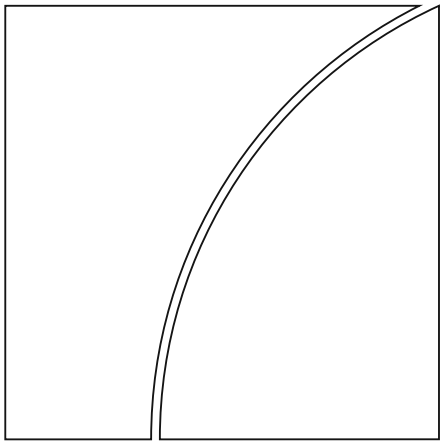

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by Nuwat Nookhwun, Jettawat Pattararangrong and Phurichai Rungcharoenkitkul

Monetary and Economic Department

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Exchange Rate Effects on Firm Performance: A NICER Approach*

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Abstract

Under dominant currency pricing, exchange rate swings affect firms' profits in domestic currency rather than price competitiveness. We quantify these valuation effects by constructing firm-specific exchange rates that reflect invoicing currencies and capture cash-flow exposures. These net-invoice-currency-weighted exchange rates (NICER) outperform trade-weighted exchange rates in explaining firm profitability, particularly for smaller exporters. Higher trade dependency amplifies NICER sensitivities, while financial hedging only partially mitigates them. NICER fluctuations also impact firm liquidity and credit conditions, with large exporters offsetting liquidity shocks through external financing. These cash-flow effects, in turn, drive exporters' investment and employment decisions.

Keywords: Exchange rates, valuation effects, dominant currency paradigm, firm-level data, firm profitability, invoicing currency, exports, financial hedging

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1 Introduction

Exchange rate fluctuations affect the economy through various channels that have yet to be fully explored. The well-known expenditure-switching channel emphasises the link between net exports and exchange rates, which, under price rigidity, is important when trades are invoiced in producer currencies (Mundell, 1963; Obstfeld and Rogoff, 1995). But, as recent research on the dominant currency paradigm argues, few currencies, notably the US dollar, dominate as the invoicing vehicle of choice (Plagborg-Moller et al., 2017; Boz et al., 2022). Under this paradigm, exchange rate fluctuations generally have little effect on the trade volume, as the prices quoted in the invoicing currency tend to be sticky. Instead, exchange rate variations affect the real economy through cash flows and profits of firms who are exposed to the "valuation effects" of their foreign-priced trade transactions. For example, when the domestic currency appreciates against the dollar, any given export receipt in dollar translates into a lower revenue in the local currency. Such channel would help account for weak evidence of the expenditure-switching channel in some recent studies, e.g. Fukui et al. (2023) which show that depreciations are expansionary but are accompanied by falling net exports. The understanding of these valuation effects and their quantitative significance, however, remains in its infancy.

We contribute to this underexplored research area by quantifying the valuation effects arising from firms' heterogeneous exposures to invoicing currencies' fluctuations on their performance. Our laboratory is Thailand, where extensive high-quality micro-level data enable a comprehensive analysis of financial and real effects of exchange rates on firms. We leverage on five large datasets covering 40,000 firms with foreign trade exposures, combining their trade activities, balance sheets and income statements, bank loans outstanding and employment decisions, as well as their foreign exchange (FX) transactions. The combined firm-matched data allow us to examine the implications of valuation effects for firms' profits, liquidity and financing decisions, the role of FX hedging in mitigating firms' exchange rate exposures, as well as firms' real decisions on employment and investment.

Beyond data coverage and quality, Thailand also makes for a particularly suitable case to study the valuation effects of exchange rates. First, it is a small open emerging market economy (EME) featuring predominant–but not exclusively–US dollar pricing and large currency mismatches in trade transactions. This sets our work apart from prior studies (Barbiero, 2021; Adams and Verdelhan, 2022a) that focus on major economies such as the US and the Euro Area, whose currencies dominate global invoicing. Second, an extensive regional trade relationships imply a significant presence of non-dollar invoicing, enabling a comparison of valuation effects across invoicing currencies.[1] Third, the Thai baht's material

[1]For some EMEs, the dollar's dominance is much higher making this comparison difficult. For example, over 90% of Chilean imports are invoiced in the US dollars with negligible invoicing in the local currency (Giuliano and Luttini, 2020). In Thailand, 75 percent of imports are priced in the US dollar, with 8 percent priced in the local currency and the remaining 18 percent priced in non-dollar currencies (Apaitan et al., 2024).

volatility during the sample period of 2007-2020, often driven by exogenous external shocks, aids the identification of exchange rate effects. Fourth, Thailand is a market economy with a developed financial market, making the empirical findings potentially relevant to other economies, including advanced ones.

To identify the valuation effects at the firm level, we first construct firm-specific effective exchange rates that account for heterogeneous invoicing currencies and the associated currency mismatches. We call these "NICER", an acronym for net-invoice-currency-weighted exchange rates. The construction of NICER is guided by a stylised theoretical framework building on Dai and Xu (2017). The model features firm optimisation, imported inputs and variable markups, and is extended to include heterogeneous invoicing-currency use while emphasising the dominant role of the US dollar. By deriving short-term profit dynamics from these first principles, our theoretical framework distinguishes the valuation effects associated with NICER from various expenditure-switching effects of exchange rates. Empirically, NICER is highly dispersed across firms in any given period, due primarily to varying dollar-invoiced exposures. Over time, NICER fluctuates with the US dollar exchange rate, though some large firms enjoy greater natural hedges and hence lower NICER volatility.

We then conduct a comprehensive assessment of how NICER fluctuations affect firms' financial and real performance, using annual data during the period 2007–2020. On the financial front, we examine profitability, liquidity as well as credit conditions as the dependent variables. On the real side, we focus on firms' investment and employment. We also explore how the valuation effects are influenced by firm characteristics, such as trade dependency and hedging activities.

Our findings highlight the significant role of NICER in both financial and real aspects of firms' performance. In terms of profitability, changes in NICER significantly impact firm cash flows in the near term. For exporters, a one-percentage-point appreciation in NICER results in a 0.2-percentage-point reduction in same-year profits, measured as EBIT (earning before interest and tax) to total assets. For importers, the impact is smaller at 0.13 percentage point, partly reflecting a reliance on domestic intermediate inputs and expenditure switching. For both exporting and importing firms, NICER outperforms traditional trade-weighted exchange rates in explaining firm profitability. These effects dissipate over time as firms adjust prices and pass on the impact of exchange rate changes, though can last up to several years.

The NICER effects on firm profits are heterogeneous across firm sizes, sectors and invoicing currencies. Small and medium-sized exporters experience larger profit impacts, while importers face uniformly smaller effects. Among economic sectors, manufacturing exporters–particularly in automotive, apparel and electronics– are most exposed to NICER fluctuations. Among invoicing currencies, non-dollar NICER induces a greater impact on firm profits than dollar NICER, reflecting the growing importance of regional and alternative invoicing currencies. Among the potential drivers of these heterogeneous effects,

international trade dependency emerges as the most robust factor. Meanwhile, differences in financial hedging offer only partial mitigation of profit exposures.

NICER fluctuations also influence firm liquidity and credit conditions. More financially-constrained firms would in principles face tighter liquidity conditions when profits fall, as they are less able to obtain external financing to offset cash flow shortfalls. We find robust evidence for such liquidity effects, as firms' cash holdings tend to dwindle following a NICER appreciation. The liquidity effect is most pronounced among small and mid-sized exporters, consistent with smaller firms generally facing tighter financial constraints. Large exporters, on the other hand, react by obtaining more credits to cushion adverse cash-flow shocks. We find no effects of NICER on firms' credit risks.

Finally, we document evidence that the valuation effects translate into real economic outcomes. Adverse NICER swings significantly impact exporters' investment and employment decisions, after controlling for the exchange rate effects through prices of imported capital goods and sector-time fixed effects. A one-percentage-point adverse change in dollar-based NICER reduces investment and employment growth in the same period by 0.2 and 0.1 percentage point, respectively. These effects are both statistically and economically significant, reinforcing the critical role of the financial channel of exchange rates under the dominant currency paradigm.

Literature

Our paper's central contribution is to the literature on the valuation channel of exchange rates. Two recent articles explore this channel, and consider the impact on firm profits in the context of advanced economies. Closest to ours is Barbiero (2021), who estimates the cash flow effects of currency mismatches of French firms. He shows that large firms absorb valuation shocks onto their balance sheets, while small exporters partially hedge their dollar-priced exports with imports. Only investment and payroll of small importing firms are sensitive to invoice currency fluctuations. Meanwhile, Adams and Verdelhan (2022a) show in six major currency areas that a local currency appreciation vis à vis the US dollar reduces firms' profits differently depending on their international trade balances and foreign currency debt issuance. Our paper is the first to examine the case of an EME. Relative to these works, we also provide a more comprehensive assessment of the financial impact on firms including via liquidity, credit conditions and credit risks, while offering further insights into what could shape these valuation effects.

Our paper also relates to several other strands in the international macroeconomics and finance literature. The first is the burgeoning literature that examines at the micro level the exchange rate passthrough to export and import prices conditional on invoicing currency (Apaitan et al., 2024; De Gregorio et al., 2024; Amiti et al., 2022; Chen et al., 2022; Auer et al., 2021; Giuliano and Luttini, 2020; Gopinath et al., 2020; Devereux et al., 2017) and emphasises the important role of exchange rates based on invoice currencies. These articles also show that passthrough varies by firm market shares and the extent of

imported inputs. In an earlier work, Bodnar et al. (2002) assess the link between exchange rate passthrough, firm profitability and exposures, but do not consider the role of invoicing currency choices as we do here.

The second strand explores the exchange rate impact on firms' performance and decisions, including on investment (Adams and Verdelhan, 2022b; Dao et al., 2021; Taylor et al., 2021; Alfaro et al., 2022), employment (Dai and Xu, 2017; Nucci and Pozzolo, 2010), leverage (Kalemli-Ozcan et al., 2021), as well as net worth and bankruptcy (Kim et al., 2015). We contribute to this strand by documenting a full range of real and financial effects induced by the valuation channel. Relative to Barbiero (2021), we find contrasting evidence of valuation shocks having significant effects on exporters' investment and hiring decisions. Our paper is, to our knowledge, the first to provide evidence on the valuation effects on firms' credit conditions, liquidity and credit risks.

The third literature examines the financial channel of exchange rates, focusing on the balance-sheet valuation effects induced by foreign-currency liabilities in the context of EMEs. One strand of this literature examines the channel through the balance sheets of borrowers, where a reliance on foreign-currency debt can make firms vulnerable to currency depreciation (Hardy, 2023; Caballero, 2021; Kalemli-Ozcan et al., 2016; Kim et al., 2015). The other strand focuses on the knock-on repercussions for banks' balance sheets and financial conditions, including cross-border lending activities (Banerjee et al., 2022; Avdjiev et al., 2019b,a; Bruno and Shin, 2015). As a domestic currency depreciation is contractionary according to this financial channel, it can offset the expansionary impact from the trade channel (see Kearns and Patel (2016) for some such evidence in EMEs). Our paper highlights another distinct financial channel, arising from currency mismatches linked to trade activity rather than balance sheet exposures. This type of financial channel affects firm profits through *cash flows* rather than marked-to-market gains and losses, and works in the same direction as the trade channel (i.e. a depreciation is expansionary).[2] We show that these valuation effects are quantitatively large, and have non-trivial implications for firm liquidity and credit.

The last related literature looks at the roles of FX hedging. Lyonnet et al. (2022) show that access to hedging instruments tends to increase the probability of pricing in a foreign currency, while Berthou et al. (2022) explore the effects of heightened hedging costs on export decisions of French firms. Our paper is among the very few that attempt to quantify the role of FX hedging in mitigating firms' sensitivity to exchange rate shocks. Similar to us, Alfaro et al. (2023) find that Chilean firms complement natural hedging by using FX financial instruments, which improve their cash flow management, promoting trade and growth. Meanwhile, Bartram et al. (2010) examine the role of FX hedging in solving exchange rate exposure puzzles.

The paper is organised as follows. Section 2 presents a motivating theoretical framework to flesh out links between exchange rates and firm profits and isolate the valuation channel.

[2]Some regard the valuation effect as part of the trade channel, e.g. Kearns and Patel (2016).

Section 3 lays out the definition of NICER and its related concepts, the empirical strategy, and the firm-level data sets used for the analysis. Section 4 discusses the empirical results and various extensions, before section 5 concludes.

2 Theoretical framework

This section develops a theoretical framework to expose the links between firm profits and exchange rates. In principles, there are three main channels through which exchange rates can affect firm profits: expenditure switching, valuation and markup adjustments. The relevance of these channels, in turn, depends on the invoicing currencies as well as the degree of price rigidity which tends to be higher in the short run. We uncover these underlying channels via a framework that extends Dai and Xu (2017), to motivate the construction of the relevant exchange rate indices.

Consider a firm i located in country n and producing differentiated products. The firm has a Cobb-Douglas production function, with inputs being labour and intermediate inputs sourced domestically and from abroad. It sells products domestically, exports them, or both. Subject to a demand function in each market k, it sets the price of the product sold to each market to maximize profits:

$$\Pi_{in} = \sum_{k} (p^*_{ink} - MC^*_{in}) q_{ink}, \tag{1}$$

where p^*_{ink} and q_{ink} are the price and quantity of output sold to country k, respectively. MC^*_{in} denotes the marginal production costs, being a function of input prices and productivity. * signifies values that are expressed in the domestic currency of firm i.

The profit function in equation 1 helps uncover the three main channels through which exchange rates operate. The expenditure switching channel is at work when exchange rates affect the quantity of goods sold q_{ink} via changes in relative good prices. The valuation channel operates via p^*_{ink} and/or MC^*, when exchange rate movements affect firm revenues or costs in domestic currency. This channel is active in the short run as firms cannot adjust prices and must absorb any exchange rate shocks via markups. In the long run, firms flexibly adjust prices to reflect changes in marginal costs and/or exchange rates. The optimal markups themselves may also be influenced by the exchange rates, giving rise to the final markup channel.

Below, we decompose the contributions of various exchange rate channels under different assumptions regarding invoice currencies. We leave detailed derivations in Appendix A, and summarise key analytical results here. For brevity, we focus on the profit-exchange rate relationship in the short run to shed light on different channels at work across paradigms. Throughout, let $e^{k/n}$ denote the nominal exchange rate between the currencies of countries n and k, where an increase in $e^{k/n}$ indicates an appreciation of currency n relative to currency k.

Producer currency pricing

First, consider the case of producer currency pricing (PCP), commonly assumed in international macroeconomic settings such as the Mundell-Fleming model. Under PCP, firms invoice goods in domestic currency, p^*_{ink}. In the short run, a firm cannot adjust prices in response to an exchange rate shock, compelling its trading partners (as buyers) to alter their demand based on pre-determined prices. In this case, trade-weighted exchange rates play a key role in capturing the impact of exchange rates on firm profits, including import-weighted exchange rates (ME), export-weighted exchange rates (XE) and exchange rates reflecting import penetration by foreign countries in the domestic market (MPE). Specifically,

$$\Delta \ln \Pi_{in} = \underbrace{\left(\frac{1}{\bar{\mu}_{in}-1}\right)\varphi_{in}\Delta ME}_{\text{Valuation Effect}} - \underbrace{\sigma\chi_{in}\Delta \ln XE}_{\substack{\text{Exp switching:}\\ \text{Export price}}} - \underbrace{\sigma(1-\chi_{in})\Delta MPE}_{\substack{\text{Exp switching:}\\ \text{Import Competition}}} + \epsilon^{PCP}_{in}, \quad (2)$$

with

$$\Delta ME = \sum_k \omega^M_{ink} \Delta \ln e^{k/n},$$

$$\Delta XE = \sum_k \omega^X_{ink} \Delta \ln e^{k/n},$$

$$\Delta MPE = \sum_k M_{kn} \Delta \ln e^{k/n},$$

where ω^M_{ink} (ω^X_{ink}) denotes the shares of firm i's imports from (exports to) country k to its total imports (exports). ΔMPE is the effective exchange rate that is weighted by import penetration ratios of each foreign country k (M_{kn}).

Equation 2 captures three distinct mechanisms. The first term on the right represents the valuation effects of firm i's imported intermediate inputs, with foreign currency prices remaining fixed in the short run. An exchange rate appreciation thus translates one-to-one into a lower cost of imported inputs in domestic currency. The strength of this channel depends on the firm's import intensity (the share of imported inputs over total costs, φ_{in}) and the average price markup ($\bar{\mu}_{in}$).[3] The second term captures the expenditure-switching effects emphasized in the literature, arising from the exchange rate passthrough (ERPT) to export prices, which in turn affects foreign demand. The third term represents another expenditure-switching channel associated with import competition. As domestic currency appreciates against currency k, firms from country k can sell their products more cheaply than local firms, intensifying competition in the domestic product market. The elasticity of substitution (σ) and export intensity (the share of exports over total sales, χ_{in}) determine

[3]Under optimal price-setting decision, $p^*_{ink} = \frac{\sigma_{ink}}{\sigma_{ink}-1} MC^*_{in} = \mu_{ink} MC^*_{in}$ for each market k, where σ_{ink} denotes elasticity of substitution. The average price markup across markets k, $\bar{\mu}_{in}$, determines the contribution of marginal cost changes to firm profits.

the strength of the last two channels.[4]

Dominant currency pricing

In the dominant currency pricing (DCP) world, trade-weighted exchange rate indices lose short-term relevance; instead, exchange rates tied to invoicing currencies gain importance. Suppose for simplicity that the US dollar is the only invoicing currency for international trade. Short-term firm profits depend on the dollar exchange rates against both the domestic currency and the firm's trading partner currencies:

$$\Delta \ln \Pi_{in} = \underbrace{\left(\frac{-\bar{\mu}_{in}\chi_{in} + \varphi_{in}}{\bar{\mu}_{ink'} - 1} \right) \Delta \ln e^{usd/n}}_{\text{Valuation effect}} \underbrace{-\sigma\chi_{in}\Delta XE^*}_{\substack{\text{Exp switching:} \\ \text{Export price}}} \underbrace{-\sigma(1-\chi_{in})M_n^{usd}\Delta \ln e^{usd/n}}_{\substack{\text{Exp switching:} \\ \text{Import Competition}}} + \epsilon_{in}^{DCP}, \tag{3}$$

with

$$\Delta XE^* = \sum_{k \neq US} \omega_{ink}^X \Delta \ln e^{k/usd}.$$

The first term represents the valuation effect, which is a function of the domestic currency's dollar exchange rate. The channel operates when there exists a currency mismatch between the firm's trade revenues and costs, due to a gap between export intensity χ_{in} and import intensity φ_{in} (adjusted by profit contributions, $\bar{\mu}_{in}$). Only the firm whose import costs are exactly matched by export revenues would be perfectly hedged, and face no valuation effect from swings in the dollar exchange rate. This motivates the use of cash flow mismatches, or net exposures, as weights to calculate an exchange rate index relevant for the valuation effect.

The second and third terms relate to the expenditure-switching effects. One is through the export price effect, which depends on the dollar exchange rates of partner countries. For example, a depreciation of country k's currency against the dollar would push up the relative prices of exports to country k. The relevant exchange rate index here is thus the export-weighted exchange rates between the US dollar and firm i's trade partner currencies, ΔXE^*. The other expenditure-switching effect works through the import competition channel, which hinges on the dollar exchange rate weighted by the penetration of foreign goods priced in dollar, M_n^{usd}.

[4]The residual ϵ_{in}^{PCP} captures the general-equilibrium effects of exchange rates on macroeconomic aggregates such as input prices and general price level, among others. In the long run, firms can flexibly adjust prices in response to changes in marginal costs, inducing further expenditure-switching effects that can be captured by import-weighted exchange rates. Given this passthrough, the valuation effects on firm costs vanish. The markup channel instead plays an important role, as the firm desires to reduce the ERPT to export prices. The firm faces a tradeoff when adjusting markup: following currency appreciation, lowering the markup reduces profit but helps moderate the ERPT to export prices, maintaining price competitiveness in foreign markets. Our theoretical framework shows that the expression linking firm profits with exchange rates is similar across invoice-currency paradigms and trade-weighted exchange rates are solely relevant.

General case

A more general case is when firms may choose to invoice in the dominant currency, the destination currency or their own (producer) currency. We analyse this case in a stylised model, where domestic firms in country n trade with only the US and country k. To sell its product to k, a firm invoices in either its domestic currency n, currency k or the US dollar. Meanwhile, the products sold to the US are invoiced in either currency n or the US dollar. The products sold domestically are always denominated in the producer currency n. We assume that imports of intermediate inputs from country k are in either the producer currency or the US dollar, while those imports from the US must be in the dollar. We then obtain the following short-term sensitivity of firm profits to exchange rates, which generally depends on currency mismatches of foreign-priced transactions:

$$\Delta \ln \Pi_{in} = \underbrace{\sum_{j\in\{usd,k\}} \left[\left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in}-1} \right) \left(\sum_{k'\in\{US,k\}} \chi^{j}_{ink'} \right) (-1) - \left(\frac{1}{\bar{\mu}_{in}-1} \right) \left(-\varphi^{j}_{in} \right) \right] \Delta \ln e^{j/n}}_{\text{Valuation effect}}$$
$$- \underbrace{\sigma \chi_{in} \Delta XE^{*}}_{\substack{\text{Exp. switching:} \\ \text{Export price (USD-invoiced)}}} - \underbrace{\sigma \chi_{in} \Delta \ln XE^{n}}_{\substack{\text{Exp. switching:} \\ \text{Export price (n-invoiced)}}} - \underbrace{\sigma(1-\chi_{in}) \Delta MPE^{inv}}_{\substack{\text{Exp. switching:} \\ \text{Import competition}}} + \epsilon^{general}_{in}, \tag{4}$$

with

$$\Delta XE^{*} = \sum_{k\neq US} \omega^{X,usd}_{ink} \Delta \ln e^{k/usd},$$
$$\Delta XE^{n} = \sum_{k} \omega^{X,n}_{ink} \Delta \ln e^{k/n},$$
$$\Delta MPE^{inv} = \sum_{j} M^{j}_{n} \Delta \ln e^{j/n}.$$

$\chi^{j}_{ink'}$ and φ^{j}_{in} measure the intensities in invoicing currencies j of exports and imports, respectively, while $\omega^{X,n}_{ink}$ and $\omega^{X,usd}_{ink}$ denote the export shares to country k that are invoiced in domestic currency and the US dollar, respectively.

The general case of equation 4 forms the basis for empirical exercises that follow. The first term on the right hand side captures short-term exchange rate effects through the valuation channel, entailing effective exchange rates based on invoicing currencies and their associated mismatches. Note how the valuation channel in this general case arises not only from dollar-priced transactions, but also trade invoiced in any foreign currencies. The next three terms capture expenditure-switching channels. Similar to the DCP case, the dollar exchange rate against the currency of firm i's export destination captures the expenditure-switching effects on the demand for dollar-priced products. Next, as in the PCP case, there is an effect from ERPT to export prices for transactions in the producer

currency (n-invoiced), with the weight of each bilateral exchange rate reflecting the share of total exports to that country invoiced in currency n. The last term shows the import competition effects on the firm's domestically-sold products, with each bilateral exchange rate being weighted by the usage of currencies to invoice competing products from abroad (M_n^j).

3 Empirical methodology

3.1 NICER and other effective exchange rates

We now develop the empirical counterpart to the theoretical prediction in equation 4. The key dependent variable will be the changes in firm profit relative to total assets: $\Delta\Pi_{in}/Asset_{in} \equiv (\Delta \ln \Pi_{in})(\Pi_{in}/Asset_{in})$, which we obtain by multiplying equation 4 by $\Pi_{in}/Asset_{in}$[5]:

$$\frac{\Delta\Pi_{in}}{Asset_{in}} = -\left(\frac{Exp_{in}+Imp_{in}}{Asset_{in}}\right)\sum_j\left(\frac{Exp_{in}^j - Imp_{in}^j}{Exp_{in}+Imp_{in}}\right)\Delta \ln e^{j/n} + \sigma\chi_{in}\frac{\Pi_{in}}{Asset_{in}}\Delta XE^* - \sigma\chi_{in}\frac{\Pi_{in}}{Asset_{in}}\Delta XE^n - \sigma(1-\chi_{in})\frac{\Pi_{in}}{Asset_{in}}\Delta MPE^{inv},$$

where $Exp_{in}^j \equiv \sum_k Exp_{ink}^j$ and $Imp_{in}^j \equiv \sum_k Imp_{ink}^j$ are, respectively, firm i's values of exports and imports invoiced in currency j. Meanwhile, $Exp_{in} \equiv \sum_j Exp_{in}^j$ and $Imp_{in} \equiv \sum_j Imp_{in}^j$ are total values of exports and imports by firm i, respectively.

The first term on the right is the valuation channel, captured by a weighted average of the exchange rates vis-à-vis invoicing currencies, with weights being the export-import mismatches scaled by total trade. A currency is more important when a firm uses it extensively for invoicing exports without balancing hedges from imports (or the reverse). We refer to these firm-specific effective exchange rates as the *net-invoice-currency-weighted exchange rates* with acronym $NICER$:

$$NICER_{i,t} = \sum_j\left(\frac{Exp_{i,t-1}^j - Imp_{i,t-1}^j}{Exp_{i,t-1}+Imp_{i,t-1}}\right)\Delta \ln e_t^{j/n}. \tag{5}$$

We empirically construct $NICER$ using bilateral exchange rates $\Delta \ln e_t^{j/thb}$, along with $Exp_{i,t}^j$ and $Imp_{i,t}^j$ expressed in local currency terms. The weight always falls within the interval $[-1, 1]$, and equals 1 (-1) when the firm relies on a single invoicing currency and has only export (import) transactions. It equals zero when there is no trade invoiced in

[5]We use changes in profit normalised by total assets instead of percentage changes to handle cases where firm profits are near zero or negative. We use $\Pi_{in} = (\bar{\mu}_{in} - 1)MC_{in}^* Y_{in}$ and the definitions of the invoicing-currency intensities $\chi_{ink}^j \equiv \frac{Exp_{ink}^j}{\bar{\mu}_{in} MC_{in}^* Y_{in}}$ and $\varphi_{in}^j \equiv \frac{Imp_{in}^j}{MC_{in}^* Y_{in}}$ to simplify the expressions.

that currency, or when the firm fully hedges its export positions with imports invoiced in the same currency. By construction, a baht appreciation would increase $NICER$ for net exporters and lower it for net importers. As such, an increase in $NICER_{i,t}$ implies adverse valuation effects for all firms. In addition, given our choice of scaling by a firm's total trade, the impact of $NICER_{i,t}$ on firm profits to assets will be shaped by its foreign trade dependency, as captured by the sum of its exports and imports to total assets.

A convenient property of $NICER_{i,t}$ is that it can be represented as the sum of more granular components $NICER^{j}_{i,t}$ corresponding to various invoicing currencies:

$$\begin{aligned} NICER_{i,t} &= NICER^{usd}_{i,t} + NICER^{fc}_{i,t} \\ &= NICER^{usd}_{i,t} + NICER^{eur}_{i,t} + NICER^{jpy}_{i,t} + NICER^{cny}_{i,t} + NICER^{other}_{i,t}, \end{aligned}$$

where

$$NICER^{fc}_{i,t} = \sum_{j \neq usd} \left(\frac{Exp^{j}_{i,t-1} - Imp^{j}_{i,t-1}}{Exp_{i,t-1} + Imp_{i,t-1}} \right) \Delta \ln e^{j/thb}_{t},$$

and

$$NICER^{other}_{f,t} = \sum_{j \neq \{usd,eur,jpy,cny\}} \left(\frac{Exp^{j}_{i,t-1} - Imp^{j}_{i,t-1}}{Exp_{i,t-1} + Imp_{i,t-1}} \right) \Delta \ln e^{j/thb}_{t}.$$

For example, $NICER^{usd}_{i,t}$ and $NICER^{fc}_{i,t}$ measure the valuation channels associated with the dollar and non-dollar exposures, respectively. This allows us to assess and compare the valuation effects arising from different invoicing currencies.

Expenditure-switching effect controls

The general case also features three expenditure-switching channels of the exchange rate impact (see Eq. 4). We control for these by introducing two effective exchange rate indices as suggested by the theoretical framework. The first one is an empirical counterpart for ΔXE^{*} :

$$\Delta XE^{*}_{i,t} = \sum_{k \neq US} \left(\frac{Exp^{k,usd}_{i,t-1}}{Exp_{i,t-1}} \right) \Delta \ln e^{k/usd}_{t},$$

where $Exp^{k,usd}_{i,t}$ is firm i's exports to country k invoiced in the vehicle currency, the US dollar. $\Delta XE^{*}_{i,t}$ serves as a control for any expenditure-switching effects due to changes in export prices in trading-partner currencies for goods invoiced in the US dollar, which can be influenced by bilateral exchange rates between the US dollar and partner currencies. Another control is for baht-invoiced export transactions, where movements in baht exchange rates against partner currencies can generate demand substitution effects as is typically the case under PCP:

$$\Delta XE^{n}_{i,t} = \sum_{k} \left(\frac{Exp^{k,thb}_{i,t-1}}{Exp_{i,t-1}} \right) \Delta \ln e^{k/thb}_{t},$$

where $Exp_{i,t}^{k,thb}$ is firm i's exports to country k invoiced in local currency. Lastly, other expenditure-switching effects that may arise from import competition with a firm's domestically-sold goods should be absorbed by industry-time fixed effects.

Trade-weighted Exchange Rates

To empirically assess the importance of NICER relative to traditional trade-weighted exchange rate indices, we construct empirical counterparts for export-weighted exchange rates (ΔXE) and import-weighted exchange rates (ΔME) as follows:

$$\Delta XE_{i,t} = \sum_k \left(\frac{Exp_{i,t-1}^k}{Exp_{i,t-1}} \right) \Delta \ln e_t^{k/usd},$$

$$\Delta ME_{i,t} = \sum_k \left(\frac{Imp_{i,t-1}^k}{Imp_{i,t-1}} \right) \Delta \ln e_t^{k/usd},$$

where $Exp_{i,t}^{k,usd}$ and $Imp_{i,t}^{k,usd}$ represent exports to and imports from country k, respectively.

3.2 Regression specifications

As the first baseline, we estimate the valuation effects of exchange rates on firm profits using a fixed-effects panel regression through the specification:

$$\begin{aligned} \frac{EBIT_{i,t} - EBIT_{i,t-1}}{Asset_{i,t-1}} =& \alpha + \beta NICER_{i,t} \\ &+ \beta^* \Delta XE_{i,t}^* + \beta^n \Delta XE_{i,t}^n + \theta X_{i,t} + \alpha_i + \gamma_{Ind,t} + \epsilon_{i,t}, \end{aligned} \tag{6}$$

where we use changes in EBIT (earning before interest and tax) scaled by lagged total assets, as the dependent variables. β captures the valuation effects of exchange rates on firm profitability for transactions invoiced in foreign currencies. Control variables, $X_{i,t}$, include the lagged dependent variable, lagged debt-to-asset ratio, and trading partners' GDP (TPGDP) and export prices (MPX). The latter two variables are firm-specific, being weighted by each firm's export shares with destination countries and firms' import shares with source countries, respectively. We also include two other exchange rate indices, ΔXE^* and ΔXE^n, to account for expenditure-switching channels, as well as firm and industry-time fixed effects.

We then explore factors that could influence the exchange-rate sensitivity of firm profits. One important factor highlighted by the theoretical framework is a firm's international trade dependency. We replace $NICER_{i,t}$ in the above specification by its interaction

terms with trade dependency, resulting in the following specification:

$$\begin{aligned}\frac{EBIT_{i,t} - EBIT_{i,t-1}}{Asset_{i,t-1}} =& \alpha + \beta NICER_{i,t} TRD_{i,t-1} + \delta TRD_{i,t-1} \\ &+ \beta^{*} \Delta XE^{*}_{i,t} TRD^{S}_{i,t-1} + \beta^{n} \Delta XE^{n}_{i,t} TRD^{S}_{i,t-1} \\ &+ \theta X_{i,t} + \alpha_i + \gamma_{Ind,t} + \epsilon_{i,t},\end{aligned} \tag{7}$$

with

$$TRD_{i,t} = \begin{cases} TRD^{S}_{i,t} = \frac{Exp_{i,t}}{Sales_{i,t}} & \text{for Exporters.} \\ TRD^{C}_{i,t} = \frac{Imp_{i,t}}{TC_{i,t}} & \text{for Importers.} \end{cases}$$

That is, to measure trade dependency in the NICER interaction terms, we use the lagged ratio of export revenue to total sales for an exporter, and the lagged ratio of import value to total expense for an importer.[6] We also interact the two expenditure-switching effects with export dependence. The term $NICER_{i,t}$ is omitted, since we assume that firms that do not have trade exposures should not be sensitive to exchange rate movements. We later perform a robustness check to test whether this assumption is valid. Another potentially important factor outside the scope of the theoretical model is the use of financial hedging. We test for the importance of FX hedging in mitigating exchange rate exposures by including triple interactions between FX hedging ratios ($FNH_{i,t-1}$), trade dependency ($TRD_{i,t-1}$) and $NICER_{i,t}$. A firm's FX hedging activity $FNH_{i,t}$ is proxied by the ratio of the firm's forward plus swap transactions to all reported FX transactions.

We further explore the effects of NICER on firm performance beyond profitability. To study the impacts on firm liquidity and financing, we replace the dependent variable in equation 7 by ratios of changes in cash and loans outstanding to lagged total assets, as well as a measure of credit risks. To evaluate the real impact of NICER on employment and investment decisions of firms, we use the following specification:

$$\begin{aligned}\Delta \ln Y_{i,t} =& \alpha + \beta NICER_{i,t} TRD_{i,t-1} + \delta TRD_{i,t-1} + \beta^{m} \Delta ME^{inv}_{i,t} TRD^{C}_{i,t-1} \\ &+ \beta^{*} \Delta XE^{*}_{i,t} TRD^{S}_{i,t-1} + \beta^{n} \Delta XE^{n}_{i,t} TRD^{S}_{i,t-1} + \theta X_{i,t} + \alpha_i + \gamma_{Ind,t} + \epsilon_{i,t},\end{aligned} \tag{8}$$

where $Y_{i,t}$ is the number of employed workers and the value of net property, plant and equipment, to capture a firm's employment and investment, respectively. While most of the explanatory variables are similar to the regression specification (7), we include as additional controls the import-weighted effective exchange rates based on invoice currencies of import transactions:

$$\Delta ME^{inv}_{i,t} = \sum_{j} \left(\frac{Imp^{j}_{i,t-1}}{Imp_{i,t-1}} \right) \Delta \ln e^{j/thb}_{t}.$$

[6] In cases where export revenue (import value) exceeds total revenue (total expense), possible given that they come from different data sources, we cap the value of these ratios at one.

This is to control for changes in the relative prices of intermediate-good imports, which can alter demand for investment and employment. Dai and Xu (2017), for example, document that lower import prices may cause export firms to substitute away from labour employment. Meanwhile, we expect the sector-time fixed effects to account for the potential correlation between exchange rates and sentiment, the latter having a strong tendency to drive investment decisions.

We finally evaluate the persistence of NICER influences. The theoretical framework predicts that the relevance of NICER should dissipate over time as prices become flexible. Using the local-projection approach, we estimate the dynamic impact over the course of three years, using the following regression specification for each impact horizon h, firstly for firm profit, liquidity and financing:

$$\begin{aligned}\frac{\Delta^h Y_{i,t+h}}{Asset_{i,t-1}} =&\alpha + \rho\frac{\Delta Y_{i,t-1}}{Asset_{i,t-2}} + \beta^h NICER_{i,t}TRD_{i,t-1} + \sum_{j=1}^{h}\delta^j NICER_{i,t+j}TRD_{i,t+j-1} + \delta TRD_{i,t-1} \\ &+ \beta^* \Delta XE^*_{i,t}TRD^S_{i,t-1} + \beta^n \Delta XE^n_{i,t}TRD^S_{i,t-1} + \theta X_{i,t} + \alpha_i + \gamma_{ind,t} + \epsilon_{i,t},\end{aligned} \tag{9}$$

and for firm investment and employment:

$$\begin{aligned}\Delta^h \ln Y_{i,t+h} =&\alpha + \rho\Delta \ln Y_{i,t-1} + \beta^h NICER_{i,t}TRD_{i,t-1} \\ &+ \sum_{j=1}^{h}\delta^j NICER_{i,t+j}TRD_{i,t+j-1} + \delta TRD_{i,t-1} + \beta^m \Delta ME^{inv}_{i,t}TRD^C_{i,t-1} \\ &+ \beta^* \Delta XE^*_{i,t}TRD^S_{i,t-1} + \beta^n \Delta XE^n_{i,t}TRD^S_{i,t-1} + \theta X_{i,t} + \alpha_i + \gamma_{ind,t} + \epsilon_{i,t}.\end{aligned} \tag{10}$$

For both specifications, the parameter of interest is β^h. As in Teulings and Zubanov (2014), the forward leads of $NICER_{i,t}TRD_{i,t-1}$ are also included in the specification to correct the bias in impulse responses inherent in the local projection method.

While theory justifies the use of $NICER_{i,t}$ and $NICER_{i,t}TRD_{i,t-1}$ as proxies for the valuation effects, their validity as empirical instruments is key. NICER is effectively a shift-share instrument that has been widely used to identify the causal effects of interest (Bartik, 1991; Goldsmith-Pinkham et al., 2020; Borusyak et al., 2022). In Appendix B.4, we discuss the conditions under which a shift-share instrument would be valid and conduct several relatively stringent tests to justify the use of NICER in our empirical exercises.

3.3 Data

We leverage on five large micro-level datasets during the period 2007-2020, merged by firm ID at the annual frequency. First, the customs database contains the universe of export and import transactions, with details including trade value in local currency and the US dollar, trade quantity, partner country, product classification according to an 11-digit Harmonized

System, and importantly the currency of invoicing. Second, the Corporate Profile and Financial Statement (CPFS) database from the Ministry of Commerce contains registered firms' annual balance sheets and income statements. Third, the Social Security Office (SSO) data cover employment in formal sectors. Fourth, the central bank's supervisory Financial Market Statistics (FMST) data cover the universe of onshore FX transactions including spot, forward and FX swaps. Lastly, we use contract-level loan data from the central bank's Loan Arrangement Database (LAR) and SMEs Data database (SMD). LAR, reported monthly by all financial institutions under supervision, covers loans extended to corporates and individuals with a total credit line or loan outstanding above 20 million Baht within a single bank. The database includes loan characteristics such as loan type, contract effective dates and maturity, loan outstanding, and classification on loan status.[7]

The merged dataset is then cleaned as follows. We drop firms that record negative EBIT over the entire period studied. We also focus only on firms with continued international presence, namely those with at least five years of international trade and at least half the number of years with available CPFS data. While the CPFS dataset consists of around 769,000 registered firms, we are left with around 40,000 firms (5.2 percent) that continuously engage in international trade. Next, we drop potential outliers by excluding observations whose values lie outside the 1^{st} and 99^{th} percentiles, for the ratio of revenue to lagged assets, the ratio of expenses to lagged assets, revenue growth, expense growth, lagged income growth, the lagged debt-to-asset ratio, the ratio of EBIT to lagged assets, operating profit margin (OPM), fixed asset growth, growth of property, plant and equipment (PPE), employment growth and wage growth. For each specification, we further exclude outlier with respect to the lagged dependent variable. Finally, we consider 25 top foreign invoicing currencies,[8] accounting for virtually all total trade during the period. Appendix B.1 presents summary statistics of data used.

Using the cleaned data, we classify firms into exporters and importers (or domestically-oriented firms) based on their observed trade transactions. A firm is an exporter if its total export value in baht terms over the sample exceeds the total import value. Based on this criterion, one-third of the firms are exporters, 1,800 of which do not have any import transactions. The remaining 27,000 firms are importers, 8,500 firms of which do not have any export transactions. We exclude these pure importers from the sample, to avoid the perfect collinearity between $NICER_{i,t}$ and $\Delta ME^{inv}_{i,t}$ among these firms.

[7]Since 2014, SMD provides similar information on all business loans of borrowers with aggregate credit line or outstanding of lower 20 million baht. In any regression with loan data, we exclude year 2014 from the sample to avoid any jump in loan outstanding.

[8]United Arab Emirates dirham, Australian dollar, Swiss franc, Chinese yuan, Euro, British pound, Hong Kong dollar, Indonesian rupiah, Indian rupee, Japanese yen, Korean won, Laotian kip, Myanmar kyat, Malaysian ringgit, the Philippine peso, Singapore dollar, New Taiwan dollar, US dollar, Vietnamese Dong, Cambodian riel, Russian ruble, Mexican peso, South African rand, Saudi riyal and Brazilian real. In computing ΔXE^n and ΔXE^*, we limit our sample to trade with countries issuing these currencies. For the Euro Area, we focus on six economies that include Belgium, Germany, Spain, France, Italy and Netherlands. The same set of countries is also used in constructing trading-partner-weighted GDP and export prices.

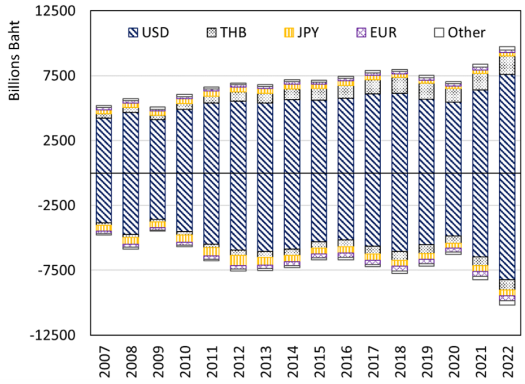
3.4 Stylised facts

A number of key stylised facts emerge, regarding the invoicing currencies used in trade transactions, firm currency exposures, and our constructed NICER.

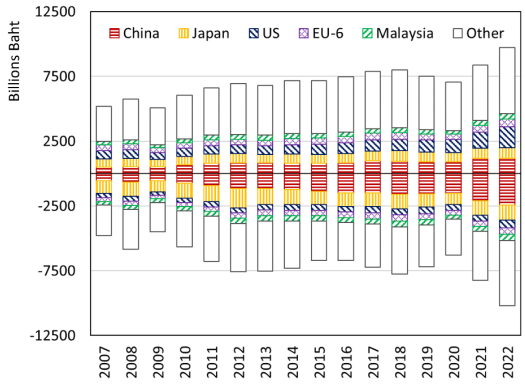
First, dollar invoicing dominates both export and import transactions, accounting for 80 percent of total trade values (Figure 1(a)). Shares of dollar-invoiced transactions are consistently high over time, despite the shares of exports to and imports from the US being only 12% and 6%, respectively (Figure 1(b)). Beyond the US dollar, other popular invoicing currencies include the Thai baht, the Japanese yen and the euro. The use of baht has been rising, particularly for export transactions, spurred in part by firms' attempt to limit FX risk exposure as encouraged by the central bank. At the same time, the use of Chinese yuan as an invoicing currency remains limited despite a significant trade share with China. While non-dollar currencies represent only 20 percent of trade value, they account for a much higher share in terms of number of trade transactions. The dominance of the US dollar as an invoicing currency extends across sectors and trading partners (see Figure B.1 in the Appendix). One notable exception is the 'transportation' sector, where the Japanese yen is also used intensively alongside the dollar due to the prominence of Japanese automobile producers. Invoicing in the partner currencies is also popular for trade with countries such as Japan, Switzerland and the euro area.

Figure 1: Trade Value Breakdown

(a) By Invoicing Currency



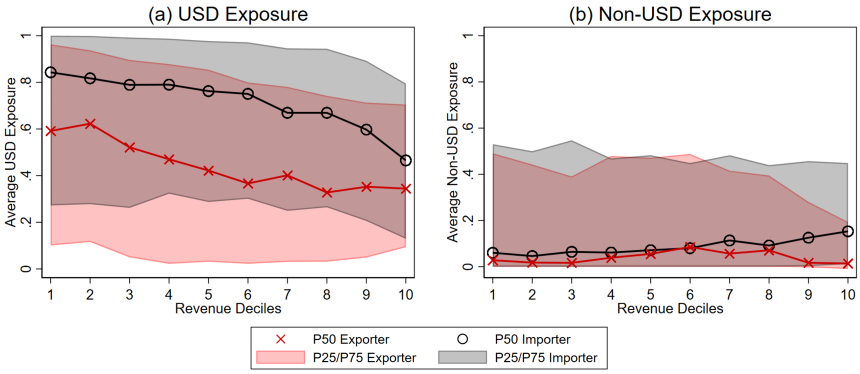
(b) By Trading Partner



Note: The figure shows total export values (positive sign) and import values (negative sign) in local currency during 2007–2022. EU-6 consists of Belgium, Germany, Spain, France, Italy and the Netherlands.

Second, firms' trade patterns create significant exchange rate exposures. Figure 2 shows the extent of currency mismatches by invoicing currencies (left and right panels) and across different firm sizes (horizontal axis). For each firm and invoicing currency, we compute average currency mismatch as the difference between exports and imports invoiced in that currency in a given year divided by total gross trade. We rank firms by sizes in ten deciles according to their 2008–2020 average revenues, and, for each decile,

Figure 2: Currency Exposure over Gross Trade by Firm Size



Note: The figure shows net currency exposures of firms, computed for each invoicing currency as the ratio of the firm's net exports to total gross trade in a given year, averaged over period 2008–2020. Firms are ranked and classified into deciles based on average revenue. We report the median exposures as well as their 25 and 75 percentiles. For importers, the sign of net exposures is flipped for the ease of comparison with exporting firms. Panel (b) shows the sum of net exposures across all non-USD invoicing currencies.

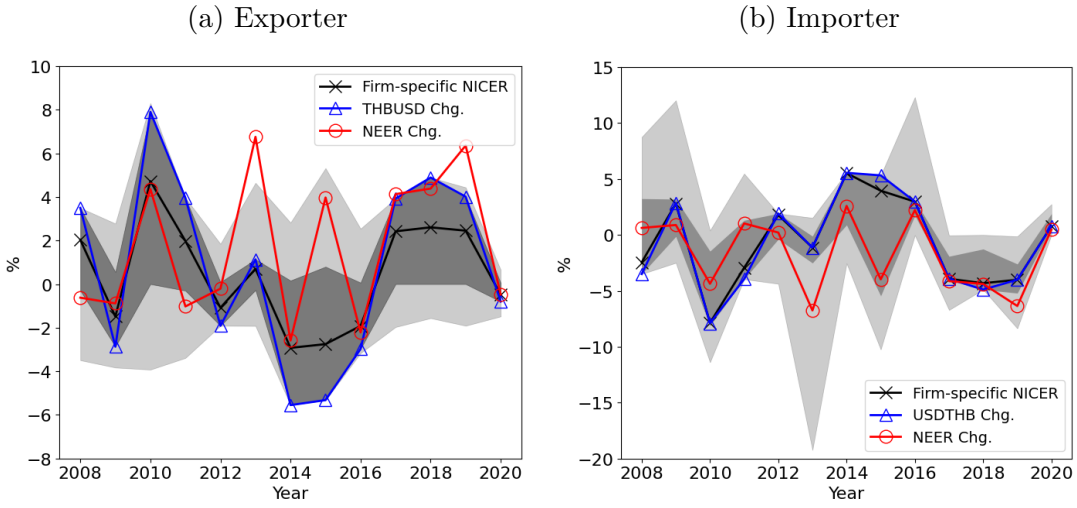
plot the median mismatch together with the 25th and 75th percentiles. Consistent with dominant dollar invoicing, firms face large net dollar exposure, more so for smaller firms and importers (panel (a)). Many importers have maximum net dollar exposure, relying solely on dollar for import invoicing with no corresponding export revenue. The dollar exposures are progressively lower for larger firms, indicating higher degrees of natural hedge and/or increasing use of non-dollar invoicing. The median non-dollar exposure (panel (b)) is generally small, if less so for large importing firms. That said the distribution is highly skewed with mismatch in the 75th percentiles close to 0.5, suggesting that many firms still have significant non-dollar exposures.[9]

Third, exchange rate exposures vary substantially both across firms and over time, as shown by the NICER dispersion and its dynamics (Figure 3). As a result, bilateral or trade-weighted exchange rates can deviate significantly from NICER, making them suboptimal indicators when the valuation effects are important. For example, in 2015 when the baht depreciated against the dollar by 5 percent, the $5^{th} - 95^{th}$ percentile range of exporters' NICER covers -5 to 5 percent (panel (a)). This implies that many firms in fact faced NICER appreciation, due to significant trade invoicing in other currencies that depreciated against the baht. More generally, the dollar-baht exchange rate tends

[9]In Appendix Figures B.2 and B.3, we further examine dollar and non-dollar currency mismatches across sectors. There is large heterogeneity in dollar exposures, especially for exporters. Net exposures are large in the food sector, reflecting its reliance on domestically-sourced input, but small in electrical, automotive and transportation & construction sectors. On the other hand, net dollar exposures for importers are larger and similar across sectors with a clear negative association with firm size. Among all sectors, the automotive sector appears to have the lowest dollar exposure, in part due to the use of Japanese yen as an invoicing currency. Non-dollar exposures are, on average, small in most sectors.

to hug the boundaries of NICER distribution over time, effectively capturing only the valuation effects of the firms relying solely on dollar invoicing with no natural hedge. Trade-weighted exchange rates such as the nominal effective exchange rates (NEER) are even more disconnected with NICER, given the downplayed role of the dollar. Similar stylised facts apply for importing firms (panel (b)).

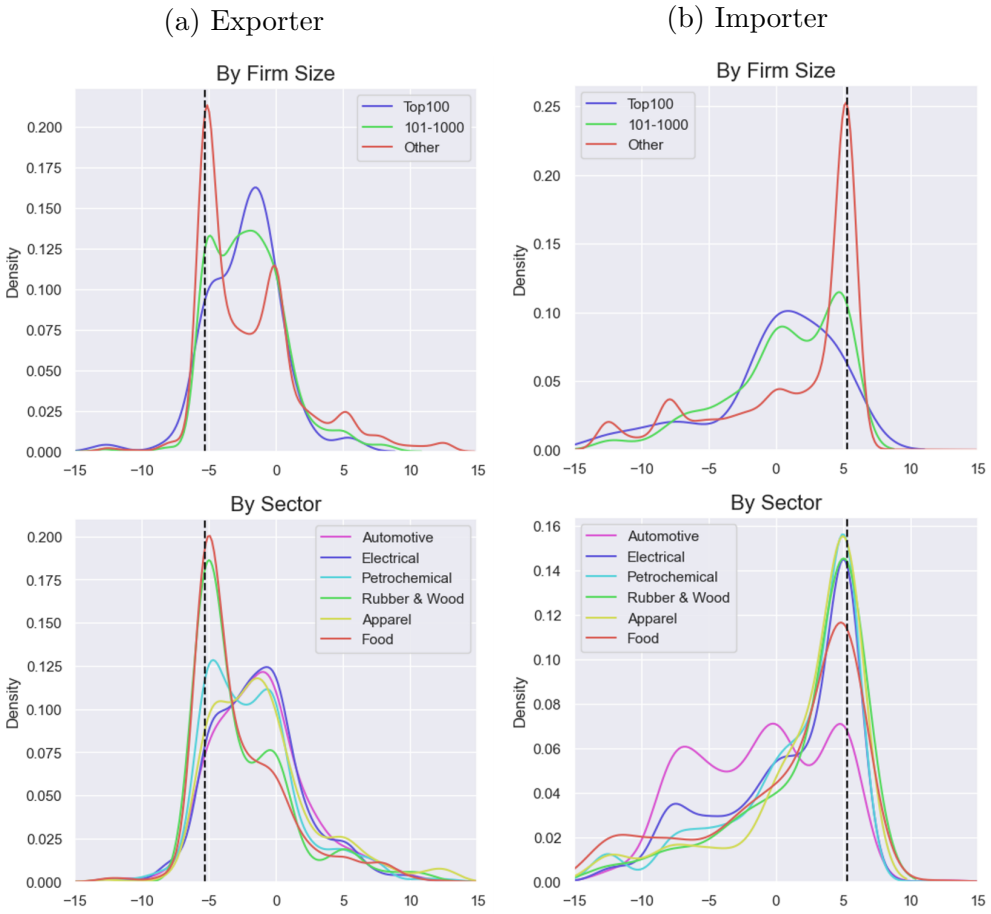
Figure 3: Firm-level NICER versus Traditional Exchange Rate Indices



Note: $16^{th} - 84^{th}$ percentiles of NICER distribution shown in dark grey, while $5^{th} - 95^{th}$ percentiles in light grey, with mean in black lines. Blue line with triangles and red line with circles denote percentage changes in the dollar-baht and the nominal effective exchange rates (NEER), respectively. For exporters (importers), positive (negative) values indicate baht appreciation.

Fourth, the NICER distributions differ materially across sectors and firm sizes. Figure 4 shows various snapshots of these distributions. For exporters (column (a)), the NICER distributions are typically bimodal, with one mode coinciding with the dollar-baht exchange rate movements, and the other lying closer to zero. These modes correspond to the masses of exporters with maximum dollar exposure on the one hand, and those with strong natural hedges on the other. Larger firms are less exposed, with the near-zero mode being more prominent (blue and green densities in top-left panel). Also contributing to the bi-modality of NICER is the significant sectoral heterogeneity, with firms in 'food' and 'rubber & wood' sectors being most exposed, while 'automotive' and 'electrical' firms being better hedged. Importers' NICER also follows the bimodal pattern, but to a lesser extent (column (b)), with more firms being exposed to exchange rate movements consistent with the second stylised fact. Largest importers tend to be more insulated with NICER mode close to zero, while NICER for smallest importers cluster around the point of maximum exposure (the negative of dollar-baht movement). Across sectors, importers' exposures are similarly elevated close to the maximum level, a notable exception being the automobile sector where NICER distribution is more uniform, partly due to the prevalence of Japanese yen

Figure 4: NICER Kernel Distributions as of 2015



Note: Columns correspond to exporters and importers. The top row shows NICER distributions by firm sizes, classified into three groups based on firms' average revenues during 2008–2020. The bottom row shows NICER distributions for six selected sectors. Vertical dashed lines represent the yearly log change in dollar-baht exchange rate, with baht depreciation represented by negative values for exporters and positive values for importers.

invoicing.[10]

4 Empirical results

4.1 Baseline results

We first estimate the impact of NICER on firms' profits, measured by changes in EBIT to lagged assets, based on equation 6. Table 1 reports estimation results for exporters and importers. Columns 1 and 4 show that coefficients of NICER have correct signs and are

[10]In Figures B.4 and B.5, we show that NICER volatility facing each firm stems mainly from dollar exposure, but decreases with firm size. Meanwhile, NICER volatility resulting from non-dollar exposures is small. In the automotive sector, large firms have relatively lower dollar exposures but also higher non-dollar NICER volatility.

significant for both groups of firms. The impact is larger for exporters, with a percentage point appreciation in NICER lowering change in EBIT to lagged assets by 0.19 percentage point, relative to 0.13 percentage point for importers. In columns 2 and 5, we distinguish exchange rate changes into those driven by dollar and non-dollar exchange rate movements. A more pronounced impact of NICER on exporters holds for both dollar and non-dollar NICER. However, the effects of non-dollar NICER are stronger for both exporters and importers, with insignificant effects of dollar NICER on importers' profit. The stronger effect from non-dollar NICER is partly driven by yen-invoiced transactions and, to a lesser extent, those priced in euro, as shown in columns 3 and 6. Meanwhile, the renminbi-based NICER has no significant effects.

What explain the different sensitivities of firm profits to exchange rate exposures across exporting and importing firms as well as invoicing currencies? One factor suggested by our theoretical framework is the degrees of trade dependency, which helps account for the stronger NICER impact for more trade-dependent exporters. The degree of price rigidity is another, e.g. importers may be more able to pass on higher production costs to domestic customers than exporters who operate in more competitive global markets. The use of FX hedging instrument is another factor that could lessen profit sensitivity. We return to assess the roles of these factors in section 4.3.

Does NICER dominate other traditional exchange rate indices in explaining firm profits? We next conduct a horse race between NICER and firm-specific trade-weighted exchange rates. The theoretical framework suggests that trade-weighted exchange rates should dominate under producer currency pricing, whereas NICER should outperform under dominant currency pricing. We distinguish between export-weighted and import-weighted exchange rates ($\Delta XE_{i,t}$ and $\Delta ME_{i,t}$) to account for differences in the elasticity of exports and imports to price changes, as well as differences in the mechanisms through which these exchange rates influence firm profits.[11] Results are shown in Table 2 for exporters (columns 1–3) and importers (columns 4–6). For exporters, only the coefficient on exported-weighted exchange rates is significant (column 2), and similarly for importers, only the coefficient on import-weighted exchange rates is significant (column 5). Columns 3 and 6 report the horse race results, with both NICER and trade-weighted exchange rates present. The coefficient on NICER remains very close to the baseline result and significant at one-percent level across both specifications. Importantly, after controlling for NICER, the effects of trade-weighted exchange rates become smaller or insignificant. These results indicate the dominant role of NICER in driving firm profits.

NICER also vastly outperforms firm-specific trade-weighted exchange rates in accounting for the dispersion of profits across firms. To illustrate this, we compute the predicted EBIT distribution across firms using estimates from columns 1–2 and 4–5 of Table 2.

[11] Under PCP, for example, while export-weighted exchange rates affect firm profits in the short run through expenditure-switching channel, the impact of import-weighted exchange rates is through the valuation channel (see Section 2).

Table 1: Impact of NICER on Firm EBIT

	ΔEBIT: Exporter			ΔEBIT: Importer		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Dep. Var.	-0.291***	-0.291***	-0.291***	-0.303***	-0.303***	-0.303***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
NICER	-0.195***			-0.128***		
	(0.016)			(0.015)		
USD-NICER		-0.107***	-0.106***		-0.027	-0.029
		(0.022)	(0.022)		(0.024)	(0.024)
FC-NICER		-0.276***			-0.173***	
		(0.021)			(0.017)	
EUR-NICER			-0.282***			-0.082***
			(0.044)			(0.031)
JPY-NICER			-0.294***			-0.216***
			(0.027)			(0.020)
CNY-NICER			-0.338			0.008
			(0.431)			(0.237)
Other-NICER			-0.172***			-0.114*
			(0.060)			(0.060)
ΔXE^*	0.007	0.006	0.006	0.009**	0.009***	0.009***
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)
ΔXE^n	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
TPGDP	0.103***	0.113***	0.114***			
	(0.029)	(0.029)	(0.029)			
MPX				0.052***	0.037**	0.022
				(0.018)	(0.018)	(0.019)
Lagged Debt-Asset	0.124***	0.124***	0.124***	0.173***	0.173***	0.173***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Constant	-6.653***	-6.694***	-6.701***	-8.774***	-8.755***	-8.730***
	(0.136)	(0.137)	(0.137)	(0.160)	(0.160)	(0.160)
Observations	89,881	89,881	89,881	71,263	71,263	71,263
R-squared	0.246	0.246	0.246	0.328	0.328	0.328
Firm FE	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER. We show results for a sample of exporting firms (columns 1–3) and importing firms (columns 4–6). Controls include firm and industry-year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Standard errors are reported in parentheses. Sample period is 2008–2020.

As shown in Figure 5, this distribution is much more dispersed under the specification with NICER, closer to data counterpart.[12] The contrast is especially notable in the case for exporters, consistent with the larger effects from NICER found in Table 2. With NICER, the standard deviations of predicted EBIT growth, computed annually across firms, average around 0.5 percent. The average standard deviation reached 0.7 percent in 2010 when the Thai baht appreciated strongly as the economy recovered from the great financial crisis (see Table 3). For importers, the average standard deviation is slightly lower at 0.4 percent. With trade-weighted exchange rates, the standard deviations of predicted EBIT growth are much lower, averaging 0.06 for exporters and 0.19 percent

[12]The empirical distribution is extremely dispersed and is not shown.

Table 2: Impact of NICER and Trade-weighted Exchange Rates on Firm EBIT

	ΔEBIT: Exporter			ΔEBIT: Importer		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Dep. Var.	-0.291***	-0.290***	-0.291***	-0.303***	-0.302***	-0.303***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
NICER	-0.195***		-0.192***	-0.128***		-0.122***
	(0.016)		(0.016)	(0.015)		(0.015)
ΔXE		-0.007***	-0.004*		-0.003	-0.003
		(0.002)	(0.002)		(0.002)	(0.002)
ΔME		-0.007	-0.008		0.033***	0.019**
		(0.007)	(0.007)		(0.008)	(0.008)
ΔXE^{*}	0.007			0.009**		
	(0.005)			(0.003)		
ΔXE^{n}	-0.002			-0.003		
	(0.003)			(0.003)		
Observations	89,881	89,881	89,881	71,263	71,263	71,263
R-squared	0.246	0.245	0.246	0.328	0.327	0.328
Control Var.	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES

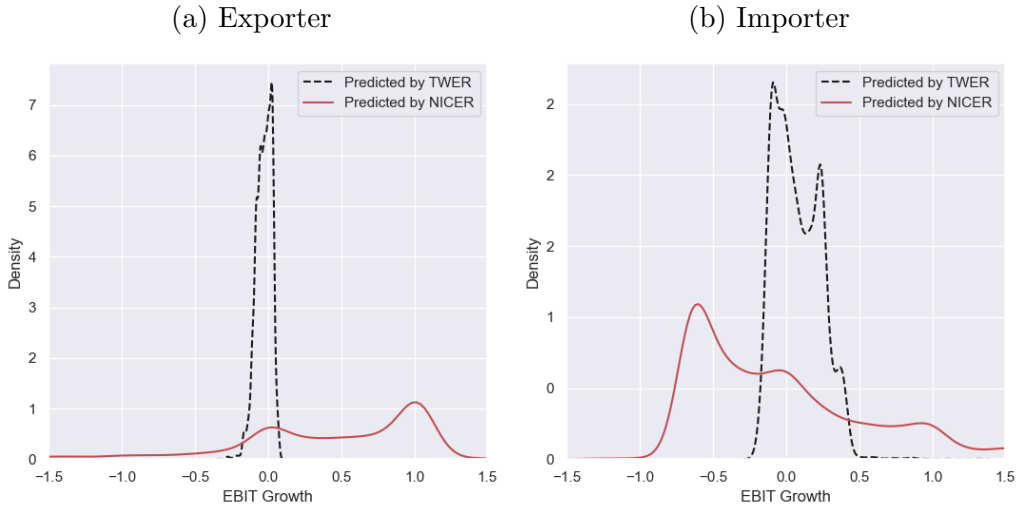
Note: This table compares the sensitivity of changes in EBIT as a ratio of lagged assets to two different concepts of exchange rates: trade-weighted exchange rates (export-weighted, ΔXE, and import-weighted, ΔME) and NICER. Results are from a firm panel regression, for samples of exporting firms in columns 1–3, and importing firms in columns 4–6. Controls include firm and industry-year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Standard errors are reported in parentheses. Sample period is 2008–2020.

for importing firms. The predicted model with NICER explains around 3–4 percent of observed profit variations across firms. This is an order of magnitude higher than the explanatory power of the model with trade-weighted exchange rates, which accounts for only 0.5–2 percent of the dispersion.

4.2 Impact by firm size and sector

We next examine how the valuation effects vary across firm sizes and economic sectors. Table 4 reports estimates with firms sorted into small, medium and large according to revenues. Controlling for sizes, exporters remain more exposed to NICER than importers. The sensitivity of exporter profits declines with firm size–the NICER coefficients are 0.24, 0.19 and 0.16 for small, medium and large firms, respectively. The monotonic decline in sensitivity is driven largely by the dollar-priced transactions, as the impact of dollar NICER on large firms' profits turns insignificant. For importers, the opposite pattern holds, with the NICER impact growing with firm size driven by the influence of non-dollar NICER. For all importers' sizes, the valuation effects from dollar NICER are insignificant and dominated by the effects of non-dollar NICER, consistent with the baseline results in Table 1. In Table B.13 in the Appendix, we show that this heterogeneity in NICER sensitivity across firm sizes does not stem from a different financial channel related to foreign-currency

Figure 5: Dispersion of EBIT Growth Explained by Exchange Rate Changes as of 2015



Note: Kernel distribution of predicted changes of firm profits in 2015 based on NICER in red solid line and trade-weighted exchange rates (TWER) in black dash line. Predicted changes in firm profits are calculated based on estimates from Columns 1–2 and 4–5 of Table 2.

liabilities (e.g. because large exporters can better access to foreign financing).[13]

To illustrate how firms are differently affected by shifts in the *nominal* exchange rates, we re-scale the estimates by multiplying the NICER sensitivity with the average net exposure of firms in each size bucket. These adjusted coefficients capture the impact of a one-percent change in the nominal exchange rate for average firms within each size group. Figure 6(b) reports these adjusted estimates and reinforces the finding that large exporting firms are more insulated from exchange rate fluctuations. The adjusted coefficients β^{fc} now become on par with β^{usd}, and are larger for small-sized firms, regardless of the invoicing currency. For importers, the adjusted coefficients β^{fc} are similarly smaller as expected, reflecting the small non-dollar exposures for both exporting and importing firms as shown in Figure 2.

Across the sectoral dimension, there are also significant variations in the strength of valuation effects. Tables 5 and 6 report the estimates when firms are grouped into eight manufacturing sectors and five non-manufacturing sectors. For exporters, the NICER impact is significant across all sectors, except for food and retail. The impact is largest in the automotive sector, followed by apparel and electronic. For importers, the NICER

[13]We account for this balance sheet channel by introducing foreign currency debt-weighted exchange rates. Based on LAR and SMD database, we compute firm-specific weight for each currency as the ratios of loans outstanding in that currency to total loans outstanding, interacted with firm leverage. We find NICER coefficients to be robust to the inclusion of debt-weighted exchange rates. The coefficients on the interaction terms between debt-weighted exchange rates and firm leverage are small and statistically insignificant. Table B.14 in the Appendix confirms that the dominant role of NICER over trade-weighted exchange rates holds across firm sizes.

Table 3: Comparison of Predicted EBIT Growth By NICER and Trade-weighted Exchange Rates (TWER)

	Standard Deviations of Predicted ΔEBIT by TWER & NICER				Variation of ΔEBIT Explained by TWER & NICER			
	Exporter		Importer		Exporter		Importer	
	TWER	NICER	TWER	NICER	TWER	NICER	TWER	NICER
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2008	0.049	0.464	0.175	0.442	0.004	0.039	0.018	0.046
2009	0.052	0.474	0.169	0.382	0.005	0.042	0.016	0.036
2010	0.037	0.679	0.102	0.487	0.003	0.057	0.009	0.043
2011	0.029	0.412	0.089	0.320	0.002	0.033	0.008	0.030
2012	0.334	0.226	0.938	0.207	0.026	0.017	0.072	0.016
2013	0.077	0.687	0.219	0.552	0.007	0.059	0.020	0.050
2014	0.030	0.480	0.092	0.357	0.003	0.042	0.009	0.034
2015	0.049	0.641	0.150	0.551	0.004	0.055	0.014	0.051
2016	0.049	0.472	0.149	0.375	0.004	0.036	0.013	0.033
2017	0.027	0.371	0.071	0.221	0.002	0.033	0.007	0.022
2018	0.023	0.385	0.058	0.215	0.002	0.036	0.006	0.023
2019	0.025	0.380	0.065	0.237	0.003	0.040	0.007	0.026
Average	0.065	0.473	0.190	0.362	0.005	0.041	0.017	0.034

Note: This table reports on the left-hand side the standard deviations of predicted EBIT growth based on trade-weighted exchange rate indices (TWER) and NICER, in each year. This is calculated using estimates from Columns 1–2 and 4–5 of Table 2. On the right-hand side, we report the proportion of across-firm variations in EBIT growth explained by TWER and NICER, in each year. This proportion is calculated as the ratio between the standard deviation of predicted EBIT growth and that of actual EBIT growth.

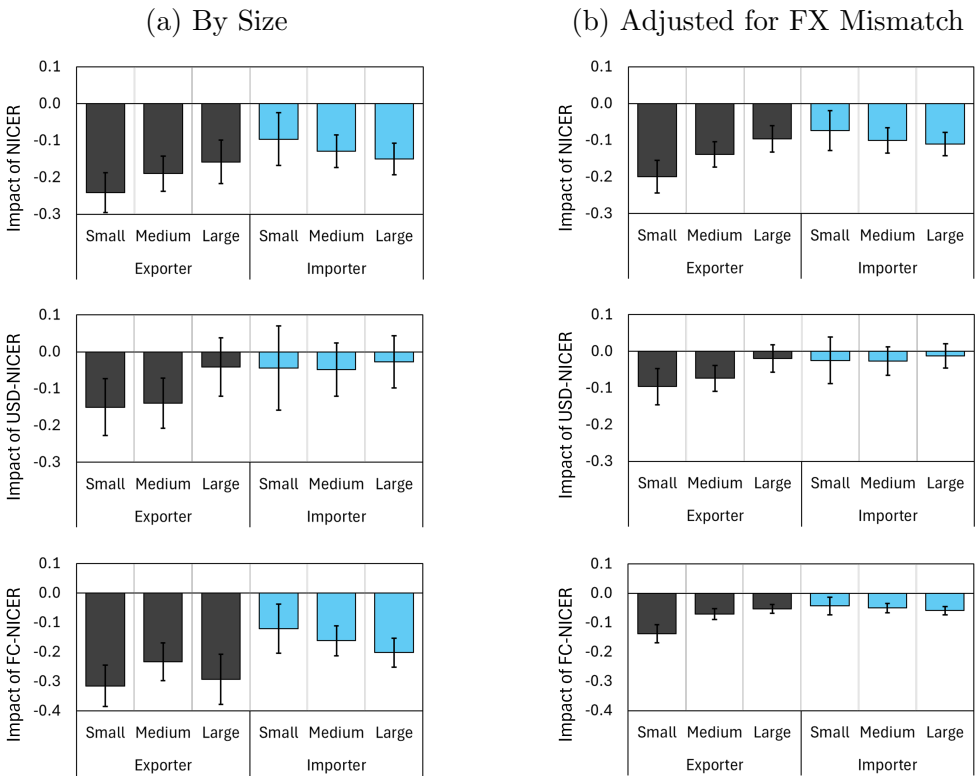
impact remains significant across the majority of sectors, albeit with more exceptions. Notably, the dollar NICER is insignificant in every manufacturing sector, while non-dollar NICER has a material and significant impact on metal, electrical and automotive sectors, as well as most of the non-manufacturing sectors.

Table 4: Impact of NICER on Firm EBIT by Firm Size

	ΔEBIT: Exporter						ΔEBIT: Importer					
	Small		Medium		Large		Small		Medium		Large	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NICER	-0.241***		-0.190***		-0.158***		-0.096***		-0.128***		-0.149***	
	(0.027)		(0.024)		(0.030)		(0.037)		(0.022)		(0.022)	
USD-NICER		-0.150***		-0.140***		-0.041		-0.044		-0.048		-0.026
		(0.039)		(0.035)		(0.041)		(0.059)		(0.037)		(0.036)
FC-NICER		-0.315***		-0.233***		-0.293***		-0.121***		-0.162***		-0.202***
		(0.036)		(0.032)		(0.044)		(0.043)		(0.026)		(0.025)
ΔXE^*	0.006	0.004	0.006	0.005	0.005	0.005	0.005	0.005	0.009*	0.009*	0.010**	0.010**
	(0.010)	(0.010)	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)	(0.010)	(0.005)	(0.005)	(0.004)	(0.004)
ΔXE^n	-0.008	-0.008	-0.004	-0.004	0.006	0.005	-0.013	-0.013	-0.007	-0.007	0.000	-0.000
	(0.006)	(0.006)	(0.004)	(0.004)	(0.005)	(0.005)	(0.014)	(0.014)	(0.005)	(0.005)	(0.004)	(0.004)
Observations	39,240	39,240	28,006	28,006	20,287	20,287	18,344	18,344	27,155	27,155	22,670	22,670
R-squared	0.285	0.285	0.301	0.301	0.295	0.296	0.429	0.429	0.373	0.374	0.319	0.320
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across firm size. We show results for a sample of exporting firms in columns 1–6, and importing firms in columns 7–12. Firm are classified into three groups according to their size (small, medium, large) based on annual revenue reported by the Office of Small and Medium Enterprise Promotion (OSMEP). Firms are classified as small if their annual revenue is less than or equal to 100 million baht (manufacturing) or 50 million baht (non-manufacturing). Medium-sized firms are those with revenue exceeding the small firm thresholds but not exceeding 500 million baht (manufacturing) or 300 million baht (non-manufacturing). Firms exceeding these upper limits are categorized as large. Controls include firm and industry-year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Standard errors are reported in parentheses. Sample period is 2008–2020.

Figure 6: Impact of NICER on Firm EBIT by Firm Size



Note: This figure reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across firm size. We show results for a sample of exporting firms in black bars, and importing firms in blue bars. Panel (a) represents the coefficients for each group from estimating equation 6 along with their 95-percent confidence interval. Panel (b) shows FX mismatch-adjusted impact of NICER, as calculated by the coefficients in panel (a) multiplied by the average of net exposures associated with each invoicing currency across all firms within each group. Firm are classified into three groups according to their size (small, medium, large) based on annual revenue reported by the Office of Small and Medium Enterprise Promotion (OSMEP). See note of Table 4 for details.

Table 5: Impact of NICER on Exporter's EBIT across Sectors

ΔEBIT: Exporter	Manufacturing		Food		Apparel		Rubber&Wood		Petrochemical		Metal		Electronic		Automotive		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
NICER	-0.207***		-0.046		-0.281***		-0.118**		-0.183***		-0.232***		-0.259***		-0.335***		-0.255***	
	(0.020)		(0.048)		(0.055)		(0.052)		(0.047)		(0.063)		(0.061)		(0.079)		(0.048)	
USD-NICER		-0.112***		-0.061		-0.059		-0.010		-0.018		-0.242**		-0.278***		-0.222*		-0.133*
		(0.030)		(0.074)		(0.085)		(0.069)		(0.068)		(0.105)		(0.102)		(0.131)		(0.070)
FC-NICER		-0.275***		-0.035		-0.416***		-0.243***		-0.326***		-0.226***		-0.249***		-0.392***		-0.353***
		(0.025)		(0.062)		(0.068)		(0.074)		(0.064)		(0.078)		(0.074)		(0.094)		(0.063)
Observations	50,308	50,308	7,518	7,518	6,446	6,446	4,822	4,822	7,900	7,900	3,528	3,528	6,846	6,846	2,818	2,818	10,328	10,328
R-squared	0.242	0.242	0.221	0.221	0.226	0.228	0.256	0.257	0.224	0.225	0.318	0.318	0.256	0.256	0.270	0.271	0.237	0.238

	Non-manufacturing		Agri&Food&Mining		Automotive Trade		Wholesale Trade		Retail Trade		Other							
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)						
NICER	-0.176***		-0.159***		-0.321**		-0.198***		-0.150*		-0.068							
	(0.026)		(0.050)		(0.125)		(0.038)		(0.081)		(0.083)							
USD-NICER		-0.098***		-0.075		-0.345**		-0.108**		-0.069		0.022						
		(0.034)		(0.068)		(0.164)		(0.049)		(0.098)		(0.117)						
FC-NICER		-0.273***		-0.239***		-0.289		-0.316***		-0.303**		-0.158						
		(0.038)		(0.067)		(0.192)		(0.056)		(0.133)		(0.117)						
Observations	39,341	39,341	9,614	9,614	1,885	1,885	18,728	18,728	4,573	4,573	4,512	4,512						
R-squared	0.259	0.260	0.234	0.235	0.244	0.244	0.261	0.262	0.263	0.263	0.269	0.269						
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES																

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across sectors. Firms are classified into 13 sectors, and grouped into manufacturing and non-manufacturing sectors based on the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4 at 2 or 3 digits as shown in parentheses. Manufacturing sectors consist of 8 industries: food (10-12), apparel (13-15), rubber & wood (16-17, 221), petrochemical (19-21, 222), metal (24-25), electronic (26-28), automotive (29-30), and other. For non-manufacturing, it is divided into 5 industries: agri & food & mining (01-03, 05-09, 462-463, 473-472), automotive trade (45), wholesale trade (46), retail trade (47), and other. Controls include firm and year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Standard errors are reported in parentheses. Sample period is 2008–2020.

Table 6: Impact of NICER on Importer's EBIT across Sectors

ΔEBIT: Importer	Manufacturing		Food		Apparel		Rubber&Wood		Petrochemical		Metal		Electronic		Automotive		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
NICER	-0.128***		-0.143*		-0.124		0.088		-0.093**		-0.137***		-0.066		-0.231***		-0.148*	
	(0.022)		(0.085)		(0.099)		(0.077)		(0.042)		(0.047)		(0.053)		(0.062)		(0.076)	
USD-NICER		-0.004		-0.129		-0.228*		0.134		-0.056		-0.012		0.127		-0.083		0.069
		(0.035)		(0.136)		(0.125)		(0.113)		(0.063)		(0.081)		(0.087)		(0.128)		(0.117)
FC-NICER		-0.186***		-0.150		0.022		0.054		-0.116**		-0.183***		-0.156**		-0.261***		-0.270***
		(0.025)		(0.103)		(0.146)		(0.098)		(0.051)		(0.053)		(0.062)		(0.066)		(0.091)
Observations	27,771	27,771	1,513	1,513	1,873	1,873	1,705	1,705	6,114	6,114	3,921	3,921	6,228	6,228	3,033	3,033	3,244	3,244
R-squared	0.322	0.323	0.352	0.352	0.389	0.389	0.311	0.311	0.284	0.284	0.323	0.324	0.324	0.325	0.351	0.351	0.287	0.288

	Non-manufacturing		Agri&Food&Mining		Automotive Trade		Wholesale Trade		Retail Trade		Other							
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)						
NICER	-0.127***		-0.178**		-0.019		-0.138***		-0.196***		0.030							
	(0.020)		(0.088)		(0.094)		(0.025)		(0.050)		(0.062)							
USD-NICER		-0.034		0.080		0.136		-0.056		-0.127		0.106						
		(0.033)		(0.134)		(0.148)		(0.041)		(0.082)		(0.098)						
FC-NICER		-0.166***		-0.341***		-0.083		-0.170***		-0.224***		-0.012						
		(0.023)		(0.109)		(0.106)		(0.028)		(0.057)		(0.075)						
Observations	43,179	43,179	2,229	2,229	1,898	1,898	25,768	25,768	7,327	7,327	5,635	5,635						
R-squared	0.335	0.335	0.335	0.338	0.316	0.317	0.334	0.334	0.333	0.333	0.352	0.353						
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES																

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across sectors. Firms are classified into 13 sectors, and grouped into manufacturing and non-manufacturing sectors, based on the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4 at 2 or 3 digits as shown in parentheses. Manufacturing sectors consist of 8 industries: food (10-12), apparel (13-15), rubber & wood (16-17, 221), petrochemical (19-21, 222), metal (24-25), electronic (26-28), automotive (29-30), and other. For non-manufacturing, it is divided into 5 industries: agri & food & mining (01-03, 05-09, 462-463, 473-472), automotive trade (45), wholesale trade (46), retail trade (47), and other. Controls include firm and year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Standard errors are reported in parentheses. Sample period is 2008–2020.

4.3 Roles of trade dependency and financial hedging

In this section, we examine the roles of two factors that could account for firms' heterogeneous sensitivities to NICER: international trade dependency and use of FX hedging instrument. While increases in trade dependency should raise firm exchange rate exposure as suggested by the theoretical model, we expect uses of financial hedging to mitigate it.

Table 7 shows the importance of trade dependency in driving the sensitivity of firm profits to NICER. Results are from estimating equation 7, which include the interaction terms between NICER and trade dependency. The coefficients for the interaction terms generally double from the baseline estimates, and are significant for both dollar and non-dollar exposures. For exporters, a complete trade dependency raises the NICER impact from 0.20 in the baseline to 0.32, and the impacts for dollar and non-dollar transactions from 0.11 and 0.28 to 0.20 and 0.47, respectively (columns 1–2). For importers, the overall NICER sensitivity increases from 0.13 to 0.29, with the coefficients for dollar and non-dollar NICER terms increasing and gaining significance (columns 5–6). That said, the low coefficients relative to the exporter case point to other factors that could have lessened the sensitivity of importer profits to dollar exchange rate changes, such as the ability to pass through costs. Consistent with these findings are the fact that trade dependency is uniformly higher for exporters and smaller firms (see Table B.11 in Appendix B.1).[14]

As a robustness check, we include the term $NICER_{i,t}$ alone into equation 7 to test whether the role of trade dependency on NICER sensitivity remains significant and large. The results, shown in columns 3–4 and 7–8, point to the coefficient estimates of the interaction terms that are close to those obtained from the specification without $NICER_{i,t}$, for the case of exporters. The coefficients on NICER are small and insignificant, consistent with our conjecture that export firms with little or no foreign income should not have exchange rate exposures. For importers, we still observe the large and significant role of trade dependency in driving firm profits, despite non-dollar NICER showing significance.

Next, we examine the role of FX hedging in mitigating exchange rate exposures. FX hedging data reveal that most firms do not hedge their exchange rate risks, and for those that hedge, do so partially (Table B.10). Hedging ratios also vary across firm sizes and sectors (Table B.11). To examine their role, we introduce double interaction terms between NICER, trade dependency and FX hedging ratios into equation 7. Results appear to be mixed overall. As shown in Table 8, we find positive coefficients indicating that FX hedging has helped mitigate firms' exposures. A full hedging weakens the valuation effects by about one-third relative to no hedging (columns 1 and 3). However, the estimates are only

[14]Table B.15 show that, for exporters, the sensitivity of profit to NICER is more comparable across firm sizes once trade dependency is accounted for. The coefficient of dollar NICER for large firms also becomes materially larger and significant. However, we still observe that large importers are more exposed to NICER movements. With trade dependency, NICER estimates of exporters become significant across all sectors, although profits in certain sectors remain insensitive to dollar NICER (Table B.16). Nevertheless, those of importers do not see changes in statistical significance (Table B.17).

Table 7: Impact of NICER on Firm EBIT: Role of International Trade Dependency

	ΔEBIT: Exporter				ΔEBIT: Importer			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged Dep. Var.	-0.291***	-0.291***	-0.291***	-0.291***	-0.303***	-0.303***	-0.303***	-0.303***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
NICER x TRD	-0.321***		-0.277***		-0.286***		-0.210***	
	(0.022)		(0.036)		(0.030)		(0.045)	
USD-NICER x TRD		-0.202***		-0.194***		-0.095**		-0.155**
		(0.029)		(0.045)		(0.044)		(0.064)
FC-NICER x TRD		-0.467***		-0.441***		-0.395***		-0.253***
		(0.032)		(0.061)		(0.035)		(0.055)
NICER			-0.034				-0.050**	
			(0.026)				(0.022)	
USD-NICER				0.005				0.034
				(0.035)				(0.035)
FC-NICER				-0.020				-0.080***
				(0.041)				(0.027)
TRD	1.374***	1.333***	1.713***	1.698***	-1.164***	-1.186***	-1.108***	-1.127***
	(0.302)	(0.302)	(0.311)	(0.311)	(0.327)	(0.327)	(0.327)	(0.327)
ΔXE^* x TRD^S	0.018**	0.016**	0.025**	0.021*	0.016	0.015	0.003	0.000
	(0.008)	(0.008)	(0.013)	(0.013)	(0.016)	(0.016)	(0.017)	(0.017)
ΔXE^n x TRD^S	-0.001	-0.001	0.006	0.006	-0.040	-0.042	-0.035	-0.035
	(0.004)	(0.004)	(0.007)	(0.007)	(0.041)	(0.041)	(0.051)	(0.051)
TPGDP x TRD^S	0.009	0.011	-0.130***	-0.136***				
	(0.036)	(0.036)	(0.046)	(0.046)				
MPX x TRD^C					0.038	0.039	-0.039	-0.015
					(0.034)	(0.034)	(0.047)	(0.047)
ΔXE^*			-0.006	-0.005			0.008**	0.009**
			(0.008)	(0.008)			(0.004)	(0.004)
ΔXE^n			-0.005	-0.005			-0.001	-0.001
			(0.005)	(0.005)			(0.004)	(0.004)
TPGDP			0.172***	0.187***				
			(0.037)	(0.037)				
MPX							0.066***	0.042*
							(0.025)	(0.025)
Lagged Debt-Asset	0.124***	0.124***	0.124***	0.124***	0.174***	0.174***	0.173***	0.173***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-7.204***	-7.192***	-7.640***	-7.672***	-8.356***	-8.335***	-8.382***	-8.355***
	(0.207)	(0.207)	(0.228)	(0.228)	(0.198)	(0.198)	(0.199)	(0.199)
Observations	89,881	89,881	89,881	89,881	71,263	71,263	71,263	71,263
R-squared	0.247	0.247	0.247	0.247	0.328	0.328	0.328	0.328
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER. We show results for a sample of exporting firms in columns 1–2, and importing firms in columns 3–4. International trade dependency (TRD) is measured by the ratio of firm total exports to total revenue for exporters, and the ratio of firm total imports to total expense for importers. Controls include firm and industry-year fixed effects. We exclude observations where the values of lagged dependent variables exceed their 1st and 99th percentiles. Sample period is 2008–2020.

Table 8: Impact of NICER on Firm EBIT: Role of Financial Hedging

	ΔEBIT: Exporter		ΔEBIT: Importer	
	(1)	(2)	(3)	(4)
Lagged Dep. Var.	-0.291***	-0.291***	-0.303***	-0.303***
	(0.003)	(0.003)	(0.004)	(0.004)
NICER x TRD	-0.339***		-0.311***	
	(0.024)		(0.033)	
NICER x TRD x FNH	0.096*		0.111*	
	(0.055)		(0.063)	
USD-NICER x TRD		-0.211***		-0.099**
		(0.032)		(0.049)
FC-NICER x TRD		-0.490***		-0.433***
		(0.035)		(0.040)
USD-NICER x TRD x FNH		0.027		0.024
		(0.064)		(0.093)
FC-NICER x TRD x FNH		0.182		0.175**
		(0.113)		(0.086)
TRD	1.519***	1.462***	-1.318***	-1.363***
	(0.311)	(0.311)	(0.345)	(0.345)
FNH	-0.042	-0.064	-0.826**	-0.864**
	(0.450)	(0.450)	(0.372)	(0.372)
TRD x FNH	-0.966	-0.871	1.149	1.282*
	(0.640)	(0.640)	(0.740)	(0.740)
Observations	89,881	89,881	71,263	71,263
R-squared	0.247	0.247	0.328	0.328
Control Var.	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER. We show results for a sample of exporting firms in columns 1–2, and importing firms in columns 3–4. Financial hedging (FNH) is calculated as the ratio of a firm's forward and swap transactions in baht terms to all FX transactions (i.e. sum of spot, forward and swap transactions). Controls include firm and industry-year fixed effects. We exclude observations where the values of lagged dependent variables exceed their 1st and 99th percentiles. Sample period is 2008–2020.

weakly significant and, once differentiating between dollar and non-dollar transactions, are significant only for importers with non-dollar invoicing (column 4). Partial mitigation may reflect the short maturity of forward transactions that typically last one to two quarters.[15]

[15]We include the interaction terms between NICER and hedging ratios as a robustness check. Results in Table B.18 show insignificant benefits of FX hedging for exporters. Only the double interactions with non-dollar NICER remain significant with the correct sign.

4.4 Impact on firm liquidity and financing

We next examine the exchange rate valuation effects on firm liquidity and credit conditions. When firms are financially constrained, adverse valuation effects on profits can translate into deterioration in liquidity and credit conditions. Independent from solvency and profitability issues, these liquidity and credit effects matter for firms' incentives and ability to hire and invest (see below), as well as broader financial stability.

To assess the liquidity effects, we use the ratio of changes in cash holdings to lagged total assets as a liquidity measure and the dependent variable in equation 7. The results are shown in Figure 7. Among exporters, the liquidity impacts are significant and larger for small and medium-sized firms, but smaller and weakly significant for large firms. For importers, NICER's effects on cash holdings are even more pronounced than for exporters, despite weaker profit impacts, though differences across firm sizes less clear. The overall significant effects of NICER is robust to alternative measures such as cash-to-assets and liquidity ratios.[16] See Appendix B.3, Table B.19 and Table B.20 for detailed results.

Turning to the NICER effects on credit conditions, we first note that the impacts are *a priori* ambiguous. Following adverse cashflow shocks, firms may resort to more external finance and borrowing to sustain operations. However, the increased credit demand may be constrained by tighter credit supply due to reduced firm net worth and heightened bankruptcy risk, as emphasised in the financial accelerator literature (Bernanke et al., 1999). Our paper contributes to this literature by providing direct evidence on how borrowing and credit risks respond to cashflow shocks arising from NICER movements.

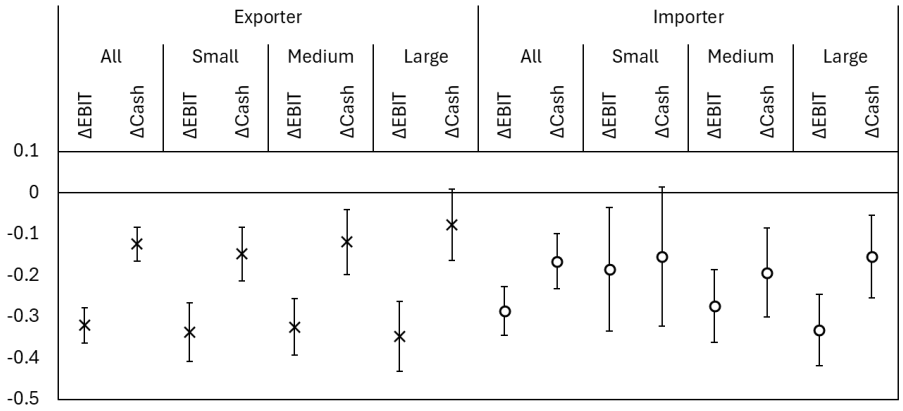
We consider five measures of firm borrowing: (1) changes in overall loans outstanding (excluding trade finance), (2) changes in long-term general loans outstanding, and (3) changes in working capital loans outstanding–all expressed as ratios of lagged assets–as well as (4) total and (5) short-term credit utilization rates, measured as loans outstanding relative to existing credit lines. For credit risks, we adopt a quantitative measure, the ratio of special-mention and nonperforming loans to total loans outstanding, while reporting results based on a qualitative measure–a dummy indicating whether a firm has any special-mention and nonperforming loans– as a robustness check in Table B.19 and Table B.20.

Figure 8 reports the impact on firm borrowing and credit risks. For exporters, we find that loans increase following adverse NICER movements, suggesting that the credit demand effect dominates. Across loan types, we find the strongest response in working-capital loans, consistent with the hypothesis that firms demand credit to fill short-term funding gaps. In a similar vein, it is the short-term needs the drive the overall credit utilisation rate. Long-term general loans, meanwhile, barely move. Looking across firm sizes, it is evident that credit demand by large firms drives the overall results, with no significant

[16]The cash-to-assets ratio is part of credit-constraint measure introduced by Kaplan and Zingales (1997), whereas Dai et al. (2021) use the liquidity ratios as one of the credit-constraint measures that influence the exchange rate passthrough to export prices.

effects on credit conditions for small and medium-sized firms. That is, only large firms are able to obtain short-term financing to offset cashflow shortfalls from NICER shocks. For importers, only credit utilization rates respond significantly to NICER changes driven by medium-sized firms, suggesting that the credit demand and supply effects largely wash out for importing firms. On the credit risk front, there is no significant increase in loan quality for either group of firms following an adverse NICER shock. The findings imply that any liquidity shortages are not severe enough to cause immediate loan impairments.

Figure 7: Impact of NICER on Firm Liquidity



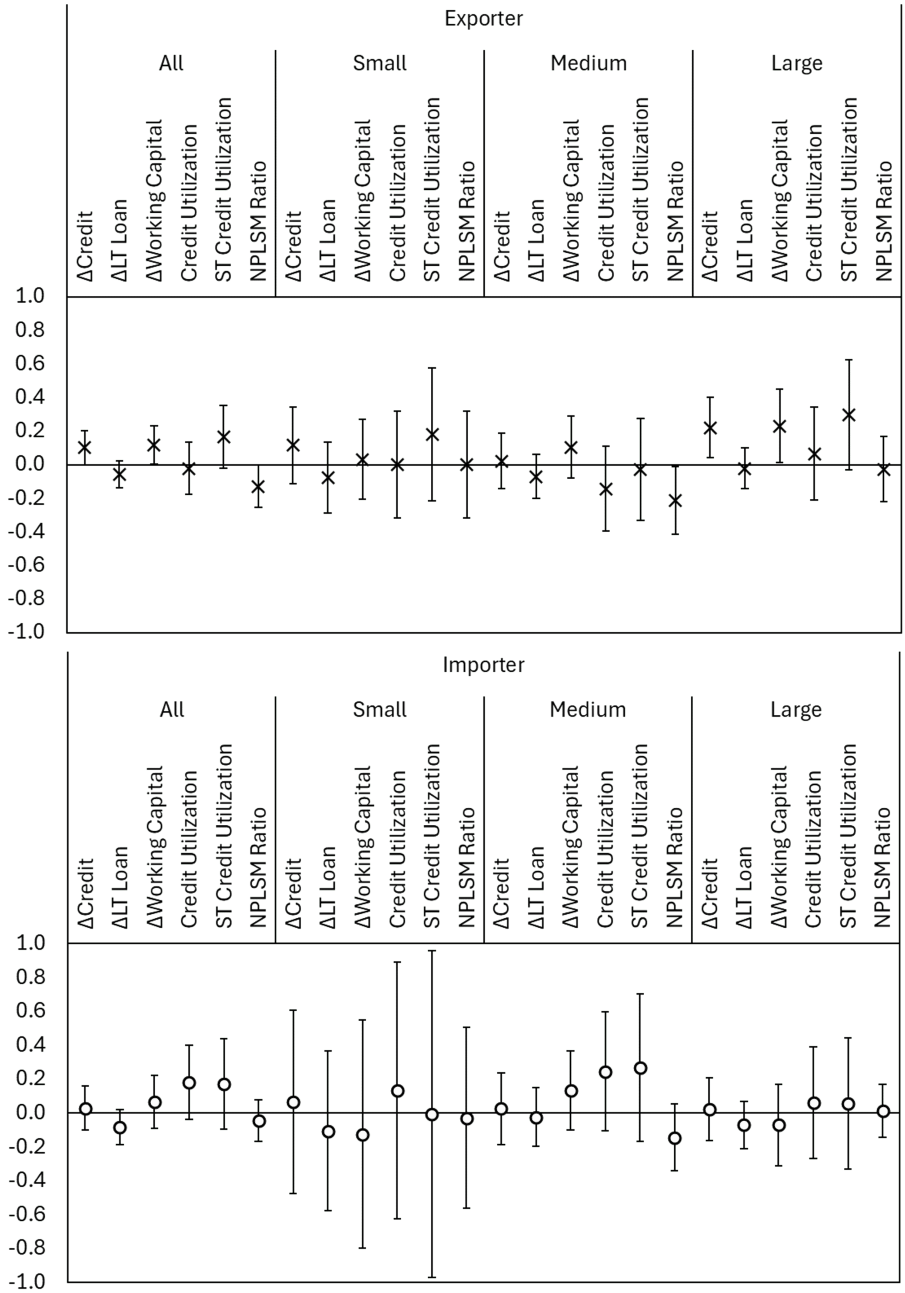
Note: This figure reports estimates from a firm panel regression of changes in EBIT and cash as a ratio of lagged assets on the interaction term between NICER and trade dependency ratios, across firm sizes. 95-percent confidence intervals are also reported. Firms are classified based on annual revenue reported by the Office of Small and Medium Enterprise Promotion (OSMEP). See note in Table 4 for details. We exclude observations where the values of lagged dependent variables exceed their 1st and 99th percentiles. Sample periods are from 2008 to 2020.

4.5 Real and dynamic effects of NICER

We now assess whether valuation effects on firm profits and liquidity influence firms' investment and hiring decisions. To proxy for firm-level investment and employment, we use annual growth of expenditures on property, plant and equipment as reported in the CPFS data, and annual employment growth from SSO data, respectively. Similar to the previous specification, we rely on the interaction term between NICER and trade dependency ratios to assess the valuation effects of exchange rates on real variables.

The real effects of NICER are significant for both investment and employment decisions of exporters (Table 9, columns 1 and 5). When distinguishing by invoicing currency, only dollar-NICER estimates are significant. For firms most dependent on trade, a one-percentage-point increase in dollar-NICER reduces investment and employment growth significantly by 0.2 and 0.1 percentage points, respectively. Meanwhile, non-dollar NICER, despite having a larger effect on profitability, does not significantly impact investment or employment. One possible explanation is its relatively low volatility. For importers, we

Figure 8: Impact of NICER on Firm Borrowing



Note: This figure reports estimates from a firm panel regression of various credit variables on the interaction term between NICER and trade dependency ratios, across firm sizes. Credit variables include changes in overall loans outstanding (excluding trade finance), long-term general loans outstanding and working capital loans outstanding as a ratio of lagged assets, overall and short-term credit utilisation rates as measured by the ratios of loans outstanding to credit lines, and the ratios of special-mention and nonperforming loans to total loans outstanding. All credit variables are at year end. Firm are classified based on annual revenue reported by the Office of Small and Medium Enterprise Promotion (OSMEP). See note in Table 4 for details. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Sample periods are from 2008 to 2020.

find no significant impact of NICER on real variables, regardless of invoicing currency. Table B.21 in Appendix further shows that the significant impact found for exporters' investment (employment) is driven by the sample of small (medium-sized) firms, whereas real decisions of large firms are insensitive to NICER movements. The latter finding may reflect the ability of large firms in managing cash-flow shocks, such as through obtaining external financing as shown earlier.

We finally evaluate the persistence of NICER influences, using the local-projection approach. Our theoretical framework predicts that the valuation channel should disappear once prices become flexible in the long run, when firms optimally pass through cash flow shocks onto product prices. How long it takes to transition to such flexible-price outcomes dictates the persistence of NICER impact. The results, shown in Figure 9, reveal highly persistent dynamics of the valuation effects. For exporters, the financial impacts of NICER on profits and liquidity are strongest in the short term, before dissipating over time. The impact turns insignificant after three years for profits and after two years for liquidity. These patterns are consistent with a gradual exchange rate pass-through to export prices. The lagged effects of NICER on credit, while insignificant, reverse signs after two years, suggesting a stronger credit supply contraction and declining credit demand for liquidity purposes. Among real variables, lagged effects are evident for both employment and investment, and persist beyond the periods the valuation effects on firm cash flows already disappear. For importers, as in some previous results, the dynamic effects of NICER are not significant across all variables.

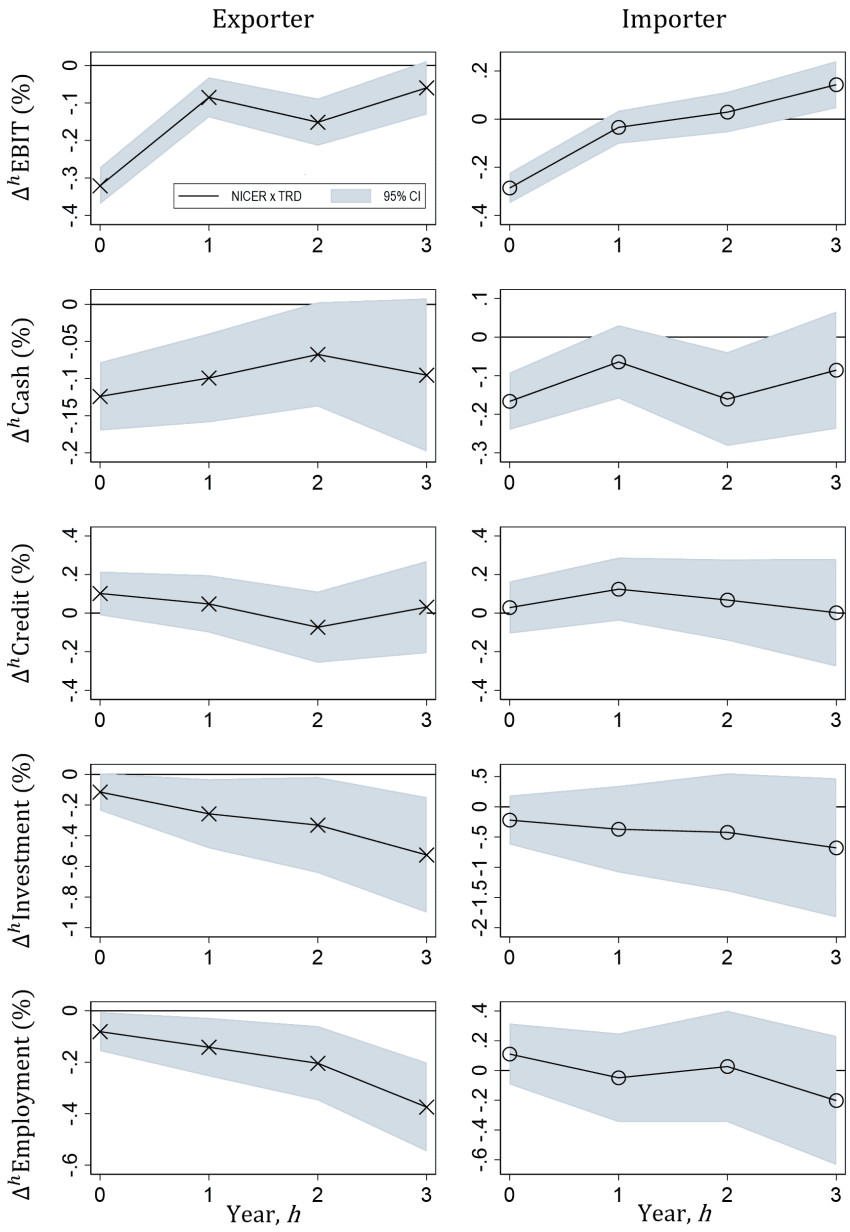
Overall, the sizeable and persistent valuation effects underscore the need to take this mechanism into account when assessing the macro-financial implications of exchange rates. As the channel is distinct from the expenditure-switching and balance-sheet-based financial channels, the quantitative impact, affected identities , time frame, and policy implications could all be different.

Table 9: Impact of NICER on Firm Investment and Employment

	ΔInvestment: Exporter		ΔInvestment: Importer		ΔEmployment: Exporter		ΔEmployment: Importer	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged Dep. Var.	0.052***	0.052***	0.004	0.004	0.140***	0.140***	0.108***	0.108***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
NICER x TRD	-0.115*		-0.219		-0.081**		0.110	
	(0.062)		(0.207)		(0.039)		(0.105)	
USD-NICER x TRD		-0.213**		-0.252		-0.113**		0.147
		(0.090)		(0.221)		(0.056)		(0.112)
FC-NICER x TRD		-0.033		-0.186		-0.055		0.073
		(0.083)		(0.221)		(0.051)		(0.112)
TRD	1.122	1.152	7.161***	7.164***	-1.403**	-1.392**	9.856***	9.854***
	(0.873)	(0.874)	(1.014)	(1.014)	(0.555)	(0.555)	(0.521)	(0.521)
ΔXE^* x TRD^S	-0.076**	-0.072**	0.048	0.048	-0.005	-0.003	-0.028	-0.028
	(0.033)	(0.033)	(0.046)	(0.046)	(0.021)	(0.021)	(0.022)	(0.022)
ΔXE^n x TRD^S	-0.011	-0.011	0.075	0.076	-0.015	-0.015	-0.002	-0.002
	(0.019)	(0.019)	(0.071)	(0.071)	(0.019)	(0.019)	(0.065)	(0.065)
ΔME^{inv} x TRD^C	-0.094	-0.105	0.071	0.081	0.110**	0.107**	0.179*	0.168*
	(0.086)	(0.086)	(0.190)	(0.192)	(0.053)	(0.053)	(0.096)	(0.096)
TPGDP x TRD^S	0.146	0.147			0.229***	0.229***		
	(0.107)	(0.107)			(0.067)	(0.067)		
MPX x TRD^C			0.221**	0.219**			0.143***	0.144***
			(0.105)	(0.105)			(0.054)	(0.054)
Lagged Debt-Asset	-0.036***	-0.035***	-0.065***	-0.065***	0.000	0.000	-0.007*	-0.007*
	(0.006)	(0.006)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	-0.656	-0.663	1.415**	1.411**	3.349***	3.345***	1.952***	1.957***
	(0.601)	(0.601)	(0.598)	(0.598)	(0.376)	(0.376)	(0.304)	(0.304)
Observations	53,591	53,591	63,011	63,011	48,114	48,114	54,554	54,554
R-squared	0.280	0.280	0.291	0.291	0.351	0.351	0.358	0.358
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of investment and employment growth on the interaction term between NICER and trade dependency ratios. We show results for exporters in columns 1–2 and 5–6, and importers in columns 3–4 and 7–8. Controls include firm and industry-year fixed effects. We exclude observations where the value of dependent variables exceeds their 5th and 95th percentiles, the level of investment is less than 100,000 baht, and the level of employment is less than 10 persons. Sample period is from 2008 to 2020.

Figure 9: Dynamic Impacts of NICER on Firm Performance



Note: The figure reports results from the local projection of various financial and real variables on the interaction term between NICER and trade dependency ratios over three years. These variables include changes in EBIT, cash holdings and loans to lagged assets, investment growth and employment growth. All credit variables are at year end. 95-percent confidence intervals are shown as dashed lines. Sample period is 2008–2020.

5 Conclusion

This paper analyses the valuation effects of exchange rates on firm performance. We construct firm-specific effective exchange rates–which we call NICER–to account for

invoicing currencies and associated currency mismatches that expose firms to cash flow shocks when exchange rates move. We find that changes in NICER significantly and materially impact firm profits, especially for small and medium-sized exporters and for those transacting in non-dollar currencies. For both exporters and importers, NICER dominates traditional trade-weighted exchange rates in explaining firm profitability. Consistent with theoretical predictions, we document that trade dependency significantly influences firm profit's sensitivity to exchange rate fluctuations, and that FX hedging offers only a partial mitigation of NICER impact. SMEs highly dependent on trade and lacking access to financial hedging are particularly vulnerable to adverse exchange rate shocks. We further show that NICER affects firm liquidity, with only large export firms managing to offset liquidity shocks by accessing short-term financing. Lastly, shifts in NICER significantly affect exporters' investment and employment decisions.

Our results carry important implications. First, the findings call for greater attention to the financial channel of exchange rates operating through firms' profits and liquidity, which matters more in the short run than the trade competitiveness channel. In analysing this financial channel, NICER is nicer than traditional trade-weighted exchange rates, offering richer and more relevant insights for policy surveillance. Second, because exchange rate fluctuations affect firms unevenly, taking this micro-level heterogeneity into consideration is crucial for macroeconomic assessments. NICER is one simple tool to capture this heterogeneity, enabling a granular assessment of macro-financial consequences of exchange rate shocks. At the same time, NICER sheds light on the distributional effects of FX intervention, allowing policymakers to conduct a more complete cost-benefit analysis. For researchers, our findings reinforce the importance of modelling heterogeneous agents in macroeconomics, and point to promising applications in international finance and trade. Lastly, our results have implications for the design of exchange rate policies. Although FX intervention can enhance macroeconomic and financial stability by shielding firms from sharp currency swings, policymakers must carefully evaluate its benefits which may disproportionately accrue to some subset of firms or decline with the use of non-dollar invoicing (because FX intervention is often conduct against the dollar). Promoting FX hedging, while helpful in mitigating firms' exposure to exchange rate risks, may also face practical constraints arising from high transaction costs and imperfect hedging strategies.

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Appendix

Appendix A Theoretical framework

A theoretical framework aims to shed light on the links between firm profits and exchange rates based on different assumptions on invoicing currencies used in trade transactions. Consider firm i, that is located in country n and produces differentiated products. A firm supplies them to destination countries k, which may include its own domestic market n. Since consumers have a CES-form utility over varieties, a firm faces the following demand function from market k:

$$q_{ink} = \left(\frac{p_{ink}}{P_k}\right)^{-\sigma_{ink}} D_k = \left(\frac{p^*_{ink} e^{k/n}}{P_k}\right)^{-\sigma_{ink}} D_k,$$

where σ is the elasticity of substitution, which may differ across markets. The good price denominated in the local currency of country k can be expressed as $p_{ink} = p^*_{ink} e^{k/n}$, where p^*_{ink} is the price denominated in the home currency of country n. * signifies the values that are expressed in the domestic currency. $e^{k/n}$ is the exchange rate between the currency of country n versus k, whereby an increase in $e^{k/n}$ shows an appreciation of currency n against currency k. P_k and D_k are the aggregate price level and demand in country k, respectively.

A firm produces output using the following production function:

$$Y_{in} = \Omega_{in} L_{in}^{1-\phi} X_{in}^{\phi}, \tag{11}$$

where Ω_{in} represents firm-level productivity, and L_{in} is labor demanded by firm i. $1-\phi$ is the share of labor costs in overall production costs, assumed to be common across all firms. X_{in} consists of a bundle of intermediate inputs j $\in$ [0,1], based on the following formula:

$$X_{in} = \exp\left\{\int_0^1 \gamma_j \ln X_{in,j} dj\right\}, \tag{12}$$

where γ_j measures the importance of input j in production, with $\int_0^1 \gamma_j dj = 1$. Intermediate inputs can be sourced from home and foreign countries, as denoted by Z_{inj} and M_{inkj}, respectively. For each intermediate input j, domestic and foreign inputs are combined based on the following function:

$$X_{in,j} = \left(Z_{inj}^{\frac{\epsilon}{1+\epsilon}} + \sum_{k \neq n} M_{inkj}^{\frac{\epsilon}{1+\epsilon}}\right)^{\frac{1+\epsilon}{\epsilon}}, \tag{13}$$

where $1+\epsilon$ is the elasticity of substitution between inputs from different sources.

The firm minimizes total costs given by TC^*_{in},

$$TC^*_{in} = W^*_n L_{in} + \int_0^1 V^*_{nj} Z_{inj} dj + \int_{J_{0,i}} \left(\sum_k \left(\frac{U_{nkj}}{e^{k/n}} \right) M_{inkj} \right) dj,$$

subject to technology constraints in (11) to (13), where λ, ψ, ζ represent a Lagrangian multiplier associated with each constraint. It takes as given labor wage W^*_n, the price of domestic intermediate input V^*_{nj} and the price of imported input U_{nkj}, the latter denominated in the currency of country k. We obtain the following first order conditions with respect to demand for labor and intermediate goods:

$$W^*_n = \lambda(1-\phi)\frac{Y_{in}}{L_{in}},$$

$$\psi = \lambda\phi\frac{Y_{in}}{X_{in}},$$

$$\zeta = \psi\gamma_j \frac{X_{in}}{X_{in,j}} \qquad \text{for all } j,$$

$$V^*_{nj} = \zeta \left(\frac{X_{in,j}}{Z_{inj}} \right)^{\frac{1}{1+\epsilon}} \qquad \text{for all } j,$$

$$\frac{U_{nkj}}{e^{k/n}} = \zeta \left(\frac{X_{in,j}}{M_{inkj}} \right)^{\frac{1}{1+\epsilon}} \qquad \text{for all } j.$$

Given optimized inputs, each firm maximizes its profits,

$$\Pi_{in} = \sum_k p^*_{ink} q_{ink} - TC^*_{in} = \sum_k p^*_{ink} q_{ink} - MC^*_{in} Y_{in},$$

by choosing optimal prices of good sold to each market k. TC^*_{in} and MC^*_{in} are total costs and the marginal cost of producing goods, respectively. The optimal price setting rule differs across the invoicing currencies of choice. In what follows, we consider three main pricing paradigms (producer currency pricing, local currency pricing and dominant currency pricing), and derive expressions for the sensitivity of firm profits to exchange rate changes for each of the three cases. We also differentiate between short-term and long-term sensitivities. For each case, we first compute the sensitivity of firm profits to each relevant bilateral exchange rate, and aggregate up these sensitivities into the expression that links firm profits to effective exchange rates.

A.1 Producer Currency Pricing (PCP)

A firm sets prices in its own currency, p^*_{ink}. By obtaining a first order condition with respect to p^*_{ink}, we get the optimal pricing rule:

$$p^*_{ink} = \left(\frac{\sigma_{ink}}{\sigma_{ink}-1}\right) MC^*_{in} = \mu_{ink} MC^*_{in},$$

where μ_{ink} represents the price markup. The marginal cost of the firm can be solved as:

$$MC^*_{in} = \lambda = \frac{1}{\Omega_{in}} \left(\frac{W^*_n}{1-\phi}\right)^{1-\phi} \left(\frac{\psi}{\phi}\right)^{\phi},$$

with

$$\psi = \frac{\exp\left\{\int \gamma_j \ln\left(\frac{V^*_{nj}}{\gamma_j}\right) dj\right\}}{\exp\{\int \gamma_j \ln b_j dj\}},$$

$$b_j = \left(\frac{X_{in,j}}{Z_{inj}}\right)^{\frac{1}{1+\epsilon}} = \left(1 + \sum_{k\neq n} \left(\frac{U_{nkj}}{e^{k/n} V^*_{nj}}\right)^{-\epsilon}\right)^{\frac{1}{\epsilon}}.$$

Or, following Amiti et al. (2014) and Dai and Xu (2017), we can write MC^*_{in} as

$$MC^*_{in} = \frac{C^*}{B^\phi \Omega_{in}},$$

with

$$C^* = \left(\frac{\exp\left\{\int \gamma_j \ln\left(\frac{V^*_{nj}}{\gamma_j}\right) dj\right\}}{\phi}\right)^{\phi} \left(\frac{W^*_n}{1-\phi}\right)^{1-\phi},$$

$$B = \exp\left\{\int \gamma_j \ln b_j dj\right\}.$$

C^* is a function of only domestic input prices, i.e., W^*_n and V^*_{nj}.

Define import intensity from country k as

$$\varphi_{ink} = \frac{\int \left(\frac{U_{nkj}}{e^{k/n}}\right) M_{inkj} dj}{\lambda Y_{in}} = \phi \int \gamma_j \left(\frac{\left(\frac{U_{nkj}}{e^{k/n} V^*_{nj}}\right)^{-\epsilon}}{1 + \sum_k \left(\frac{U_{nkj}}{e^{k/n} V^*_{nj}}\right)^{-\epsilon}}\right) dj.$$

We can, then, compute the elasticity of MC^*_{in} with respect to each bilateral exchange rate

$e^{k/n}$:

$$\begin{aligned}\frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} &= -\phi \frac{\partial \ln B}{\partial \ln e^{k/n}} + \frac{\partial \ln C^*}{\partial \ln e^{k/n}} = -\phi \int \gamma_j \frac{\partial \ln b_j}{\partial \ln e^{k/n}} dj + \frac{\partial \ln C^*}{\partial \ln e^{k/n}} \\ &= -\phi \frac{\partial \ln \left(\frac{U_{nkj}}{e^{k/n} V^*_{nj}} \right)}{\partial \ln e^{k/n}} \int \gamma_j \left(\frac{\left(\frac{U_{nkj}}{e^{k/n} V^*_{nj}} \right)^{-\epsilon}}{1 + \sum_k \left(\frac{U_{nkj}}{e^{k/n} V^*_{nj}} \right)^{-\epsilon}} \right) dj + \frac{\partial \ln C^*}{\partial \ln e^{k/n}} \\ &= -\eta^M_{e^{k/n}} \varphi_{ink} + \eta^{C^*}_{e^{k/n}}.\end{aligned}$$

That is, the sensitivity of a firm's marginal costs to bilateral exchange rates between the domestic currency versus currency k depends on its import intensity from country k (φ_{ink}) and the exchange rate passthrough (ERPT) to relative prices of intermediate input imports from country k ($\eta^M_{e^{k/n}} = \frac{\partial \ln(U_{nkj}/e^{k/n} V^*_{nj})}{\partial \ln e^{k/n}}$). The second term on the right ($\eta^{C^*}_{e^{k/n}} = \frac{\partial \ln C^*}{\partial \ln e^{k/n}}$) measures the general equilibrium effects of exchange rates on domestic input prices.

Short-term Sensitivity

Consider first the sensitivity of firm profits to each bilateral exchange rate. Given the profit function, $\Pi_{in} = \sum_{k'} p^*_{ink'} q_{ink'} - MC^*_{in} Y_{in} = \sum_{k'} (p^*_{ink'} - MC^*_{in}) q_{ink'}$, we can compute such sensitivity as

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/n}} = \sum_{k'} \chi_{ink'} \left[\left(\frac{\mu_{ink'}}{\mu_{ink'} - 1} \right) \frac{\partial \ln p^*_{ink'}}{\partial \ln e^{k/n}} - \left(\frac{1}{\mu_{ink'} - 1} \right) \frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} + \frac{\partial \ln q_{ink'}}{\partial \ln e^{k/n}} \right],$$

where $\chi_{ink'}$ is the share of profits from sales to country k' over total profits.

The key assumption underlying the derivation of short-term impact is price stickiness, i.e., good prices are sticky in the currency of invoicing and, thus, do not move in response to exchange rate changes $\left(\frac{\partial \ln p^*_{ink'}}{\partial \ln e^{k/n}} = 0 \quad \text{for all} \quad k' \right)$. As imported input prices are also sticky in the producer currency, the firm faces full ERPT into the local-currency prices ($\eta^M_{e^{k/n}} = 1$), and so the elasticity of a firm's marginal costs becomes:

$$\frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} = -\varphi_{ink} + \eta^{C^*}_{e^{k/n}}.$$

We are left with the expression for the sensitivities of quantity of output produced and sold to each market in k', which can be categorized into three groups:[17]

[17]For simplicity, we drop subscript *ink* from σ. We also ignore any general-equilibrium effects on a firm's product demand, and leave them in the residual terms (ζ, $\tilde{\psi}$). We intend to account for these effects by introducing relevant controls.

(1) For goods sold to country k: $q_{ink} = \left(\frac{p^*_{ink} e^{k/n}}{P_k}\right)^{-\sigma} D_k$,

$$\frac{\partial \ln q_{ink}}{\partial \ln e^{k/n}} = -\sigma + \zeta_{e^{k/n},k}, \quad \text{where} \quad \zeta_{e^{k/n},k} = \sigma \frac{\partial \ln P_k}{\partial \ln e^{k/n}} + \frac{\partial \ln D_k}{\partial \ln e^{k/n}}$$

(2) For goods exported to country c (k,n not included): $q_{inc} = \left(\frac{p^*_{inc} e^{c/n}}{P_c}\right)^{-\sigma} D_c$,

$$\frac{\partial \ln q_{inc}}{\partial \ln e^{k/n}} = \zeta_{e^{k/n},c}, \quad \text{where} \quad \zeta_{e^{k/n},c} = -\sigma \frac{\partial \ln e^{c/n}}{\partial \ln e^{k/n}} + \sigma \frac{\partial \ln P_c}{\partial \ln e^{k/n}} + \frac{\partial \ln D_c}{\partial \ln e^{k/n}}$$

(3) For goods sold to domestic market n: $q_{inn} = \left(\frac{p^*_{inn}}{P_n}\right)^{-\sigma} D_n$,

$$\begin{aligned}
\frac{\partial \ln q_{inn}}{\partial \ln e^{k/n}} &= -\sigma \frac{\partial \ln p^*_{inn}}{\partial \ln e^{k/n}} + \sigma \frac{\partial \ln P_n}{\partial \ln e^{k/n}} + \frac{\partial \ln D_n}{\partial \ln e^{k/n}} \\
&= -\sigma(0) + \sigma \left[\sum_{i \in \Omega_{nn}} \frac{\partial \ln P_n}{\partial \ln p_{inn}} \frac{\partial \ln p_{inn}}{\partial \ln e^{k/n}} + \sum_c \sum_{i \in \Omega_{cn}} \frac{\partial \ln P_n}{\partial \ln p_{icn}} \frac{\partial \ln p_{icn}}{\partial \ln e^{k/n}} + \sum_{i \in \Omega_{kn}} \frac{\partial \ln P_n}{\partial \ln p_{ikn}} \frac{\partial \ln p_{ikn}}{\partial \ln e^{k/n}} \right] \\
&\quad + \frac{\partial \ln D_n}{\partial \ln e^{k/n}} \\
&= \sigma \left[\tilde{M}_{e^{k/n},nn} + \sum_c \tilde{M}_{e^{k/n},cn} - \sum_{i \in \Omega_{kn}} S_{ikn} \eta^{e^{k/n}}_{ikn} \right] + \frac{\partial \ln D_n}{\partial \ln e^{k/n}} \\
&= \sigma[-\bar{\eta}^{e^{k/n}}_{kn} M_{kn}] + \tilde{\psi}_{e^{k/n},n}
\end{aligned}$$

with

$$\tilde{\psi}_{e^{k/n},n} = \sigma \left(\tilde{M}_{e^{k/n},nn} + \sum_c \tilde{M}_{e^{k/n},cn} \right) + \frac{\partial \ln D_n}{\partial \ln e^{k/n}}.$$

Terms inside the squared bracket capture competition effects on demand for firm i's goods sold domestically. $\tilde{M}_{e^{k/n},nn}$ and $\sum_c \tilde{M}_{e^{k/n},cn}$ are the aggregate domestic market share of domestic firms and third country exporters (adjusted by passthrough rate), respectively. S_{ikn} and $\eta^{e^{k/n}}_{ikn}$ are the domestic market share and the ERPT into the good price of individual firm i from country k, respectively. In the last equality, we focus on the competition from goods from country k, whose local-currency prices are directly influenced by $e^{k/n}$. $\bar{\eta}^{e^{k/n}}_{kn}$ captures average ERPT rates into the local-currency price of country k's firms selling in country n. This equals to one in the short run. M_{kn} is the aggregate market share of country k firms in market n, i.e., import penetration of country k firms. $\zeta_{e^{k/n},k}$, $\zeta_{e^{k/n},c}$ and $\tilde{\psi}_{e^{k/n},n}$ capture general-equilibrium effects of bilateral exchange rates on domestic and foreign aggregate demand and foreign price levels. $\tilde{\psi}_{e^{k/n},n}$ also covers the impact on domestic price levels due to products of other domestic firms and foreign firms in country c, which compete with firm i's products in the domestic market.

So, we have:

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/n}} = \underbrace{\left(\sum_{k'} \chi_{ink'} \left(\frac{1}{\mu_{ink'}-1}\right)\right) \varphi_{ink}}_{\text{Valuation Effect}} - \underbrace{\sigma \chi_{ink}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} - \underbrace{\sigma M_{kn} \chi_{inn}}_{\substack{\text{Exp switching:} \\ \text{Import Competition}}} + \epsilon_{in}.$$

We note three important channels of the short-run impact of bilateral exchange rate changes on firm profits under PCP. The first one is the valuation effects associated with intermediate input imports from country k, which are invoiced in country k's currency. Given price stickiness, when these imports are converted into a firm's domestic currency, a firm faces a valuation effect on its production costs that depends on import intensity from country k or φ_{ink}. The other two channels concern expenditure-switching effects on (1) country k's demand (q_{ink}) due to ERPT to export prices expressed in currency k and (2) domestic demand (q_{inn}), as domestic price levels respond to prices of competing imports from country k.[18] Aggregating the equation above across all relevant bilateral exchange rates to obtain the sensitivity of firm profits to effective exchange rates:

$$\begin{aligned}\Delta \ln \Pi_{in} = &\left(\sum_{k'} \chi_{ink'} \left(\frac{1}{\mu_{ink'}-1}\right)\right) \left(\sum_{k} \varphi_{ink} \Delta \ln e^{k/n}\right) - \sigma \left(\sum_{k} \chi_{ink} \Delta \ln e^{k/n}\right) \\ &- \sigma \chi_{inn} \left(\sum_{k} M_{kn} \Delta \ln e^{k/n}\right) + \epsilon_{in}^{PCP}.\end{aligned}$$

We then express $\chi_{ink} = \chi_{in}\omega_{ink}^{X}$ and $\varphi_{ink} = \varphi_{in}\omega_{ink}^{M}$, where ω_{ink}^{X} (ω_{ink}^{M}) is the share of exports to (imports from) country k out of the firm's total exports (imports). χ_{in} and φ_{in} measure a firm's share of export revenue to total sales and share of import costs to total costs, respectively. Further assuming that price markup is similar across markets and equals $\bar{\mu}_{in}$, the above equation becomes:

$$\Delta \ln \Pi_{in} = \left(\frac{1}{\bar{\mu}_{in}-1}\right) \varphi_{in} \Delta ME - \sigma \chi_{in} \Delta \ln XE - \sigma(1-\chi_{in}) \Delta MPE + \epsilon_{in}^{PCP},$$

with

$$\Delta ME = \sum_{k} \omega_{ink}^{M} \Delta \ln e^{k/n},$$

$$\Delta XE = \sum_{k} \omega_{ink}^{X} \Delta \ln e^{k/n},$$

$$\Delta MPE = \sum_{k} M_{kn} \Delta \ln e^{k/n}.$$

ΔME and ΔXE are import-weighted and export-weighted exchange rate indices, respectively. Specifically, $\omega_{ink}^{M} = \frac{Imp_{ink}}{\sum_{k'} Imp_{ink'}}$, whereas $\omega_{ink}^{X} = \frac{Exp_{ink}}{\sum_{k'} Exp_{ink'}}$. Imp_{ink} (Exp_{ink})

[18] Note that the general-equilibrium effects of exchange rates on domestic input costs are captured by ϵ_{in}.

denotes firm i's imports from (exports to) country k. ΔMPE is an effective exchange rate weighted by import penetration ratios of country k (M_{kn}). Thus, trade-weighted exchange rates are relevant in capturing the short-term exchange rate effects on firm profits, but not necessarily through the expenditure-switching mechanisms as will be the case over the long term.

Long-term sensitivity

In the long run, in response to changes in bilateral exchange rates of currency k, a firm can adjust its product price to reflect changes in marginal costs:

$$\frac{\partial \ln p^*_{ink'}}{\partial \ln e^{k/n}} = \frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} + \frac{\partial \ln \mu_{ink'}}{\partial \ln e^{k/n}} = -\eta^M_{e^{k/n}} \varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},ik'},$$

where $\eta^{\mu}_{e^{k/n},ik'}$ is markup elasticity for goods sold to market k'. A firm may decide to adjust its price markup, i.e., prices do not adjust by the same percentage as changes in marginal costs. We next consider the exchange-rate sensitivities of output in three distinct markets that will respond to changes in relative prices.

(1) For goods sold to country k: $q_{ink} = \left(\frac{p^*_{ink} e^{k/n}}{P_k}\right)^{-\sigma} D_k$,

$$\frac{\partial \ln q_{ink}}{\partial \ln e^{k/n}} = -\sigma[-\eta^M_{e^{k/n}} \varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},ik} + 1] + \zeta_{e^{k/n},k}$$

(2) For goods exported to country c (k,n not included): $q_{inc} = \left(\frac{p^*_{inc} e^{c/n}}{P_c}\right)^{-\sigma} D_c$,

$$\frac{\partial \ln q_{inc}}{\partial \ln e^{k/n}} = -\sigma[-\eta^M_{e^{k/n}} \varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},ic}] + \zeta_{e^{k/n},c}$$

(3) For goods sold to domestic market n: $q_{inn} = \left(\frac{p^*_{inn}}{P_n}\right)^{-\sigma} D_n$,

$$\frac{\partial \ln q_{inn}}{\partial \ln e^{k/n}} = -\sigma[-\eta^M_{e^{k/n}} \varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},in}] + \sigma[-\overline{\eta}^{e^{k/n}}_{kn} M_{kn}] + \tilde{\psi}_{e^{k/n},n}.$$

We note that these sensitivities of demand for a firm's product additionally capture the passthrough of changes in marginal costs onto the product prices,

Then, we have for each bilateral exchange rate:

$$\begin{aligned}
\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/n}} &= \sum_{k'} \chi_{ink'} \left(\frac{\mu_{ink'}}{\mu_{ink'} - 1} \right) [-\eta^M_{e^{k/n}} \varphi_{ink} + \eta^{\mu}_{e^{k/n},ik'}] \\
&\quad - \sum_{k'} \chi_{ink'} \left(\frac{1}{\mu_{ink'} - 1} \right) [-\eta^M_{e^{k/n}} \varphi_{ink}] \\
&\quad + \sigma \eta^M_{e^{k/n}} \varphi_{ink} - \sigma(\eta^{\mu}_{e^{k/n},ik} + 1)\chi_{ink} - \sigma \sum_{c \notin \{n,k\}} (\eta^{\mu}_{e^{k/n},ic})\chi_{inc} - \sigma(\eta^{\mu}_{e^{k/n},in})\chi_{inn} \\
&\quad - \sigma \bar{\eta}^{e^{k/n}}_{kn} M_{kn} \chi_{inn} + \epsilon_{in} \\
&= \underbrace{-\eta^M_{e^{k/n}} \varphi_{ink} + \chi_{ink} \left(\frac{\mu_{ink}}{\mu_{ink} - 1} \right) \eta^{\mu}_{e^{k/n},ik}}_{\text{Markup adjustment}} + \underbrace{\sigma \eta^M_{e^{k/n}} \varphi_{ink}}_{\substack{\text{Exp switching:} \\ \text{Import cost}}} \\
&\quad \underbrace{- \sigma(\eta^{\mu}_{e^{k/n},ik} + 1)\chi_{ink}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} \underbrace{- \sigma \bar{\eta}^{e^{k/n}}_{kn} M_{kn} \chi_{inn}}_{\substack{\text{Exp switching:} \\ \text{Import competition}}} + \epsilon_{in}.
\end{aligned}$$

To get the second equality, we put all terms associated with $\eta^{\mu}_{e^{k/n},ic}$ and $\eta^{\mu}_{e^{k/n},in}$ in the residual term. The first two terms on the right relate the impact of markup adjustments on firm profits. The first term picks up the markup impact if the firm were to adjust its prices fully by the same percentage as changes in its marginal costs. The second term represents the firm's voluntary markup adjustments that apply to market k. The last three channels all capture the expenditure-switching effects. The import cost channel results from the passthrough of changes in a firm's marginal costs onto its good prices, which in turn affects demand in both domestic and foreign destinations. The export price channel captures the impact from ERPT to export prices. Last is the import competition channel. The last two channels already appear in the short run, but the difference is degrees of ERPT that are normally incomplete over the longer term.

We can obtain the sensitivity of firm profits to effective exchange rates as follows:

$$\begin{aligned}
\Delta \ln \Pi_{in} = &- \bar{\eta}^M_n \varphi_{in} \Delta ME + \left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) \bar{\eta}^{\mu}_n \chi_{in} \Delta XE + \alpha_n \varphi_{in} \Delta ME \\
&- \beta_n \chi_{in} \Delta XE - \gamma_n (1 - \chi_{in}) \Delta MPE + \epsilon^{PCP}_{in},
\end{aligned}$$

where α_n, β_n and γ_n are average of $\alpha_{nk} = \sigma \eta^M_{e^{k/n}}$, $\beta_{nk} = \sigma(\eta^{\mu}_{e^{k/n},ik} + 1)$ and $\gamma_{nk} = \sigma \bar{\eta}^{e^{k/n}}_{kn}$, respectively. $\bar{\eta}^M_n$ and $\bar{\eta}^{\mu}_n$ measure average ERPT to import prices and average markup elasticity, respectively. As is typically the case for a PCP assumption, under flexible prices, all trade-weighted exchange rates can capture expenditure-switching effects on firm product demand (through the last three terms in the above equation) and hence profits.

A.2 Local Currency Pricing (LCP)

Next, we consider the case of local currency pricing, where goods are invoiced in the local currency of importers (p_{ink}), as opposed to the currency of producers or exporters. We also assume that imported intermediate input prices are also set by foreign firms in the local currency of importers, i.e., currency n, as denoted by superscript * (U^*_{nkj}). Under this case, we express a firm's profits as $\sum_{k'} \left\{ \left(\frac{p_{ink'}}{e^{k'/n}} \right) q_{ink'} - MC^*_{in} q_{ink'} \right\}$.

Short-term sensitivity

Consider the sensitivity of firm profits to each bilateral exchange rate against currency k. The LCP assumption implies no ERPT in the short run, and thus no impact on prices of a firm's products $\left(\frac{\partial \ln p_{ink'}}{\partial \ln e^{k/n}} = 0 \quad \text{for all} \quad k' \right)$. Given local-currency good prices held fixed, a firm faces the first-order impact on its revenue through the valuation effects on its export transactions with country k $\left(\frac{\partial \ln \frac{p_{ink}}{e^{k/n}}}{\partial \ln e^{k/n}} = -1 \right)$. Prices of imported inputs are also held fixed in currency n in the short run, but changes in marginal costs may still arise from changes in domestic costs:

$$\frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} = \eta^{C^*}_{e^{k/n}}.$$

While there is no change in local-currency good prices, changes in quantity demanded may result from the general equilibrium effects of exchange rates on aggregate demand and price levels, as captured in $\zeta_{e^{k/n},k}$, $\zeta_{e^{k/n},c}$ and $\tilde{\psi}_{e^{k/n},n}$.[19] So, we have:

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/n}} = \underbrace{\left(\frac{\mu_{ink}}{\mu_{ink} - 1} \right) (-1) \chi_{ink}}_{\text{Valuation Effect}} + \epsilon_{in}.$$

Aggregate up into effective exchange rates:

$$\begin{aligned} \Delta \ln \Pi_{in} &= \sum_k \left(\frac{\mu_{ink}}{\mu_{ink} - 1} \right) \chi_{ink} \Delta \ln e^{k/n} + \epsilon^{LCP}_{in} \\ &= \left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) \chi_{in} \Delta \ln XE + \epsilon^{LCP}_{in}. \end{aligned}$$

In short run, we do not find any expenditure switching effects under the LCP assumption, but the valuation effect is the key channel in operation. Since a firm's products sold in foreign countries are priced in their local currencies, the firm faces an impact from exchange rate changes when its export revenue is converted into its own currency. In this case, only export-weighted exchange rate index matters to firm profits, but this time

[19] $\tilde{M}_{e^{k/n},nn}$ and $\sum_c \tilde{M}_{e^{k/n},cn}$, however, do not exist in the short run, since competing products from both domestic and foreign firms also have their prices invoiced in the local currency.

through the valuation channel.

Long-term sensitivity

In the longer run, ERPT to both export and import prices takes place. A firm's marginal costs are similar to the case under PCP, and depend as well on the ERPT to imported input prices:

$$\frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} = -\eta^M_{e^{k/n}}\varphi_{ink} + \eta^{C^*}_{e^{k/n}}.$$

That is, those imports, either as a factor of production or as a final product that domestic firms are competing against, will also experience some ERPT just like in the case of PCP. Based on the optimal price-setting rule, $p_{ink} = e^{k/n}\frac{\sigma_{ink}}{1-\sigma_{ink}}MC^*_{in} = e^{k/n}\mu_{ink}MC^*_{in}$, firm i also has incentives to pass the impact of exchange rate changes, along with changes in marginal costs, onto its good prices, which in turn triggers an expenditure-switching effect. As the passthrough takes place, the valuation effects dissipate. The exchange-rate elasticity of prices can be shown by:

$$\begin{aligned}\frac{\partial \ln p_{ink'}}{\partial \ln e^{k/n}} &= \frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} + \frac{\partial \ln \mu_{ink'}}{\partial \ln e^{k/n}} + \frac{\partial \ln e^{k'/n}}{\partial \ln e^{k/n}} \\ &= \begin{cases} -\eta^M_{e^{k/n}}\varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},ik'} + 1 & \text{if } k' = k. \\ -\eta^M_{e^{k/n}}\varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},ik'} & \text{if } k' = n. \\ -\eta^M_{e^{k/n}}\varphi_{ink} + \eta^{C^*}_{e^{k/n}} + \eta^{\mu}_{e^{k/n},ik'} + \frac{\partial \ln e^{k'/n}}{\partial \ln e^{k/n}} & \text{otherwise.} \end{cases}\end{aligned}$$

We can also show that the quantity of goods demanded is similar to the case of PCP, and depends on the extent of ERPT to both input and product prices, as well as how a firm optimally adjusts its price markup. Models with exogenous invoicing choices even imply a similar ERPT rate regardless of invoicing currency choices. Hence, the long-term elasticity of firm profits to exchange rates converges to that obtained in the case of PCP. That is, the long-term impact of exchange rate changes on firm profits under the LCP assumption can be conveniently captured by trade-weighted exchange rate indices associated with a firm's export destination, import source and import competition.

A.3 Dominant Currency Pricing (DCP)

Last, we consider the case of dominant currency pricing, where for simplicity it is assumed that all product prices and imported input prices are invoiced in the US dollar. That is, the US dollar is the vehicle currency of choice for trade transactions. The only exception is for goods sold in domestic markets (by all domestic firms) that will be in the local currency. We, first, note that, under this assumption, quantity demanded by consumers in foreign country k, as shown by $q_{ink} = (\frac{p^{usd}_{ink}e^{k/usd}}{P_k})^{-\sigma}D_k$, will depend on exchange rates between the US dollar and country k's currency. Firm profits, as a result, depend on both

dollar exchange rates against domestic currency n and the exchange rates between the US dollar vis à vis country k's currency:

$$\begin{aligned}\Pi_{in} &= \sum_{k' \neq n} \left(\frac{p_{ink'}^{usd}}{e^{usd/n}} \right) q_{ink'} + p_{inn}^{*} q_{inn} - TC_{in}^{*} \\ &= \sum_{k' \neq n} \left(\frac{p_{ink'}^{usd}}{e^{usd/n}} \right) (\frac{p_{ink}^{usd} e^{k/usd}}{P_k})^{-\sigma} D_k + p_{inn}^{*} (\frac{p_{inn}^{*}}{P_n})^{-\sigma} D_n - MC_{in}^{*} Y_{in}\end{aligned}$$

For exported goods, the optimal price-setting rule to maximize firm profits satisfies:

$$p_{ink'}^{usd} = e^{usd/n} \left(\frac{\sigma_{ink'}}{1 - \sigma_{ink'}} \right) MC_{in}^{*} = e^{usd/n} \mu_{ink'} MC_{in}^{*}$$

That is, a firm takes into account dollar exchange rates against its own currency when setting its dollar-denominated product prices ($p_{ink'}^{usd}$). Meanwhile, price-setting for domestically-sold products is similar to the case of PCP.

Short-term sensitivity

In the short run, product prices and imported input prices remain sticky in the US dollar. These prices in terms of a firm's domestic currency, however, are sensitive to changes in dollar exchange rates against its currency n through the valuation channel. The elasticity of firm marginal costs and prices (expressed in currency n) are as follows:

$$\frac{\partial \ln MC_{in}^{*}}{\partial \ln e^{usd/n}} = -\eta_{e^{usd/n}}^{M} \varphi_{in}^{usd} + \eta_{e^{usd/n}}^{C^{*}},$$

$$\frac{\partial \ln \frac{p_{ink'}^{usd}}{e^{usd/n}}}{\partial \ln e^{usd/n}} = -1 \qquad \text{for} \qquad k' \neq n,$$

where $\eta_{e^{usd/n}}^{M}$ is the ERPT to import prices as a result of changes in exchange rates between dollar vis-à-vis currency n, assumed to be one in the short run. φ_{in}^{usd} is import intensity of products invoiced in the US dollar. Specifically,

$$\varphi_{in}^{usd} = \frac{\int \sum_k \left(\frac{U_{nkj}^{usd}}{e^{usd/n}} \right) M_{inkj} dj}{\lambda Y_{in}}.$$

Note that, in this case, $\varphi_{in}^{usd} = \varphi_{in}$ since all imports are invoiced in the US dollar.

We next consider in turn how changes in exchange rates affect the quantity of goods demanded by each market. For foreign demand, we consider two cases: US and non-US demand.

(1) For goods sold to country k (other than the United States): $q_{ink} = \left(\frac{p_{ink}^{usd} e^{k/usd}}{P_k} \right)^{-\sigma} D_k$,

$$\frac{\partial \ln q_{ink}}{\partial \ln e^{usd/n}} = \zeta_{e^{usd/n},k}, \quad \text{where} \quad \zeta_{e^{usd/n},k} = -\sigma \frac{\partial \ln e^{k/usd}}{\partial \ln e^{usd/n}} + \sigma \frac{\partial \ln P_k}{\partial \ln e^{usd/n}} + \frac{\partial \ln D_k}{\partial \ln e^{usd/n}},$$

$$\frac{\partial \ln q_{ink}}{\partial \ln e^{k/usd}} = -\sigma + \zeta_{e^{k/usd},k}, \quad \text{where} \quad \zeta_{e^{usd/n},k} = \sigma \frac{\partial \ln P_k}{\partial \ln e^{k/usd}} + \frac{\partial \ln D_k}{\partial \ln e^{k/usd}}$$

Two exchange rate parities affect demand from country k, with different mechanisms at play. While dollar exchange rates against currency n mainly affect it through general-equilibrium effects on country k's aggregate demand and price level (as captured in $\zeta_{e^{usd/n},k}$), the dollar exchange rates against currency k can have a more direct expenditure-switching effect, since they alter relative prices of a firm's exports denominated in the local currency of country k.

(2) For goods sold to the US: $q_{in,US} = \left(\frac{p_{ink}^{usd}}{P_{US}}\right)^{-\sigma} D_{US}$,

$$\frac{\partial \ln q_{in,US}}{\partial \ln e^{usd/n}} = \zeta_{e^{usd/n},US}, \quad \text{where} \quad \zeta_{e^{usd/n},US} = \sigma \frac{\partial \ln P_{US}}{\partial \ln e^{usd/n}} + \frac{\partial \ln D_{US}}{\partial \ln e^{usd/n}}$$

(3) For goods sold to domestic market n: $q_{inn} = \left(\frac{p_{inn}^{*}}{P_n}\right)^{-\sigma} D_n$,

$$\frac{\partial \ln q_{inn}}{\partial \ln e^{usd/n}} = \sigma[-\bar{\eta}_n^{e^{usd/n}} M_n^{usd}] + \tilde{\psi}_{e^{usd/n},n} \quad \text{with} \quad \tilde{\psi}_{e^{usd/n},n} = \frac{\partial \ln D_n}{\partial \ln e^{usd/n}}.$$

The impact of exchange rates on the product quantity demanded from domestic consumers is mainly through the import competition channel, as foreign goods that are denominated in the US dollar become relatively cheaper (more expensive) as the US dollar depreciates (appreciates). M_n^{usd} measures the penetration of imports that are invoiced in the US dollar, while $\bar{\eta}_n^{e^{usd/n}}$ captures the extent of exchange rate passthrough to local-currency prices of these imports, assumed to be one in the short run.

The sensitivity of firm profits to bilateral exchange rate changes, therefore, consists of the sensitivity to two exchange rate parities:

$$\begin{aligned}\frac{\partial \ln \Pi_{in}}{\partial \ln e^{usd/n}} = \sum_{k' \neq n} \chi_{ink'} \Bigg[\left(\frac{\mu_{ink'}}{\mu_{ink'}-1}\right) \frac{\partial \ln \frac{p_{ink'}^{usd}}{e^{usd/n}}}{\partial \ln e^{usd/n}} - \left(\frac{1}{\mu_{ink'}-1}\right) \frac{\partial \ln MC_{in}^{*}}{\partial \ln e^{usd/n}} + \frac{\partial \ln q_{ink'}}{\partial \ln e^{usd/n}} \Bigg] \\ + \left(\frac{\mu_{inn}}{\mu_{inn}-1}\right) \frac{\partial \ln p_{inn}^{*}}{\partial \ln e^{usd/n}} - \left(\frac{1}{\mu_{inn}-1}\right) \frac{\partial \ln MC_{in}^{*}}{\partial \ln e^{usd/n}} + \frac{\partial \ln q_{inn}}{\partial \ln e^{usd/n}},\end{aligned}$$

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/usd}} = \sum_{k'} \chi_{ink'} \left[\frac{\partial \ln q_{ink'}}{\partial \ln e^{k/usd}}\right] \quad \text{for} \quad k \notin \{n, US\}.$$

So, we have:

$$\begin{aligned}\frac{\partial \ln \Pi_{in}}{\partial \ln e^{usd/n}} = &\underbrace{\sum_{k' \neq n} \chi_{ink'} \left(\frac{\mu_{ink'}}{\mu_{ink'}-1}\right)(-1) - \sum_{k'} \chi_{ink'} \left(\frac{1}{\mu_{ink'}-1}\right)(-\varphi_{in}^{usd})}_{\text{Valuation Effect}} \\ &- \underbrace{\sigma M_n^{usd} \chi_{inn}}_{\substack{\text{Exp switching:} \\ \text{Import competition}}} + \epsilon_{in}^{e^{usd/n}},\end{aligned}$$

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/usd}} = - \underbrace{\sigma \chi_{ink}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} + \epsilon_{in}^{e^{k/usd}} \quad \text{for} \quad k \notin \{n, US\}.$$

Aggregate up across all bilateral exchange rates:

$$\begin{aligned}
\Delta \ln \Pi_{in} = & \left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) \left(\sum_{k' \neq n} \chi_{ink'} \right) (-1) \Delta \ln e^{usd/n} - \left(\frac{1}{\bar{\mu}_{in} - 1} \right) (-\varphi_{in}^{usd}) \Delta \ln e^{usd/n} \\
& - \sigma M_n^{usd} \chi_{inn} \Delta \ln e^{usd/n} + \sigma \sum_{k \neq \{n, US\}} \chi_{ink} \Delta \ln e^{k/usd} + \epsilon_{in}^{DCP} \\
= & \left(\frac{-\bar{\mu}_{in} \chi_{in} + \varphi_{in}^{usd}}{\bar{\mu}_{in} - 1} \right) \Delta \ln e^{usd/n} \\
& - \sigma (1 - \chi_{in}) M_n^{usd} \Delta \ln e^{usd/n} + \sigma \chi_{in} \Delta XE^* + \epsilon_{in}^{DCP},
\end{aligned}$$

where $\Delta XE^* = \sum_k \omega_{ink}^X \Delta \ln e^{k/usd}$. The short-run exchange-rate impact on firm profits depends mainly on dollar exchange rates against the domestic currency of a firm, whose magnitude of the impact is determined by [1] dollar mismatches between export revenue and import costs through the valuation channel, as captured by the difference in export and import intensity, and [2] degrees of import penetration from dollar-invoiced goods through the import competition channel. Meanwhile, trade-weighted exchange rate index still matters towards capturing the expenditure-switching channel, but the relevant index is the export-weighted exchange rates between the US dollar and a firm's trade partner currencies.

Long-term sensitivity

We show that the long-term exchange rate sensitivity of firm profits resembles the case of PCP and LCP. First, on the sensitivity of a firm's marginal costs, since foreign firms that sell their intermediate inputs may adjust their dollar-denominated input prices in the long run in response to changes in dollar exchange rates of their own currency (the exchange rate passthrough effect), we have:

$$\frac{\partial \ln MC_{in}^*}{\partial \ln e^{k/usd}} = -\eta_{e^{k/usd}}^M \varphi_{ink}^{usd} + \eta_{e^{k/usd}}^{C^*},$$

in addition to their sensitivity to changes in dollar exchange rates against currency n as already shown in the short-run case ($\frac{\partial \ln MC_{in}^*}{\partial \ln e^{usd/n}} = -\eta_{e^{usd/n}}^M \varphi_{in}^{usd} + \eta_{e^{usd/n}}^{C^*}$). $\eta_{e^{k/usd}}^M$ captures passthrough to import prices from fluctuations of $e^{k/usd}$, whereas $\eta_{e^{usd/n}}^M$ may differ from one in long run if foreign sellers of intermediate inputs adjust their markups in response to $e^{usd/n}$, perhaps to mitigate any changes in demand from country n. φ_{ink}^{usd} is import intensity from country k, invoiced in the US dollar. Changes in firm i's marginal costs translate into changes in its product prices sold to each market k'. We consider separately

how prices react to both exchange rate parities ($e^{usd/n}$ and $e^{k/usd}$):

$$\frac{\partial \ln p^{usd}_{ink'}}{\partial \ln e^{usd/n}} = \frac{\partial \ln MC^*_{in}}{\partial \ln e^{usd/n}} + \frac{\partial \ln \mu_{ink'}}{\partial \ln e^{usd/n}} + \frac{\partial \ln e^{usd/n}}{\partial \ln e^{usd/n}} = -\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{C^*}_{e^{usd/n}} + \eta^{\mu}_{e^{usd/n},ik'} + 1 \quad \text{for } k' \neq n,$$

$$\frac{\partial \ln p^*_{inn}}{\partial \ln e^{usd/n}} = \frac{\partial \ln MC^*_{in}}{\partial \ln e^{usd/n}} + \frac{\partial \ln \mu_{inn}}{\partial \ln e^{usd/n}} = -\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{C^*}_{e^{usd/n}} + \eta^{\mu}_{e^{usd/n},in},$$

$$\frac{\partial \ln p^{usd}_{ink'}}{\partial \ln e^{k/usd}} = \frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/usd}} + \frac{\partial \ln \mu_{ink'}}{\partial \ln e^{k/usd}} + \frac{\partial \ln e^{usd/n}}{\partial \ln e^{k/usd}} = -\eta^M_{e^{k/usd}} \varphi^{usd}_{ink} + \eta^{C^*}_{e^{k/usd}} + \eta^{\mu}_{e^{k/usd},ik'} + \frac{\partial \ln e^{usd/n}}{\partial \ln e^{k/usd}} \quad \text{for } k' \neq n$$

$$\frac{\partial \ln p^*_{inn}}{\partial \ln e^{k/usd}} = \frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/usd}} + \frac{\partial \ln \mu_{inn}}{\partial \ln e^{k/usd}} = -\eta^M_{e^{k/usd}} \varphi^{usd}_{ink} + \eta^{C^*}_{e^{k/usd}} + \eta^{\mu}_{e^{k/usd},in}.$$

Note that the firm i over the longer run passes on changes in dollar exchange rates against its own currency to its export prices.

Now, let's see the sensitivity of good demand.

(1) For goods sold to country k (other than the United States): $q_{ink} = \left(\frac{p^{usd}_{ink} e^{k/usd}}{P_k}\right)^{-\sigma} D_k$,

$$\frac{\partial \ln q_{ink}}{\partial \ln e^{usd/n}} = -\sigma[-\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{C^*}_{e^{usd/n}} + \eta^{\mu}_{e^{usd/n},ik} + 1] + \zeta_{e^{usd/n},k},$$

$$\frac{\partial \ln q_{ink}}{\partial \ln e^{k/usd}} = -\sigma - \sigma[-\eta^M_{e^{k/usd}} \varphi^{usd}_{ink} + \eta^{C^*}_{e^{k/usd}} + \eta^{\mu}_{e^{k/usd},ik}] + \zeta_{e^{k/usd},k}$$

Consider the sensitivity to dollar exchange rates against currency k. The first term on the right captures the expenditure-switching effects from the ERPT to local-currency export prices as in the short-run case, while the second term relates to the expenditure-switching effects coming from the passthrough of changes in a firm's marginal costs onto dollar-denominated product prices.

(2) For goods sold to the US: $q_{in,US} = \left(\frac{p^{usd}_{ink}}{P_{US}}\right)^{-\sigma} D_{US}$,

$$\frac{\partial \ln q_{in,US}}{\partial \ln e^{usd/n}} = -\sigma[-\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{C^*}_{e^{usd/n}} + \eta^{\mu}_{e^{usd/n},iUS} + 1] + \zeta_{e^{usd/n},US},$$

$$\frac{\partial \ln q_{in,US}}{\partial \ln e^{k/usd}} = -\sigma[-\eta^M_{e^{k/usd}} \varphi^{usd}_{ink} + \eta^{C^*}_{e^{k/usd}} + \eta^{\mu}_{e^{k/usd},iUS}] + \zeta_{e^{k/usd},US}$$

with

$$\zeta_{e^{k/usd},US} = \sigma \frac{\partial \ln P_{US}}{\partial \ln e^{k/usd}} + \frac{\partial \ln D_{US}}{\partial \ln e^{k/usd}}$$

(3) For goods sold to domestic market n: $q_{inn} = \left(\frac{p_{inn}}{P_n}\right)^{-\sigma} D_n$,

$$\frac{\partial \ln q_{inn}}{\partial \ln e^{usd/n}} = -\sigma[-\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{C^*}_{e^{usd/n}} + \eta^{\mu}_{e^{usd/n},in}] + \sigma[-\bar{\eta}^{e^{usd/n}}_n M^{usd}_n] + \tilde{\psi}_{e^{usd/n},n},$$

$$\frac{\partial \ln q_{inn}}{\partial \ln e^{k/usd}} = -\sigma[-\eta^M_{e^{k/usd}} \varphi^{usd}_{ink} + \eta^{C^*}_{e^{k/usd}} + \eta^{\mu}_{e^{k/usd},in}] + \sigma[-\bar{\eta}^{e^{k/usd}}_n M^{usd}_{kn}] + \tilde{\psi}_{e^{k/usd},n}$$

with

$$\tilde{\psi}_{e^{k/usd},n} = \frac{\partial \ln D_n}{\partial \ln e^{k/usd}}.$$

Next, we derive how firm profits respond to exchange rates, first for dollar exchange rates against currency n and then against currency k:

$$\begin{aligned}
\frac{\partial \ln \Pi_{in}}{\partial \ln e^{usd/n}} &= \sum_{k'} \chi_{ink'} \left(\frac{\mu_{ink'}}{\mu_{ink'} - 1} \right) \left[-\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{\mu}_{e^{usd/n},ik'} \right] \\
&\quad - \sum_{k'} \chi_{ink'} \left(\frac{1}{\mu_{ink'} - 1} \right) \left[-\eta^M_{e^{usd/n}} \varphi^{usd}_{in} \right] \\
&\quad + \sigma \eta^M_{e^{usd/n}} \varphi^{usd}_{in} - \sigma \sum_{k' \neq n} \chi_{ink'} (\eta^{\mu}_{e^{usd/n},ik'} + 1) - \sigma \chi_{inn} \eta^{\mu}_{e^{usd/n},in} - \sigma \bar{\eta}^{e^{usd/n}}_n M^{usd}_n \chi_{inn} + \epsilon^{e^{usd/n}}_{in} \\
&= \underbrace{-\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \sum_{k' \neq n} \chi_{ink'} \left(\frac{\mu_{ink'}}{\mu_{ink'} - 1} \right) [\eta^{\mu}_{e_{usd,n},ik'}]}_{\text{Markup adjustment}} + \underbrace{\sigma(\eta^M_{e^{usd/n}} \varphi^{usd}_{in})}_{\substack{\text{Exp switching:} \\ \text{Import cost}}} \\
&\quad \underbrace{- \sigma \sum_{k' \neq n} \chi_{ink'} (\eta^{\mu}_{e^{usd/n},ik'} + 1)}_{\substack{\text{Exp switching:} \\ \text{Export price}}} \underbrace{- \sigma \bar{\eta}^{e^{usd/n}}_n M^{usd}_n \chi_{inn}}_{\substack{\text{Exp switching:} \\ \text{Import competition}}} + \epsilon^{e^{usd/n}}_{in}.
\end{aligned}$$

To get the second equality, we put $\eta^{\mu}_{e^{usd/n},in}$ in the residual term. We do the same for $\eta^{\mu}_{e^{k/usd},ik'}$ for all $k' \neq k$ in the sensitivity of firm profits to dollar exchange rates against currency k below:

$$\begin{aligned}
\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/usd}} &= \underbrace{-\eta^M_{e^{k/usd}} \varphi^{usd}_{ink} + \chi_{ink} \left(\frac{\mu_{ink}}{\mu_{ink} - 1} \right) \eta^{\mu}_{e^{k/usd},ik}}_{\text{Markup adjustment}} + \underbrace{\sigma \eta^M_{e^{k/usd}} \varphi^{usd}_{ink}}_{\substack{\text{Exp switching:} \\ \text{Import cost}}} \\
&\quad \underbrace{- \sigma \chi_{ink}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} \underbrace{- \sigma \bar{\eta}^{e^{k/usd}}_n M^{usd}_{kn} \chi_{inn}}_{\substack{\text{Exp switching:} \\ \text{Import competition}}} + \epsilon^{e^{k/usd}}_{in} \quad \text{for} \quad k \notin \{n, US\}.
\end{aligned}$$

Aggregate up to obtain the sensitivity of firm profits to effective exchange rates (also assume that $\eta^M_{e^{usd/n}} + \eta^M_{e^{k/usd}} \approx \eta^M_{e^{k/n}}$ and $\eta^{\mu}_{e^{usd/n},ik} + \eta^{\mu}_{e^{k/usd},ik} \approx \eta^{\mu}_{e^{k/n},ik}$):

$$\begin{aligned}
\Delta \ln \Pi_{in} &= - \sum_k \eta^M_{e^{k/n}} \varphi^{usd}_{ink} \Delta e^{k/n} + \sum_{k \neq n} \chi_{ink} \left(\frac{\mu_{ink}}{\mu_{ink} - 1} \right) \eta^{\mu}_{e^{k/n},ik} \Delta \ln e^{k/n} + \sigma \sum_{k'} \eta^M_{e^{k/n}} \varphi^{usd}_{ink} \Delta \ln e^{k/n} \\
&\quad - \sigma \sum_{k \neq n} \chi_{ink} (\eta^{\mu}_{e^{k/n},ik} + 1) \Delta \ln e^{k/n} - \sigma \sum_k \bar{\eta}^{e^{k/n}}_n M^{usd}_{kn} \chi_{inn} \Delta \ln e^{k/n} + \epsilon^{DCP}_{in} \\
&= -\bar{\eta}^M_n \varphi_{in} \Delta ME + \left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) \bar{\eta}^{\mu}_n \chi_{in} \Delta XE + \alpha_n \varphi_{in} \Delta ME \\
&\quad - \beta_n \chi_{in} \Delta XE - \gamma_n (1 - \chi_{in}) \Delta MPE + \epsilon^{DCP}_{in}.
\end{aligned}$$

A.4 A Stylised Model with Heterogeneous Currency Choice

In reality, firms have heterogeneous invoicing currency choices. For example, firm i's exports may be invoiced in its domestic currency, the local currency of importers and a vehicle currency such as the US dollar. In this subsection, we offer a stylised model that combines the three extreme cases shown earlier, yet a tractable one. Assume a firm exports to two countries, the US and country k. Exports to the country k can be invoiced in the firm's own currency (PCP), country k's currency (LCP) and the US dollar (DCP), while exports to the US are assumed to be in the producer currency or the US dollar. Goods sold domestically are always denominated in the domestic currency. We can express a firm's profit functions as follows:

$$\Pi_{in} = \sum_{k' \in \{n,US,k\}} p^*_{ink'} q^*_{ink'} + \sum_{k' \neq n} \left(\frac{p^{usd}_{ink'}}{e^{usd/n}} \right) q^{usd}_{ink'} + \left(\frac{p^{k}_{ink}}{e^{k/n}} \right) q^{k}_{ink} - MC^*_{in} Y_{in}.$$

We use superscript *, usd and k to indicate the invoice currency used in trade transactions. A firm's imported inputs are from country k and the US. Imports from the former can be in either currency k or the US dollar. We note the following expression for b_j:

$$b_j = \left(\frac{X_{in,j}}{Z_{inj}} \right)^{\frac{1}{1+\epsilon}} = \left(1 + \sum_{k' \in \{US,k\}} \left(\frac{U^{usd}_{nk'j}}{e^{usd/n} V^*_{nj}} \right)^{-\epsilon} + \left(\frac{U^{k}_{nkj}}{e^{k/n} V^*_{nj}} \right)^{-\epsilon} \right)^{\frac{1}{\epsilon}}.$$

In the short run, firm i's marginal costs are sensitive to exchange rates of currency n against the US dollar and the currency of country k:

$$\frac{\partial \ln MC^*_{in}}{\partial \ln e^{usd/n}} = -\eta^M_{e^{usd/n}} \varphi^{usd}_{in} + \eta^{C^*}_{e^{usd/n}},$$

$$\frac{\partial \ln MC^*_{in}}{\partial \ln e^{k/n}} = -\eta^M_{e^{k/n}} \varphi^{k}_{in} + \eta^{C^*}_{e^{k/n}},$$

where φ^{usd}_{in} and φ^{k}_{in} are intensity of imports in the US dollar and currency k, respectively. We may assume that the exchange-rate passthrough rates, $\eta^M_{e^{usd/n}}$ and $\eta^M_{e^{k/n}}$, equal to one in the short run.

Note also that in the short run, prices are fixed in the currency of invoicing. As before, there exists a valuation effect on foreign-priced transactions (i.e., either LCP or DCP) when prices are converted into the domestic currency of firm i:

$$\frac{\partial \ln \frac{p^{usd}_{ink'}}{e^{usd/n}}}{\partial \ln e^{usd/n}} = -1 \quad \text{for} \quad k' \in \{US, k\},$$

$$\frac{\partial \ln \frac{p^{k}_{ink}}{e^{k/n}}}{\partial \ln e^{k/n}} = -1.$$

Consider, next, the sensitivity of demand to each bilateral exchange rate:

(1) Foreign demand for goods invoiced in the producer currency ($q^*_{in,US}$ and q^*_{ink}):

$$\frac{\partial \ln q^*_{ink'}}{\partial \ln e^{k'/n}} = -\sigma + \zeta_{e^{k'/n},ik'}, \quad \text{where} \quad k' \in \{US, k\}$$

As in PCP, foreign demand is sensitive to the exchange rates between the producer currency and the currency of destination markets, bringing about expenditure-switching effects.
(2) Demand for goods sold domestically (q^*_{inn}):

$$\frac{\partial \ln q^*_{inn}}{\partial \ln e^{usd/n}} = \sigma[-\bar{\eta}^{e^{usd/n}}_n M^{usd}_n] + \tilde{\psi}_{e^{usd/n},n},$$

$$\frac{\partial \ln q^*_{inn}}{\partial \ln e^{k/n}} = \sigma[-\bar{\eta}^{e^{k/n}}_n M^{k}_n] + \tilde{\psi}_{e^{k/n},n}$$

The import competition channel takes place, as foreign-priced goods imported from aboard become cheaper or more expensive due to exchange rate changes. We can assume that exchange rate passthrough equals to one in the short run.
(3) Foreign demand for goods under the dominant currency pricing (q^{usd}_{ink}):

$$\frac{\partial \ln q^{usd}_{ink}}{\partial \ln e^{k/usd}} = -\sigma + \zeta_{e^{k/usd},ik}$$

$$\frac{\partial \ln q^{usd}_{ink}}{\partial \ln e^{usd/n}} = \zeta_{e^{usd/n},ik}$$

As in DCP, we again note that two exchange rate parities are relevant.
(4) Foreign demand for goods under local currency pricing ($q^{usd}_{in,US}$ and q^{k}_{ink}):

$$\frac{\partial \ln q^{k'}_{ink'}}{\partial \ln e^{k'/n}} = \zeta_{e^{k'/n},ik'}, \quad \text{where} \quad k' \in \{US, k\}.$$

Expenditure switching effects do not occur in this case, as prices are sticky in the local currency of trade partners.

The sensitivity of firm profits to bilateral exchange rate changes can be derived as follows:

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{v/n}} = \sum_j \sum_{k'} \chi^j_{ink'} \left[\left(\frac{\mu_{ink'}}{\mu_{ink'} - 1} \right) \frac{\partial \ln p^j_{ink'}}{\partial \ln e^{v/n}} - \left(\frac{1}{\mu_{ink'} - 1} \right) \frac{\partial \ln MC^*_{in}}{\partial \ln e^{v/n}} + \frac{\partial \ln q^j_{ink'}}{\partial \ln e^{v/n}} \right].$$

Consider in turn the sensitivity of firm profits to each relevant bilateral exchange rate:

(1) exchange rates between currency n and the US dollar:

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{usd/n}} = \underbrace{\sum_{k' \in \{US,k\}} \chi_{ink'}^{usd} \left(\frac{\mu_{ink'}}{\mu_{ink'} - 1} \right) (-1) - \sum_{j} \sum_{k'} \chi_{ink'}^{j} \left(\frac{1}{\mu_{ink'} - 1} \right) (-\varphi_{in}^{usd})}_{\text{Valuation Effect}}$$
$$- \underbrace{\sigma \chi_{in,US}^{*}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} - \underbrace{\sigma M_{n}^{usd}}_{\substack{\text{Exp switching:} \\ \text{Import Competition}}} + \epsilon_{in}^{e^{usd/n}}$$

(2) exchange rates between the US dollar and currency k:

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/usd}} = - \underbrace{\sigma \chi_{ink}^{usd}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} + \epsilon_{in}^{e^{k/usd}}$$

(3) exchange rates between currency n and currency k:

$$\frac{\partial \ln \Pi_{in}}{\partial \ln e^{k/n}} = \underbrace{\chi_{ink}^{k} \left(\frac{\mu_{ink}}{\mu_{ink} - 1} \right) (-1) - \sum_{j} \sum_{k'} \chi_{ink'}^{j} \left(\frac{1}{\mu_{ink'} - 1} \right) (-\varphi_{in}^{k})}_{\text{Valuation Effect}}$$
$$- \underbrace{\sigma \chi_{ink}^{*}}_{\substack{\text{Exp switching:} \\ \text{Export price}}} - \underbrace{\sigma M_{n}^{k}}_{\substack{\text{Exp switching:} \\ \text{Import Competition}}} + \epsilon_{in}^{e^{k/n}}.$$

Aggregate up across all bilateral exchange rates:

$$\begin{aligned}
\Delta \ln \Pi_{in} = & \left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) \left(\sum_{k' \in \{US,k\}} \chi_{ink'}^{usd} \right) (-1) \Delta \ln e^{usd/n} - \left(\frac{1}{\bar{\mu}_{in} - 1} \right) (-\varphi_{in}^{usd}) \Delta \ln e^{usd/n} \\
& + \left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) (\chi_{ink}^{k}) (-1) \Delta \ln e^{k/n} - \left(\frac{1}{\bar{\mu}_{in} - 1} \right) (-\varphi_{in}^{k}) \Delta \ln e^{k/n} \\
& - \sigma \chi_{ink}^{k} \Delta \ln e^{k/usd} - \sigma \chi_{in,US}^{*} \Delta \ln e^{usd/n} - \sigma \chi_{ink}^{*} \Delta \ln e^{k/n} + \lambda_{in} \\
& - \sigma (1 - \chi_{in}) M_{n}^{usd} \Delta \ln e^{usd/n} - \sigma (1 - \chi_{in}) M_{n}^{k} \Delta \ln e^{k/n} + \epsilon_{in}^{general} \\
= & \underbrace{\sum_{j \in \{usd,k\}} \left[\left(\frac{\bar{\mu}_{in}}{\bar{\mu}_{in} - 1} \right) \left(\sum_{k' \in \{US,k\}} \chi_{ink'}^{j} \right) (-1) - \left(\frac{1}{\bar{\mu}_{in} - 1} \right) (-\varphi_{in}^{j}) \right] \Delta \ln e^{j/n}}_{\text{Valuation effect}} \\
& \underbrace{-\sigma \chi_{in} \Delta XE^{*} - \sigma \chi_{in} \Delta \ln XE^{n} - \sigma (1 - \chi_{in}) \Delta MPE^{inv}}_{\text{Expenditure switching}} + \epsilon_{in}^{general}
\end{aligned}$$

with

$$\Delta XE^{*} = \sum_{k \neq US} \omega_{ink}^{X,usd} \Delta \ln e^{k/usd}.$$

$$\Delta XE^{n} = \sum_{k} \omega_{ink}^{X,n} \Delta \ln e^{k/n},$$

$$\Delta MPE^{inv} = \sum_{v} M_n^v \Delta \ln e^{v/n},$$

$\chi^v_{ink'}$ and φ^v_{in} measure intensity of exports to country k' and imports from any sources in invoicing currencies v, respectively, while $\omega^{X,n}_{ink}$ and $\omega^{X,usd}_{ink}$ denote export share to country k that is invoiced in currency n and the US dollar, respectively. The above equation not only accounts for valuations effects from dollar mismatches, but also from mismatches of currency-k transactions. Recall that valuation effects can also arise when goods and input are invoiced in foreign currencies under LCP and PCP, respectively. ΔMPE^{inv} is an effective exchange rate based on import penetration that accounts for invoiced currencies used.

Appendix B Additional empirical results

B.1 Data and stylized facts

Figure B.1: Ratio of Dollar-invoicing Trade to Total Trade (by Partner and Sector)

	Animal & animal products (01-05)	Chemicals & allied industies (28-38)	Foodstuffs (16-24)	Footwear & headgear (64-67)	Machinery & electrical (84-85)	Metals (72-83)	Mineral products (25-27)	Miscellaneous (90-97)	Plastics & rubbers (39-40)	Raw hides, skins, leather & fur (41-43)	Stone & glass (68-71)	Textiles (50-63)	Transportation (86-89)	Vegetable products (06-15)	Wood & wood products (44-49)
Australia	69%	57%	78%	78%	49%	78%	99%	60%	76%	89%	93%	83%	33%	79%	53%
Brazil	96%	71%	100%	88%	76%	90%	100%	78%	95%	100%	88%	99%	57%	100%	97%
China	87%	93%	89%	72%	90%	93%	98%	84%	97%	84%	86%	91%	58%	88%	86%
Hong Kong	53%	69%	77%	66%	96%	56%	98%	71%	89%	90%	92%	78%	92%	73%	48%
India	99%	90%	87%	80%	80%	91%	98%	71%	94%	84%	96%	94%	74%	99%	92%
Indonesia	72%	88%	93%	56%	73%	87%	100%	68%	92%	75%	86%	97%	67%	92%	94%
Japan	69%	42%	65%	56%	49%	57%	88%	41%	56%	66%	40%	50%	40%	80%	66%
Korea	98%	88%	94%	83%	90%	87%	96%	86%	94%	83%	87%	96%	76%	95%	81%
Malaysia	35%	86%	72%	63%	88%	87%	98%	73%	87%	79%	81%	82%	60%	87%	74%
Mexico	96%	82%	94%	99%	94%	87%	95%	83%	90%	98%	98%	96%	68%	97%	76%
Phillipines	99%	62%	75%	78%	86%	94%	100%	74%	90%	93%	95%	92%	46%	99%	84%
Russia	76%	98%	98%	26%	77%	99%	100%	59%	89%	85%	69%	87%	38%	93%	89%
Saudi Arabia	98%	99%	98%	97%	95%	89%	100%	89%	93%	91%	93%	95%	92%	99%	93%
Singapore	25%	83%	53%	39%	90%	80%	98%	62%	85%	34%	93%	59%	89%	84%	70%
Switzerland	34%	28%	55%	59%	33%	30%	96%	6%	43%	7%	99%	27%	68%	61%	24%
Taiwan	98%	92%	91%	81%	96%	97%	100%	81%	94%	95%	87%	94%	81%	91%	94%
UAE	98%	87%	96%	93%	90%	87%	100%	90%	87%	85%	92%	93%	79%	95%	93%
UK	80%	47%	61%	95%	78%	76%	90%	61%	73%	79%	78%	73%	30%	56%	54%
US	98%	79%	94%	87%	95%	97%	100%	91%	93%	97%	95%	96%	81%	98%	98%
Vietnam	90%	78%	64%	92%	72%	90%	100%	78%	89%	94%	86%	94%	65%	72%	95%
CLM	13%	36%	38%	31%	50%	58%	75%	48%	46%	83%	61%	51%	49%	48%	69%
EU-6	79%	41%	64%	77%	51%	52%	64%	45%	62%	40%	63%	65%	36%	66%	38%

Note: Sum of export and import transactions over 2007–2022. EU-6 consists of Belgium, Germany, Spain, France, Italy and the Netherlands, while CLM denotes Cambodia, Laos and Myanmar. Sector classification is based on HS-2.

Table B.10: Descriptive Statistics

	Exporters						Importers					
	N	Mean	Std. Dev.	99th	Median	1th	N	Mean	Std. Dev.	99th	Median	1th
ΔVx	104055	4.99	87.11	312.21	1.12	-225.12	71455	-6.76	159.18	466.02	-2.48	-482.71
ΔVm	63623	-12.45	129.12	372.27	-5.69	-433.88	227458	2.77	100.93	326.97	1.98	-305.11
ΔEBIT/Asset	114032	0.86	12.71	49.22	0.12	-34.68	270191	1.15	12.70	49.66	0.21	-33.69
Cash Ratio	105882	11.87	16.92	81.13	4.79	0.03	253236	13.00	17.07	77.50	5.93	0.03
ΔCash/Asset	92552	1.36	28.02	50.44	0.05	-36.85	221503	1.77	16.22	53.16	0.11	-35.43
Liquidity Ratio	122033	19.52	258.31	98.42	23.41	-132.48	315295	23.19	1237.35	98.59	29.99	-102.90
Leverage Ratio	122046	65.05	390.03	276.39	57.11	0.77	315327	67.82	1354.14	242.99	56.58	0.86
ΔCredit/Asset	47074	1.05	21.10	65.47	-0.05	-43.61	104705	1.68	20.91	66.23	-0.03	-39.61
ΔCD excl. TF	46256	0.80	19.74	58.91	-0.06	-39.64	101279	1.26	17.87	54.82	-0.04	-33.17
ΔLT Loan	35531	0.27	14.23	42.00	-0.25	-22.36	80683	0.66	13.72	42.06	-0.18	-20.37
ΔTrade Finance	13602	0.94	18.29	52.01	-0.01	-36.17	39239	1.21	19.09	57.03	0.03	-38.69
ΔWorking Capital	31986	0.58	18.77	51.07	0.00	-44.89	66213	0.88	16.93	45.61	0.02	-36.09
Credit Utilization	60362	48.20	34.87	100.00	51.57	0.00	142108	46.76	39.42	100.00	48.81	0.00
ST Credit Utilization	50200	51.62	41.04	100.73	57.69	0.00	116799	49.01	45.14	100.65	51.91	0.00
ΔInvestment	111207	-2.73	48.34	195.35	-6.11	-135.09	265552	0.70	56.07	223.84	-5.94	-138.57
ΔEmployment	105844	3.50	20.00	69.31	0.00	-57.54	248265	5.38	20.89	69.31	0.00	-55.96
NPLSM Dummy	60362	0.05	0.22	1.00	0.00	0.00	142108	0.03	0.18	1.00	0.00	0.00
NPL Ratio	53314	1.63	12.14	100.00	0.00	0.00	125641	0.87	8.75	27.42	0.00	0.00
NPLSM Ratio	53314	4.29	19.14	100.00	0.00	0.00	125641	2.60	14.81	100.00	0.00	0.00
TRD	122058	0.54	0.39	1.00	0.61	0.00	315349	0.40	0.37	1.00	0.31	0.00
FNH	122058	0.13	0.28	1.00	0.00	0.00	315349	0.08	0.24	1.00	0.00	0.00

(a) Full Sample

	Small Exporters						Small Importers					
	N	Mean	Std. Dev.	99th	Median	1th	N	Mean	Std. Dev.	99th	Median	1th
ΔVx	48751	-1.02	94.25	312.24	-3.55	-257.22	17901	-18.45	165.89	445.86	-11.56	-488.64
ΔVm	22106	-19.64	140.66	384.91	-13.16	-453.50	113436	-1.15	100.40	308.79	-1.46	-299.31
ΔEBIT/Asset	54462	0.83	15.19	58.14	-0.03	-39.74	141054	1.01	14.71	57.43	0.03	-38.14
Cash Ratio	51042	13.88	19.72	90.81	5.28	0.04	133608	14.32	18.89	84.67	6.24	0.04
ΔCash/Asset	43581	1.33	38.43	60.34	0.01	-45.26	113612	1.65	18.05	60.45	0.05	-41.12
Liquidity Ratio	59230	21.04	368.77	99.16	30.17	-186.15	169453	24.21	1620.50	99.18	37.11	-135.89
Leverage Ratio	59236	72.32	558.16	359.07	56.54	0.51	169477	74.62	1785.78	305.25	53.97	0.57
ΔCredit/Asset	12563	0.41	25.55	73.61	-0.56	-57.00	33971	1.14	24.56	77.05	-0.58	-47.96
ΔCD excl. TF	12467	0.65	26.51	74.42	-0.52	-55.76	32879	1.21	23.08	70.74	-0.49	-43.35
ΔLT Loan	9156	0.62	22.31	63.09	-0.97	-31.50	24864	0.77	17.78	57.54	-0.81	-27.58
ΔTrade Finance	1670	-1.76	22.89	35.29	-0.30	-44.61	8983	-0.13	20.48	59.49	-0.43	-48.55
ΔWorking Capital	8753	0.07	24.02	58.27	0.01	-64.43	21908	0.79	22.36	62.53	0.02	-47.49
Credit Utilization	17513	51.92	34.36	100.00	57.55	0.00	49644	47.68	35.34	100.00	50.97	0.00
ST Credit Utilization	13427	56.48	39.42	100.73	67.97	0.00	37917	50.53	43.94	100.65	54.91	0.00
ΔInvestment	51565	-7.49	57.00	220.22	-9.52	-164.21	136457	-3.51	63.64	241.45	-10.30	-163.59
ΔEmployment	48228	1.71	23.18	69.31	0.00	-69.31	123210	3.93	24.00	69.31	0.00	-69.31
NPLSM Dummy	17513	0.06	0.24	1.00	0.00	0.00	49644	0.04	0.20	1.00	0.00	0.00
NPL Ratio	15381	2.75	15.91	100.00	0.00	0.00	42651	1.53	11.64	99.89	0.00	0.00
NPLSM Ratio	15381	5.93	22.73	100.00	0.00	0.00	42651	3.84	18.21	100.00	0.00	0.00
TRD	59247	0.57	0.39	1.00	0.66	0.00	169498	0.42	0.37	1.00	0.34	0.00
FNH	59247	0.04	0.18	0.39	0.00	0.00	169498	0.03	0.15	0.00	0.00	0.00

(b) Small Firms

Table B.10: Descriptive Statistics (continued)

	Medium-sized Exporters						Medium-sized Importers					
	N	Mean	Std. Dev.	99th	Median	1th	N	Mean	Std. Dev.	99th	Median	1th
ΔVx	32516	9.86	83.72	333.14	3.05	-197.80	28163	-5.08	165.30	485.03	-2.22	-494.67
ΔVm	22241	-10.41	128.11	371.57	-4.92	-429.19	74513	6.41	100.25	334.09	4.67	-305.83
ΔEBIT/Asset	35382	0.90	10.29	38.96	0.20	-27.30	85415	1.37	10.49	41.38	0.36	-26.16
Cash Ratio	32321	10.40	14.35	66.00	4.42	0.02	78880	11.77	15.11	67.41	5.65	0.02
ΔCash/Asset	28830	1.56	15.22	44.99	0.07	-28.36	70871	2.06	15.48	47.63	0.16	-29.18
Liquidity Ratio	37161	18.83	39.94	92.29	19.63	-91.14	96549	22.81	624.81	92.54	25.48	-72.05
Leverage Ratio	37166	61.01	42.61	186.38	60.92	2.56	96556	61.99	624.80	164.59	60.44	4.03
ΔCredit/Asset	18305	1.24	19.06	62.08	-0.07	-40.13	42373	2.01	19.32	64.77	-0.02	-36.36
ΔCD excl. TF	17970	0.96	17.35	55.98	-0.09	-36.88	40884	1.42	16.05	51.25	-0.04	-29.63
ΔLT Loan	14054	0.32	11.46	37.43	-0.31	-19.76	33438	0.74	12.86	36.76	-0.19	-16.98
ΔTrade Finance	5391	1.03	16.03	52.01	0.01	-35.77	18185	1.50	17.42	55.91	0.13	-36.32
ΔWorking Capital	12866	0.67	16.27	46.70	0.02	-38.32	27457	0.96	14.89	40.36	0.03	-30.61
Credit Utilization	22848	49.98	34.05	100.00	54.31	0.00	55954	48.71	42.63	100.00	51.04	0.00
ST Credit Utilization	19367	53.82	43.59	100.85	61.35	0.00	47581	50.65	46.71	100.67	54.55	0.00
ΔInvestment	35233	0.96	43.14	185.20	-5.17	-99.05	85217	5.18	49.69	207.63	-3.81	-99.70
ΔEmployment	34205	4.68	17.99	69.31	2.04	-42.29	83005	6.83	18.36	69.31	4.13	-40.55
NPLSM Dummy	22848	0.05	0.21	1.00	0.00	0.00	55954	0.03	0.17	1.00	0.00	0.00
NPL Ratio	20520	1.47	11.49	99.81	0.00	0.00	50834	0.53	6.69	0.00	0.00	0.00
NPLSM Ratio	20520	3.88	18.27	100.00	0.00	0.00	50834	1.98	12.79	99.96	0.00	0.00
TRD	37167	0.52	0.39	1.00	0.55	0.00	96557	0.38	0.35	1.00	0.29	0.00
FNH	37167	0.14	0.28	0.87	0.00	0.00	96557	0.10	0.25	0.82	0.00	0.00

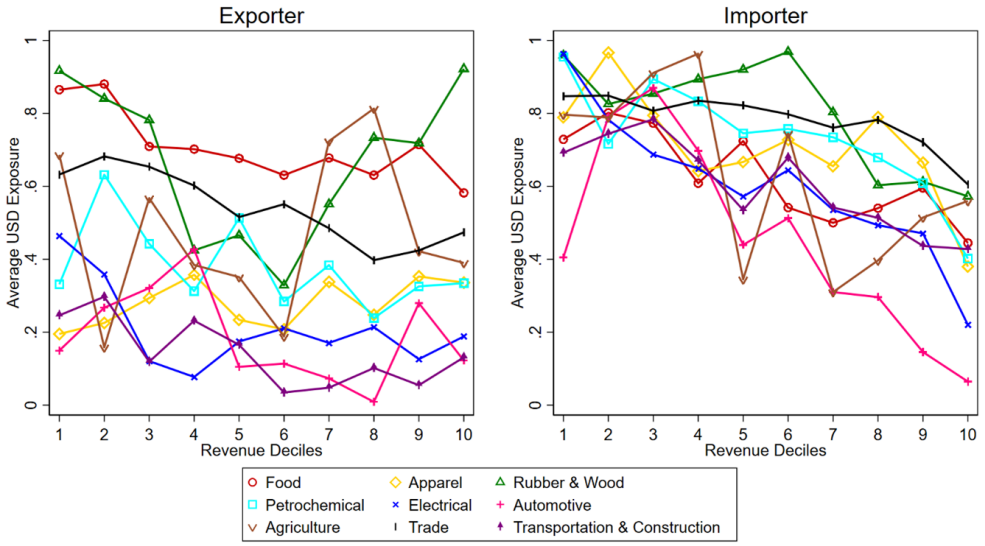
(c) Medium-sized Firms

	Large Exporters						Large Importers					
	N	Mean	Std. Dev.	99th	Median	1th	N	Mean	Std. Dev.	99th	Median	1th
ΔVx	22788	10.88	74.16	290.55	4.27	-145.37	25391	-0.37	146.51	450.69	0.92	-461.69
ΔVm	19276	-6.57	115.34	357.11	-1.88	-412.54	39509	7.16	103.23	372.98	4.65	-322.61
ΔEBIT/Asset	24188	0.89	9.31	32.65	0.32	-25.09	43722	1.17	9.16	33.84	0.45	-22.81
Cash Ratio	22519	9.42	12.29	55.36	4.37	0.02	40748	11.07	13.65	60.61	5.54	0.01
ΔCash/Asset	20141	1.16	9.02	31.74	0.12	-22.99	37020	1.58	10.73	37.73	0.19	-24.87
Liquidity Ratio	25642	17.01	33.39	81.11	17.32	-68.34	49293	20.44	31.25	82.67	20.36	-59.18
Leverage Ratio	25644	54.12	37.92	148.82	52.78	5.76	49294	55.86	29.70	130.42	56.14	6.19
ΔCredit/Asset	16206	1.34	19.40	63.52	0.00	-38.27	28361	1.81	18.26	56.26	0.00	-34.33
ΔCD excl. TF	15819	0.73	15.63	50.94	0.00	-34.13	27516	1.09	12.53	42.08	0.00	-27.40
ΔLT Loan	12321	-0.04	8.02	27.40	-0.01	-17.28	22381	0.41	8.93	30.41	0.00	-16.39
ΔTrade Finance	6541	1.56	18.67	57.77	0.02	-35.23	12071	1.78	20.35	55.54	0.18	-36.76
ΔWorking Capital	10367	0.90	16.44	49.73	0.00	-36.50	16848	0.87	10.72	35.70	0.00	-27.51
Credit Utilization	20001	42.90	35.61	100.00	42.33	0.00	36510	42.52	39.27	100.00	41.97	0.00
ST Credit Utilization	17406	45.42	38.50	100.57	46.41	0.00	31301	44.67	43.84	100.44	45.32	0.00
ΔInvestment	24409	2.00	31.69	123.83	-2.80	-69.05	43878	5.10	39.02	160.38	-1.58	-76.86
ΔEmployment	23411	5.49	14.69	56.41	3.92	-32.20	42050	6.79	14.54	57.54	5.00	-31.30
NPLSM Dummy	20001	0.05	0.21	1.00	0.00	0.00	36510	0.03	0.17	1.00	0.00	0.00
NPL Ratio	17413	0.85	8.37	23.55	0.00	0.00	32156	0.54	6.89	0.00	0.00	0.00
NPLSM Ratio	17413	3.33	16.37	100.00	0.00	0.00	32156	1.93	12.47	99.52	0.00	0.00
TRD	25644	0.53	0.37	1.00	0.57	0.00	49294	0.37	0.35	1.00	0.26	0.00
FNH	25644	0.32	0.37	0.97	0.10	0.00	49294	0.24	0.35	0.97	0.00	0.00

(d) Large Firms

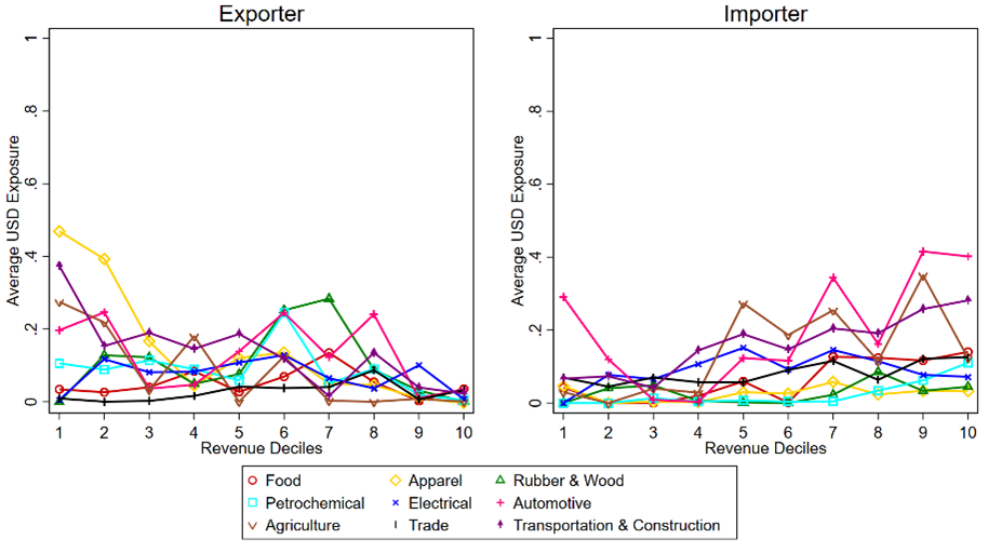
Note: This table presents descriptive statistics for all variables used in the estimation. We use the cleaned dataset during the period 2008-2020.

Figure B.2: USD Exposure by Sector



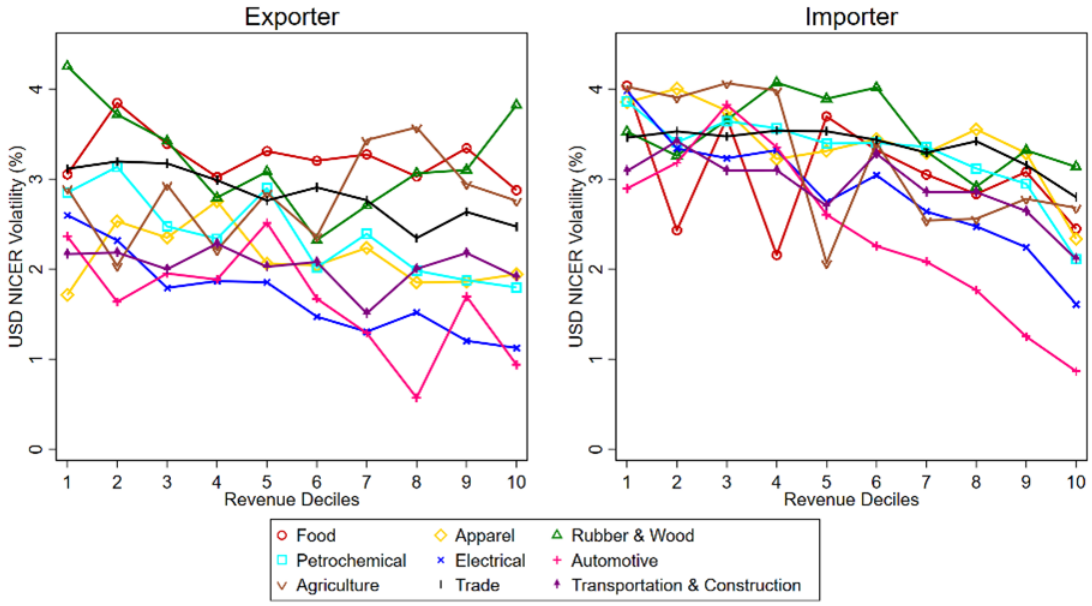
Note: The figure shows net USD exposures of exporting firms (left panel) and importing firms (right panel) across nine sectors. We compute for each firm the ratio of net dollar-priced exports to total gross trade value in a given year, and calculate the average over 2008–2020. Firms are ranked and classified into 10 deciles based on their average revenue over the period. For each sector, we report the median exposure within each decile. For importers, the sign of net exposure is flipped to allow comparison with exporting firms.

Figure B.3: Non-USD Exposure by Sector



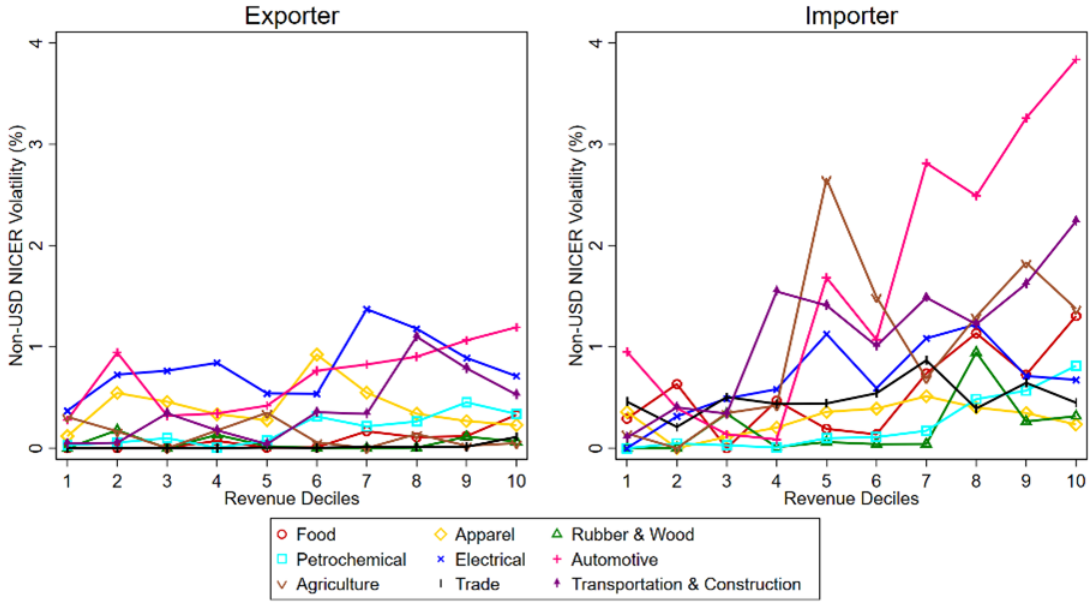
Note: The figure shows net non-USD exposures of exporting firms (left panel) and importing firms (right panel) across nine sectors. We compute for each firm the ratio of net non-dollar-priced exports to total gross trade value in a given year, and calculate the average over 2008–2020. Firms are ranked and classified into 10 deciles based on their average revenue over the period. For each sector, we report the median exposure within each decile. For importers, the sign of net exposure is flipped to allow comparison with exporting firms.

Figure B.4: USD NICER Volatility across Sectors



Note: Firm-level USD NICER volatility is the standard deviation of USD NICER ($NICER^{usd}_{i,t}$) facing each firm during 2008-2020. Firms are ranked and classified into 10 deciles based on their average revenue over the period. We report the median volatility within the deciles for each of the nine sectors.

Figure B.5: Non-USD NICER Volatility across Sectors



Note: Firm-level non-USD NICER volatility is the standard deviation of non-USD NICER ($NICER^{fc}_{i,t}$) facing each firm during 2008-2020. Firms are ranked and classified into 10 deciles based on their average revenue over the period. We report the median volatility within the deciles for each of the nine sectors.

Table B.11: Trade Dependency and Financial Hedging Ratios across Firm Sizes and Sectors

	Trade Dependency		Financial Hedging	
	Exporter	Importer	Exporter	Importer
By Size				
Small	59%	37%	10%	9%
Medium	53%	30%	20%	17%
Large	50%	28%	37%	30%
By Sector				
Manufacturing	37%	19%	22%	17%
Non-manufacturing	48%	35%	18%	16%
Food	43%	17%	34%	23%
Rubber & Wood	47%	21%	33%	15%
Apparel	37%	17%	23%	16%
Petrochemical	26%	17%	21%	19%
Electrical	27%	22%	15%	13%
Automotive	22%	18%	15%	18%
Agriculture	38%	16%	16%	14%
Trade	50%	37%	18%	16%

Note: This table presents the averages of international trade dependency and financial hedging ratios for each group of firms classified by firm sizes and sectors. For the empirical analysis, we use the cleaned dataset during 2007-2022.

B.2 Valuation effects on trade values

In this section, we perform a preliminary analysis on how the valuation effects affect export and import values. For a firm that invoices its trade in the dollar, a swing in the dollar exchange rate should directly affect the values of its sales and purchases in baht. The strength of these effects should depend on the reliance on the dollar as an invoicing currency. To this end, we define an invoicing-currency weighted exchange rate, $ICER^z_{i,t}$as:

$$ICER^x_{i,t} = \sum_j \left(\frac{Exp^j_{i,t-1}}{Exp_{i,t-1}} \right) \Delta \ln e^{j/thb}_t,$$

$$ICER^m_{i,t} = \sum_j \left(\frac{Imp^j_{i,t-1}}{Imp_{i,t-1}} \right) \Delta \ln e^{j/thb}_t.$$

These exchange rate indices are weighted by export and import shares, rather than net exposures which matter for firm profits under the baseline. We estimate the valuation effects on firms' export and import value growth using the following specification:

$$\Delta V^z_{i,t} = \alpha + \beta ICER^z_{i,t} + \theta X^z_{f,t} + \alpha_i + \gamma_{Ind,t} + \epsilon^z_{i,t}, \tag{14}$$

where $z \in \{x, m\}$. $V^x_{f,t}$ and $V^m_{f,t}$ are firm's value of exports and imports in baht terms, respectively.

As reported in Table B.12, there are large and significant effects of ICER on both export and import value growth, more so for dollar-priced transactions. For exports, the estimated effects of dollar-ICER are around one-half, as shown in columns 2 and 3. The impact from weighted non-dollar exchange rates, as captured by $ICER^{fc}_{i,t}$, is also less than one, but remains statistically significant.

The effects on imports are less than one, though large and significant. In column 5, the estimated coefficient of USD and non-USD exchange rates equal 1.1 and 0.4, respectively. This may be a result of expenditure-switching effects at work. That is, when baht appreciates against the invoicing currencies, imports become cheaper and so firms import a higher quantity of goods, thereby attenuating the decline in a firm's import value.

Table B.12: Impact of ICER on Export and Import Value Growth

	ΔV^X			ΔV^M		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Dep. Var.	-0.275***	-0.275***	-0.275***	-0.303***	-0.303***	-0.303***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ICER	-0.357***			-0.572***		
	(0.090)			(0.086)		
USD-ICER		-0.460***	-0.472***		-1.106***	-1.102***
		(0.144)	(0.145)		(0.153)	(0.153)
FC-ICER		-0.308***			-0.451***	
		(0.105)			(0.091)	
EUR-ICER			-0.422*			-0.720***
			(0.220)			(0.168)
JPY-ICER			-0.192			-0.370***
			(0.127)			(0.106)
CNY-ICER			-0.971			-1.067
			(2.438)			(1.306)
Other-ICER			-0.852***			-0.228
			(0.330)			(0.310)
ΔXE^*	-0.016	-0.015	-0.015	0.004	0.006	0.006
	(0.024)	(0.024)	(0.024)	(0.022)	(0.022)	(0.022)
ΔXE^n	0.022	0.022	0.021	0.013	0.012	0.012
	(0.018)	(0.018)	(0.018)	(0.021)	(0.021)	(0.021)
TPGDP	0.309*	0.301*	0.285*			
	(0.160)	(0.160)	(0.161)			
MPX				-0.243**	-0.280**	-0.318***
				(0.117)	(0.117)	(0.120)
Constant	-2.220***	-2.174***	-2.090***	0.990***	1.143***	1.207***
	(0.504)	(0.506)	(0.510)	(0.240)	(0.242)	(0.246)
Observations	135,752	135,752	135,752	112,149	112,149	112,149
R-squared	0.212	0.212	0.212	0.245	0.245	0.245
Firm FE	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES

Note: This table reports, based on a firm panel regression, the sensitivity of the yearly log change in export value (columns 1–3) and import value (columns 4–6) in baht terms to invoice-weighted exchange rates. The invoice-weighted indices are calculated without netting export exposure with import exposure, and are normalized by firm total export (or import) value. Controls include firm and industry-year fixed effects. We exclude observations where the value of the dependent variables exceeds their 1st and 99th percentiles. The sample period is 2008–2020.

B.3 Other NICER regression results

Table B.13: Financial Channel of Exchange Rates: Impact of NICER and Debt-weighted Exchange Rates on Firm EBIT

	ΔEBIT: Exporter								ΔEBIT: Importer							
	All	All	Small	Small	Medium	Medium	Large	Large	All	All	Small	Small	Medium	Medium	Large	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Lagged Dep. Var.	-0.317***	-0.317***	-0.350***	-0.350***	-0.303***	-0.303***	-0.329***	-0.330***	-0.321***	-0.321***	-0.354***	-0.354***	-0.335***	-0.335***	-0.314***	-0.314***
	(0.005)	(0.005)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.008)	(0.005)	(0.005)	(0.014)	(0.014)	(0.008)	(0.008)	(0.008)	(0.008)
NICER x TRD	-0.264***	-0.265***	-0.214***	-0.214***	-0.276***	-0.276***	-0.278***	-0.281***	-0.234***	-0.235***	-0.206	-0.203	-0.220***	-0.220***	-0.287***	-0.285***
	(0.029)	(0.029)	(0.066)	(0.066)	(0.043)	(0.043)	(0.047)	(0.047)	(0.037)	(0.037)	(0.142)	(0.142)	(0.057)	(0.057)	(0.051)	(0.051)
DWER x Credit-Asset		0.270		0.628		0.132		0.372		-0.214		1.265		0.101		0.381
		(0.238)		(1.683)		(0.567)		(0.250)		(0.348)		(6.143)		(0.650)		(0.374)
TRD	2.269***	2.267***	1.476*	1.465*	1.543**	1.541**	3.238***	3.241***	-1.321***	-1.320***	-5.039***	-5.027***	-1.373**	-1.376**	-1.962***	-1.978***
	(0.396)	(0.396)	(0.877)	(0.878)	(0.625)	(0.625)	(0.718)	(0.718)	(0.409)	(0.409)	(1.353)	(1.354)	(0.644)	(0.644)	(0.612)	(0.612)
Credit-Asset		0.742		-3.867		0.412		1.977		-1.080		-28.648		0.878		4.271
		(1.500)		(15.679)		(3.537)		(1.567)		(2.325)		(26.602)		(3.909)		(2.624)
ΔXE^{*} x TRD^{S}	0.021	0.021	-0.026	-0.026	0.050	0.050	0.001	0.001	0.045**	0.045**	0.051	0.056	-0.021	-0.021	0.047**	0.047**
	(0.018)	(0.018)	(0.057)	(0.057)	(0.032)	(0.032)	(0.023)	(0.023)	(0.021)	(0.021)	(0.290)	(0.290)	(0.101)	(0.101)	(0.019)	(0.019)
ΔXE^{n} x TRD^{S}	0.001	0.001	-0.028	-0.028	-0.006	-0.006	0.011	0.011	-0.008	-0.008	-0.276	-0.277	-0.021	-0.021	0.028	0.027
	(0.008)	(0.008)	(0.037)	(0.037)	(0.013)	(0.013)	(0.009)	(0.009)	(0.053)	(0.053)	(0.388)	(0.388)	(0.067)	(0.067)	(0.074)	(0.074)
TPGDP x TRD^{S}	-0.052	-0.052	-0.040	-0.040	-0.030	-0.030	-0.046	-0.048								
	(0.045)	(0.045)	(0.106)	(0.106)	(0.068)	(0.068)	(0.080)	(0.080)								
MPX x TRD^{C}									-0.057	-0.057	-0.296	-0.295	-0.043	-0.044	0.022	0.022
									(0.042)	(0.042)	(0.181)	(0.181)	(0.067)	(0.067)	(0.055)	(0.055)
Lagged Debt-Asset	0.137***	0.137***	0.138***	0.138***	0.165***	0.164***	0.166***	0.166***	0.164***	0.164***	0.222***	0.222***	0.169***	0.169***	0.165***	0.164***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.012)	(0.012)	(0.006)	(0.006)	(0.006)	(0.006)
Constant	-8.989***	-8.989***	-10.103***	-10.096***	-10.341***	-10.341***	-9.905***	-9.915***	-8.176***	-8.178***	-11.935***	-11.935***	-8.550***	-8.556***	-7.302***	-7.274***
	(0.271)	(0.271)	(0.611)	(0.612)	(0.451)	(0.451)	(0.493)	(0.493)	(0.262)	(0.262)	(0.875)	(0.876)	(0.431)	(0.432)	(0.401)	(0.402)
Observations	47,810	47,810	12,318	12,318	17,685	17,685	16,134	16,134	40,183	40,183	5,774	5,774	15,840	15,840	16,648	16,648
R-squared	0.290	0.290	0.359	0.359	0.344	0.344	0.308	0.308	0.342	0.342	0.472	0.472	0.411	0.411	0.341	0.341
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across firm size. We control for the financial channel of exchange rates associated with firms' foreign-currency liabilities, by including the interaction terms between debt-weighted exchange rates ($DWER_{i,t}$) and firm leverage. $DWER_{i,t}$ uses the proportions of bank loans outstanding in respective currencies as weights. We show results for a sample of exporting firms in columns 1–8, and importing firms in columns 9–16. Firm are classified into three groups according to their size (small, medium, large) based on annual revenue reported by the Office of Small and Medium Enterprise Promotion (OSMEP). Firms are classified as small if their annual revenue was less than or equal to 100 million baht (manufacturing) or 50 million baht (non-manufacturing). Medium-sized firms are those with revenue exceeding the small firm thresholds but not exceeding 500 million baht (manufacturing) or 300 million baht (non-manufacturing). Firms exceeding these upper limits were categorized as large. Controls include firm and industry-year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.14: Impact of NICER and Trade-weighted Exchange Rates on Firm EBIT

	ΔEBIT: Exporter						ΔEBIT: Importer					
	All	All	All	Small	Medium	Large	All	All	All	Small	Medium	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lagged Dep. Var.	-0.291***	-0.290***	-0.291***	-0.312***	-0.279***	-0.320***	-0.303***	-0.302***	-0.303***	-0.350***	-0.310***	-0.282***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.006)	(0.007)	(0.004)	(0.004)	(0.004)	(0.007)	(0.006)	(0.007)
NICER	-0.195***		-0.192***	-0.234***	-0.186***	-0.157***	-0.128***		-0.122***	-0.086**	-0.129***	-0.128***
	(0.016)		(0.016)	(0.027)	(0.024)	(0.030)	(0.015)		(0.015)	(0.038)	(0.023)	(0.023)
ΔXE		-0.007***	-0.004*	-0.009*	-0.005	0.001		-0.003	-0.003	-0.001	-0.005	-0.002
		(0.002)	(0.002)	(0.005)	(0.003)	(0.004)		(0.002)	(0.002)	(0.005)	(0.003)	(0.003)
ΔME		-0.007	-0.008	-0.027*	-0.014*	0.006		0.033***	0.019**	0.025	0.003	0.075***
		(0.007)	(0.007)	(0.015)	(0.008)	(0.011)		(0.008)	(0.008)	(0.026)	(0.011)	(0.019)
ΔXE^{*}	0.007						0.009**					
	(0.005)						(0.003)					
ΔXE^{n}	-0.002						-0.003					
	(0.003)						(0.003)					
TPGDP	0.103***	0.099***	0.104***	0.075	0.136***	0.120**						
	(0.029)	(0.029)	(0.029)	(0.049)	(0.045)	(0.057)						
MPX							0.052***	0.086***	0.035*	0.045	0.038	-0.042
							(0.018)	(0.019)	(0.020)	(0.050)	(0.030)	(0.033)
Lagged Debt-Asset	0.124***	0.124***	0.124***	0.128***	0.149***	0.162***	0.173***	0.173***	0.173***	0.197***	0.175***	0.181***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
Constant	-6.653***	-6.718***	-6.646***	-7.109***	-8.306***	-7.960***	-8.774***	-8.740***	-8.792***	-11.200***	-8.797***	-8.533***
	(0.136)	(0.136)	(0.136)	(0.214)	(0.268)	(0.322)	(0.160)	(0.160)	(0.160)	(0.351)	(0.281)	(0.291)
Observations	89,881	89,881	89,881	39,240	28,006	20,287	71,263	71,263	71,263	18,344	27,155	22,670
R-squared	0.246	0.245	0.246	0.285	0.301	0.295	0.328	0.327	0.328	0.429	0.373	0.320
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table compares the sensitivity of changes in EBIT as a ratio of lagged assets to two concepts of exchange rates: trade-weighted exchange rates and NICER. Results are from a firm panel regression, where we show results for a sample of exporting firms in columns 1–6, and importing firms in columns 7–12. Controls include firm and industry-year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.15: Impact of NICER on Firm EBIT by Firm Size: Role of International Trade Dependency

	ΔEBIT: Exporter						ΔEBIT: Importer					
	Small		Medium		Large		Small		Medium		Large	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NICER x TRD	-0.337***		-0.325***		-0.348***		-0.185**		-0.274***		-0.332***	
	(0.036)		(0.035)		(0.043)		(0.076)		(0.045)		(0.044)	
USD-NICER x TRD		-0.230***		-0.202***		-0.227***		-0.042		-0.138**		-0.130**
		(0.049)		(0.046)		(0.053)		(0.115)		(0.068)		(0.064)
FC-NICER x TRD		-0.446***		-0.487***		-0.558***		-0.260***		-0.346***		-0.458***
		(0.049)		(0.052)		(0.069)		(0.089)		(0.053)		(0.052)
ΔXE^{*} x TRD^{S}	0.018	0.016	0.016	0.014	0.013	0.010	-0.026	-0.027	0.083	0.081	0.040**	0.039*
	(0.014)	(0.014)	(0.011)	(0.011)	(0.019)	(0.019)	(0.029)	(0.029)	(0.061)	(0.061)	(0.020)	(0.020)
ΔXE^{n} x TRD^{S}	-0.005	-0.005	-0.003	-0.003	0.004	0.004	-0.060	-0.061	-0.039	-0.039	-0.020	-0.022
	(0.009)	(0.009)	(0.005)	(0.005)	(0.006)	(0.006)	(0.074)	(0.074)	(0.065)	(0.065)	(0.076)	(0.076)
Observations	39,240	39,240	28,006	28,006	20,287	20,287	18,344	18,344	27,155	27,155	22,670	22,670
R-squared	0.285	0.285	0.302	0.303	0.298	0.299	0.430	0.431	0.374	0.374	0.320	0.320
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across firm size. We show results for a sample of exporting firms in columns 1–6, and importing firms in columns 7–12. Firm are classified into three groups according to their size (small, medium, large) based on annual revenue reported by the Office of Small and Medium Enterprise Promotion (OSMEP). Firms are classified as small if their annual revenue was less than or equal to 100 million baht (manufacturing) or 50 million baht (non-manufacturing). Medium-sized firms are those with revenue exceeding the small firm thresholds but not exceeding 500 million baht (manufacturing) or 300 million baht (non-manufacturing). Firms exceeding these upper limits were categorized as large. Controls include firm and industry-year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.16: Impact of NICER on Exporter's EBIT across Sectors: Role of International Trade Dependency

ΔEBIT: Exporter	Manufacturing		Food		Apparel		Rubber&Wood		Petrochemical		Metal		Electronic		Automotive		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
NICER x TRD	-0.380***		-0.166***		-0.433***		-0.177**		-0.413***		-0.633***		-0.575***		-0.882***		-0.365***	
	(0.029)		(0.063)		(0.074)		(0.072)		(0.082)		(0.115)		(0.102)		(0.149)		(0.062)	
USD-NICER x TRD		-0.260***		-0.208**		-0.208*		-0.115		-0.169		-0.561***		-0.646***		-0.834***		-0.186**
		(0.041)		(0.089)		(0.121)		(0.089)		(0.118)		(0.177)		(0.166)		(0.223)		(0.085)
FC-NICER x TRD		-0.482***		-0.129		-0.552***		-0.279**		-0.618***		-0.684***		-0.537***		-0.914***		-0.548***
		(0.038)		(0.085)		(0.090)		(0.112)		(0.108)		(0.149)		(0.124)		(0.188)		(0.086)
Observations	50,308	50,308	7,518	7,518	6,446	6,446	4,822	4,822	7,900	7,900	3,528	3,528	6,846	6,846	2,818	2,818	10,328	10,328
R-squared	0.243	0.244	0.223	0.223	0.228	0.228	0.257	0.257	0.225	0.226	0.321	0.321	0.262	0.262	0.277	0.277	0.238	0.239

	Non-manufacturing		Agri&Food&Mining		Automotive Trade		Wholesale Trade		Retail Trade		Other							
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)						
NICER x TRD	-0.252***		-0.182***		-0.505***		-0.233***		-0.325***		-0.313**							
	(0.034)		(0.060)		(0.159)		(0.048)		(0.108)		(0.138)							
USD-NICER x TRD		-0.150***		-0.067		-0.520***		-0.121**		-0.239*		-0.055						
		(0.041)		(0.075)		(0.190)		(0.059)		(0.126)		(0.172)						
FC-NICER x TRD		-0.437***		-0.348***		-0.468		-0.439***		-0.558***		-0.769***						
		(0.055)		(0.089)		(0.299)		(0.079)		(0.204)		(0.228)						
Observations	39,341	39,341	9,614	9,614	1,885	1,885	18,728	18,728	4,573	4,573	4,512	4,512						
R-squared	0.259	0.260	0.234	0.235	0.242	0.242	0.261	0.261	0.264	0.264	0.270	0.272						
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES																

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across sectors. Firms are classified into 13 sectors, which can be broadly grouped into manufacturing and non-manufacturing sectors, based on the International Standard Industrial Classification of All Economic Activities-ISIC Revision 4. Controls include firm and year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.17: Impact of NICER on Importer's EBIT across Sectors: Role of International Trade Dependency

ΔEBIT: Importer	Manufacturing		Food		Apparel		Rubber&Wood		Petrochemical		Metal		Electronic		Automotive		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
NICER x TRD	-0.302***		-0.028		-0.453*		0.211		-0.245**		-0.264***		-0.143		-0.477***		-0.413**	
	(0.051)		(0.219)		(0.248)		(0.222)		(0.113)		(0.099)		(0.120)		(0.139)		(0.190)	
USD-NICER x TRD		0.003		0.148		-0.588**		0.098		-0.125		-0.122		0.268		0.070		0.186
		(0.077)		(0.278)		(0.284)		(0.277)		(0.151)		(0.150)		(0.180)		(0.289)		(0.276)
FC-NICER x TRD		-0.478***		-0.304		-0.125		0.378		-0.367**		-0.345***		-0.370***		-0.566***		-0.794***
		(0.061)		(0.346)		(0.417)		(0.330)		(0.151)		(0.119)		(0.141)		(0.144)		(0.229)
Observations	27,771	27,771	1,513	1,513	1,873	1,873	1,705	1,705	6,114	6,114	3,921	3,921	6,228	6,228	3,033	3,033	3,244	3,244
R-squared	0.322	0.323	0.349	0.350	0.390	0.391	0.317	0.317	0.285	0.285	0.322	0.323	0.323	0.324	0.351	0.353	0.287	0.290

	Non-manufacturing		Agri&Food&Mining		Automotive Trade		Wholesale Trade		Retail Trade		Other							
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)						
NICER x TRD	-0.282***		-0.311*		-0.080		-0.320***		-0.315***		0.039							
	(0.037)		(0.162)		(0.173)		(0.045)		(0.091)		(0.153)							
USD-NICER x TRD		-0.133**		-0.023		0.037		-0.175***		-0.087		-0.089						
		(0.055)		(0.207)		(0.249)		(0.068)		(0.138)		(0.211)						
FC-NICER x TRD		-0.365***		-0.696***		-0.139		-0.393***		-0.432***		0.137						
		(0.043)		(0.237)		(0.195)		(0.052)		(0.106)		(0.189)						
Observations	43,179	43,179	2,229	2,229	1,898	1,898	25,768	25,768	7,327	7,327	5,635	5,635						
R-squared	0.335	0.336	0.335	0.337	0.316	0.316	0.334	0.335	0.331	0.332	0.353	0.353						
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES																

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER, across sectors. Firms are classified into 13 sectors, which can be broadly grouped into manufacturing and non-manufacturing sectors, based on the International Standard Industrial Classification of All Economic Activities-ISIC Revision 4. Controls include firm and year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.18: Impact of NICER on Firm EBIT: Role of Financial Hedging

	ΔEBIT: Exporter				ΔEBIT: Importer			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lagged Dep. Var.	-0.291***	-0.291***	-0.291***	-0.291***	-0.303***	-0.303***	-0.303***	-0.303***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
NICER	-0.028				-0.076***			
	(0.028)				(0.022)			
NICER x TRD	-0.308***	-0.339***			-0.195***	-0.314***		
	(0.040)	(0.024)			(0.047)	(0.033)		
NICER x FNH	0.015	-0.019			-0.005	-0.093*		
	(0.094)	(0.088)			(0.059)	(0.054)		
NICER x TRD x FNH	0.076	0.119			0.111	0.265**		
	(0.129)	(0.121)			(0.117)	(0.109)		
USD-NICER			0.018				0.006	
			(0.037)				(0.037)	
FC-NICER			-0.034				-0.089***	
			(0.044)				(0.027)	
USD-NICER x TRD			-0.232***	-0.213***			-0.110	-0.095*
			(0.049)	(0.032)			(0.071)	(0.049)
FC-NICER x TRD			-0.447***	-0.490***			-0.284***	-0.436***
			(0.066)	(0.035)			(0.061)	(0.040)
USD-NICER x FNH			-0.068	-0.048			0.084	0.096
			(0.115)	(0.107)			(0.098)	(0.089)
FC-NICER x FNH			0.192	0.148			-0.057	-0.166**
			(0.163)	(0.152)			(0.075)	(0.067)
USD-NICER x TRD x FNH			0.111	0.086			-0.110	-0.129
			(0.154)	(0.146)			(0.182)	(0.170)
FC-NICER x TRD x FNH			-0.066	-0.009			0.262*	0.458***
			(0.239)	(0.227)			(0.156)	(0.144)
TRD	1.515***	1.519***	1.464***	1.463***	-1.268***	-1.323***	-1.299***	-1.351***
	(0.311)	(0.311)	(0.311)	(0.311)	(0.345)	(0.345)	(0.345)	(0.345)
FNH	-0.055	-0.044	-0.044	-0.049	-0.870**	-0.914**	-0.841**	-0.857**
	(0.450)	(0.450)	(0.451)	(0.450)	(0.376)	(0.376)	(0.377)	(0.377)
TRD x FNH	-0.946	-0.964	-0.896	-0.889	1.219	1.290*	1.237*	1.279*
	(0.640)	(0.640)	(0.641)	(0.640)	(0.745)	(0.745)	(0.746)	(0.746)
ΔXE^{*} x TRD^{S}	0.018**	0.018**	0.016**	0.016**	0.017	0.016	0.015	0.015
	(0.008)	(0.008)	(0.008)	(0.008)	(0.016)	(0.016)	(0.016)	(0.016)
ΔXE^{n} x TRD^{S}	-0.001	-0.001	-0.001	-0.001	-0.041	-0.041	-0.042	-0.042
	(0.004)	(0.004)	(0.004)	(0.004)	(0.041)	(0.041)	(0.041)	(0.041)
TPGDP x TRD^{S}	0.006	0.008	0.011	0.010				
	(0.036)	(0.036)	(0.036)	(0.036)				
MPX x TRD^{C}					0.046	0.040	0.039	0.039
					(0.034)	(0.034)	(0.034)	(0.034)
Lagged Debt-Asset	0.124***	0.124***	0.124***	0.124***	0.174***	0.174***	0.174***	0.174***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-7.181***	-7.188***	-7.179***	-7.176***	-8.279***	-8.241***	-8.253***	-8.224***
	(0.213)	(0.213)	(0.213)	(0.213)	(0.205)	(0.204)	(0.205)	(0.204)
Observations	89,881	89,881	89,881	89,881	71,263	71,263	71,263	71,263
R-squared	0.247	0.247	0.247	0.247	0.328	0.328	0.329	0.328
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of changes in EBIT as a ratio of lagged assets on NICER. We show results for a sample of exporting firms in columns 1–2, and importing firms in columns 3–4. Financial hedging (FNH) is calculated as the ratio of a firm's forward and swap transactions in baht terms to all FX transactions (i.e. sum of spot, forward and swap transactions). Controls include firm and industry-year fixed effects. We exclude observations where the values of lagged dependent variables exceed their 1st and 99th percentiles. Sample period is 2008–2020.

Table B.19: Impact of NICER on Exporter's Liquidity and Credit

Exporter	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔCD excl. TF	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
NICER x TRD	-0.073***	-0.124***	-0.074**	0.139***	0.126**	0.102**	-0.057	-0.097	0.119**	-0.021	0.168*	-0.002*	-0.000	-0.128*
	(0.017)	(0.021)	(0.029)	(0.026)	(0.058)	(0.052)	(0.041)	(0.086)	(0.058)	(0.079)	(0.095)	(0.001)	(0.019)	(0.065)
Observations	79,925	69,595	94,237	93,935	29,175	28,493	21,447	8,314	19,394	37,073	30,550	33,070	31,307	31,525
R-squared	0.727	0.229	0.852	0.887	0.256	0.255	0.282	0.317	0.262	0.772	0.776	0.560	0.513	0.532

	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔCD excl. TF	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio
	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
USD-NICER x TRD	-0.048**	-0.070**	-0.041	0.113***	0.019	0.028	-0.075	-0.199*	0.095	-0.128	0.076	-0.002	0.009	-0.111
	(0.022)	(0.029)	(0.039)	(0.034)	(0.074)	(0.066)	(0.051)	(0.111)	(0.073)	(0.101)	(0.121)	(0.001)	(0.024)	(0.084)
FC-NICER x TRD	-0.108***	-0.185***	-0.115***	0.170***	0.259***	0.197***	-0.031	0.026	0.153*	0.115	0.290**	-0.001	-0.012	-0.150
	(0.026)	(0.030)	(0.043)	(0.038)	(0.082)	(0.074)	(0.059)	(0.121)	(0.087)	(0.112)	(0.137)	(0.001)	(0.027)	(0.094)
Observations	79,925	69,595	94,237	93,935	29,175	28,493	21,447	8,314	19,394	37,073	30,550	33,070	31,307	31,525
R-squared	0.727	0.229	0.852	0.887	0.256	0.255	0.282	0.317	0.262	0.772	0.776	0.560	0.513	0.532
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of various financial variables on the interaction term between NICER and trade dependency ratios. These variables include (1) the ratio of cash to total assets, (2) the ratio of changes in cash to lagged assets, (3) liquidity ratios (i.e., ratios of net current assets to total assets), (4) leverage ratios or debt-to-asset ratios, (5) changes in overall loans outstanding, (6) changes in loans outstanding (excluding trade finance), (7) changes in long-term general loans outstanding, (8) changes in trade finance loans outstanding, and (9) changes in working capital loans outstanding as a ratio of lagged assets, (10) overall and (11) short-term credit utilization rates as measured by the ratios of loans outstanding to credit lines, (12) the dummy variable indicating whether a firm has special mention or non-performing loans, (13) the ratios of nonperforming loans to total loans outstanding, and (14) the ratios of special-mention and nonperforming loans to total loans outstanding. All credit variables are at year end. We exclude observations where the value of dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.20: Impact of NICER on Importer's Liquidity and Credit

Importer	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔCD excl. TF	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
NICER x TRD	-0.093***	-0.166***	-0.122***	0.263***	0.120	0.029	-0.082	0.309***	0.067	0.183	0.171	-0.000	0.019	-0.044
	(0.025)	(0.034)	(0.037)	(0.031)	(0.079)	(0.066)	(0.053)	(0.097)	(0.079)	(0.112)	(0.136)	(0.001)	(0.019)	(0.062)
Observations	62,581	53,995	75,947	75,977	23,977	23,269	18,635	10,062	14,028	29,643	24,131	26,755	25,779	25,865
R-squared	0.778	0.277	0.873	0.901	0.313	0.312	0.331	0.345	0.322	0.771	0.781	0.585	0.507	0.552

	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔCD excl. TF	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio
	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
USD-NICER x TRD	-0.094***	-0.161***	-0.101*	0.270***	-0.035	-0.094	-0.102	0.285**	-0.164	-0.096	-0.135	-0.001	-0.001	-0.088
	(0.036)	(0.050)	(0.055)	(0.047)	(0.115)	(0.097)	(0.074)	(0.139)	(0.115)	(0.167)	(0.203)	(0.001)	(0.028)	(0.091)
FC-NICER x TRD	-0.092***	-0.170***	-0.134***	0.259***	0.200**	0.090	-0.070	0.323***	0.191**	0.310**	0.312**	-0.000	0.029	-0.022
	(0.030)	(0.039)	(0.043)	(0.037)	(0.090)	(0.075)	(0.061)	(0.112)	(0.091)	(0.125)	(0.153)	(0.001)	(0.022)	(0.070)
Observations	62,581	53,995	75,947	75,977	23,977	23,269	18,635	10,062	14,028	29,643	24,131	26,755	25,779	25,865
R-squared	0.778	0.277	0.873	0.901	0.313	0.313	0.331	0.345	0.323	0.771	0.781	0.585	0.507	0.552
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of various financial variables on the interaction term between NICER and trade dependency ratios. These variables include (1) the ratio of cash to total assets, (2) the ratio of changes in cash to lagged assets, (3) liquidity ratios (i.e., ratios of net current assets to total assets), (4) leverage ratios or debt-to-asset ratios, (5) changes in overall loans outstanding, (6) changes in loans outstanding (excluding trade finance), (7) changes in long-term general loans outstanding, (8) changes in trade finance loans outstanding, and (9) changes in working capital loans outstanding as a ratio of lagged assets, (10) overall and (11) short-term credit utilization rates as measured by the ratios of loans outstanding to credit lines, (12) the dummy variable indicating whether a firm has special mention or non-performing loans, (13) the ratios of nonperforming loans to total loans outstanding, and (14) the ratios of special-mention and nonperforming loans to total loans outstanding. All credit variables are at year end. We exclude observations where the value of dependent variables exceeds their 1st and 99th percentiles. Sample period is from 2008 to 2020.

Table B.21: Impact of NICER on Firm Investment and Employment by Firm Size

	ΔInvestment: Exporter						ΔInvestment: Importer					
	Small		Medium		Large		Small		Medium		Large	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NICER x TRD	-0.207*		0.007		-0.124		-0.902*		-0.155		0.107	
	(0.118)		(0.110)		(0.107)		(0.537)		(0.351)		(0.318)	
USD-NICER x TRD		-0.509***		-0.135		-0.218		-0.886		-0.015		-0.092
		(0.186)		(0.159)		(0.141)		(0.579)		(0.376)		(0.337)
FC-NICER x TRD		-0.028		0.127		-0.007		-0.916		-0.284		0.333
		(0.145)		(0.146)		(0.156)		(0.574)		(0.372)		(0.342)
Observations	15,461	15,461	18,884	18,884	17,375	17,375	13,911	13,911	24,440	24,440	21,852	21,852
R-squared	0.329	0.329	0.311	0.311	0.304	0.304	0.381	0.381	0.320	0.320	0.282	0.283

	ΔEmployment: Exporter						ΔEmployment: Importer					
	Small		Medium		Large		Small		Medium		Large	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NICER x TRD	-0.073		-0.116*		-0.110*		1.192***		-0.119		-0.061	
	(0.078)		(0.065)		(0.064)		(0.353)		(0.173)		(0.143)	
USD-NICER x TRD		-0.190		-0.203**		-0.072		1.222***		-0.095		-0.020
		(0.125)		(0.096)		(0.085)		(0.384)		(0.186)		(0.151)
FC-NICER x TRD		-0.008		-0.046		-0.156*		1.162***		-0.141		-0.109
		(0.095)		(0.086)		(0.092)		(0.387)		(0.184)		(0.154)
Observations	11,937	11,937	17,841	17,841	16,718	16,718	7,925	7,925	22,894	22,894	21,497	21,497
R-squared	0.399	0.399	0.390	0.389	0.395	0.395	0.433	0.434	0.390	0.386	0.401	0.401
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a firm panel regression of investment and employment growth on the interaction term between NICER and trade dependency ratios by size. We show results for exporters in columns 1-6, and importers in columns 7-12. Controls include firm and year fixed effects. We exclude observations where the value of lagged dependent variables exceeds their 5th and 95th percentiles, the level of investment is less than 100,000 baht, and the level of employment is less than 10 persons. Sample period is from 2008 to 2020.

B.4 Validating shift-share instrument

The firm-specific exchange rate indices, $NICER_{i,t}$ and $NICER_{i,t}TRD_{i,t-1}$, resemble the shift-share instrument that has been widely used to identify the causal effects of interest (Bartik, 1991; Goldsmith-Pinkham et al., 2020; Borusyak et al., 2022). In our case, the shifts are bilateral exchange rate changes, while the shares are firm exposures to each shift. Identification can come from either exogenous shares or exogenous shifts. As in Barbiero (2021), the exchange rate movements, i.e. the shifts, arguably provide most exogenous variations in $NICER_{i,t}$. Such shift-based identification rests on two assumptions for instrument validity. First, the quasi-randomness of the shifts requires each bilateral exchange rate to be uncorrelated with other drivers for firms most exposed to that currency's movements. The second assumption is the existence of many serially-uncorrelated shifts. By considering 25 invoicing currencies over a 14-year period, we allow for ample instances of exogenous exchange rate shocks that meet these assumptions.[20]

Following Borusyak et al. (2025), we conduct three robustness exercises to check the validity of shift-share instrument. First, we re-construct the trading partner GDP growth using NICER weights as an alternative control for macroeconomic confounders. Second, we add the sum of NICER shares as another control, since these shares do not necessarily sum to one for each firm. Third, we perform a pre-trend test by regressing lagged firm outcomes on the shift-share instrument.

The results generally validate our use of NICER as instruments. Table B.22 shows that, by including the share-weighted TPGDP and the sum of shares as additional controls, results with respect to firm EBIT remain robust. While the estimated impacts on exporters' employment and investment lose statistical significance, the estimates remain similar to the baseline result. Pre-trend tests, reported in Table B.23, show no significant NICER association with every firm outcome. This implies that the instruments are most likely not confounded by unobserved firm-level factors, thus validating the use of NICER as a shift-share instrument.

[20]Each bilateral exchange rate used in constructing NICER exhibits no or weak serial correlation, allowing us to employ one-period-lag exposure as a share, which in turn enhances the power of shift-share instruments.

Table B.22: Adding Controls for Shift-share Identification

Exporter	ΔEBIT				ΔPPE				ΔEMP			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NICER x TRD	-0.321***	-0.367***	-0.302***	-0.366***	-0.115*	-0.074	-0.091	-0.070	-0.081**	-0.083*	-0.052	-0.084*
	(0.022)	(0.031)	(0.022)	(0.031)	(0.062)	(0.081)	(0.064)	(0.081)	(0.039)	(0.050)	(0.040)	(0.050)
Sum of Shares x Year FE		✓		✓		✓		✓		✓		✓
Share-weighted TPGDP			✓	✓			✓	✓			✓	✓
Observations	89,881	89,881	89,881	89,881	53,591	53,591	53,591	53,591	48,114	48,114	48,114	48,114
R-squared	0.247	0.249	0.247	0.249	0.280	0.281	0.280	0.281	0.351	0.354	0.351	0.354

Importer	ΔEBIT				ΔPPE				ΔEMP			
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
NICER x TRD	-0.286***	-0.379***	-0.290***	-0.379***	-0.219	-0.315	-0.211	-0.315	0.110	0.103	0.152	0.107
	(0.030)	(0.036)	(0.030)	(0.036)	(0.207)	(0.227)	(0.210)	(0.227)	(0.105)	(0.115)	(0.106)	(0.115)
Sum of Shares x Year FE		✓		✓		✓		✓		✓		✓
Share-weighted TPGDP			✓	✓			✓	✓			✓	✓
Observations	71,263	71,263	71,263	71,263	63,011	63,011	63,011	63,011	54,554	54,554	54,554	54,554
R-squared	0.328	0.328	0.328	0.328	0.291	0.291	0.291	0.291	0.358	0.359	0.358	0.359
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates of firm outcome on $NICER_{i,t}TRD_{i,t-1}$ using Eq.7 for the ratio of EBIT to lagged assets, and Eq.8 for investment and employment growth (ΔPPE and ΔEMP). Controls include (1) the sum of shares, i.e. currency exposure times trade dependency ratio, for each firm in a given period and (2) export-weighted trading partners' GDP using shares as weights. We show results for exporters in columns 1-12, and importers in columns 13-24. WE also include firm and industry-year fixed effects. Sample period is from 2008 to 2020.

Table B.23: Pre-trend Test

Firm Outcome: One-year Lag																
Exporter	ΔEBIT	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio	ΔPPE	ΔEMP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
NICER x TRD	-0.013	0.017	0.024	0.044	-0.078	0.127	-0.043	0.134	0.019	-0.016	-0.025	-0.003	-0.066	-0.323	-0.111	0.106
	(0.085)	(0.037)	(0.061)	(0.049)	(0.053)	(0.114)	(0.078)	(0.135)	(0.104)	(0.204)	(0.165)	(0.002)	(0.037)	(0.182)	(0.089)	(0.080)
Observations	74,752	64,814	55,964	83,502	83,392	22,153	16,993	7,198	15,681	30,032	25,308	26,045	24,947	25,150	62,570	52,804
R-squared	0.186	0.743	0.213	0.858	0.896	0.261	0.278	0.308	0.258	0.772	0.777	0.608	0.463	0.604	0.257	0.365
Importer	ΔEBIT	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio	ΔPPE	ΔEMP
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
NICER x TRD	-0.146*	0.063	0.039	0.012	0.069	-0.008	-0.067	-0.082	-0.029	0.133	0.041	-0.001	0.022	-0.128*	-0.233	-0.029
	(0.078)	(0.039)	(0.082)	(0.093)	(0.076)	(0.078)	(0.101)	(0.203)	(0.083)	(0.139)	(0.163)	(0.001)	(0.020)	(0.063)	(0.141)	(0.052)
Observations	65,705	57,602	49,711	69,937	69,993	21,474	17,801	9,552	13,087	26,937	21,853	23,666	22,995	23,076	58,801	52,158
R-squared	0.240	0.781	0.209	0.878	0.907	0.316	0.319	0.360	0.316	0.775	0.787	0.582	0.353	0.551	0.279	0.377
Firm Outcome: Two-year Lag																
Exporter	ΔEBIT	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio	ΔPPE	ΔEMP
	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)
NICER x TRD	-0.013	0.043	0.110*	0.084	-0.031	0.051	-0.097	-0.009	0.078	-0.203	-0.363	-0.000	-0.083	-0.045	-0.203	0.122
	(0.054)	(0.035)	(0.053)	(0.056)	(0.046)	(0.138)	(0.106)	(0.108)	(0.150)	(0.204)	(0.242)	(0.002)	(0.047)	(0.138)	(0.162)	(0.080)
Observations	61,032	52,301	44,670	69,676	69,625	16,900	12,989	5,833	12,162	23,121	19,828	20,711	18,902	19,038	52,359	45,078
R-squared	0.245	0.749	0.273	0.862	0.897	0.299	0.321	0.302	0.335	0.764	0.764	0.614	0.454	0.591	0.263	0.376
Importer	ΔEBIT	Cash Ratio	ΔCash	Liquidity Ratio	Leverage Ratio	ΔCredit	ΔLT Loan	ΔTF	ΔWC	UTR	ST UTR	NPLSM Dummy	NPL Ratio	NPLSM Ratio	ΔPPE	ΔEMP
	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)
NICER x TRD	0.031	-0.011	-0.124*	0.048	-0.079	-0.060	0.042	-0.201	-0.235*	-0.382**	-0.265*	-0.000	0.029	-0.046	-0.036	-0.130
	(0.101)	(0.044)	(0.062)	(0.090)	(0.074)	(0.087)	(0.092)	(0.202)	(0.117)	(0.129)	(0.128)	(0.001)	(0.017)	(0.111)	(0.193)	(0.095)
Observations	54,365	46,993	39,904	58,474	58,524	16,202	13,497	7,591	10,140	20,439	16,886	18,252	17,093	17,165	49,551	44,702
R-squared	0.252	0.785	0.238	0.881	0.907	0.373	0.379	0.385	0.382	0.768	0.774	0.575	0.399	0.539	0.280	0.384
Control Var.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. x Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table reports estimates from a balance test by regressing the lagged firm outcome on $NICER_{i,t}TRD_{i,t-1}$ using the specification in Eq.7. For investment and employment growth (ΔPPE and ΔEMP), we use Eq.8. We show results for one-period lag of firm outcome in columns 1-32, and its two-period lag in columns 33-64. Controls include firm and industry-year fixed effects. Sample period is from 2008 to 2020.

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