cetorelli & Goldberg (2012). At the same time, the proximity of the banks mitigates the information asymmetry and contract enforcement problems better and hence allows firms connected to these global banks to obtain trade credit on a preferential basis. On the other hand, Indian importers working with purely domestic institutions (either Indian or from the exporting country) might find it difficult to obtain trade finance in alternate currencies. This is consistent with the evidence that banks specialize in geographies and/or currencies in which they intermediate the trade finance (Paravisini *et al.* (2020)) and that the banks providing credit in alternate currencies such as Euros are located in concentrated European financial centers (Emter *et al.* (2024)). Hence, we expect that firms with a relationship with the global banks are able to secure credit in alternative currencies and substitute dollar invoicing more aggressively.

Table 13 presents the evidence consistent with this narrative. We begin by splitting the panel into two groups of exporting countries depending upon whether the banks/affiliates of these countries are present in India in 2012 or not.[14] Columns 1-2 provide evidence consistent with the narrative developed above. Firms having access to exporting country banks in India reduce the share of dollar invoicing on trade transactions with that country from the pre- to post-taper period by an additional 12.7 pp. in response to a 1 pp. dollar credit shock, almost double the magnitude compared to the firms not having access to exporting country banks in India.

[14]We estimate our baseline specification of invoicing with firm× product× time and country× product fixed effects, and standard country controls as we have used throughout the paper. The dependent variable is the share of monthly firm-country-product imports that are dollar-invoiced invoiced in dollars.

In columns 3-4, we tackle the challenge that the two sets of countries (with and without banking presence in India) differ in terms of ex-ante per capita income levels and in terms of the intensity of the dollar credit shock faced by these countries. Utilizing this insight, we predict the banking presence of the exporting country in India using a logit model using these two characteristics, namely, dollar credit shock and per capita income level. The pseudo-R^2 of this first stage is 18.23% with income level positively and significantly predicting a banking presence of foreign banks in India. Having estimated the propensity score, we resort to the weighted regression, where weights are as suggested in Imbens & Wooldridge (2009). In particular, we use the $\frac{1}{p.score}$ for observations where the exporting country has a banking presence in India and $\frac{1}{1-p.score}$ otherwise, where p.score is the estimated probability of bank presence in India. Consistent with columns 1-2, we continue to find that for the p.score weighted regressions, that the firms are able to substitute dollar invoicing with alternate currencies with almost double the intensity while importing the products from the countries having banking presence in India.

In column 5, we estimate an interactive model that allows us to perform a *within-country* test. In particular, we measure a firm's exposure to foreign banking presence in India as the share of the firm's ex-ante trade with the countries having a bank present in India. We define this measure for any firm f as

$$\text{Foreign Bank Exposure}_f^{pre} = \sum_c \left(\frac{trade_{fc}^{pre}}{trade_f^{pre}} \right) \times \mathbb{1}\left(\text{Banking Presence in India}\right)_c \tag{10}$$

and denote it by FB_f. A median firm has no exposure to the exporting countries having banking presence in India, but for an average firm, 22.55% of its ex-ante imports are with the countries having banking presence in India.

This firm-level measure allows us to study the invoicing responses to the dollar credit shock of two firms importing from a given country at a point in time but having differential access to global banks within India. We achieve this by absorbing country×time fixed effects. The coefficient on the triple interaction of Post, dollar credit shock, and firm's access to foreign banks within India is -0.134, which is statistically and economically significant. The coefficient implies that a firm having one standard deviation higher access to the foreign banks within India reduces dollar invoicing by 7.77% more in response to a 1 pp. larger dollar credit shock within a given country.

Overall, we present robust evidence that having proximate global banking presence allows

importing firms to smooth out dominant currency shocks by substituting the dominant currency with alternative currencies while invoicing the trade.

6.2 Global Banks and Trade

Does the relative ease of obtaining trade finance in alternate currencies once a firm has a relationship with a global bank allow these firms to maintain the trade relationships and trade quantity? Table 14 presents the evidence in support of this. We re-estimate the trade model in Equation 7, but now by splitting the panel into firms with below-median and above-median access to the global banks within India, where the firm's exposure/access to global banks within India is defined in Equation 10. The dependent variable is the dummy for firm-country-product exit during time t, and we analyze the coefficient on the interaction between Post×dollar credit shock to study the trade response. Column 3 shows that the firm's exit probability from a particular country-product pair rises from the pre- to post-taper period for firms having below-median access to global banks within India by 19.5 pp. or by 48% relative to mean exit probability in response to a 1 pp. larger dollar credit shock. Contrary to this, column 4 shows that the presence of global banks within India completely mitigates the adverse trade impact for firms having access to these banks. The coefficient on the post×dollar credit shock is both statistically and economically insignificant. Overall, columns 3-4 present the evidence that the presence of global banks in India allows firms trading with the parent country of such banks to maintain the trade relationships by allowing these firms to borrow trade finance in alternative currencies.

We sharpen our estimation by performing a within-country test by considering a triple interaction of Post dummy, dollar credit shock, and the firm's access to the foreign banks and absorbing country×time fixed effects. Here, we study the trade impact of dollar credit shocks within a given country for two sets of firms having more or less access to the global banks. Column 5 shows that the coefficient on the triple interaction is significantly negative, with a large coefficient of -0.271. Economically, this means that in response to a 1 pp. higher dollar credit shock, a firm's exit probability rises by 20.6% less (relative to the mean exit probability) if a firm has a one standard deviation higher access to global banks within India.

One of the main findings of the earlier sections is that the disruption to the trade relations is concentrated within the highly dollarized firms. In columns 6-7, we split the sample into two sets of countries with and without a banking presence in India. We consider the interaction of Post

Dummy, dollar credit shock, and the firm's share of dollarization and perform a within-country test. Column 6 shows that for a given country not having any banking presence in India, more dollarized firms experience a bigger rise in the exit probability in the post-taper period in response to a dollar credit shock. However, column 7 highlights global banks' role in mitigating the impact of trade credit shocks, even for dollarized firms. In particular, the coefficient on the triple interaction is economically small and statistically insignificant, which shows that more dollarized firms do not face more severe trade outcomes in response to the dollar credit shocks when exporting country banks are present in proximity.

Overall, the table provides a robust evidence that proximity of global banks, by allowing firms to switch to the alternative currencies for trade invoicing, help firms maintain the trade relationships.

7 Conclusion

Our analysis establishes two novel empirical facts. First, dollar invoicing is not as sticky as previously thought, and that it responds to the dollar credit shocks. Second, we establish a *dollar invoicing* channel highlighting how the excess dollarization (or excess reliance on one dominant currency more generally) of trade amplifies the adverse effects of trade credit shocks on trade. The firm's ability to substitute the dominant currency invoicing after adverse credit supply shocks to a dominant currency (dollars in our analysis) mitigates the impact of such credit supply shocks to these dominant currencies.

Our paper provides timely insight at a time when many countries are attempting to establish trade payment systems in alternative currencies other than dominant currencies. Examples include India, Saudi Arabia, China, South Africa, and Russia. For example, Saudi Arabia ended its petrodollar deal with the US in April 2024, which now allows Saudi Arabia to use alternative currencies to invoice oil exports.

Our analysis shows that diversified and more flexible trade invoicing regimes help firms and countries mitigate credit crises specific to a particular dominant currency. Hence, a direct policy implication would be for a country or firms to build banking connections that can support trade finance in multiple currencies and also work out more broader trade contracts with counterparties that allow payments in alternate currencies.

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Tables

Table 1: Summary Statistics: Imports Transaction Data

This table provides summary statistics for the Indian imports data used in the paper.

	N	P25	Median	P75	Mean	SD
Transaction Size (in USD)	3,257,888	62.71	308.26	1577.43	5726.04	124646.8
Number of Firms	27303					
Number of Products	6838					
Number of Countries	159					
Number of Products per Firm	198,189	7	21	54	43.99	64.32
Number of Partners per Firm	54,093	1	3	6	4.62	5.44
Invoicing Share (USD)	2,152,402				66.07	
Invoicing Share (EUR)	578,714				17.76	
Invoicing Share (JPY)	207,798				6.38	
Invoicing Share (INR)	133,677				4.10	
Invoicing Share (GBP)	101,694				3.12	

Table 2: Cross-Border Dollar Credit Shock

This table provides summary statistics of baseline dollar credit shock. The shock is as defined in Equation **??** and is given by

$$\text{shock}_c = -1 \times \left\{ \frac{\text{Dollar Credit}_{c,\text{Q2 2013}}}{\text{Dollar Credit}_{c,\text{Q1 2013}}} - 1 \right\}$$

where Dollar $\text{Credit}_{c,\text{Q2 2013}}$ is the stock of cross-border dollar credit by banks in the country c. Because we multiply the quarter-on-quarter credit change by -1, a positive $shock_c$ value indicates a *drop* in the cross-border bank credit by banks of exporting country c from pre- to post-taper. We construct our dollar credit shock as the drop in the aggregate dollar credit by the banks of exporting countries around the taper episode. We construct the shock this way to generate a more intuitive negative coefficient on the impact on dollar invoicing when dollar credit falls.
We refer to this shock as *Bank-To-Bank Dollar Credit Shock*. In Panel B, we compute the correlation of this baseline shock with various alternative definitions of shocks. *Bank-To-All* and *Bank-To-Non Financial* includes dollar credit extended by exporting country banks to *All* and Non-Financial sector of borrowing country. Bank-to-bank level shock measures the drop in the level of dollar credit extended by the banks of exporting countries to banks of other countries.

Panel A: Pre to Post % Change in Dollar Credit
from Exporting Country Banks to Borrowing Country Banks

	P75	Median	P25	Mean	SD	N
(Baseline) 1-quarter window	11.594	2.397	-4.069	-1.332	50.759	125
EM	17.060	8.285	-1.646	6.432	15.610	22
EU	3.752	-3.206	-10.775	-6.759	14.419	19
2-quarter window	14.757	2.671	-9.031	-7.215	57.304	125

Panel B: Correlation Across Measures of Dollar Credit Shocks

Dollar Credit Shock Between Exporting Country Banks and Importing Country	
Banks	1
All Borrowers	0.67
Non-Financial Firms	-0.05

Table 3: Dollar Credit Shock and Dollar Invoicing

This table estimates the response of the share of dollar-invoiced trade to the cross-border dollar credit shock. The dependent variable in columns 1-5 (7) is the share of firm-country-product-month (firm-country-month) dollar-invoiced imports invoiced and denoted by Share of Dollar Invoiced Imports$_{fcpt}$ (Share of \$ Invoiced Imports$_{fct}$). In column 6, the dependent variable is the dummy indicating if a firm-country-product had any transaction invoiced in dollars during that month. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dep Var	Share of Dollar (\$) Invoiced Imports$_{fcpt}$					\$ Invoiced Imports$_{fcpt} > 0$	Share of \$ invoiced imports$_{fct}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post × Shock	-0.069***	-0.073***	-0.073***	-0.055***	-0.075***	-0.065***	-0.070***
	(0.012)	(0.013)	(0.020)	(0.016)	(0.013)	(0.018)	(0.018)
Inflation (%)		0.004	0.003	-0.002	0.002	0.003	0.002
		(0.004)	(0.004)	(0.002)	(0.004)	(0.005)	(0.006)
Industrial Growth (%)		0.001	0.001	0.001	0.001	0.001	0.002*
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Export Growth (%)		-0.010	-0.021	-0.013	-0.043	-0.013	-0.081***
		(0.024)	(0.029)	(0.022)	(0.029)	(0.027)	(0.027)
Currency Depreciation (%)		0.085	0.189	-0.035	0.242	0.199	-0.003
		(0.172)	(0.191)	(0.076)	(0.194)	(0.218)	(0.296)
Currency Volatility (%)		-1.432*	-0.952	0.182	0.489	-1.002	1.038
		(0.821)	(1.061)	(0.719)	(1.226)	(1.067)	(1.713)
Equity Returns (%)			-0.000	0.000	0.000	-0.000	0.001
			(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Interest Rate (%)			-0.000	0.003	-0.005	-0.000	-0.010
			(0.004)	(0.003)	(0.006)	(0.004)	(0.008)
Credit To GDP (%)			-0.001	0.001	-0.000	-0.001	-0.001
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Adj. R-Sq.	0.656	0.648	0.641	0.875	0.798	0.624	0.577
Obs.	89889	72148	66837	40453	219354	66837	63016
Macro Controls		✓	✓	✓	✓	✓	✓
External Controls		✓	✓	✓	✓	✓	✓
Financial Controls			✓	✓	✓	✓	✓
Country FE							✓
Firm×Time FE					✓		✓
Firm×HS2 × Time FE	✓	✓	✓	✓		✓	
Country×HS2 FE	✓	✓	✓		✓	✓	
Firm×Country×HS2 FE				✓			
Y-Mean	0.638	0.603	0.611	0.608	0.718	0.630	0.648

Table 4: Importance of Banks and Dollar

This table estimates the response of the share of dollar-invoiced trade to the cross-border credit shocks computed for alternate set of borrowers and currencies. The dependent variable in all the columns is the share of firm-country-product-month dollar-invoiced imports and denoted by Share of Dollar Invoiced Imports$_{fcpt}$. Column 1 (2) measures the dollar credit shock as the drop in the outstanding cross-border dollar credit between exporting country banks and importing country banks (non-financial firms) from first to second quarter of 2013. Column 3 measures the cross-border credit shock as the drop in the cross-border non-dollar credit between exporting and importing country banks from first to second quarter of 2013. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	Share of Dollar Invoiced Imports$_{fcpt}$		
Cross-Border Credit Shock	By Type of Borrower Institution		By Type of Currency
	Banks	Non-Financials	Non-Dollar
Post × Shock	-0.073***	0.028	-0.005
	(0.019)	(0.049)	(0.030)
Adj. R-Sq.	0.641	0.641	0.641
Obs.	66837	66837	66837
Macro Controls	✓	✓	✓
External Controls	✓	✓	✓
Financial Controls	✓	✓	✓
Firm ×HS2×Time FE	✓	✓	✓
Country×HS2 FE	✓	✓	✓
Y-Mean	0.611	0.611	0.611

Table 5: Invoicing Currency Substitution

This table documents the response of share of trade invoiced in alternate currencies to the cross-border dollar credit shock. The dependent variable in all the columns is the share firm-country-product-month imports invoiced in various currencies as highlighted in the columns heading. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

	Share of Imports Invoiced in Column's Currency$_{fcpt}$						
Invoicing Currency	INR	EUR	JPY	GBP	EUR	EUR	EUR
						EU =1	EU=0
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post × Shock	0.015*	0.049***	-0.002	-0.004	0.005	0.009	0.087***
	(0.008)	(0.016)	(0.007)	(0.007)	(0.022)	(0.065)	(0.026)
Adj. R-Sq.	0.673	0.670	0.601	0.552	0.710	0.609	0.424
Obs.	66837	66837	66837	66837	66837	9643	39606
Macro Controls	✓	✓	✓	✓	✓	✓	✓
External Controls	✓	✓	✓	✓	✓	✓	✓
Financial Controls	✓	✓	✓	✓	✓	✓	✓
Firm×HS2 ×Time FE	✓	✓	✓	✓	✓	✓	✓
Country×HS2 FE	✓	✓	✓	✓	✓	✓	✓
Y-Mean	0.611	0.611	0.611	0.611	0.611	0.218	0.778

Table 6: Variation in Measures of Dollarization

The table estimates the mean of the measures of dollarization for the pre-period spanning nine months prior to May 2013 in the cross-section of the country-product pairs. Columns 1-3 estimate the mean of share of dollar-invoiced country-product imports in the pre-period denoted by $\$^{pre}_{cp}$, and columns 4-6 estimate the mean of the flexibility in dollar invoicing for a country-product pair in the pre-period, denoted by $\sigma(\$^{pre})_{cp}$. Columns 1 and 4 include country fixed effects, while columns 2 and 5 include product fixed effects. Columns 3 and 6 include both country and product fixed effects. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dep. Var (Dollarization)	Share ($\$^{pre}_{cp}$)			Flexibility ($\sigma(\$^{pre}_{cp})$)		
	(1)	(2)	(3)	(4)	(5)	(6)
Y-Mean (Constant)	0.619***	0.620***	0.618***	0.167***	0.167***	0.168***
	(0.007)	(0.010)	(0.007)	(0.005)	(0.005)	(0.005)
Adj. R-Sq.	0.519	0.067	0.565	0.153	0.086	0.270
Obs.	2008	2019	2005	1549	1569	1543
Country FE	✓		✓	✓		✓
HS2 FE		✓	✓		✓	✓

Table 7: Dollarization (Share Measure) and Dollar Invoicing After Taper-Tantrum

This table documents how the response of dollar invoicing of trade to the cross-border dollar credit shock varies with the extent of trade dollarization. The dependent variable in all the columns is the share of firm-country-product-month dollar-invoiced imports and denoted by Share of Dollar Invoiced Imports$_{fcpt}$. Column 1 (2) uses a sub-sample of country-product pairs with above-median (below-median) share measure of dollarization, denoted by $\$_{cp}^{pre}$. Column 3 (4) uses a sub-sample of firms with above-median (below-median) share measure of dollarization, where firm's dollarization is measured as in Equation 4, and denoted by $\$_{f}^{pre}$. Column 5 uses firm's share measure of dollarization $\$_{f}^{pre}$. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	Share of Dollar Invoiced Imports$_{fcpt}$				
Dollarization	Share ($\$_{cp}^{pre}$)		Firm's Share ($\$_{f}^{pre}$)		
	High	Low	High	Low	
	(1)	(2)	(3)	(4)	(5)
Post × Shock	0.016	-0.096***	0.002	-0.086***	
	(0.029)	(0.021)	(0.047)	(0.015)	
Post × Shock × $\$_{f}^{pre}$					0.221**
					(0.100)
Shock × $\$_{f}^{pre}$					-0.648***
					(0.156)
Adj. R-Sq.	0.489	0.674	0.791	0.689	0.633
Obs.	5426	20652	2583	33293	44669
Macro Controls	✓	✓	✓	✓	✓
External Controls	✓	✓	✓	✓	✓
Firm ×HS2 × Time FE	✓	✓	✓	✓	✓
Country×HS2 FE	✓	✓	✓	✓	
Country×Time FE					✓
Y-Mean	0.967	0.461	0.933	0.577	0.633
SD-Dollarization	0.008	0.356	0.013	0.232	0.244

Table 8: Dollarization (Flexibility Measure) and Dollar Invoicing After Taper-Tantrum

This table documents how the response of dollar invoicing of trade to the cross-border dollar credit shock varies with the extent of trade dollarization. The dependent variable in all the columns is the share of firm-country-product-month dollar-invoiced imports and denoted by Share of Dollar Invoiced Imports$_{fcpt}$. Column 1 (2) uses a sub-sample of country-product pairs with below-median (above-median) invoicing flexibility, denoted by $\sigma(\$)^{pre}_{cp}$. Column 3 (4) uses a sub-sample of firms with below-median (above-median) invoicing flexibility, where firm's invoicing flexibility is measured as in Equation 5, and denoted by $\sigma(\$)^{pre}_{f}$. Column 5 uses firm's invoicing flexibility measure $\sigma(\$)^{pre}_{f}$. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	Share of Dollar Invoiced Imports$_{fcpt}$				
Dollarization	Flexibility ($\sigma(\$)^{pre}_{cp}$)		Firm's Flexibility ($\sigma(\$)^{pre}_{f}$)		
	Low	High	Low	High	
	(1)	(2)	(3)	(4)	(5)
Post× Shock	-0.046	-0.094***	-0.048*	-0.092***	
	(0.033)	(0.020)	(0.026)	(0.017)	
Post× Shock × $\sigma(\$)^{pre}_{f}$					-0.501***
					(0.159)
Shock × $\sigma(\$)^{pre}_{f}$					0.050
					(0.344)
Adj. R-Sq.	0.989	0.668	0.851	0.675	0.631
Obs	1085	30858	6474	29375	44669
Macro Controls	✓	✓	✓	✓	✓
External Controls	✓	✓	✓	✓	✓
Firm×HS2 × Time FE	✓	✓	✓	✓	✓
Country×HS2 FE	✓	✓	✓	✓	
Country×Time FE					✓
Y-Mean	0.567	0.598	0.716	0.579	0.633
SD-Dollarization	0.000	0.133	0.045	0.076	0.101

Table 9: Real Effects of Dollarization (Share Measure)

This table documents how the response of international trade to the cross-border dollar credit shock varies with the extent of trade dollarization. The dependent variable in columns 1-4 is a dummy indicating firm-country-product exit during the period t defined in Equation 6 and denoted by $\mathbb{1}(Exit)_{fcpt}$. The dependent variable in column 5 is the natural logarithm of the firm-country-product-month imports, denoted by $\ln(\text{Imports})_{fcpt}$. Column 3 (4) uses a sub-sample of firms with above-median (below-median) share measure of dollarization, where firm's dollarization is measured as in Equation 4, and denoted by $\$_f^{pre}$. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	$\mathbb{1}(Exit)_{fcpt}$				$Log(\text{Imports})_{fcpt}$
Dollarization	Firm's Share ($\$_f^{pre}$)				
		High	Low		
	(1)	(2)	(3)	(4)	(5)
Post × Shock	0.099***	0.197**	0.081**		
	(0.031)	(0.094)	(0.032)		
Post × Shock × $\$_f^{pre}$				0.349**	-0.759***
				(0.145)	(0.284)
Shock × $\$_f^{pre}$				-0.723***	3.511**
				(0.211)	(1.427)
Adj. R-Sq	0.355	0.383	0.353	0.362	0.512
Obs.	50388	8271	42055	60943	44669
Macro Controls	✓	✓	✓		
External Controls	✓	✓	✓		
Firm×HS2 × Time FE	✓	✓	✓	✓	✓
Country×HS2 FE	✓	✓	✓		
Country× Month FE				✓	✓
Y-Mean	0.430	0.488	0.418	0.433	10.341
SD-Dollarization		0.030	0.210	0.235	0.244

Table 10: Real Effects of Dollarization (Flexibility Measure)

This table documents how the response of international trade to the cross-border dollar credit shock varies with the extent of trade dollarization. The dependent variable in columns 1-4 is a dummy indicating firm-country-product exit during the period t defined in Equation 6 and denoted by $\mathbb{1}(Exit)_{fcpt}$. The dependent variable in column 5 is the natural logarithm of the firm-country-product-month imports, denoted by $\ln(\text{Imports})_{fcpt}$. Column 2 (3) uses a sub-sample of firms with below-median (above-median) invoicing flexibility measure of dollarization, where the firm's invoicing flexibility measure is defined in Equation 4, and denoted by $\sigma(\$)_f^{pre}$. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	$\mathbb{1}(Exit)_{fcpt}$				$Log(\text{Imports})_{fcpt}$
Dollarization		Firm's Flexibility ($\sigma(\$)_f^{pre}$)			
		Low	High		
	(1)	(2)	(3)	(4)	(5)
Post × Shock	0.099***	0.193***	0.075**		
	(0.031)	(0.050)	(0.028)		
Post × Shock × $\sigma(\$)_f^{pre}$				-0.716***	0.689
				(0.260)	(1.057)
Shock × $\sigma(\$)_f^{pre}$				1.455***	-8.280**
				(0.474)	(3.210)
Adj. R-Sq.	0.355	0.313	0.370	0.361	0.512
Obs.	50388	10262	40062	60943	44669
Macro Controls	✓	✓	✓	✓	✓
External Controls	✓	✓	✓	✓	✓
Firm×HS2 × Time FE		✓	✓	✓	✓
Country×HS2 FE	✓	✓	✓		
Country×Time FE				✓	✓
Y-Mean	0.430	0.454	0.424	0.433	10.341
SD-Dollarization		0.044	0.073	0.098	0.101

Table 11: Firm-Level Real Effects

This table documents the response of the international trade to the cross-border dollar credit shock at the firm level. The dependent variable is natural logarithm of the firm-month imports denoted by $Log(\text{Imports})_{ft}$. Column 2 (3) uses a sub-sample of firms with below-median (above-median) invoicing flexibility measure of dollarization, where the firm's invoicing flexibility measure is defined in Equation 4, and denoted by $\sigma(\$)_f^{pre}$. Column 4 (5) uses a sub-sample of firms with above-median (below-median) share measure of dollarization, where firm's dollarization is measured as in Equation 4, and denoted by $\$_f^{pre}$. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	$Log(\text{Imports})_{ft}$				
Dollarization		Firm's Flexibility ($\sigma(\$)_f^{pre}$)		Firm's Share ($\$_f^{pre}$)	
		Low	High	High	Low
	(1)	(2)	(3)	(4)	(5)
Post×Shock	-0.361***	-0.361***	-0.258*	-0.249**	-0.044
	(0.081)	(0.112)	(0.141)	(0.117)	(0.172)
Adj. R-Sq.	0.728	0.722	0.727	0.739	0.706
Obs.	79286	47124	31209	49486	28847
Firm FE	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓
Y-Mean	10.891	10.756	11.132	10.764	11.150
SD-Dollarization		0.055	0.095	0.023	0.285

Table 12: Summary of Country Characteristics Sorted on Presence of Foreign Bank Affiliate in India

This table documents summary statistics of important country characteristics for a group of exporting countries with and without a banking presence in India at the end of the year 2012. Dollar credit shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. GDP Per Capita is measured at the end of 2012 in current dollars. Foreign investments refer to the foreign portfolio investments in debt and equity instruments at the end of 2012, and these are scaled by the 2012 GDP measured in current dollars. Currency Depreciation During Taper measures the depreciation of the country's local currency against the dollar between the end of April 2013 and the end of June 2013. The inter-bank rate refers to the average rate at which local banks report having lent to the other banks in the overnight repo market of each country, and we measure the rise in inter-bank rate between the end of April 2013 and the end of June 2013.

Variable	Mean	SD	P25	P50	P75	N
Dollar Credit Shock (%)						
Foreign Bank =0	-4.218	32.161	-14.286	-3.619	10.414	87
Foreign Bank =1	-1.881	17.017	-9.777	-1.646	6.821	23
GDP Per Capita (US $)						
Foreign Bank =0	16.406	22.992	2.285	7.454	19.881	81
Foreign Bank =1	34.411	22.977	9.416	42.372	50.176	23
% Foreign Investments / GDP						
Foreign Bank =0	0.824	1.615	0.007	0.050	0.724	14
Foreign Bank =1	0.072	6.849	-0.283	-0.016	0.125	14
Currency Depreciation During Taper (%)						
Foreign Bank =0	2.770	5.485	0.197	1.202	3.342	78
Foreign Bank =1	2.628	3.464	0.003	1.689	3.719	23
Rise in Interbank Rate During Taper (%)						
Foreign Bank =0	6.627	35.534	-7.880	0.000	4.762	36
Foreign Bank =1	0.019	5.091	-0.917	0.000	2.000	18

Table 13: Presence of Exporting Country Bank in India on Invoicing

This table documents how the response of international trade to the cross-border dollar credit shock varies with the foreign banking presence in India. The dependent variable in all the columns is the share of firm-country-product-month dollar-invoiced imports and denoted by Share of Dollar Invoiced Imports$_{fcpt}$. Columns 2 and 4 (1 and 3) uses a sub-sample of countries with (without) a banking presence in India. In columns 3 and 4, observations are weighted by a function of Propensity Matching Score (PMS), where PMS is computed using a logit model estimated on the cross-section of countries that uses logarithm of GDP per capita and cross-border dollar credit shock as the characteristics to predict banking presence in India. Firm's Foreign Bank Exposure, denoted by FB_f is the ex-ante fraction of firm's imports from the countries having a banking presence in India and is computed as in Equation 10. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	Share of Dollar Invoiced Imports$_{fcpt}$				
	Exporting Country Bank in India				
	No	Yes	No	Yes	
Weights			1/PMS	1/(1-PMS)	
	(1)	(2)	(3)	(4)	(5)
Post×Shock	-0.068**	-0.127***	-0.066*	-0.138***	
	(0.033)	(0.030)	(0.034)	(0.029)	
Post × Shock × Firm's Foreign Bank Exposure					-0.134***
					(0.040)
Shock × Firm's Foreign Bank Exposure					0.123
					(0.099)
Adj. R-Sq.	0.681	0.617	0.690	0.633	0.615
Obs.	15630	32595	15630	32595	90659
Macro Controls	✓	✓	✓	✓	
External Controls	✓	✓	✓	✓	
Financial Controls					
Firm×HS2×Time FE	✓	✓	✓	✓	✓
Country×HS2 FE	✓	✓	✓	✓	
Y-Mean	0.617	0.562	0.617	0.562	0.638
SD-Firm's Foreign Bank Exposure					0.370

Table 14: Role of Global Banks for International Trade

The dependent variable is the dummy indicating the firm-country-product exit during the period t as defined in Equation 6, and denoted by $\mathbb{1}(Exit)_{fcpt}$. Firm's Foreign Bank Exposure, denoted by FB_f is the ex-ante fraction of firm's imports from the countries having a banking presence in India and is computed as in Equation 10. Columns 1 and 6 (2 and 7) uses a sub-sample of countries with (without) a banking presence in India. Column 4 (5) uses a sample of firms with below-median (above-median) exposure to the foreign banking presence. Post is a dummy variable assuming a value of 1 for the period after May 2013 and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The fixed effects are mentioned at the bottom of the table. Standard errors are clustered at the country and the product level. Superscripts ***, ** ,* indicate significance at the 1%, 5%, and 10% level.

Dependent Var.	$\mathbb{1}(Exit_{fcpt})$						
	Exporting Country Bank in India		Firm's Exposure to Foreign Banks (FB_f)			Exporting Country Bank in India	
	No	Yes	Low	High		No	Yes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post × Shock	0.102**	0.121*	0.195***	-0.022			
	(0.037)	(0.066)	(0.046)	(0.060)			
Post × Shock × FB_f					-0.271***		
					(0.097)		
Shock × FB_f					0.575***		
					(0.178)		
Post × Shock × $\$_f^{pre}$						0.399**	0.100
						(0.172)	(0.267)
Shock × $\$_f^{pre}$						-0.757***	-0.310
						(0.222)	(0.295)
Adj. R-Sq.	0.276	0.390	0.322	0.386	0.362	0.331	0.398
Obs.	9888	19659	23890	23416	60943	14840	26122
Macro Controls	✓	✓	✓	✓			
External Controls	✓	✓	✓	✓			
Financial Controls	✓	✓	✓	✓			
Firm×HS2 ×Time FE						✓	✓
Country×HS2 FE	✓	✓	✓	✓			
Country×Time FE					✓	✓	✓
Y-Mean	0.394	0.468	0.405	0.444	0.433	0.430	0.452
SD-Dollarization						0.223	0.229
SD-FB_f					0.330		

Figures

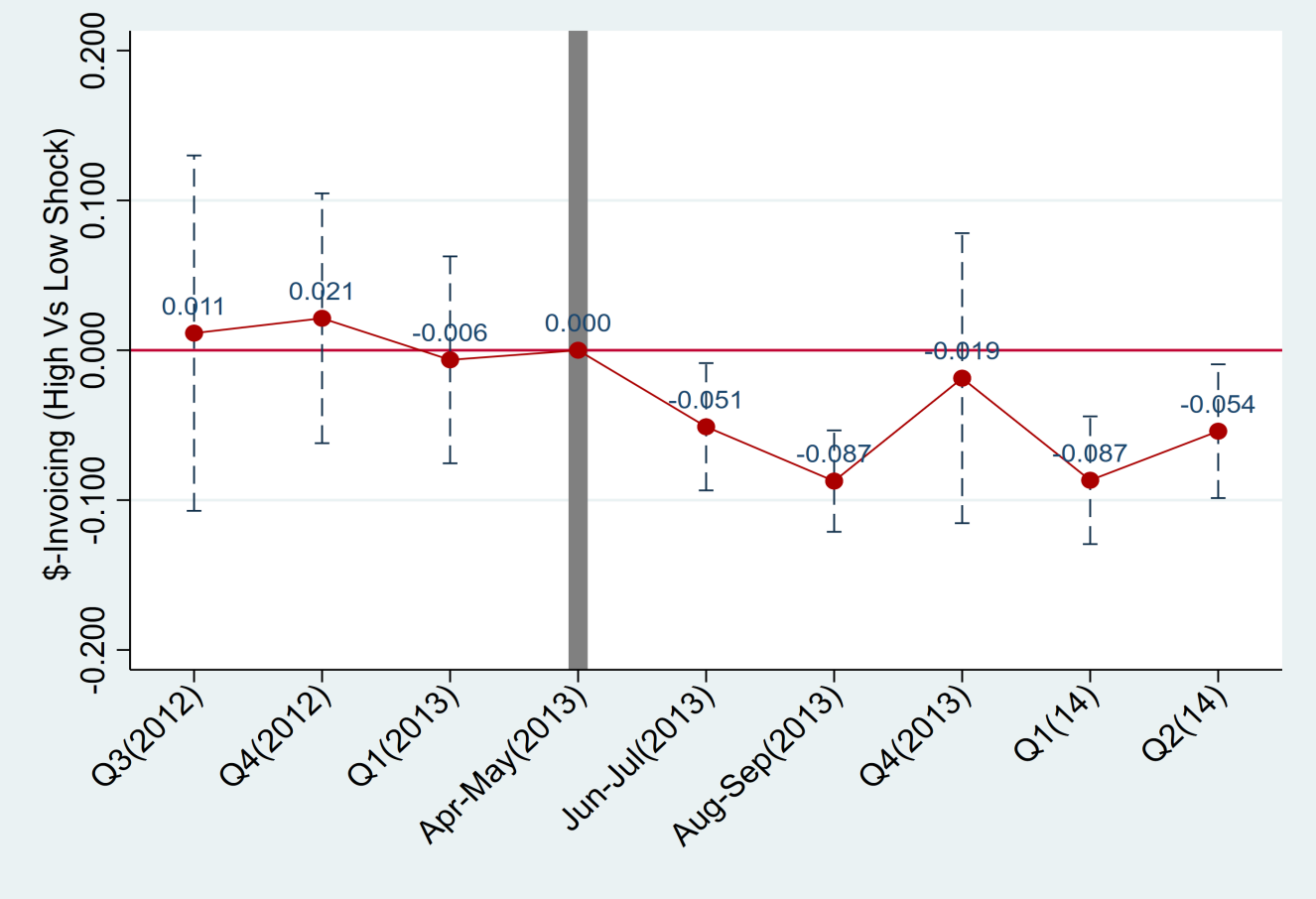

Figure 2: Dollar Credit Shock and Dollar Invoicing

This figure plots the estimates of the response of the share of dollar-invoiced trade to the cross-border dollar credit shock. We estimate the plotted coefficient (β_t) as follows:

$$inv^{\$}_{fcpt} = \beta_0 \left[shock_{\,c}\right] + \sum_t \gamma_t \mathbb{1}(t) + \sum_t \beta_t \left[\mathbb{1}(t) \times shock_c\right] + \delta_{fpt} + \delta_{cp} + \theta' \mathbb{X}_{ct} + \varepsilon_{fpct}$$

where $\mathbb{1}(t)$ denotes the dummy which takes value of 1 during the time period t and 0 otherwise. Shock refers to the country's drop in the cross-border dollar credit between the first and the second quarter of 2013 and is defined in Equation 1. The time periods are created by clubbing the adjacent months as highlighted on the x-axis. The plot shows the 95 percent confidence intervals around the point estimates of the β_t. Standard errors are clustered at the country and the product level. The shaded vertical line represents the period (April to May 2013), which serves as the base period, and other coefficients are relative to the coefficient in this time period.

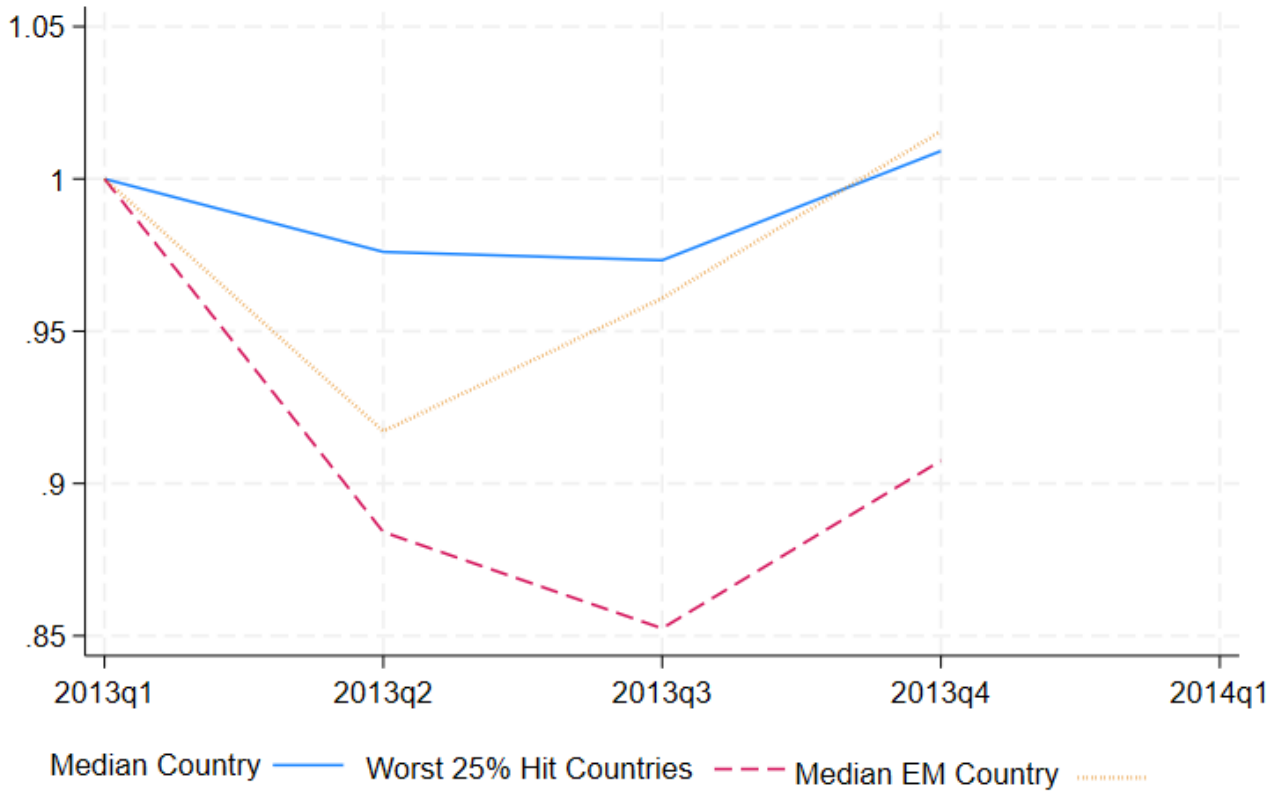

Figure 3: Cross-Border Dollar Credit (Relative to Q1-2013)

The figure plots the bank-to-bank cross-border dollar credit relative to the first quarter of 2013 (Q1-2013). The level for Q1-2013 is normalized to 1. For each quarter, we plot the trade-weighted summary statistic of the cross-border dollar credit, where we use 2012 import weights for India from the United Nations Comtrade database. The solid line plots the trade-weighted median, the dashed line plots the trade-weighted 25^{th} percentile of the relative dollar credit, and the dotted line plots the trade-weighted median of the relative dollar credit for the group of emerging economies.