Exchange Rate Risk in Public Firms

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November 2022

Abstract

In their income statements, firms report the overall effect of exchange rate-induced revaluations of their monetary items, notably cash, accounts receivables and payables, and debt, all net of any financial hedging. Using publicly available data, we revisit the exchange rate disconnect puzzle at the firm level in six major currency areas. A local currency appreciation affects industries and firms heterogeneously based on their international trade balance and foreign currency debt issuance. Foreign exchange gains and losses pass through strongly to firms' profits and are reflected in the loadings of their stock returns on exchange rates.

Keywords: Exchange rates, hedging, net income, equity returns.

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Firms are exposed to exchange rate risk through their trade in goods (imports and exports) and assets (investments and liabilities). A given appreciation of the local currency may bring income gains or losses depending on whether the firms import or exports, invest or borrow. Yet, firms may decide to hedge the impact of exchange rates, financially and operationally, either fully or partially. Net of hedging, what is the impact of exchange rates on firms' profits?

At the macroeconomic level, the impact of exchange rates is elusive. A large literature, following Meese and Rogoff (1983), reports that macroeconomic variables are not significantly related to changes in exchange rates in developed countries, a well-known empirical fact at odds with most models in international economics and known as the exchange rate disconnect puzzle.

In this paper, we revisit the impact of exchange rates on real variables, but we do so at the firm level and with a particular attention to foreign exchange (FX) transaction risk. We find that some firms report large FX transaction gains and losses that are correlated with exchange rate shocks. These firms do not fully hedge their exposure to exchange rate risk, either financially or operationally, thus changes in exchange rates directly affect their profits.

We find a significant impact of exchange rates on firms' profits thanks to a key but under-studied accounting variable: FX transaction income. Global accounting standards specify that firms transacting in foreign currencies need to report these transactions by converting the corresponding amounts into their own functional currency equivalent. When exchange rates subsequently move, firms need to report in a specific line of their income statement the effect of these exchange rate movements on the value of their monetary items. Thus, cash and cash equivalents, accounts receivables and payables, loans and bonds, among other items, need to be remeasured, giving rise to FX transaction income. For example, a Japanese firm that invoices for \$1M of exports to be paid three months later has to report the impact of the change in exchange rate between the transaction date and the settlement date: \$1M does not mean the same amount in yen at the signature of the contract and at the time of the actual payment. Likewise, the same Japanese firm that borrows \$1M needs to report the impact of subsequent changes in exchange rates on its debt. The FX transaction income aggregates all gains and losses, both realized and unrealized, on imports and

exports, investments and liabilities, across parents and subsidiaries.

Firms may choose to partially or fully hedge this exchange rate risk, and global accounting standards do not force them to report the details of their financial or operating hedges. But FX transaction income is reported net of financial hedging. To pursue the previous example, the Japanese firm may enter in a FX forward contract at the transaction date that specifies the amount of yen obtained in exchange of a $1M three months later. In this case, the Japanese firm fully hedges the exchange rate risk, and the FX transaction income simply reflects the cost of hedging, independent of the subsequent change in exchange rate. To the contrary, FX transaction income that comoves with exchange rates signals an exposure to FX risk that is not fully financially hedged. Every public firm, in developed or developing countries, must thus report in its income statement the impact of exchange rate movements net of any financial hedging.

Using such accounting data, we focus on six major countries and currency areas – the United States, the euro area, Japan, Taiwan, South Korea, and India – that vary in terms of trade openness, the share of foreign currency invoicing in international trade, and foreign currency debt issuance. Our sample covers the 1987–2020 period. For each country or area, we first document the properties of FX transaction income and then study the passthrough of those FX shocks to firms' profits.

At the aggregate level, FX transaction income strongly comoves with exchange rate changes. An appreciation of the local currency against the U.S. dollar leads to moderate FX transaction losses for firms in Japan and Taiwan, but large FX transaction gains for firms in South Korea and India. In contrast, firms in the U.S. and the euro area report only modest FX transaction gains and losses that are weakly correlated with the value of the dollar and the euro, respectively. This latter result is consistent with the large share of local currency transactions in the U.S. and the euro area reported notably in Boz et al. (2022). The contrasting results obtained for Japan and Taiwan on the one hand and South Korea and India on the other hand call for more investigation, and we turn to micro-level data to determine which observable characteristics are informative about firms' exposure to FX transaction risk.

Using industry-level data on imports and exports, we find a strong link between international trade and FX transaction risk. A firm that exports in foreign currency and records an account receivable will incur a loss when the local currency appreciates and the foreign currency depreciates. To the contrary, a firm that imports in foreign currency will incur a gain when the local currency appreciates. As this intuition suggests, when the local currency appreciates, firms in export-intensive industries tend to report FX transaction losses, while firms in import-intensive industries tend to report FX transaction gains. This finding indicates that many firms do not fully hedge the exchange rate risk that arises when selling goods or purchasing intermediate inputs abroad in foreign currency, if these transactions involve a delay between invoicing and payment. We obtain similar results using firm-level data on foreign sales available for a smaller subset of observations in our sample: firms that export a large share of their output tend to report FX transaction losses when the local currency appreciates.

Similarly, a firm that borrows in a foreign currency will incur a gain when the local currency appreciates and the foreign currency depreciates: thanks to the exchange rate change, that firm will eventually reimburse a smaller amount of local currency. To the contrary, a firm that invests in foreign currency will incur a loss when the local currency appreciates. In three of the six currency areas, we find a strong relationship between foreign currency debt issuance and FX transaction risk: firms with large amounts of foreign currency-denominated debt report FX transaction gains when the local currency appreciates, due to the decline in the local currency value of these liabilities. In the U.S., the euro area and Japan, we do not find a link between the amount of foreign currency debt and the sensitivity of FX transaction income to exchange rates, suggesting that foreign-currency debt may be financially hedged in those countries (e.g. through FX swaps).

Together these facts imply that many firms are highly exposed to exchange rate risk through international trade and capital structure decisions. Financial hedging of this risk must thus be limited in scope: if these firms fully hedged their exchange rate risk by purchasing FX derivatives, for example, their FX transaction income would not comove with exchange rates, contrary to the data. This finding does not yet imply that exchange rates affect corporate profits, since firms

may hedge their FX transaction risk operationally, not just financially. For example, a Japanese firm may pay some workers in foreign currency, and foreign currency wages are generally excluded from the calculation of FX transaction income. A Japanese exporter that invoices in U.S. dollars would incur a FX transaction loss when the U.S. dollar depreciates, but this loss may be offset by lower wages paid in dollars. Similarly, the Japanese firm can partially insulate itself from exchange rate risk by purchasing intermediate inputs throughout the year in the same foreign currency. If these purchases do not involve a delay between invoicing and payment, then only the firm's sales in foreign currency will be reflected in the FX transaction income it reports. The passthrough of FX transaction income to firms' profits is thus informative about the operational hedges that firms may employ.

In the data, we find that any such operational hedges must be limited in scope: we estimate a large positive passthrough on average from FX transaction income to firms' profits before taxes, ranging from roughly half in Japan to nearly one-for-one in Taiwan. In all countries in our sample, the passthrough is statistically significant: there is no example of a country where the average firm offsets its FX transaction gains and losses perfectly. To the contrary, in half of our sample, we cannot reject a perfect passthrough, where the FX transaction income is reflected one-for-one in the firm's bottom line. We attribute the low passthrough in Japan to offsetting changes in operating income, which halve the impact of FX transaction gains and losses on final profits.

As a robustness check, we turn to stock returns and link firms' exposure to FX transaction risk to their stock prices. Using our observable determinants of firms' FX transaction risk exposure (such as industry-level trade and foreign currency debt), we sort firms in each country into four portfolios based on whether their income is expected to fall or rise when the local currency appreciates. We then estimate the loading of each portfolio's monthly stock return on the change in the exchange rate, controlling for the total market return in the same country. In the countries where firms appear highly exposed to exchange rates, we find a positive relationship between FX transaction risk exposure and the exchange rate loadings of stock returns across portfolios. When the local currency appreciates, firms that tend to report FX transaction losses experience large negative

stock returns, while firms that tend to report FX transaction gains experience modest positive returns.

Our paper exploits FX transaction income, an accounting variable that is available for most publicly traded firms, thus alleviating concerns about the external validity of any finding. It is comprehensive as it aggregates both realized and unrealized gains and losses across parent firms and subsidiaries. While firm-level exports and foreign currency bond issuances are available in some countries, imports and foreign currency investments usually are not available, making the net currency exposure difficult to assess. FX transaction income aggregates across exports and imports, investment and liabilities. Our work is easily replicable and can be extended to other countries beyond the six currency areas that we study. This accounting variable, however, is far from the perfect signal of FX risk. It misses some important FX exposure: for example, it is silent on competitivity issues, transactions that do not involve payment delays, subsidiaries' valuation effects, and second-round exposure. A Japanese firm may suffer from a yen appreciation because, for example, its costs are in yen, without reporting any FX transaction income if its clients pay immediately. It may also suffer from a yen appreciation because the value of its foreign subsidiary declines. It may also suffer from a yen appreciation indirectly, even if it is not transacting in any foreign currency, because its clients or suppliers are themselves affected by the change in exchange rate. Despite its shortcomings, FX transaction income is a useful signal since it highlights some significant impact of exchange rate shocks, even in developed countries where the evidence is scarce and the exchange rate disconnect is the consensus.

The rest of this paper is organized as follows. Section 1 connects our paper to different strands of the literature. Section 2 describes the accounting treatment of FX transaction income. Section 3 presents the aggregate data on FX transaction income and investigates the determinants of exposure to FX transaction risk across firms. Section 4 estimates the passthrough from firms' FX transaction income to their final profits. Section 5 links firms' exposure to FX transaction risk to exchange rate risk reflected in their stock returns. Section 6 concludes. A separate Appendix describes the data sources and provides additional accounting examples and robustness checks.

1 Literature Review

The paper builds on and contributes to five strands of the literature.

First, a very large literature studies the exchange rate disconnect puzzle. While earlier work, notably by Harberger (1950) and Laursen and Metzler (1950), describe the theoretical link between exchange rates and the rest of the economy, Meese and Rogoff (1983), in a seminal paper among the most cited in international economics, show that exchange rates appear disconnected from many real macroeconomic variables in developed countries. The puzzle remains to this day, although recent papers successfully link dollar exchange rates to capital flows (Lilley, Maggiori, Neiman and Schreger, forthcoming, Kalemli-Ozcan and Varela, 2019, Camanho, Hau, and Rey, 2021). Exceptions to the exchange rate disconnect puzzle appear in emerging markets, where very large depreciations have a significant impact on the rest of the economy.[1] Among developed economies, most papers focus on multinational firms, which are the most likely exposed to currency risk.[2] The empirical evidence of the effect of exchange rates on real variables is scarce: Campa and Goldberg (1995) report the sectoral response of investment to exchange rate shocks in four developed countries over the 1970–1990 period, especially in low mark-up sectors; Goldberg (1997) study the investment response in Latin America; Nucci and Pozzolo (2001) report similar results on a sample of Italian manufacturing firms. Maurin, Thesmar, and Thoenig (2003), using French exports, builds firm-level exchange rates to study the demand for skill labor. More recently, Barbiero (2020) uses very detailed data on foreign transactions of French firms to build firm-specific exchange rate shocks and report a small causal impact of exchange rates on investment. We share a similar objective,

[1] A growing literature, from Forbes (2002), Aguiar (2005), Desai, Fritz, and Forbes (2008) to Ranciere, Tornell, and Vamvakidis (2014), Kim, Tesar, and Zhang (2015), Alfaro, Asis, Chari, and Panizza (2017), Ahnert, Forbes, Friedrich, and Reinhardt (2018), Niepmann and Schmidt-Eisenlohr (2019), Kohn, Leibovici, and Szkup (2020), Verner and Gyongyosi (2020), Salomao and Varela (2021), Kalemli-Ozcan, Liu, and Shim (2021) and Keller (2021) study the impact of exchange rates on firms and households. Verner and Gyongyosi (2020) establish a causal impact of exchange rates on Hungarian households' consumption.

[2] Goldberg and Kolstad (1995) investigate the effect of exchange rate variability on the location choices of multinational firms. They find that the share of production overseas correlates positively with exchange rate volatility. Bernard, Jensen and Schott (2009) show that multinational firms and exporters tend to be larger and more productive, employ more workers, and sell more products than firms that sell only domestically. Taylor, Wang and Xu (2020), using fixed to floating exchange rate regime change and downgrades of sovereign debts, find that greater volatility in currency markets reduces firms' capital expenditures.

but only rely on publicly available data.

Second, strong link between FX transaction risk and bilateral dollar-based exchange rates speaks to the prevalence of the U.S. dollar as the invoicing currency in international trade (Goldberg and Tille, 2009, Gopinath, 2016, Boz, Gopinath and Plagborg-Moller, 2017, 2019, Gopinath and Stein, 2018, Ito et al., 2018, and Boz et al., 2022).Our work echoes the exchange rate to inflation pass-through literature that compares the impact of exchange rates on prices across countries, depending notably on the shares of domestic currency invoicing (Gopinath, Itskhoki, and Rigobon, 2010, Devereux, Tomlin and Dong, 2015, and Forbes, Hjortsoe, and Nenova, 2017). When firms invoice in their local currency, also known as producer pricing, international trade exhibits no FX transaction risk.

Third, a theoretical and empirical literature studies how firms manage currency risk and respond to its unhedged component. In a frictionless world without taxes, the Modigliani-Miller theorem implies that hedging does not affect the firm's value: in essence, hedging can be left out to investors. In the presence of market imperfections, however, volatility can be costly, and firms may want to hedge their currency risk in the presence of (i) managerial risk aversion (Stulz, 1984) or asymmetric information about managers (Breeden and Viswanathan, 1990); (ii) convex taxes (Smith and Stulz, 1985); (iii); financial distress costs and debt overhang (Myers, 1977; Smith and Stulz, 1985); and (iv) costly external financing (Froot, Scharfstein, and Stein, 1993, and Rampini and Viswanathan, 2010).

On the empirical front, however, our knowledge of nonfinancial firms' hedging decisions and its impact on corporate variables is severely limited by data availability. Nonfinancial firms do not have to report the precise amounts and values of FX derivatives in their balance sheet or income statements. The empirical literature is thus limited and scattered across specific and often hand-collected datasets.[3] Alfaro, Calani, and Varela (2021) is an exception: using Chilean data on trade

[3]Guay and Kothari (2003) hand-collect the notional amounts of 234 firms' derivatives positions as of December 1997 from their Form 10-K SEC filings (more precisely, the "Footnotes to Financial Statements") and found that, under some assumptions, the estimated amounts of interest rate, currency, and commodity price risks hedged by large firms are modest relative to their sizes. Kim, Mathur and Nam (2006) find evidence of substitutability between operational and financial hedging using a textual analysis of annual reports. Allayannis and Ofek (2001) suggest that operational hedging is not as effective as the use of financial derivatives in mitigating FX risk. Boyer and Marin

credit, exports, and FX derivatives, they show that Chilean firms' FX hedging is limited, increasing with firm sizes and decreasing with the illiquidity of FX forward contracts. Such a wealth of data is unfortunately not available in many countries.

Fourth, our work connects to the literature on foreign currency nonfinancial corporate debt. Bruno and Shin (2017) document apparent carry trader-like behavior among nonfinancial firms issuing U.S. dollar-denominated corporate debt in emerging markets: issuing firms seem to exploit low U.S. dollar yields to add to their already-high cash balances. Focusing on India, Acharya and Vij (2020) document a market timing effect in U.S. dollar bond issuance related to interest rate differentials relative to the U.S., and show that firms' stock prices become more sensitive to exchange rate movements after issuance. Salomao and Varela (2021) compare characteristics of foreign versus domestic currency borrowers in Hungary and find that foreign currency borrowers have higher observed productivity. Liao (2020) and Caramichael, Gopinath and Liao (2021) compute currency-hedged foreign currency corporate borrowing costs and argue that firms exploit differences across currencies when determining the currency denomination of new bond issuances. Ivashina, Gutierrez and Salomao (2021) study U.S. dollar borrowing by firms in Peru with a focus on determinants of the supply of dollar credit. Turning to real effects of foreign currency debt revaluations around large exchange rate movements, Aguiar (2005) studies investment of Mexican firms with foreign currency debt around the 1994 peso devaluation, while Kim, Tesar and Zhang (2015) study exit decisions among small South Korean firms in the 1997-1998 Asian financial crisis.

Fifth, the paper links the public firms' currency exposure to their equity prices. Inspired by the model of Adler and Dumas (1984), a large literature reports the challenges of measuring currency risk in stock returns.[4] Dominguez and Tesar (2006) find some currency risk in equity returns in a

(2013) find that the use of foreign currency hedging instruments reduces the firms' distance-to-default. Allayannis and Weston (2015) also use the footnotes to the 10-K reports and find that hedging is linked to higher market-to-book ratios. Lyonnet, Martin and Mejean (2016), using survey data on a sample of European exporting firms, find that larger firms are more likely to both invoice exports in a foreign currency and use financial derivatives. Hoberg and Moon (2017), using text-based measures of 10-K filings, find that firms prefer using financial derivatives to hedge when these instruments are more liquid and available. Bartram (2019) surveys the exposure of nonfinancial firms and presents evidence that they use derivatives for hedging purposes, not speculation.

[4]See, among others, Jorion (1990), Bodnar and Gentry (1993), Amihud (1994), Bartov and Bodnar (1994), Sercu and Uppal (1995), He and Ng (1998), Bodnar and Wong (2000), Griffin and Stulz (2001), Williamson (2001), Bodnar, Dumas, and Marston (2002), Doukas (2003), and Bartram, Brown, and Minton (2010). Most of these papers focus

larger sample of eight developed countries. He and Ng (1998) report exchange rate risk in Japanese firm's stock returns and link it to their exports. None of these papers use the accounting variables that we focus on. In the countries we study where firms are highly exposed to exchange rate fluctuations based on their reported FX transaction income, we show that this exchange rate risk is reflected in their equity returns.

2 FX Transaction Income

This section first describes the accounting rules that govern how firms report their FX transaction gains and losses and then proposes a simple accounting example.

2.1 Accounting Rules

The two main accounting standards used globally — the International Financial Reporting Standards (IFRS) and the Generally Accepted Accounting Principles (GAAP) — define similarly how to report the impact of exchange rates on firms' income. The IFRS accounting rules are described in the International Accounting Standard (IAS) No. 21: The Effects of Changes in Foreign Exchange Rates while the GAAP-equivalent rules are in defined in the Accounting Standards Codification (ASC) No. 830: Foreign Currency Matters. Under both rules, foreign currency transaction risk arises at the firm level when an entity takes part in a transaction that (i) is denominated in a currency other than its functional currency and (ii) creates a monetary balance sheet account. Let us define those terms precisely.

An entity's functional currency is the currency of the primary economic environment in which the entity operates; normally, that is the currency of the environment in which an entity primarily generates and expends cash. When reporting a transaction done in a foreign currency, the firm needs first to convert the foreign currency amount into its functional currency equivalent at the

on the U.S. stock market. Dominguez (1998) reports exchange rate risk in Japanese firm's equity returns in the energy and utilities sector and among medium and large industrial firms. But other papers study multinational firms, notably Denis, Denis, and Yost (2002), Desai, Foley, and Hines (2008), Baker, Foley, and Wurgler (2009), and Fillat and Garetto (2015).

time of the transaction. Under both the IFRS and GAAP accounting rules, when exchange rates subsequently change, monetary items need to be remeasured while nonmonetary items do not. Broadly speaking, a monetary item is an asset or liability that conveys a right to receive or deliver either a fixed or determinable number of units of currency. Monetary items thus include, (i) on the assets side, cash and cash equivalents, investments in debt securities classified as held to maturity, accounts receivables, loans, and deferred tax assets, and (ii) on the liabilities side, accounts payables, bonds payable and other long-term debt, and deferred tax liabilities. Nonmonetary items include investments in equity securities, investments in debt securities classified as trading or available for sale, inventories, plant, property and equipment, goodwill and intangible assets, common and preferred stocks, and noncontrolling interests.

The exchange rate remeasurement leads to FX transaction gains and losses that need to be reported in the income statement. This reported FX transaction income has three key characteristics.

First, the FX transaction income includes both *realized* and *unrealized* gains and losses. If a foreign currency transaction is initiated and settled within a reporting period, it creates a realized gain or loss that flows to the income statement. If the reporting date falls between initiation and settlement, then the unrealized transaction gain or loss also appears in the income statement. This is noteworthy, as other unrealized gains or losses are reported in a balance sheet item, the accumulated other comprehensive income.

Second, since the FX transaction income is a line in the income statement, it aggregates the information across all subsidiaries. While some transactions between a firm and its subsidiary (e.g., borrowing and lending) cancel out, FX transaction gains and losses on inter-company transactions do not not cancel out each other. FX transaction income includes all gains and losses on inter-company foreign currency transactions that are not considered a long-term investment.

Third, the FX transaction income is reported net of hedging in most cases. As companies enter into hedging contracts to minimize the impact of exchange rates on their net income, the gains and losses on these FX hedges are generally recognized immediately in net income. Cash flow

hedges (i.e., hedges that affect the amount of cash flows to be realized from a future transaction) are an exception: in this case, the hedging gains and losses are reported in accumulated other comprehensive income. In all other cases, whether companies chose to designate derivatives as hedges per se or not, the associated gains and losses are reported in net income.

Figure 1 depicts the values of FX transaction income reported in the annual reports of Nintendo Co., Ltd., a large Japanese company that uses the Japanese yen as its functional currency. Within Nintendo's consolidated statements of income, FX transaction income is reported as a component of non-operating income (labeled as "foreign exchange gains" or "foreign exchange losses"). Nintendo typically reports large FX transaction losses when the Japanese yen appreciates against the U.S. dollar, and gains when the yen depreciates. For example, from March 2007 to March 2008 when the yen appreciated almost 18% against the dollar, Nintendo reported FX transaction income for fiscal year 2007 of -¥92.3 billion. This value represents over 5% of its total assets and 35% of net income in the same year. In order to understand how FX transaction income is determined and its relationship with exchange rates, we now turn to several examples.

2.2 Example

Let us consider the simple example of a Japanese firm that sells in U.S. dollars.[5] The firm sells on May 1st its product for $\$1M$ (at a time when \$1 is worth ¥105) and receives the payment three months later on August 1st (at a time when \$1 is worth ¥95).

At the end of June, when \$1 is worth ¥100, the firm publishes its quarterly accounting report. The firm's invoice was initially recorded for $¥105M$, but the mark-to-market value of the sale is now only $¥100M$. At that point, to keep track of this unrealized loss, the firm records an FX transaction income of $(100 - 105) \times \$1M = -¥5M$.

On August 1st, at the time of settlement, since the dollar depreciated further and \$1 is now worth only ¥95, the firm needs to record an additional loss of $(95 - 100) \times \$1M = -¥5M$. The total annual FX transaction loss is thus $(95 - 105) \times \$1M = -¥10M$. In this example, the firm

[5] Appendix A provides more examples, detailing the accounting treatment of purchase, with and without hedging, investment, and borrowing decisions.

invoices in U.S. dollars but functions in yen; when the U.S. dollar is worth less yen at the settlement date than at the time of the sale (i.e., the U.S. dollar depreciated and the yen appreciated), the firm books a loss. As this example shows, both realized and unrealized exchange rate gains and losses are reported in the income statement.

The firm may decide to hedge partially or completely its exchange rate exposure, and the income statement only reports the impact of exchange rates after hedging. Let us pursue the example above and assume that the firm signs on May 1st a three-month FX forward contract: according to this contract, the firm will be able to convert its U.S. dollars into yen three months later, on August 1st, at the forward rate of ¥103 per U.S. dollar.

On June 30th, the firm needs to report its exchange rate exposure in its quarterly report. At that point, assume that the forward contract that expires on August 1st trades at a forward rate of ¥98 per U.S. dollar. Assuming a 6% discount rate to account for the time value of money between June 30th and August 1st (i.e., one month), the firm the books a gain of $(103-98) \times \$1,000,000 \times (1.06)^{-\frac{1}{12}} = ¥4,976M$. Intuitively, the firm is better off having signed a forward contract that converts $\$1M$ into $¥103M$ than entering a forward contract now and receiving $¥98M$ one month later. The total FX transaction exposure is then only $-5M + 4,976M = -¥0,024M$ — this is a small loss compared to the $¥5M$ loss in the absence of hedging.

On August 1st, when the forward rate is then ¥95 per U.S. dollar (the same value as the spot rate since the forward contract matures that day), the firm books a second hedging gain of $(103-95) \times \$1M - 4,976M = ¥3,024M$ and a total FX transaction exposure of $-5M + 3,024M = -¥1.976M$. Hedge accounting may at first appear a bit complicated, but the overall result is intuitive. The firm invoiced for $\$1M$, at a time when that meant $¥105M$, but it immediately settles, through its forward contract, for $¥103M$. The economic loss corresponds to the difference between the spot rate (at the time of the sale) and the forward rate that it actually receives. The loss is thus only $(103 - 105) \times \$1M = -¥2M$. One can easily check that it is the sum of the two FX transaction exposures recorded ($¥0,024M + ¥1.976M = ¥2M$).

This example shows that, even in the presence of perfect hedging, the FX transaction income

is not zero: in that case, the FX transaction income corresponds to the forward discount (the difference between the forward and the spot rate at the time of the sale). When covered interest rate parity holds, the log forward discount corresponds to the interest rate difference across two countries. With perfect hedging, the FX transaction income is thus small and approximately uncorrelated with subsequent changes in exchange rates, as interest rates account for a small and often insignificant part of future exchange rate changes.

FX transaction risk also arises when investing or borrowing in foreign currency. In the simplest possible example, assume another Japanese firm issues three-month U.S. dollar-denominated commercial paper on May 1st with face value $1M. In the firm's quarterly report published at the end of June, the firm records FX transaction income of $(105 - 100) \times \$1M = +¥5M$, reflecting an unrealized gain from the lower value (in yen) of the principal that it will repay in U.S. dollars one month in the future. On August 1st, the firm records an additional $¥5M$ FX transaction gain after the yen continues to appreciate against the U.S. dollar. The total annual FX transaction income of $(105 - 95) \times \$1M = +¥10M$ reflects the difference in the local currency value of the foreign currency-denominated principal between the final payment and initial issuance dates.[6] Note that foreign currency debt in this example can serve as a hedge to the exchange rate risk arising from export transactions. When the yen appreciates (and the U.S. dollar depreciates), the exporting firm collects less yen from its previously-invoiced sales in dollars, but it also reimburses less yen to settle any debts denominated in dollars. A firm that perfectly matched the principal and maturity of its dollar debt with the value and settlement date of its accounts receivable would report zero FX transaction income at each reporting date, reflecting the fact that it has perfectly hedged its exposure to exchange rate risk.

[6]For simplicity, we have assumed the commercial paper issued by the firm does not pay interest. Foreign currency interest payments introduce an additional term in the expression for FX transaction income that is determined by the difference between the average spot exchange rate over the period since the previous interest payment (reflecting the average exchange rate at which interest accrues over the period) and the spot exchange rate at the date of the actual interest payment. We provide a detailed description in Appendices A.3 and A.4. However, the revaluation of principal for foreign currency-denominated debt is likely to be much larger in magnitude than the revaluation of interest payments. This is because of both the large value of principal payments relative to individual interest payments, and the fact that principal is revalued based on year-to-year changes in spot exchange rates (rather than the difference between the annual average and year-end exchange rates used to revalue interest payments).

2.3 Taking Stock

Before turning to the data, let us review the major strengths and weaknesses of the FX transaction income from an economist's perspective.

First, FX transaction income obviously misses some exchange rate exposure. In the absence of delay of payment, FX transaction risk is zero: e.g., if the Japanese firms sells in U.S. dollars and receives those immediately, it can convert them into yen — there is no exchange rate change, no exchange rate risk in this example, and no FX transaction income either. Yet, the level of exchange rates may affect firms too, by affecting for example the competitiveness of their products or the business of their suppliers and clients. This level effect of exchange rates would not show up directly in FX transaction income. At best, FX transaction gains and losses signal that a given firm transacts in foreign currency. We thus view the FX transaction income as only one component of the impact of exchange rates on firms.

FX transaction income only focuses on exchange rate risk, but offers a very comprehensive measure of that risk. Firms cannot chose to ignore it, as reporting is mandatory. It covers both realized and unrealized losses, in the parent firm and its subsidiaries. The information is publicly available in all public firms, alleviating concerns of external validity. Economists can thus use it to study international corporate finance issues in all developed and emerging markets.

Second, FX transaction income is reported net of financial hedging, and firms do not have to report standardized information on their financial hedging. At best, firms describe their hedging activities in their annual reports, often in simple footnotes. FX transaction income is thus not the right variable to study the determinants of hedging decisions, or how financial hedging is implemented in practice. But it is useful to study the impact of exchange rates on firms. If FX transaction income were reported before financial hedging, any shock may well be offset by a FX forward, futures, swap, or option contract, and thus have no impact on corporate decisions. From our perspective, reporting after financial hedging helps. Net of financial hedging, FX transaction gains and losses affect corporate profits, unless some operational hedging cancels them out.

From a theoretical perspective, FX transaction income is promising, but several empirical ques-

tions remain: Do those FX transaction gains and losses reflect actual exchange rate shocks, or only hedging costs? Do they reflect international trade in goods or assets, or both? Are they offset by other corporate actions, as operational hedging would suggest? We now turn to the data to make progress on these questions.

2.4 Data

Our firm-level financial statement data come from the Compustat North America and Global Fundamentals annual files. Our sample comprises a mix of developed and developing countries: the euro area, India, Japan, South Korea, Taiwan, and the United States.[7] We merge firms' financial statement data with stock price data from the Compustat North America and Global Security Daily files. Our main sample consists of firm-year observations from 1987 (the earliest available year in the Compustat Global files) to 2020 for which we have both financial statement and stock price data. We exclude firms in the finance and utility sectors and apply additional filters similar to ones used elsewhere in the corporate finance literature. Finally, we winsorize all firm-level variables at the [1%,99%] level for each country-year. Since many firms report zero FX transaction income in most country-years, we compute the quantiles used in winsorization for this variable by excluding observations equal to zero. Appendix D provides a detailed description of our sample construction, as well as summary statistics for each country.

We supplement the basic firm-level data with additional data on international trade at both the industry and firm level, and foreign currency debt at the firm level.

Our industry-level trade data come from the World Input-Output Database (WIOD). This database provides estimates of total sales and purchases between individual country-industry pairs, including sales to final demand sectors (e.g. households or governments). We use these data to compute net exports (exports minus imports) relative to gross output for 56 narrowly-defined industries within each country in our sample, and map the industry codes available in the Com-

[7] Our set of euro area countries consists of Belgium, France, Germany, Italy, the Netherlands, and Spain. For these countries, we start our sample in 1999 after the initial adoption of the euro.

pustat Fundamentals files to these industries.[8] In addition, for a subset of firm-year observations in our sample we obtain firm-level data on foreign sales from the Refinitiv Worldscope dataset. Unfortunately, we do not have any measure of imports or foreign purchases for individual firms.

Our data on foreign currency debt come from the Capital IQ Capital Structure Debt file, which reports characteristics of firms' individual debt liabilities such as maturity and currency of denomination. The Capital IQ data are available for a shorter time period, but include a large majority of the firms in each country we study starting from the early- to mid-2000s until the end of our sample period. We use these data to compute the share of foreign currency-denominated debt (in local currency value) among the firm's total outstanding debt in each available year.

Our available data do not provide a fully comprehensive breakdown of every potential source of firm-level exposure to exchange rate risk. While we observe international sales for some firms, we never observe international purchases for individual firms. Furthermore, we do not observe invoicing currency shares for firms' sales and purchases, and instead can only observe the total value (in local currency) of firms' accounts receivable and accounts payable. We do not observe the share of the firms' cash or security holdings which are denominated in foreign currency. We do not observe firms' financial hedging decisions or use of financial derivatives such as forward contracts. However, as previously noted, from the firm's FX transaction income we *do* observe the overall impact of exchange rate movements on the value of these unobserved foreign currency-denominated assets and liabilities, net of any financial hedging positions.

We relate firms' FX transaction income to changes in exchange rates in each country. For non-U.S. countries, we use the change in the nominal bilateral U.S. dollar exchange rates obtained from the Federal Reserve Board's H.10 data release. For the U.S., we use the change in the Bank of International Settlements' effective U.S. dollar exchange rate index, which is computed using trade weights.[9] In all cases, the exchange rate is expressed U.S. dollar per foreign currency: an

[8] Appendix D.4 provides details on the construction of the NAICS-to-WIOD industry concordance table.

[9] We obtain results similar to those reported in subsequent sections when we use the BIS effective exchange rate indices for each non-U.S. country in our sample. However, for most of these countries the bilateral U.S. dollar exchange rates explain a larger share of the observed variation in firms' FX transaction income, based on regressions similar to those reported in Section 3.3.

increase thus corresponds to an appreciation of the local currency.

3 FX Transaction Risk Across Countries and Firms

We first study the properties of aggregate FX transaction income across the six countries in our sample. At the aggregate level, both the magnitude of aggregate FX transaction income and its correlation with the value of the domestic currency differ significantly across countries. We then look in the cross-section of firms to determine which observable characteristics are informative about firms' exposure to FX transaction risk. International trade balances (observed at the industry level) and foreign currency debt issuance (observed at the firm level) emerge as the two strongest signals of exposure to FX transaction risk.

3.1 FX Transaction Income at the Aggregate Level

We first characterize firms' exposure FX transaction risk at the aggregate level in each country. Figure 2 plots total FX transaction income, scaled by total assets, for each country and year in our sample. We first compute the sum of FX transaction income across all firms reporting a non-missing value in a given year. We then scale total FX transaction income by total assets for the same group of firms, and plot values for each year along the vertical axis. We report the change in the exchange rate over the same year along the horizontal axis, with a positive value indicating an appreciation of the local currency.

At the aggregate level, firms' exposure to FX transaction risk differs substantially across countries. The most prominent difference is the relationship between aggregate FX transaction income and the value of the local currency. In the Euro Area, South Korea, and India, firms tend to report larger FX transaction *gains* (or smaller FX transaction losses) when the local currency appreciates. In contrast, firms in Japan and Taiwan tend to report FX transaction *losses* when the local currency appreciates. For U.S. firms, there is no clear relationship between aggregate FX transaction income and the value of the U.S. dollar.

Additionally, the magnitude of aggregate FX transaction income (relative to total firm assets) differs across countries. In the U.S. and the Euro Area, this magnitude is modest: the absolute value of total FX transaction income is typically less than 0.1% of total assets. Boz et al., (2022) document that a large share of trade between U.S. and Euro Area firms and the rest of the world is invoiced in either the U.S. dollar or the euro (respectively), and foreign currency non-financial corporate debt issuance is less common than in other countries.[10] These facts suggests that most firms in these two countries face minimal foreign exchange risk through international trade and capital structure decisions, consistent with the small values of aggregate FX transaction income depicted in Figure 2. In the other four countries we consider, total FX transaction income is much larger in magnitude. South Korean firms typically report the largest values of total FX transaction income; in the two years of our sample where the Korean won experienced the sharpest depreciations (1997 and 2008), South Korean firms reported aggregate FX transaction losses on the order of -1.5% of total firm assets.

While total FX transaction income in most countries and years amounts to a few tenths of one percentage point of total firm assets, these values are quite large when compared to other flow variables such as operating income (as opposed to stock variables such as assets). In the Appendix, Figure B1 scales total FX transaction income by total operating income (after depreciation) reported by firms in the same year. At the aggregate level, FX transaction income typically amounts to several percentage points of operating income. The large FX transaction losses reported by South Korean firms in 2008 amounted to a striking 30% of total operating income in the same year.

Our examination of aggregate FX transaction income reveals two key facts. First, the FX transaction gains and losses reported by individual firms rarely wash out in the aggregate. In the majority of countries we consider, total FX transaction income represents several percentage points of operating income in the typical year. Second, both the magnitude of FX transaction income

[10]Moreover, firms in these countries may be more likely to hedge the exchange rate risk arising from foreign currency debt issuance. Liao (2020) documents that issuance of U.S. dollar-denominated bonds by European firms and issuance of euro-denominated bonds by U.S. firms is strongly correlated with corporate borrowing costs net of FX hedging.

and its relationship with the value of the local currency differ substantially across the countries we study. When their domestic currency appreciates, firms in Japan and Taiwan tend to report moderate FX transaction losses at the aggregate level, while firms in South Korea and India tend to report significant FX transaction gains. Firms in the U.S. and the Euro Area appear to be only modestly exposed to FX transaction risk at the aggregate level.

3.2 FX Transaction Income at the Firm Level

Moving down from the aggregate level, Figure 3 depicts the magnitude of FX transaction income at the level of individual firms. For each of the six currency areas, we collect all firm-year observations with non-zero FX transaction income, then compute the 50th percentile (left panels) and 75th percentile (right panels) for the absolute value of firms' scaled FX transaction income. The top panels depict percentiles for the absolute value of FX transaction income scaled by the firm's total assets in the same year, while the bottom panels scale by total pre-tax income. These statistics summarize the magnitude of firms' FX transaction income at the intensive margin in each country: among firms that report exposure to FX transaction risk in a given year (as indicated by a nonzero value of FX transaction income), how large are the resulting gains and losses for the typical firm, as a percentage of assets or income? The percentiles shown in Figure 3 indicate that a large share of exposed firms in several countries report values of FX transaction income which are substantial in magnitude. In Japan, Taiwan, South Korea and India, FX transaction income amounts to over 10% of firms' pre-tax income for more than a quarter of firm-year observations reporting any exposure.

While these statistics summarize the magnitudes of firms' FX transaction income, the examples discussed in Section 2.2 suggest that the relationship between FX transaction income and the value of the local currency may vary across firms depending on their mix of foreign currency-denominated assets versus liabilities. To assess how the financial impact of a given exchange rate movement varies across firms, Figures 4 and 5 plot the distribution of FX transaction income (scaled by total assets) across firms, in years with large local currency appreciations and depreciations (respectively). In

years with large exchange rate movements, some firms report FX transaction gains or losses as large as several percentage points of their total assets. Although the distribution of FX transaction income in a given year often skews either positive or negative, in each year there are some firms that report FX transaction gains while the majority of firms report losses (or vice versa).[11] Firms thus appear to differ in terms of the sign and magnitude of their exposure to changes in the value of the local currency: an appreciation leads some firms to report income gains while others report losses.

In addition, we show in Appendix C that the magnitude of individual firms' exposure to FX transaction risk is persistent. In levels, FX transaction income is nearly serially uncorrelated across subsequent years, as would be expected if these gains and losses are generated by serially uncorrelated changes in nominal exchange rates. However, the absolute value of FX transaction income exhibits a strong positive serial correlation at the firm level: firms that previously reported large FX transaction gains or losses tend to report similarly large FX transaction gains or losses in the future.

Next, we link this heterogeneity in firms' exposure to FX transaction risk to observable industry and firm characteristics.

3.3 Determinants of Firms' Exposure to FX Transaction Risk

We now formally investigate the relationship between firms' observable characteristics and their exposure to FX transaction risk. For each country, we estimate the following panel regression:

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \beta \Delta s_t + \gamma' \left(\Delta s_t \times X_{i,t} \right) + \varepsilon_{i,t} \tag{1}$$

[11] The histograms reported in Figures 4 and 5 show the cross-sectional distribution of FX transaction income relative to total firm assets. The values of aggregate FX transaction income relative to aggregate assets shown in Figure 2 are obtained by taking an asset-weighted average over this distribution. The distribution of FX transaction gains and losses across the firm size distribution can explain, for example, why the histograms reported for South Korea appear nearly symmetric while the values of aggregate FX transaction income in the same years were large in magnitude.

The dependent variable is firm i's FX transaction gain or loss reported in fiscal year t, scaled by total firm assets in the same year. We convert the dependent variable to basis points (e.g. a value of +100 indicates an FX transaction gain equal to 1% of total assets). Δs_t denotes the change in the value of the domestic currency over fiscal year t, measured in percentage points. We also interact Δs_t with a vector of firm characteristics $X_{i,t}$, so that the passthrough from the exchange rate change Δs_t to FX transaction income (scaled by assets) for firm i is given by

$$\frac{d\left(FXTransactionIncome_{i,t}/Assets_{i,t}\right)}{ds_t} = \beta + \gamma' X_{i,t} \tag{2}$$

Finally, we also include firm fixed effects α_i.

We include firm characteristics $X_{i,t}$ that could potentially be informative about firms' exposure to FX transaction risk. Our main specification uses industry-level trade data.[12] Using data from the World Input-Output Database, we compute net exports to the rest of the world relative to total gross output at the country-industry level.[13] If a firm sells a large share of its output abroad in foreign currency, but does not fully hedge the currency risk associated with any delays of payment, then the firm should report an FX transaction loss when the foreign currency depreciates against the domestic currency (i.e. when $\Delta s_t > 0$). Conversely, if a firm sells most of its output in domestic currency but purchases a large share of intermediate inputs abroad in foreign currency (with a delay between purchase invoicing and payment), then the firm should report an FX transaction gain when the foreign currency depreciates.

While our main specification includes net exports at the industry level, the other characteristics we include are all observed at the level of individual firms. We include the log of total firm assets to determine whether FX transaction risk exposure differs across the firm size distribution. Large firms may be more likely to export to the rest of the world and thus be exposed to FX transaction risk, but they may also be more financially sophisticated and capable of implementing financial

[12]Foreign sales are available for a subset of firm-year observations in our sample. Table B2 reports estimates for regressions similar to the ones reported in this section, but with foreign sales included as an additional firm characteristic.

[13]See Appendix Section D.4 for a description of the World Input-Output Database (WIOD) and our procedure for mapping NAICS codes reported in the Compustat Fundamentals files to the 56 WIOD industries.

or operational hedging strategies. We include cash, net trade credit,[14] and total debt, each scaled by total firm assets. The Compustat Fundamentals files provide only the total value (in domestic currency) of firms' cash holdings, trade credit, and debt liabilities, without specifying the share of each value denominated in foreign currency (e.g. the share of domestic vs. foreign currency cash holdings). Nonetheless, these characteristics may still be informative about firms' FX transaction risk exposure if the underlying assets and liabilities are at least partially denominated in foreign currency. However, for a subset of firm-year observations we have detailed data on the currency denomination of debt liabilities from Capital IQ. For these observations, we compute the domestic currency value of total foreign currency debt, scaled by total firm assets. We standardize all firm-level characteristics other than the debt-related variables, so that they have zero mean and unit standard deviation over the full sample of firm-year observations for each country.

Table 1 reports estimates of regression (2) for the subsample of firm-year observations where foreign currency debt is available in Capital IQ. Table B1 in the Appendix reports estimates for the full sample of firm-year observations using total debt in place of foreign currency debt, while Table B2 reports estimates for a smaller sample of firm-year observations where we observe the share of foreign sales. The discussion here focuses on the specification in Table 1 that controls for foreign currency debt.

Firms in export-intensive industries tend to report large FX transaction losses when the domestic currency appreciates. In Taiwan, for example, the most export-intensive industries have net exports equal to 50% of their gross output. The coefficient estimates in Table 1 imply that a 10% appreciation of the New Taiwan dollar against the U.S. dollar leads a typical firm in a high-export industry to report a FX transaction loss equal to $10 \times (-4.07 - 13.28 \times 0.5)$ basis points $\approx 1.07\%$ of total firm assets, almost twice as large as the 0.41% FX transaction loss that would be reported by a typical firm in an industry with no net exports. We find a similar relationship across industries in all countries except the U.S. and the Euro Area, where a much larger share of trade is invoiced

[14] We define net trade credit as the difference between accounts receivable and accounts payable. A positive value indicates that the firm has extended more credit to its customers than has been extended to it by its suppliers.

in the same currency in which firms report their financial statements (Boz et al., 2022).[15]

Estimated coefficients on both cash and net trade credit are negative for almost all countries, although the point estimates are modest in magnitude. Since both cash and net trade credit are net assets on firms' balance sheets, these negative coefficient estimates are consistent with the presence of a small foreign currency-denominated component of cash holdings and trade credit, the value of which is marked down when the domestic currency appreciates (resulting in an FX transaction loss).

On the liabilities side of the balance sheet, however, we do observe the exact currency composition of debt for a large share of firm-year observations in our sample. In Taiwan, South Korea and India, the three countries in our sample where foreign currency non-financial corporate debt issuance is most prevalent, we obtain large positive and highly statistically significant coefficient estimates for firms' foreign currency debt (relative to assets). When the domestic currency appreciates, firms write down the value of their foreign currency debt and report an FX transaction gain. For a Korean firm with foreign currency debt equal to 10% of assets (roughly the 92nd percentile for observations in our sample), a 10% appreciation of the Korean won against the U.S. dollar leads to an additional FX transaction gain of 0.60% of total assets.[16]

Figure 6 provides a visualization of the relationship between international trade balances and FX transaction risk exposure across industries. For each country we estimate a similar panel regression to (1), but replacing industry net exports with a collection of indicator variables for industries j:

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \Delta s_t \times \sum_j \beta_j \mathbf{1}\left(Industry(i) = j\right) + \gamma'\left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t} \quad (3)$$

We collect the estimated industry coefficients $\widehat{\beta}_j$. To facilitate comparison of these coefficients

[15]Table B2 in the Appendix reports estimates using the firm-level foreign sales share as an additional conditioning variable. Estimated coefficients for the foreign sales share are negative and statistically significant in most countries, as expected based on the examples described in Section 2.2. Coefficients on industry-level net exports remain negative and statistically significant for most countries, but are generally smaller in magnitude.

[16]Estimated coefficients for total debt (including both domestic and foreign currency debt) reported in Table B1 are much smaller in magnitude than the coefficients on foreign currency debt in Table 1.

across countries, we then compute the deviation $\widetilde{\beta}_j$ of these coefficients from the average value in the country (weighted by the count N_j of firm-year observations for industry j in the sample):

$$\widetilde{\beta}_j \equiv \widehat{\beta}_j - \sum_{j'} \widehat{\beta}_{j'} \times \frac{N_{j'}}{N} \tag{4}$$

In Figure 6 we plot values of $\widetilde{\beta}_j$ for each industry on the vertical axis, against the industry's ratio of net exports to gross output on the horizontal axis. A strong negative relationship emerges in the four countries with large shares of foreign currency invoicing (Japan, Taiwan, South Korea, and India). Firms in export-intensive industries, such as automobile or furniture manufacturing, tend to report the largest FX transaction losses in years when the local currency appreciates. In the same years, firms in import-intensive industries such as petroleum refining tend to report the largest FX transaction gains. This pattern is to be expected if firms in these countries face delays between delivery of goods and payment for both foreign sales and purchases, yet do not fully hedge the resulting exchange rate risk when these transactions are invoiced in foreign currency. An appreciation of the local currency leads firms that are net sellers to the rest of the world to report an FX transaction loss on the foreign currency payments they will receive from customers in the future, while firms that are net purchasers from the rest of the world report FX transaction gains on the future payments they must make to suppliers.

Similarly, Figure 7 provides a visualization of the relationship between foreign currency debt and FX transaction risk exposure across firms. In each country, we first sort firm-year observations with positive foreign currency debt outstanding into quintiles based on the value of foreign currency leverage (the ratio of foreign currency debt to total assets). We then estimate a similar panel regression to (1), but replacing foreign currency leverage with indicator variables for the five foreign currency leverage quintiles:

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \Delta s_t \times \sum_{k=1}^{5} \eta_k \mathbf{1}\left(FCLeverageQuintile(i,t) = k\right) + \gamma'\left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t} \tag{5}$$

In Figure 7 we plot the estimated coefficients $\widehat{\eta}_k$ for each quintile on the vertical axis, against the average value of foreign currency leverage for firm-year observations in each quintile. We separately plot the three areas in which we find a weak relationship between foreign currency debt and exposure FX transaction risk (the U.S., Euro Area, and Japan) and the three areas where we find a strong relationship (Taiwan, South Korea, and India). In the latter set of countries, a 10% appreciation of the local currency against the U.S. dollar leads firms in the top foreign currency leverage quintile to report an FX transaction gain of 0.40% of total assets in India, 0.50% of assets in Taiwan, and 1.25% of assets in South Korea. In contrast, for the former set of countries the estimated coefficients for each of the foreign currency leverage quintile indicators are all nearly zero, despite large shares of foreign currency debt in the top quintile of U.S. and Euro Area firms.

As discussed in Section 2.4, we do not directly observe all of the activities which expose firms to FX transaction risk. For international trade we primarily rely on industry-level data, and although data on foreign sales are available for some observations, we have no firm-level data on foreign purchases or currency invoicing in trade. Although we observe the currency composition of firms' debt liabilities, we do not have similar detailed data on the currency composition of their cash and securities holdings. Additionally, throughout this section we have related FX transaction risk to a single exchange rate for all firms in the same country (the bilateral exchange rate against the U.S. dollar in non-U.S. countries, and the BIS effective dollar index for the U.S.). In reality, the relevant exchange rate for revaluing each firm's assets and liabilities will depend on the specific currency composition of their assets, liabilities, and trade invoicing. While we do not observe such detailed data at the firm level, the FX transaction income that we do observe still summarizes the net impact of any exchange rate movements on the value of all of the firm's foreign currency-denominated assets and liabilities.

4 Firm Passthrough of FX Transaction Income to Profits

In this section we study the passthrough from firms' FX transaction income to profits. FX transaction income is one of the items that enters directly into the calculation of firms' total income.

However, firms may be partially insulated from these exchange rate valuation gains and losses if another component of income is negatively correlated with their FX transaction income. For example, consider a Japanese exporter that invoices its sales in U.S. dollars. A broad strengthening of the dollar will generate FX transaction gains for *past* sales for which the firm has not yet collected payment. However, if prices are sticky in dollars, then the strengthening of the dollar may reduce *future* sales for the rest of the year; any such changes in expected future transactions are not reflected in the firm's FX transaction income. Alternatively, the firm may operationally hedge its exposure to exchange rate risk in a way that does not drive its overall FX transaction income to zero, yet still dampens the impact of exchange rate fluctuations on its final profits. If the same firm purchases inputs throughout the year in U.S. dollars with no delay of payment, then a strengthening of the dollar will increase its costs. However, these higher costs will not be accounted for in the firms' FX transaction income since there is assumed to be no delay of payment when purchasing inputs. In this section, we quantify the strength of these effects that potentially generate a smaller passthrough from FX transaction income to final profits.

For each country, we estimate the following panel regression:

$$\frac{PretaxIncome_{i,t}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t} + \beta \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t} \tag{6}$$

$PretaxIncome_{i,t}$ denotes the pre-tax income reported by firm i in year t, which we scale by total firm assets in the previous year $t-1$. α_i denotes firm fixed effects, while $\theta_{Industry(i),t}$ denotes industry-year fixed effects.[17] In order to study firms' dynamic responses over the two years after they initially report FX transaction income using a single fixed sample, we estimate this regression and others that follow in this section using only firm-year observations (i,t) where firm i is continuously present in the sample from year $t-1$ to year $t+2$. If FX transaction income were uncorrelated with all of the other components of income, then regression (6) would recover a complete passthrough of $\beta = 1$.[18]

[17] Throughout the paper, we use the World Input-Output Database's 56-industry classification. Appendix Section D.4 describes our procedure for mapping NAICS codes reported in Compustat to the set of WIOD industries.

[18] FX transaction gains and losses are included in the calculation of taxable income, so firms' corporate tax

Table 2 reports estimated passthrough coefficients from FX transaction income to firms' pre-tax profits. In all countries, we obtain positive and statistically significant estimates of passthrough coefficients, ranging from 0.52 in Japan to nearly 1 in the Euro Area and Taiwan. The large positive passthrough coefficient estimates imply that any operational hedging of FX transaction gains and losses, or offsetting gains and losses elsewhere in the income statement, are limited in scope.

To further understand the passthrough from firms' FX transaction income to their pre-tax profits, we estimate similar regressions using firms' non-operating and operating income (after depreciation) as dependent variables. Table 3 reports passthrough coefficient estimates using firms' non-operating income as the dependent variable. FX transaction income is generally included in the calculation of firms' non-operating income. Because non-operating income excludes other components of pre-tax income, we obtain passthrough coefficients which are closer to 1 and more precisely estimated across all countries. Table 4 instead reports estimates using operating income (after depreciation) as the dependent variable. Importantly, FX transaction income is generally *not* included in the calculation of firms' operating income, so the mechanical relationship present for pre-tax income or non-operating income is absent here. We obtain negative coefficient estimates across all countries, indicating that firms' operating income tends to be negatively correlated with their FX transaction income. The strength of this relationship varies considerably across countries. For Japanese firms, a 100¥ increase in FX transaction income tends to be offset by a 43¥ reduction in operating income, resulting in the relatively low passthrough from FX transaction income to profits reported in Table 2.

So far we have ignored corporate taxes to assess the passthrough of FX transaction income to pre-tax profits. FX transaction income is generally treated as taxable income (even if the FX transaction gains are losses have not yet been realized), thus the presence of corporate taxes mechanically reduces the passthrough of FX transaction income to post-tax income. To measure this passthrough to post-tax income, we estimate a similar regression to Equation (6), but replacing

payments are mechanically related to FX transaction income. This generates an incomplete passthrough $\beta < 1$ even in the absence of operational hedging by firms. We therefore focus on passthrough to pre-tax income to measure the extent of potential operational hedging. However, we also show that estimated passthrough coefficients for post-tax income remain large and significant, although they are smaller in magnitude due to the effect of corporate taxes.

the firm's pre-tax income with its ordinary income, which deducts corporate taxes paid.[19] Table 5 reports the estimated passthrough coefficients for ordinary (post-tax) income. We again obtain positive and statistically significant coefficient estimates,[20] although they are smaller in magnitude than the estimated passthrough coefficients for pre-tax income due to the effect of corporate taxes. FX transaction gains and losses thus have a large effect on firms' final profits, even after accounting for the potential effects of operational hedging, offsetting effects of exchange rate movements on future sales, and corporate taxes.

We next investigate whether FX transaction income reported in the current year is correlated with firm income in the years that follow. Conventional wisdom about exchange rate dynamics suggests that the answer is likely to be "no." Nominal exchange rates are known to be well-approximated by a random walk process in levels, which implies that changes in nominal exchange rates are serially uncorrelated. Since firms' FX transaction income is primarily determined by changes in exchange rates, we expect a weak or zero correlation between current FX transaction income and future FX transaction income or profits reported by the same firm.[21]

To answer this question, we estimate a dynamic version of regression (6), where we relate current FX transaction income to *future* profits at a horizon of h years ahead:

$$\frac{PretaxIncome_{i,t+h}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t+h} + \beta_h \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t+h} \tag{7}$$

Because FX transaction income and profits are measured in different years when $h > 0$, the mechanical relationship between the two variables that arose in the previous regressions with $h = 0$

[19] In the Compustat Global Annual Fundamentals file, the income before extraordinary items variable (item code `ib`) contains fewer non-missing observations than the two net income variables (item codes `nicon` for consolidated net income, and `ninc` for non-consolidated net income).

[20] The estimated post-tax passthrough coefficient for the U.S. is only significant at the 10% level.

[21] One potential exception is the case where firms financially hedge their exposure to exchange rate risk using FX forward contracts. Section 2.2 shows that a firm which hedges its exchange rate risk using a forward contract will report FX transaction income approximately equal to the difference between the forward and spot rates on the date when the contract is purchased, with no adjustment for realized changes in spot rates. Since forward premia and discounts are known to be persistent, financial hedging through forward contracts can create a persistent component of FX transaction income, although the magnitude of this component will likely be small relative to the large gains and losses arising from movements in spot exchange rates if the same position is not hedged. Our inclusion of firm fixed effects in regression (7) helps to eliminate this persistent component for firms that consistently hedge using forward contracts over the sample period.

is no longer present.

Figure 8 shows the estimated passthrough coefficients at horizons $h = 0, 1, 2$.[22] For the majority of countries, we precisely estimate small passthrough coefficients β_h for horizons $h > 0$.[23] Therefore, firms' FX transaction gains and losses can be interpreted as a transitory shock to profits in the same year, with no effects on future profits over short to medium horizons.

5 FX Transaction Risk and Stock Returns

So far, we have shown that exposure to FX transaction risk varies significantly across firms: an appreciation of the local currency affects industries and firms heterogenously, based on observable characteristics like international trade activity and foreign currency debt issuance. Moreover, the FX transaction gains and losses resulting from these exchange rate movements pass through strongly to firms' profits.A natural question that arises is whether firms' exposure to FX transaction risk is reflected in stock prices: do firms that report income gains when the local currency appreciates also experience high stock returns, while firms that report losses experience low returns? We address this question in this section.

We first use the coefficient estimates from regression (1), reported in Table 1, to construct a measure of FX transaction risk exposure as a function of observable firm characteristics. Equation (2) shows the regression-implied loading of a firm's FX transaction income (scaled by total assets) on the change in the value of the local currency Δs_t, given the coefficients and observed firm characteristics $X_{i,t}$. Using the estimated coefficients (which we denote by $\widehat{\beta}$ and $\widehat{\gamma}$), we compute the implied FX transaction income loading $\widehat{\delta}_{i,t}$ of firm i in year t:

$$\widehat{\delta}_{i,t} = \frac{d\left(\widehat{FXTransactionIncome}_{i,t}/Assets_{i,t}\right)}{ds_t} \equiv \widehat{\beta} + \widehat{\gamma}' X_{i,t} \tag{8}$$

[22] The bands reported in Figure 8 represent +/- two standard errors, double-clustered by firm and year (as in Table 2).

[23] The coefficients for the U.S. are estimated least precisely, due to the relatively small number of U.S. firms reporting large FX transaction gains and losses.

If the local currency appreciates by 1% in year t, then $\widehat{\delta}_{i,t}$ represents the FX transaction income (measured relative to total assets at the end of the year, in basis points) that firm i would be expected to report based on its characteristics in the same year.[24] Because we use firms' shares of foreign currency debt to compute these loadings, we use return data starting in 2001 when the Capital IQ data on foreign currency debt first cover the majority of firms in our sample.

Following a long tradition in asset pricing, we adopt a portfolio approach to study whether this exposure to FX transaction risk is reflected in the sensitivity of firms' stock prices to exchange rates. In each year t, we sort firms i in each country into four portfolios based on their estimated FX transaction income loading $\widehat{\delta}_{i,t}$ on the exchange rate. Portfolio 4 contains firms with the largest loadings $\widehat{\delta}_{i,t}$; based on their characteristics in year t, these firms tend to report the largest FX transaction gains (or smallest FX transaction losses) when the local currency appreciates. Portfolio 1 contains firms with the smallest loadings $\widehat{\delta}_{i,t}$, which tend to report the largest FX transaction losses (or smallest gains) when the local currency appreciates. After assigning firms to portfolios in each year, we construct monthly value-weighted returns $R_{p,m}$ for each portfolio $p = 1, \ldots, 4$. We rebalance portfolios annually based on firm characteristics $X_{i,t}$ in each year.

After constructing monthly portfolio returns, we follow Dominguez and Tesar (2006) and measure exchange rate exposure in stock returns by estimating the following time series regression for each portfolio:

$$R_{p,m} = \alpha_p + \beta_{p,mkt} R_{mkt,m} + \beta_{p,\Delta s_m} \Delta s_m + \varepsilon_{p,m} \tag{9}$$

Here $R_{mkt,m}$ denotes the return on the country's total stock market return index[25] and Δs_m denotes the monthly change in the exchange rate.[26] As before, $\Delta s_m > 0$ indicates an appreciation of the local currency in month m. Controlling for the market return $R_{mkt,m}$ helps to explain a large share

[24] To compute $\widehat{\delta}_{i,t}$, we use coefficients estimated using the full sample of firm-year observation, and firm characteristics observed in real-time by investors only at the end of year t. This introduces look-ahead bias when sorting firms into portfolios based on $\widehat{\delta}_{i,t}$. The exercise described in this section is *not* intended to replicate the pseudo out-of-sample performance of an investing strategy. Instead, we investigate whether firms' FX transaction risk expsure - estimated over the full sample period - is also reflected in their stock returns over the same period.

[25] See the Data Appendix for a definition of the total stock market return index used for each country.

[26] We use monthly changes in the same exchange rates used for each country in our annual firm-level analysis, i.e. bilateral exchange rates against the U.S. dollar for non-U.S. firms, and the BIS effective dollar exchange rate index for U.S. firms.

of variation in the stock returns of individual firms and portfolios, resulting in estimates of the exchange rate loadings $\beta_{p,\Delta s_m}$ that are both more precise and do not simply reflect the presence of common risk factors affecting both exchange rates and the total market return. However, it also forces us to study *relative* exchange rate exposures in the cross-section of firms, rather than the *absolute* level of exchange rate exposure for the overall stock market.

Figure 9 presents estimated exchange rate loadings $\widehat{\beta}_{p,\Delta s_m}$ for stock returns across the four portfolios in each country. In the four countries in our sample where firms appear highly exposed to exchange rate fluctuations (Japan, Taiwan, South Korea, and India), our estimated FX transaction income loadings are positively related to the exchange rate loadings of firms' stock returns. These estimated loadings $\widehat{\beta}_{p,\Delta s_m}$ in the four countries are negative (with three of four statistically significant) for portfolio 1, which contains firms that report the largest FX transaction losses when the local currency appreciates. For portfolio 4, which contains firms that report the largest FX transaction *gains*, the estimated loadings are positive and small. Across the four portfolios, the estimated loadings are (weakly) monotonically increasing in Japan and Taiwan. While estimates are not monotonic across portfolios for South Korea and India, we still find a positive relation between FX transaction income loadings and the exchange rate loadings of stock returns. In India the first and last portfolios have the lowest and highest exchange rate loadings (respectively). In South Korea the estimated loadings are negative for the first two portfolios and positive for the last two, although FX transaction risk does not appear to be as strongly reflected in the cross-section of stock returns as in the other countries.

For the U.S. and the Euro Area, the initial panel regressions reported in Table 1 show that few firm characteristics strongly signal firms' exposure to FX transaction risk. As a result, in these countries we find weak or negative relationships between our FX transaction risk measure and the exchange rate loadings of stock returns. Since firm size (as measured by total assets) is the only statistically significant characteristic predicting FX transaction risk exposure for U.S. firms, our results may reflect a correlation between size-based equity risk factors and the dollar exchange rate, as the portfolio sort likely fails to capture economically meaningful differences in exposure to

exchange rate risk across firms.

Overall, in the four countries we study where accounting data indicate that many firms are highly exposed to FX transaction risk, we find that this risk is reflected in the cross-section of stock returns. Firms that report large income losses when the local currency appreciates also experience low stock returns, while firms that report income gains appear insulated from this risk (or even experience positive returns). These correlations likely reflect not only the direct and immediate effect of exchange rates on firms' current profits that is measured in their reported FX transaction income, but also news about future cash flows due to changes in exchange rates. For example, when the local currency appreciates, an exporting firm that sells in foreign currency will report an FX transaction loss, but investors may also predict lower future cash flows if foreign currency output prices and local currency input costs are rigid.

6 Conclusion

Firms have to report the direct impact of exchange rates on their income statements. Since FX transaction income is recorded net of exchange rate derivatives that hedge it, accounting data immediately indicate that firms do not fully hedge the direct impact of exchange rates with FX derivatives. Using these data, we characterize firms' exposure to exchange rate risk in six major currency areas. At the aggregate level we find substantial differences in firms' exposure to FX transaction risk across countries, both in terms of the magnitude of the resulting gains and losses and their correlation with the value of the domestic currency. We show that exposure to FX transaction risk is linked to international trade and to foreign currency debt issuance, suggesting that many firms do not financially hedge the exchange rate risk arising from their trade and capital structure decisions. These FX transaction gains and losses pass through strongly to firms' final profits, indicating that any operationally hedging of these exchange rate valuation effects is limited in scope. Finally, exposure to FX transaction risk is reflected in the cross-section of stock returns: firms that report the largest income losses when the local currency appreciates also simultaneously experience low stock returns.

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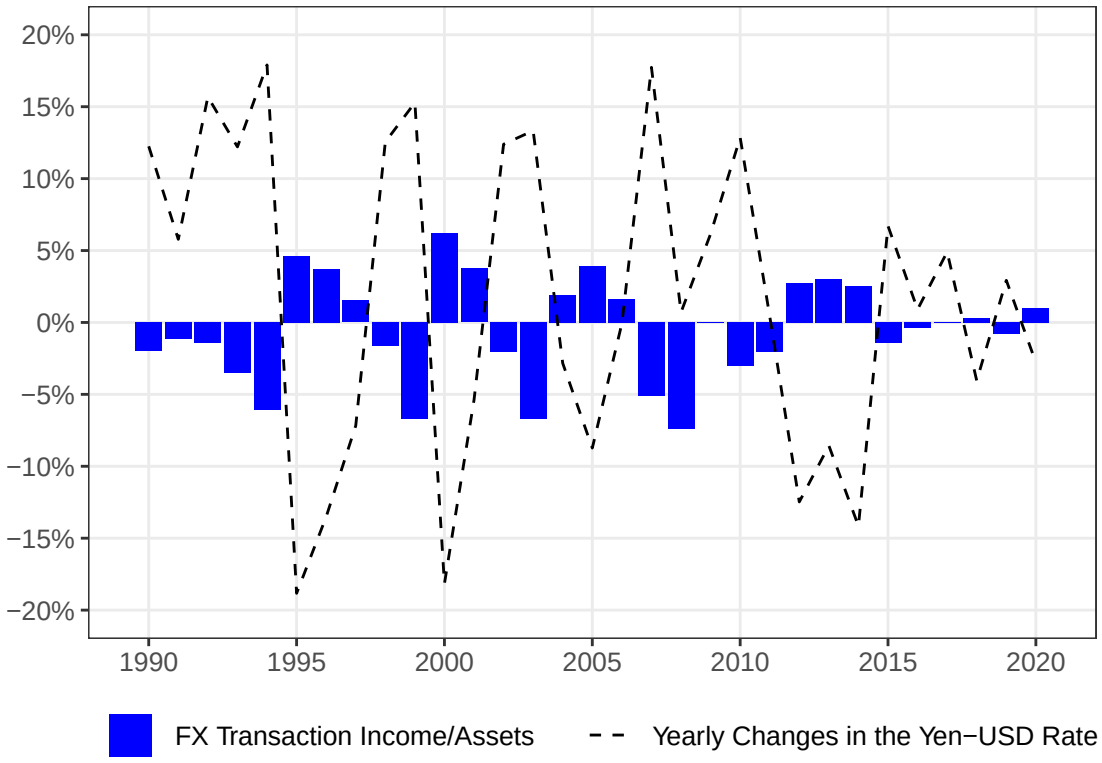
Figure 1. Foreign Transaction Income: the Example of Nintendo Co.

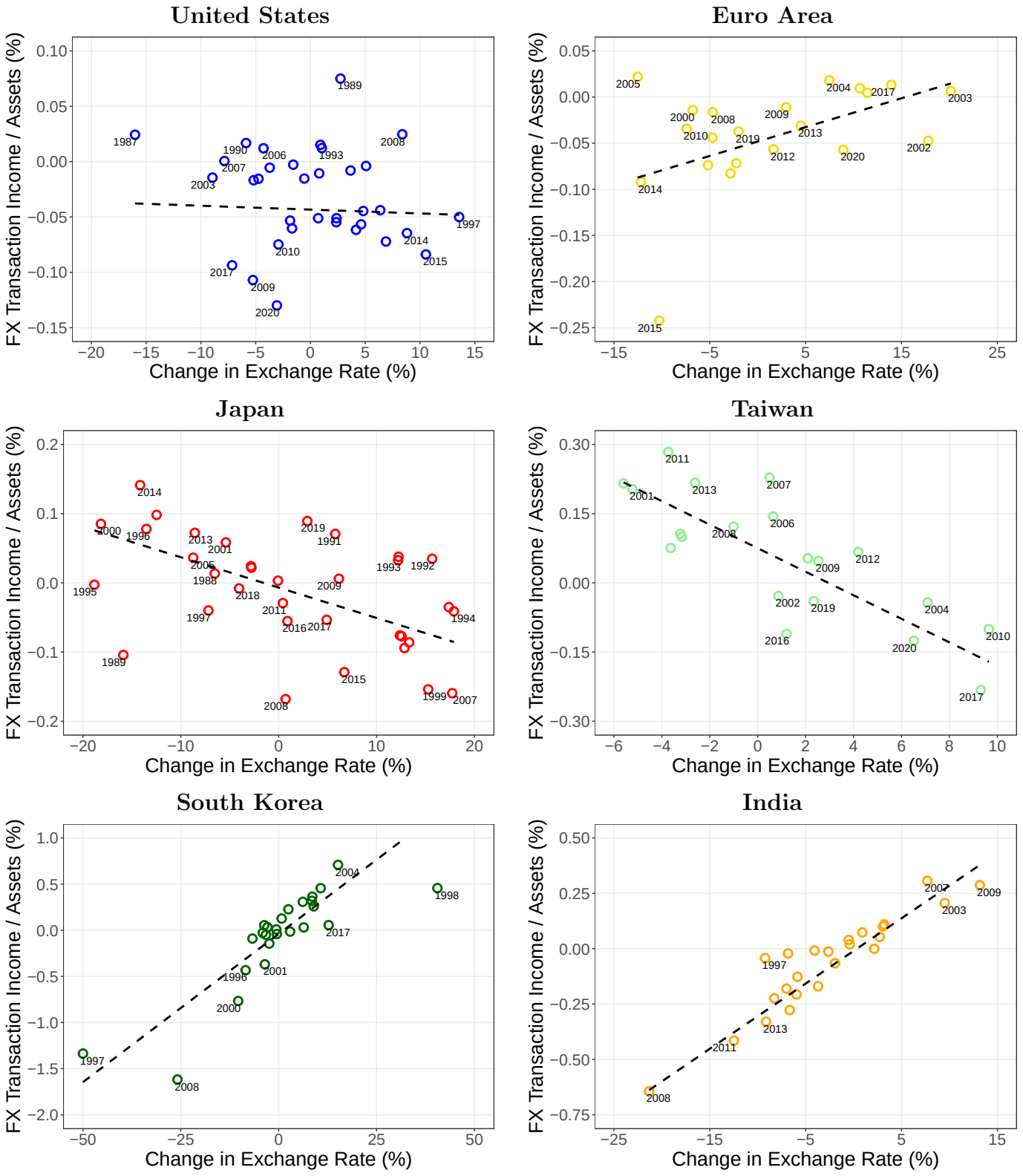


The figure above presents the FX transaction income (scaled by total assets) reported in Nintendo's consolidated statements of income. The dashed line represents the yearly change in the exchange rate defined in U.S. dollars per Yen, such that a positive change corresponds to an appreciation of the yen. The source is Nintendo's annual financial statements, as recorded in the Compustat Global Fundamentals Annual file. The table below shows an excerpt from the consolidated statements of income presented in Nintendo's 2015 annual financial statements. The highlighted line shows Nintendo's FX transaction income, included within the calculation of non-operating income.

Consolidated statements of income

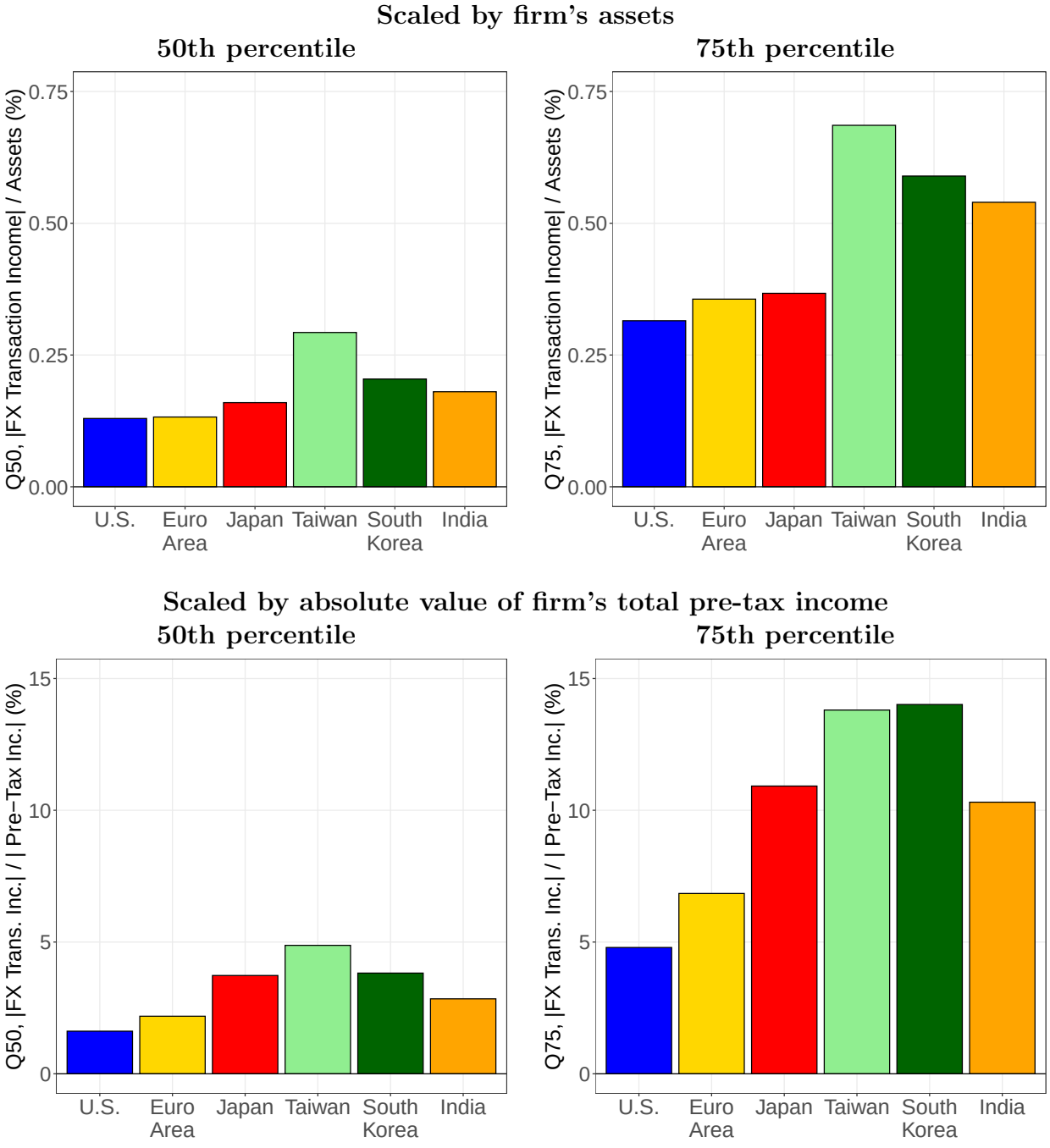
	Previous fiscal year (From April 1, 2013 to March 31, 2014)		Current fiscal year (From April 1, 2014 to March 31, 2015)		
		(Millions of yen)		(Millions of yen)	(Millions of dollars)
Net sales		571,726		549,780	4,581
Cost of sales	*1, *3	408,506	*1, *3	335,196	2,793
Gross profit		163,219		214,584	1,788
Selling, general and administrative expenses	*2, *3	209,645	*2, *3	189,814	1,581
Operating income (loss)		(46,425)		24,770	206
Non-operating income					
Interest income		5,279		4,018	33
Foreign exchange gains		39,287		34,051	283
Gain on redemption of securities		2,299		5,233	43
Other		6,271		2,740	22
Total non-operating income		53,136		46,043	383
Non-operating expenses					
Sales discounts		440		205	1
Other		184		77	0
Total non-operating expenses		624		283	2
Ordinary income		6,086		70,530	587

Figure 2. Aggregate Foreign Exchange Transaction Income and Exchange Rates



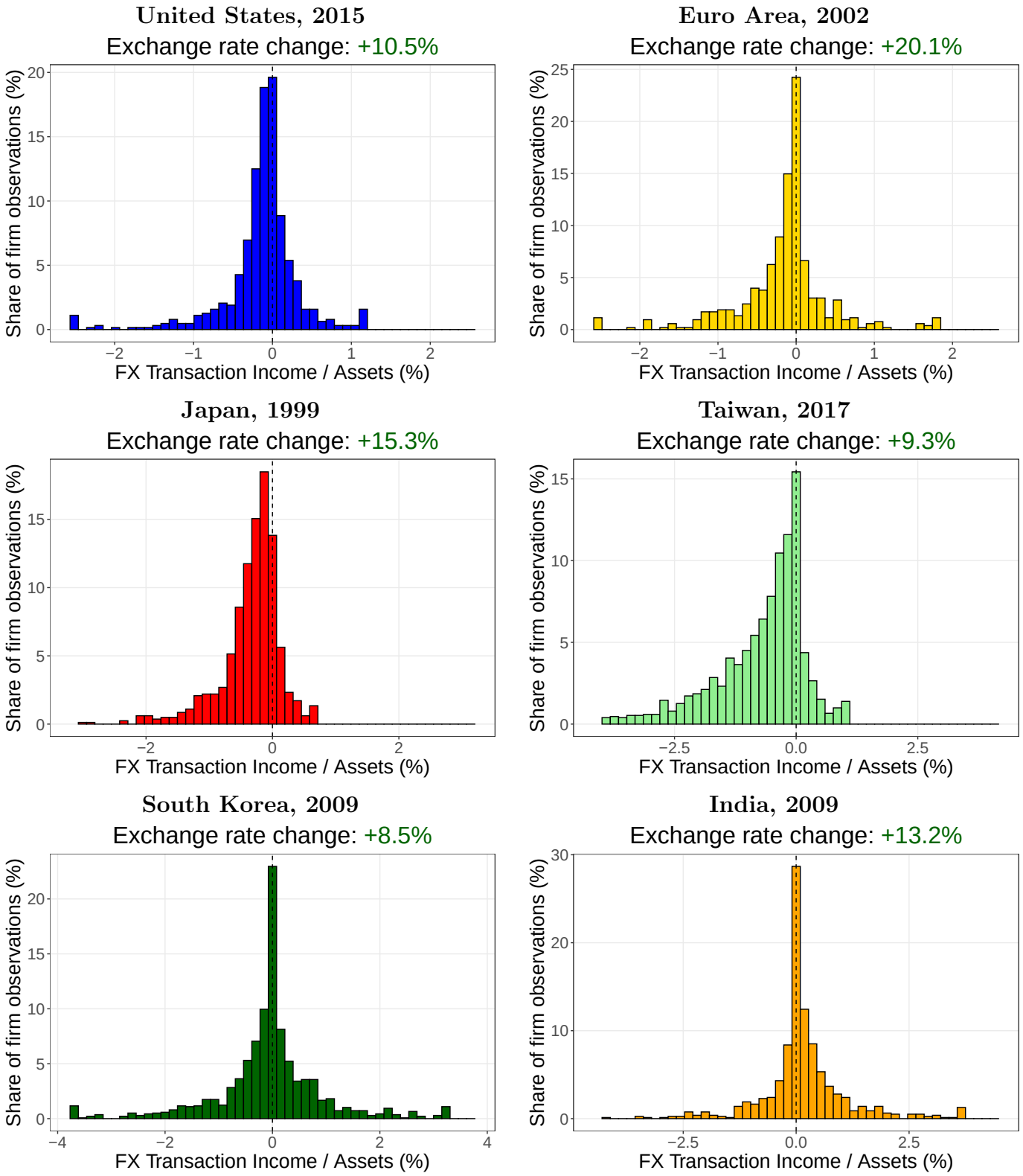
This figure presents aggregate foreign exchange transaction income in each year for the six countries and currency areas in our sample. We compute aggregate FX transaction income as the sum of FX transaction income across all firms in our sample for which a non-missing value is available in the given year. We then divide aggregate FX transaction income by aggregate total assets for the same set of firms. The figure includes only country-years for which at least 200 firms in our sample report non-missing FX transaction income. The vertical axis reports aggregate FX transaction income over aggregate assets in each year. The horizontal axis reports the change in the value of the local currency in the same year; for the U.S. we use the change in the BIS's trade-weighted U.S. dollar index, and for all other countries we use the bilateral exchange rate against the U.S. dollar.

Figure 3. 50th and 75th Percentiles of FX Transaction Income



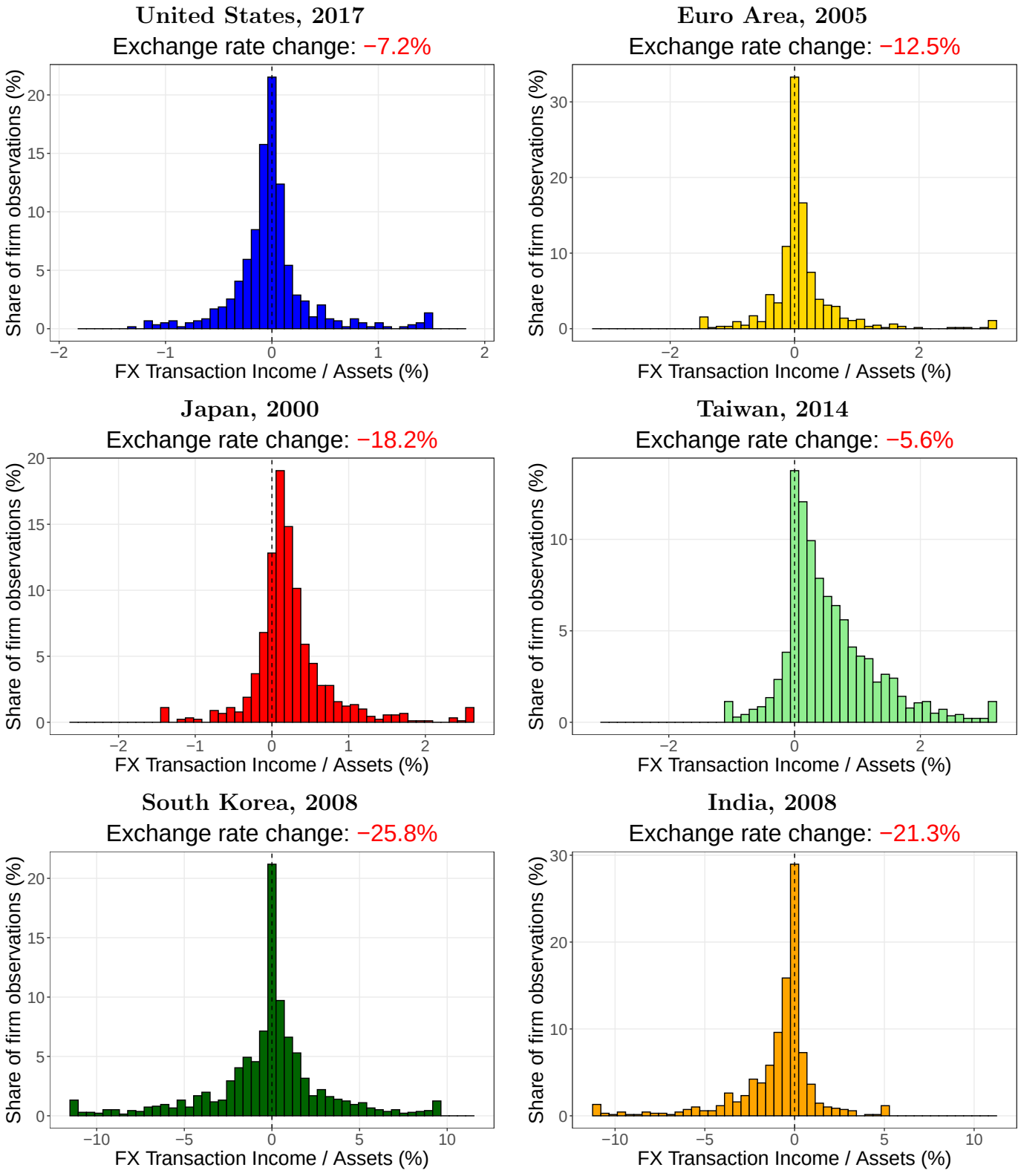
This figure depicts percentiles of the scaled absolute value of FX transaction income, computed for each country across all firm-year observations where FX transaction income is nonzero. The top panels report the 50th (left) and 75th (right) percentiles of FX transaction income scaled by the firm's total assets in the same year. The bottom panels report the 50th (left) and 75th (right) percentiles of FX transaction income scaled by the firm's total pre-tax income in the same year.

Figure 4. Distribution of FX Transaction Income: Local Currency Appreciations



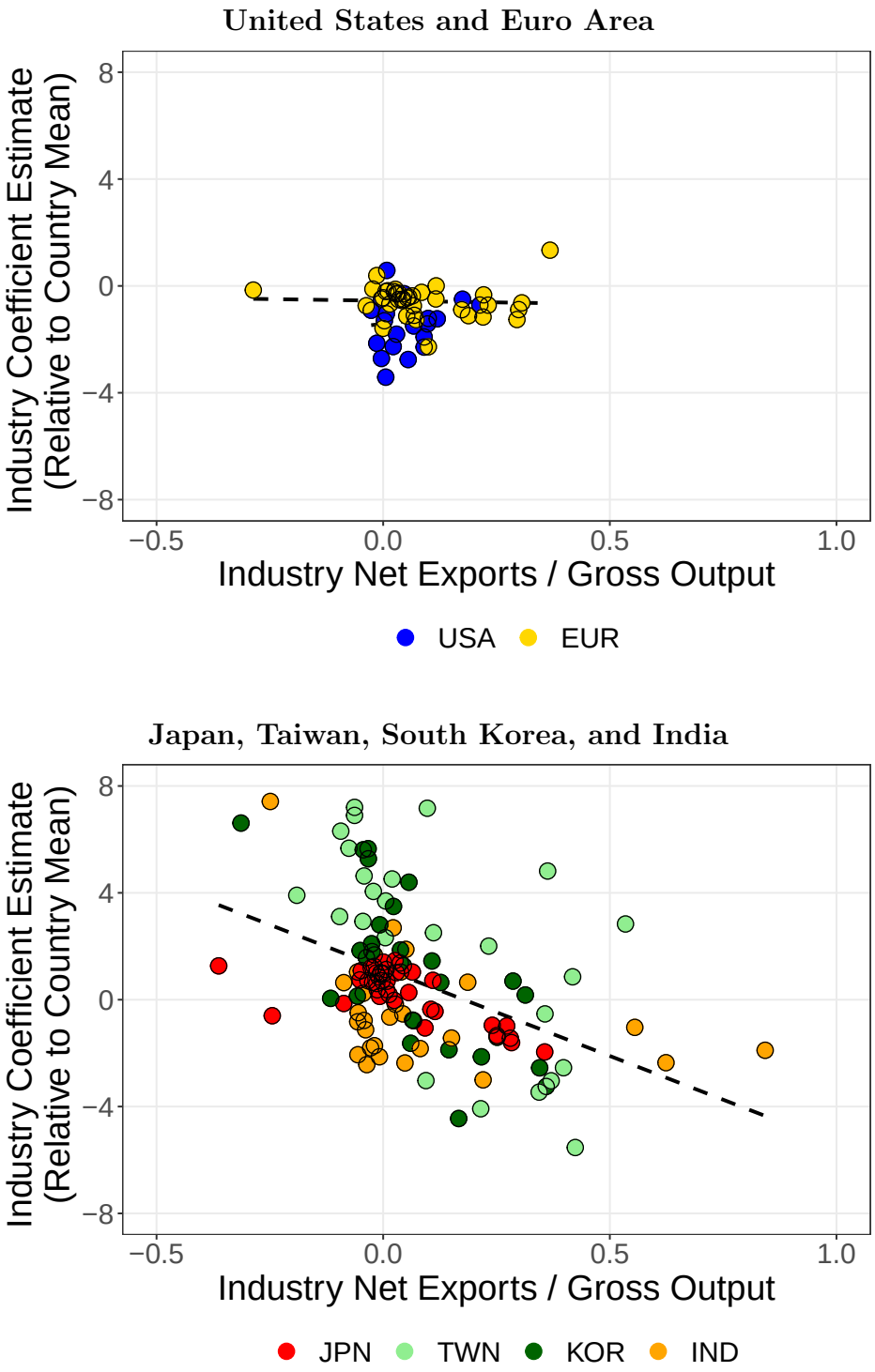
This figure presents the distribution of FX transaction income (scaled by total assets) across firms in each country, in selected years with large local currency appreciations. We winsorize the ratio of FX transaction income to total assets at the 1st and 99th percentiles for each country-year. The histograms exclude firms that report zero FX transaction income.

Figure 5. Distribution of FX Transaction Income: Local Currency Depreciations



This figure presents the distribution of FX transaction income (scaled by total assets) across firms in each country, in selected years with large local currency depreciations. We winsorize the ratio of FX transaction income to total assets at the 1st and 99th percentiles for each country-year. The histograms exclude firms that report zero FX transaction income.

Figure 6. FX Transaction Risk and International Trade

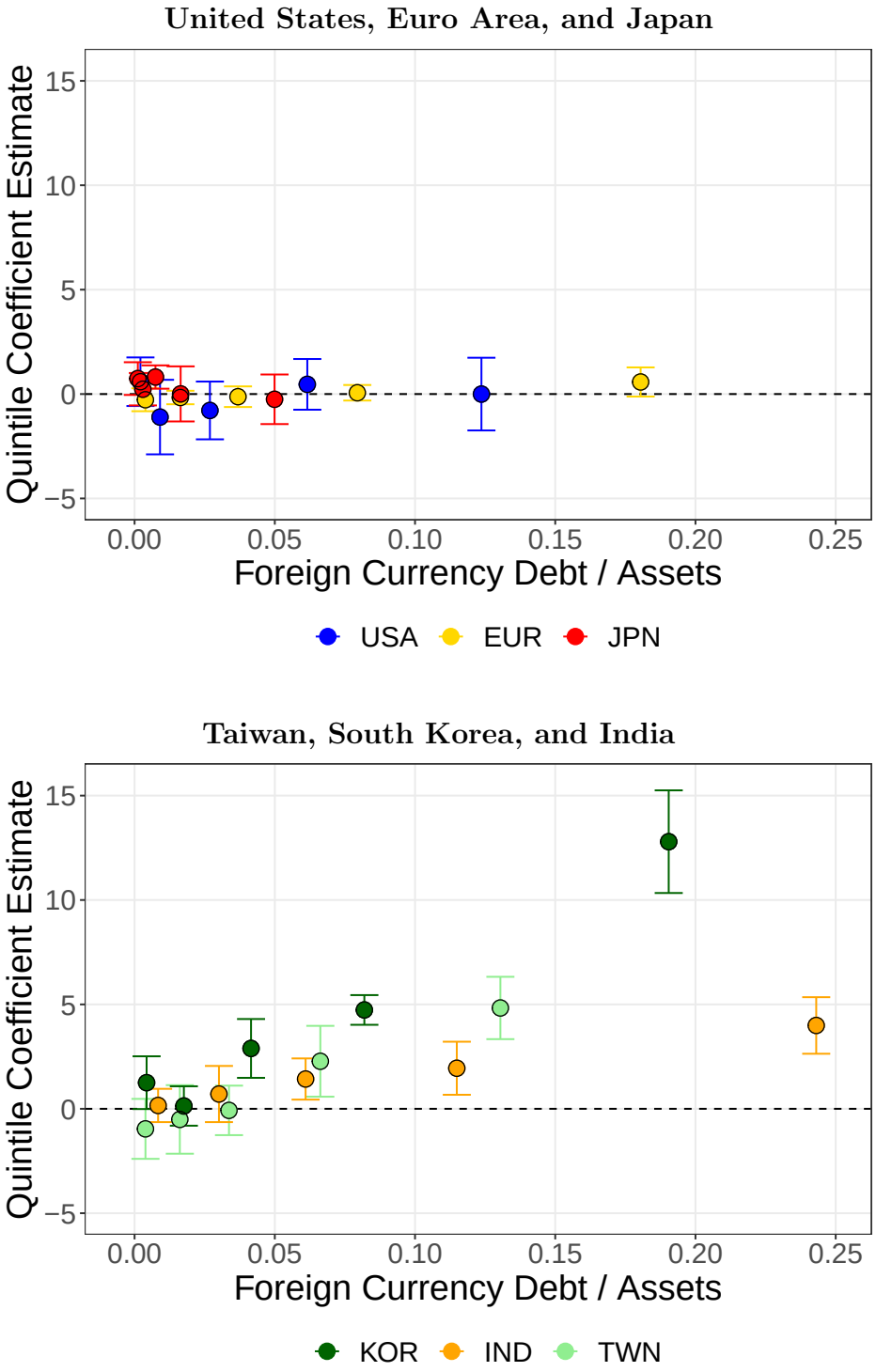


This figure presents estimated FX transaction income loadings and net exports across industries. We first estimate the following panel regression, which includes interactions of the exchange rate change Δs_t with a set of industry indicator variables (see Section 3.3 for details on other controls):

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \Delta s_t \times \sum_j \beta_j \mathbf{1}\left(Industry(i) = j\right) + \gamma'\left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t}$$

The vertical axis plots values of $\widetilde{\beta}_j$, defined as the difference between the estimated industry coefficent $\widehat{\beta}_j$ and an observation count-weighted average of all industry coefficients: $\widetilde{\beta}_j \equiv \widehat{\beta}_j - \sum_{j'} \widehat{\beta}_{j'} \times N_{j'}/N$. The horizontal axis plots the ratio of net exports (total exports minus total imports) to gross output for each industry, computed using data from the World Input-Output Database. For each country, we plot only industries with at least 100 firm-year observations in the sample from Table 1.

Figure 7. FX Transaction Risk and Foreign Currency Debt

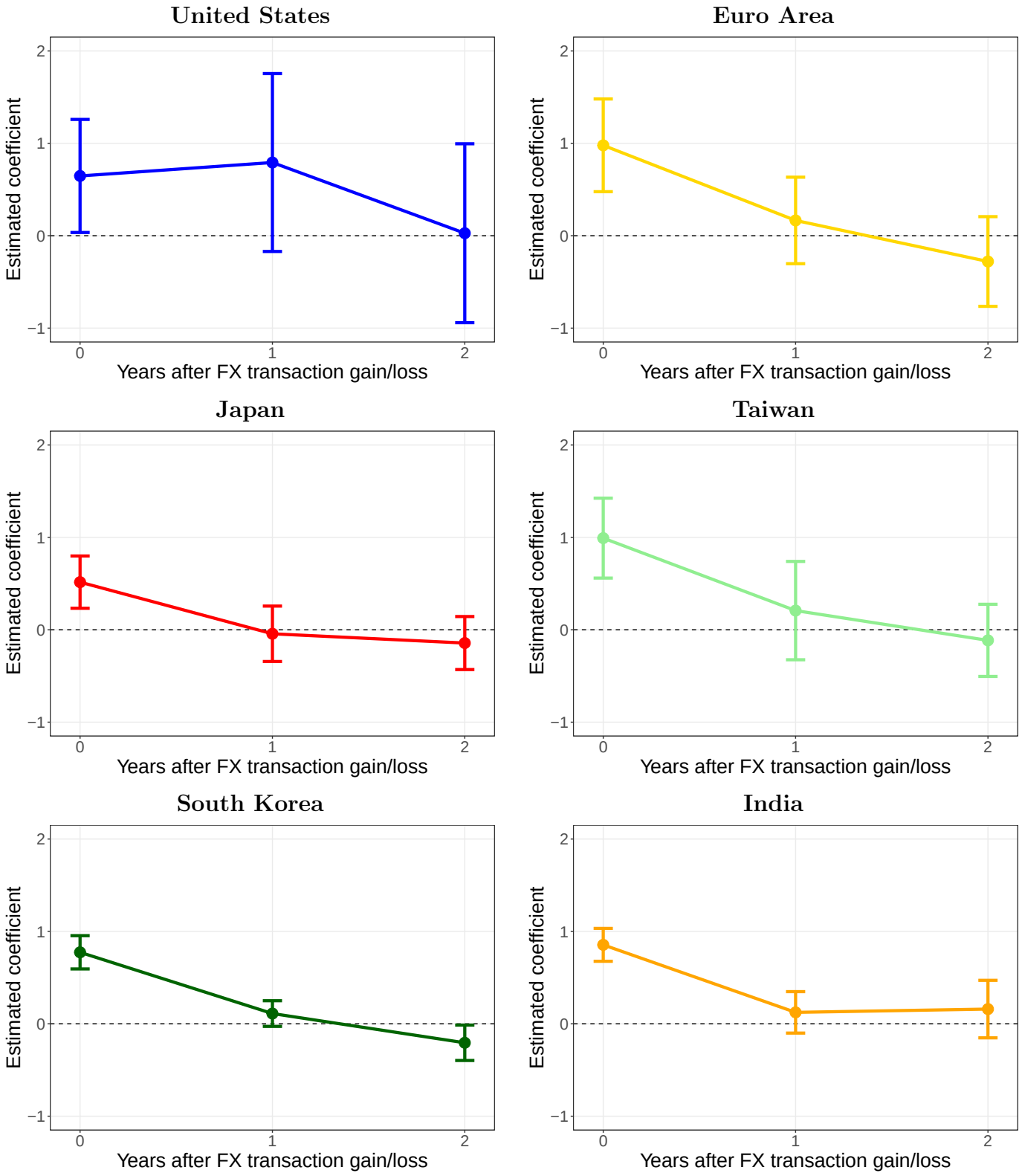


This figure presents estimated FX transaction income loadings and average levels of foreign currency debt (relative to total assets) across quintiles of firm-year observations sorted on foreign currency leverage. In each country, we first assign firm-year observations with positive foreign currency debt outstanding to one of five quintiles based on foreign currency leverage (the ratio of foreign currency debt to total assets). We then estimate the following panel regression, which includes interactions of the exchange rate change Δs_t with a set of indicator variables for the five foreign currency leverage quintiles (see Section 3.3 for details on other controls):

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \Delta s_t \times \sum_{k=1}^{5} \eta_k \mathbf{1}\left(FCLeverageQuintile(i,t) = k\right) + \gamma' \left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t}$$

The vertical axis plots coefficient estimates $\widehat{\eta}_k$ for the foreign currency leverage quintile indicators. The horizontal axis plots average foreign currency leverage across firm-year observations belonging to each quintile. Bands represent +/- 2 standard errors, which are double-clustered by firm and year.

Figure 8. FX Transaction Income and Firms' Pre-Tax Profits: Dynamics

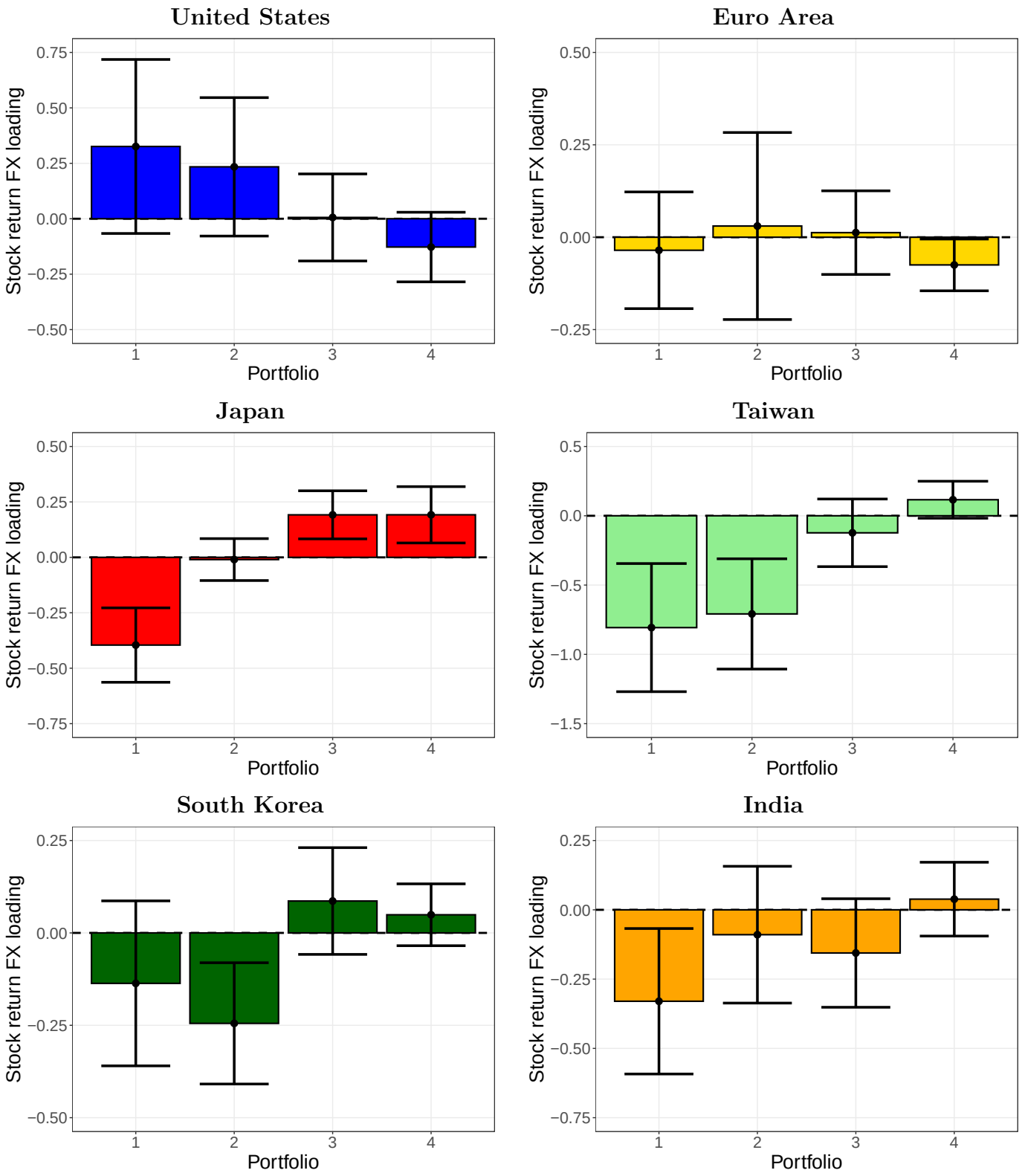


This figure presents estimate coefficients β_h from regressions

$$\frac{PretaxIncome_{i,t+h}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t+h} + \beta_h \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t+h}$$

for the six countries in our sample and fixed horizons $h = 0, 1, 2$. α_i denotes firm fixed effects, and $\theta_{Industry(i),t}$ denotes industry-year fixed effects (based on the World Input-Output Table industry classification). The sample in each regression consists of firm-year observations (i, t) for which firm i is continuously present in the sample from years $t-1$ to $t+2$, so that the same sample is used in all regressions for each country. Bands represent +/- 2 standard errors, which are double-clustered by firm and year.

Figure 9. Exchange Rate Loadings of Portfolio Stock Returns



This figure presents estimated exchange rate loadings $\widehat{\beta}_{p,\Delta s_m}$ of monthly stock returns for portfolios $p = 1, \ldots, 4$ in each country. Firms are sorted on their estimated FX transaction income loadings $\widehat{\delta}_{i,t}$ as described in Section 5. Exchange rate loadings are estimated from the time series regression:

$$R_{p,m} = \alpha_p + \beta_{p,mkt} R_{mkt,m} + \beta_{p,\Delta s_m} \Delta s_m + \varepsilon_{p,m}$$

$R_{p,m}$ denotes the value-weighted portfolio return in month m. $R_{mkt,m}$ denotes the country's total market stock return in month m. Δs_m denotes the change in the exchange rate in month m, with a positive value indicating an appreciation of the local currency. Bands represent +/- 2 heteroskedasticity-robust standard errors.

Table 1. Determinants of Firms' Exposure to FX Transaction Risk

	FX Transaction Income / Assets (basis points)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
Exchange rate change Δs_t (%)	-1.33^{***}	-0.55^{***}	-0.71^{***}	-4.07^{***}	-0.74	1.76^{***}
	(0.25)	(0.11)	(0.09)	(0.32)	(0.53)	(0.46)
$\Delta s_t \times$Industry Net Exports / Output	1.29	-0.50	-6.39^{***}	-13.28^{***}	-11.85^{***}	-3.36^{**}
	(1.71)	(0.80)	(0.60)	(0.92)	(1.38)	(1.24)
$\Delta s_t \times$Log Assets (std.)	0.88^{***}	0.36^{***}	-0.03	1.77^{***}	0.36^{*}	0.06
	(0.25)	(0.08)	(0.07)	(0.22)	(0.18)	(0.14)
$\Delta s_t \times$Cash / Assets (std.)	-0.01	-0.26^{***}	-0.22^{***}	-2.34^{***}	-1.19^{***}	-0.24^{**}
	(0.15)	(0.08)	(0.06)	(0.42)	(0.16)	(0.10)
$\Delta s_t \times$Net Trade Credit / Assets (std.)	0.04	-0.11	-0.01	-1.39^{***}	-1.46^{***}	-0.68^{**}
	(0.20)	(0.08)	(0.04)	(0.18)	(0.27)	(0.24)
$\Delta s_t \times$Foreign Currency Debt / Assets	1.29	2.52	-4.09	35.97^{***}	60.22^{***}	17.37^{***}
	(7.02)	(1.57)	(10.00)	(4.90)	(3.44)	(2.95)
Firm FEs?	Y	Y	Y	Y	Y	Y
Observations	10,248	20,936	36,589	22,394	21,249	22,983
R^2	0.22	0.14	0.21	0.39	0.25	0.24
Note:						*p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \beta \Delta s_t + \gamma' \left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t}$$

for the six countries in our sample. The dependent variable is converted to basis points (i.e. the original ratio is multiplied by 10^4). Δs_t denotes the change in the exchange rate in percentage points, with a positive value indicating an appreciation of the local currency. α_i denotes firm fixed effects. Log assets, the ratio of cash to assets, and the ratio of net trade credit to assets are all standardized to have zero mean and unit standard deviation in each country. Standard errors are reported in parentheses and are double-clustered by firm and year.

Table 2. FX Transaction Income and Firms' Pre-Tax Profits

	Pretax Income / Lagged Assets (%)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
FX Transaction Income / Lagged Assets (%)	0.65**	0.98***	0.52***	0.99***	0.77***	0.85***
	(0.31)	(0.25)	(0.14)	(0.22)	(0.09)	(0.09)
Firm FEs?	Y	Y	Y	Y	Y	Y
Industry-Year FEs?	Y	Y	Y	Y	Y	Y
Observations	11,679	15,865	55,612	18,550	21,914	17,837
R^2	0.69	0.62	0.51	0.59	0.50	0.64
Note:						*p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{PretaxIncome_{i,t}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t} + \beta \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

for the six countries in our sample. α_i denotes firm fixed effects, and $\theta_{Industry(i),t}$ denotes industry-year fixed effects (based on the World Input-Output Table industry classification). The sample consists of firm-year observations (i,t) for which firm i is continuously present in the sample from years $t-1$ to $t+2$, for consistency with the longer-horizon regression estimates reported in Figure 8. Standard errors are reported in parentheses and are double-clustered by firm and year.

Table 3. FX Transaction Income and Firms' Non-Operating Income

	Non-Operating Income / Lagged Assets (%)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
FX Transaction Income / Lagged Assets (%)	0.85***	1.13***	0.99***	1.00***	0.85***	1.06***
	(0.08)	(0.10)	(0.05)	(0.03)	(0.06)	(0.04)
Firm FEs?	Y	Y	Y	Y	Y	Y
Industry-Year FEs?	Y	Y	Y	Y	Y	Y
Observations	11,679	15,865	55,612	18,550	21,914	17,837
R^2	0.53	0.32	0.30	0.35	0.33	0.40

Note: *p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{NonoperatingIncome_{i,t}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t} + \beta \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

for the six countries in our sample. α_i denotes firm fixed effects, and $\theta_{Industry(i),t}$ denotes industry-year fixed effects (based on the World Input-Output Table industry classification). The sample consists of firm-year observations (i,t) for which firm i is continuously present in the sample from years $t-1$ to $t+2$, for consistency with the longer-horizon regression estimates reported in Figure 8. Standard errors are reported in parentheses and are double-clustered by firm and year.

Table 4. FX Transaction Income and Firms' Operating Income

	Operating Income / Lagged Assets (%)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
FX Transaction Income / Lagged Assets (%)	−0.12	−0.21	−0.43***	−0.02	−0.09	−0.22**
	(0.26)	(0.20)	(0.10)	(0.22)	(0.08)	(0.08)
Firm FEs?	Y	Y	Y	Y	Y	Y
Industry-Year FEs?	Y	Y	Y	Y	Y	Y
Observations	11,679	15,860	55,612	18,548	21,911	17,823
R^2	0.75	0.67	0.57	0.63	0.53	0.64

Note: *p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{OperatingIncome_{i,t}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t} + \beta \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

for the six countries in our sample. Operating income is measured net of depreciation. α_i denotes firm fixed effects, and $\theta_{Industry(i),t}$ denotes industry-year fixed effects (based on the World Input-Output Table industry classification). The sample consists of firm-year observations (i,t) for which firm i is continuously present in the sample from years $t-1$ to $t+2$, for consistency with the longer-horizon regression estimates reported in Figure 8. Standard errors are reported in parentheses and are double-clustered by firm and year.

Table 5. FX Transaction Income and Firms' Post-Tax Profits

	Ordinary Income / Lagged Assets (%)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
FX Transaction Income / Lagged Assets (%)	0.56*	0.80***	0.45***	0.85***	0.63***	0.67***
	(0.29)	(0.24)	(0.12)	(0.18)	(0.08)	(0.08)
Firm FEs?	Y	Y	Y	Y	Y	Y
Industry-Year FEs?	Y	Y	Y	Y	Y	Y
Observations	11,679	15,865	55,612	18,550	21,914	17,837
R^2	0.68	0.59	0.45	0.58	0.49	0.61
Note:						*p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{OrdinaryIncome_{i,t}}{Assets_{i,t-1}} = \alpha_i + \theta_{Industry(i),t} + \beta \frac{FXTransactionIncome_{i,t}}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

for the six countries in our sample. α_i denotes firm fixed effects, and $\theta_{Industry(i),t}$ denotes industry-year fixed effects (based on the World Input-Output Table industry classification). The sample consists of firm-year observations (i,t) for which firm i is continuously present in the sample from years $t-1$ to $t+2$, for consistency with the longer-horizon regression estimates reported in Figure 8. Standard errors are reported in parentheses and are double-clustered by firm and year.

A Appendix: Accounting for FX Transaction Risk

This section presents some detailed examples of foreign currency transaction income, along with their associated accounting entries.

A.1 Purchase without hedging

Suppose that USCo is a company operating and reporting in U.S. dollars. It purchases inventory for 1,000,000 Euros on February 1, 20X0 on a 90-day trade credit. The foreign currency liability account is then settled on May 1, 20X0. Assume that the exchange rate on February 1, 20X0 is USD 1.25 = 1 EUR. The US company must then report the transaction and accounts payable in its functional currency, and the effect on its balance is as follows in Table A1:

Table A1. Foreign Currency Transaction - Entries on February 1, 20X0

Account	Type	Decrease	Increase
Inventory	Assets		1,250,000
Accounts payables	Liabilities		1,250,000

Assume that the next reporting date is March 31, 20X0 and that the spot rate on that day is USD 1.30 = 1 EUR. While the transaction has not settled yet, the company still needs to report the full extent of the impact of the exchange rate change from 1.25 to 1.30 on its net income, as if it was already realized. The company will update its account payables and record a foreign currency transaction loss of $50,000, as shown in Table A2.

Table A2. Foreign Currency Transaction - Entries on March 31, 20X0

Account	Type	Decrease	Increase
Accounts payables	Liabilities		50,000
Foreign currency transaction loss	Income Statement		50,000

Suppose that on settlement day, May 1, 20X0, the foreign exchange rate is USD 1.35 = 1 EUR. The company first records an entry to recognize the difference between the US dollar balance on settlement day (1,350,000 US dollars) and the balance as of the previous reporting date on March

31, 20X0 (1,300,000 US dollars). The offsetting entry is then the foreign currency transaction loss that will be reported in the income statement of the following period, on June 31, 20X0. These entries are presented in Table A3.

Table A3. Foreign Currency Transaction - Entries on May 1, 20X0

Account	Type	Decrease	Increase
Accounts payable	Liabilities		50,000
Foreign currency transaction loss	Income Statement		50,000

Finally, the company also records the payment of the account payables in cash, as in Table A4.

Table A4. Foreign Currency Transaction - Entries on May 1, 20X0

Account	Type	Decrease	Increase
Accounts payable	Liabilities	1,350,000	
Cash	Assets	1,350,000	

Both realized and unrealized gains and losses due to foreign exchange transactions are reported in the income statement.[27] In the example above, the company incurred an unrealized loss of $50,000 reported on March 31, 20X0 on the income statement, as well as a realized loss of $50,000 reported on June 31, 20X0.

The inventory that USCo bought is a non-monetary item (other examples include investments in common stocks and property, plant, and equipment). Unlike monetary items as cash or accounts payables/receivables, the value of non-monetary items (inventory in our example) is not adjusted for subsequent changes in exchange rates.

A.2 Purchase with hedging

What happens if the firm hedges its foreign currency position? Suppose now that the same company USCo, which operates and reports in U.S. dollars and purchases inventory for 1,000,000 Euros on February 1, 20X0 on a 90-days trade credit, decides to hedge its currency risk. Assume that the

[27] Exceptions to this rule are gains and losses to net investment hedges and long-term inter-company transactions that are not expected to be settled in the foreseeable future. Foreign currency gains and losses on these two exceptions are recorded in the cumulative translation adjustment account.

spot rate on February 1^{st} is USD 1.25 = 1 EUR, and that the company enters a forward contract to buy 1,000,000 Euros at USD 1.27 = 1 EUR in 90 days. Suppose also that the next reporting date is on March 31^{st}. Table A5 below summarizes the exchange rates and corresponding gains and losses recorded over the three month period of the hedging contract.

Table A5. Spot, Forward Rates, and Contract Valuations

Date	Spot rate	Forward rate	Contract value	Contract gain/loss
02/01/20X0	1.25	1.27	0	0
03/31/20X0	1.30	1.31	39,806	39,806
05/01/20X0	1.35	1.35	80,000	40,194

At any point in time, the current forward contract's fair value is computed as the difference between the current and the previous forward rates multiplied by the notional currency amount, discounted back from the settlement date. In the example above, using an annual discount rate of 6%, the current forward contract's fair value is $\$39,806 = (1.31 - 1.27) \times 1,000,000 \times (1.06)^{-\frac{1}{12}}$. The discount period is one month (from the end of March to the start of May). The gains or losses on the contract are then computed as the difference between the current and previous forward contract's fair values.

The gains or losses on the forward hedging contract are entered in the same accounting line as the gains or losses on the underlying foreign currency liability (as previously noted, the only exception are cash flow hedges that concern future transactions). Table A6 compares the net reporting of the foreign exchange gains and loss in the cases with and without the forward hedging contract. On March 31st, the firm reports the sum of the forward contract's fair value and the FX transaction loss: $-50,000 + 39,806 = -\$10,194$. On May 1st, the forward contract's fair value becomes $(1.35 - 1.27) \times €1M$, and the firm keeps track of its difference with its previous value: $(1.35 - 1.27) \times €1M - 39,806 = \$40,194$. The firm then reports a FX transaction exposure equal to the FX transaction loss and the hedging component: $-50,000 + 40,194 = -\$9,806$. The total FX transaction loss corresponds to the difference between the spot and forward rate, multiplied by the notional: $(1.25 - 1.27) \times €1M = -\$20,000$. It is also equal, by construction, to the sum of the two FX transaction exposures reported: $-\$10,194 - \$9,806 = -\$20,000$.

Table A6. Foreign Currency Transaction - FX Rates and Valuations

Date	Spot rate	Forward rate	Payable	FX gain/loss	FX gain/loss with Hedging
02/01/20X0	1.25	1.27	1,250,000	0	0
03/31/20X0	1.30	1.31	1,300,000	(50,000)	(10,194)
05/01/20X0	1.35	1.35	1,350,000	(50,000)	(9,806)

The FX gains/loss column of Table A6 reports the net effect of foreign exchange transaction income in the case where no hedging is used (see section A.1 above). These amounts correspond to the reported entries on the income statements as of March $31^{st}, 20X0$ (second row), and as of June $31^{st}, 20X0$ (third row). The last column (denoted "FX gain/loss with Hedging") reports the net effect considering both the foreign exchange gain/loss and the forward contract gain/loss. In the case where the company uses a hedging contract, this net foreign exchange transaction income is what the company ultimately reports on its income statements as of March $31^{st}, 20X0$ (second row), and as of June $31^{st}, 20X0$ (third row). The sum of these two entries is the total FX transaction loss after hedging. Intuitively, the firm agrees to pay 1,000,000 euros on February 1, 20X0 at a time when the euro is worth \$1.25 and decides to avoid exchange rate risk by signing a forward contract such that each euro costs \$1.27. The FX loss is thus (\$1.25 - \$1.27) $\times$ 1,000,000 = \$20,000.

A.3 Investment without hedging

Let us now consider investments in debt and equity denominated in a foreign currency. Three cases arise:

- the debt securities are held to maturity: in this case, they are monetary items and the foreign currency transaction gains or losses are recognized in the income statement;
- the debt or equity securities are available for sale: in this case, according to IFRS, firms should report FX transaction income in earnings, whereas according to GAAP (ASC 320),

firms should report it in other comprehensive Income;

- the debt or equity securities are for trading: the changes in fair value due to exchange rate changes are recognized in the income statement (ASC 320-10-35-1).

Let us go through an example of the first case. Suppose that USCo, whose functional currency is the U.S. dollar, purchases a ten-year bond with a face value of 1,000,000 Euros on January 1, 20X0. The bond pays a 6 percent annual interest and is sold at par (i.e., at its face value). Assume that USCo classifies the bond as held to maturity and that the exchange rates are 1€= \$1.2 on January 1, 20X0, 1€= \$1.4 on December 31, 20X0, and that the average value of the daily spot exchange rate is 1€= \$1.3 in 20X0.

USCo records the initial investment (€1,000,000×1.2 = \$1, 200, 000) as in Table A7.

Table A7. Initial Investment - Entries on January 1, 20X0

Account	Increase	Decrease
Investment in held-to-maturity security	1,200,000	
Cash		1,200,000

The bond pays an interest income of 6% of €1,000,000, i.e., €60,000. The accrued interest receivable is recorded at the weighted-average exchange rate of 1€= \$1.3 and thus equal \$78,000. At the end of the year, USCo records the new value of the bond, along with the interest income and the foreign currency transaction gain. That gain comes from two parts: (i) the value of the bond increases by \$200,000, from \$1,200,000 to \$1,400,000 because the value of the euro increases from 1€= \$1.2 at the start of the year to 1€= \$1.4 at the end of the year; (ii) the value of the accrued interest income increases by \$6,000, from \$78,000 at the average exchange rate of 1€= \$1.3 to \$84,000 at the end of the year rate of 1€= \$1.4. The total foreign currency transaction gain is thus \$206,000, as noted in Table A8.

Table A8. Foreign Currency Transaction - Entries on December 31, 20X0

Investment in held-to-maturity security	1,400,000
Accrued interest receivable	78,000
Interest income	84,000
Foreign currency transaction gain	206,000

A.4 Borrowing without hedging

The calculation of foreign currency transaction gains for foreign currency-denominated debts incurred by the firm is essentially the same as for held-to-maturity debt securities owned by the firm, as described in the previous section. The key difference is that because debts incurred by the firm represent a liability rather than an asset, an appreciation of the foreign currency against the firm's functional currency results in an FX transaction loss rather than a gain.

We consider the same example as in Section A.3, but instead assume that USCo *issues* a ten-year Euro-denominated bond at par with a face value of 1,000,000 Euros and 6 percent annual interest payments.

On January 1, 20X0 USCo records the initial proceeds from issuance (€1,000,000×1.2 = $\$1,200,000$) as in Table A9.

Table A9. Initial Debt Issuance - Entries on January 1, 20X0

Account	Type	Increase	Decrease
Long-term debt	Liability	1,200,000	
Cash	Asset	1,200,000	

The accrued interest payable is again recorded at the weighted-average exchange rate of 1€= $1.3 and equals $78,000. At the end of the year, USCo records the new value of the bond, along with the interest income and the foreign currency transaction loss resulting from the appreciation of the euro against the U.S. dollar. As before, the loss consists of: (i) the $200,000 increase in the U.S. dollar value of the euro-denominated principal; (ii) the $6,000 difference between the value of the accrued interest income (based on average spot exchange rate throughout the year) and

the actual interest payment (based on the spot exchange rate on December 31, 20X0). The total foreign currency transaction loss is $206,000, reported in Table A10.

Table A10. Foreign Currency Transaction - Entries on December 31, 20X0

Long-term debt	1,400,000
Accrued interest payable	78,000
Interest expense	84,000
Foreign currency transaction loss	206,000

B Appendix: Additional Tables and Figures

Table B1. Determinants of Firms' Exposure to FX Transaction Risk: Full Sample without Foreign Currency Debt

	FX Transaction Income / Assets (basis points)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
Exchange rate change Δs_t (%)	-0.81^{***}	-0.29^{**}	-0.50^{***}	-4.04^{***}	-1.34^{**}	1.30^{***}
	(0.26)	(0.13)	(0.09)	(0.33)	(0.56)	(0.38)
$\Delta s_t \times$Industry Net Exports / Output	0.58	−0.46	-3.88^{***}	-12.97^{***}	-5.73^{**}	-2.83^{**}
	(1.43)	(0.78)	(0.52)	(0.84)	(2.50)	(1.23)
$\Delta s_t \times$Log Assets (std.)	0.79^{***}	0.40^{***}	0.002	1.97^{***}	0.42^{**}	0.25^{**}
	(0.16)	(0.08)	(0.04)	(0.21)	(0.16)	(0.12)
$\Delta s_t \times$Cash / Assets (std.)	−0.18	-0.32^{***}	−0.08	-2.31^{***}	-0.85^{***}	−0.06
	(0.11)	(0.09)	(0.05)	(0.46)	(0.20)	(0.10)
$\Delta s_t \times$Net Trade Credit / Assets (std.)	0.04	−0.11	−0.01	-1.30^{***}	-0.84^{***}	-0.66^{***}
	(0.12)	(0.07)	(0.03)	(0.18)	(0.28)	(0.24)
$\Delta s_t \times$Total Debt / Assets	−1.14	-0.97^{**}	0.53^{**}	1.18	7.08^{**}	2.46^{***}
	(0.83)	(0.47)	(0.22)	(1.74)	(3.08)	(0.66)
Firm FEs?	Y	Y	Y	Y	Y	Y
Observations	15,178	21,826	64,793	24,429	29,033	24,624
R^2	0.21	0.14	0.14	0.37	0.12	0.22
Note:						*p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \beta \Delta s_t + \gamma' \left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t}$$

for the six countries in our sample. The dependent variable is converted to basis points (i.e. the original ratio is multiplied by 10^4). Δs_t denotes the change in the exchange rate in percentage points, with a positive value indicating an appreciation of the local currency. Log assets, the ratio of cash to assets, and the ratio of net trade credit to assets are all standardized to have zero mean and unit standard deviation in each country. Standard errors are reported in parentheses and are double-clustered by firm and year.

Table B2. Determinants of Firms' Exposure to FX Transaction Risk: Subsample with Foreign Sales Share

	FX Transaction Income / Assets (basis points)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
Exchange rate change Δs_t (%)	-0.89^{***}	-0.22^{**}	-0.54^{***}	-3.61^{***}	-1.63^{***}	1.77^{***}
	(0.32)	(0.08)	(0.07)	(0.32)	(0.30)	(0.35)
$\Delta s_t \times$Industry Net Exports / Output	0.82	0.37	-2.49^{***}	-8.45^{***}	-4.16^{**}	-3.78^{***}
	(1.74)	(0.77)	(0.62)	(1.29)	(1.57)	(1.20)
$\Delta s_t \times$Log Assets (std.)	0.82^{***}	0.54^{***}	0.47^{***}	2.02^{***}	2.37^{***}	-0.12
	(0.25)	(0.10)	(0.08)	(0.22)	(0.41)	(0.20)
$\Delta s_t \times$Cash / Assets (std.)	0.03	-0.32^{***}	-0.19^{**}	-2.47^{***}	-1.06^{***}	-0.19
	(0.16)	(0.10)	(0.09)	(0.39)	(0.19)	(0.11)
$\Delta s_t \times$Net Trade Credit / Assets (std.)	0.07	-0.03	0.07	-1.39^{***}	-0.98	-0.74^{***}
	(0.22)	(0.07)	(0.06)	(0.22)	(0.64)	(0.19)
$\Delta s_t \times$Foreign Currency Debt / Assets	-3.47	2.79	15.43^{**}	34.75^{***}	32.23^{***}	18.48^{***}
	(6.67)	(1.79)	(5.72)	(5.33)	(9.72)	(3.18)
$\Delta s_t \times$Foreign Sales Share	-0.63	-1.24^{***}	-4.76^{***}	-4.21^{***}	-9.57^{***}	0.52
	(0.84)	(0.37)	(0.49)	(0.63)	(1.72)	(1.16)
Firm FEs?	Y	Y	Y	Y	Y	Y
Observations	8,516	14,426	22,509	12,949	9,274	11,254
R^2	0.25	0.18	0.31	0.42	0.38	0.27

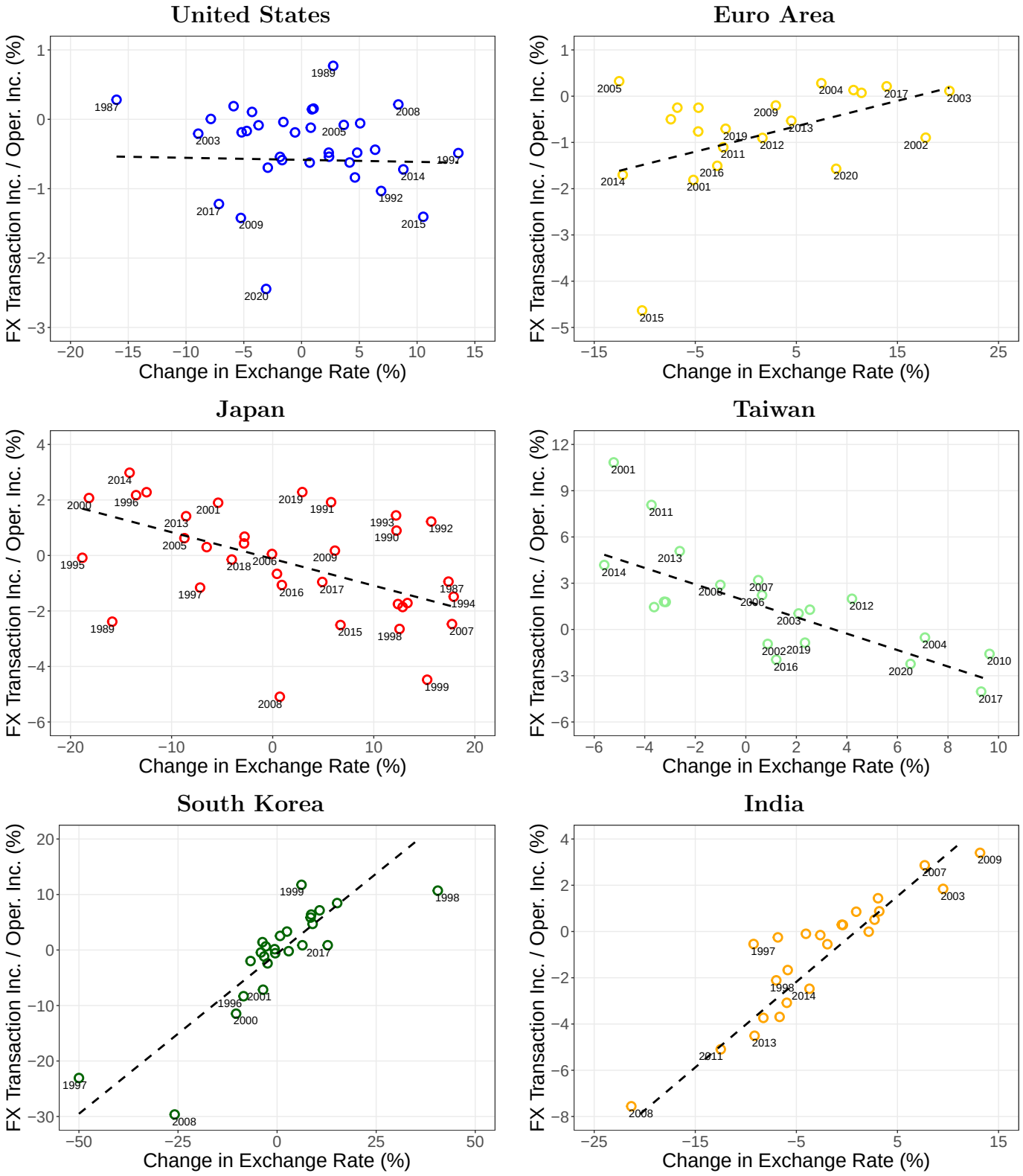
Note: *p<0.1; **p<0.05; ***p<0.01

This table reports estimates from the regression

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha_i + \beta \Delta s_t + \gamma' \left(\Delta s_t \times X_{i,t}\right) + \varepsilon_{i,t}$$

for the six countries in our sample. The dependent variable is converted to basis points (i.e. the original ratio is multiplied by 10^4). Δs_t denotes the change in the exchange rate in percentage points, with a positive value indicating an appreciation of the local currency. Log assets, the ratio of cash to assets, and the ratio of net trade credit to assets are all standardized to have zero mean and unit standard deviation in each country. The foreign sales share takes values between 0 and 1 (inclusive). Standard errors are reported in parentheses and are double-clustered by firm and year.

Figure B1. Aggregate FX Transaction Income (Relative to Operating Income) and Exchange Rates



This figure presents aggregate foreign exchange transaction income in each year for the six countries and currency areas in our sample. We compute aggregate FX transaction income as the sum of FX transaction income across all firms in our sample for which a non-missing value is available in the given year. We then divide aggregate FX transaction income by aggregate operating income for the same set of firms. The figure includes only country-years for which at least 200 firms in our sample report non-missing FX transaction income. The vertical axis reports aggregate FX transaction income over aggregate operating income in each year. The horizontal axis reports the change in the value of the local currency in the same year; for the U.S. we use the change in the BIS's trade-weighted U.S. dollar index, and for all other countries we use the bilateral exchange rate against the U.S. dollar.

C Appendix: Additional Properties of FX Transaction Income

This section presents additional results on the persistence of FX transaction income at the firm level. In levels, FX transaction income appears close to serially uncorrelated for an individual firm, as expected if these gains and losses primarily arise from serially uncorrelated changes in nominal exchange rates. However, firms' *exposure* to FX transaction risk is persistent: firms that previously reported nonzero FX transaction income are likely to do so again in the future, and the magnitude of firms' FX transaction income is strongly correlated across years.

Table C1 reports the firm-level autocorrelation of FX transaction income, in levels. Estimates in Panel A correspond to the following panel regression of FX transaction income (scaled by total firm assets) on its lagged value:

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha + \rho \frac{FXTransactionIncome_{i,t-1}}{Assets_{i,t-1}} + \varepsilon_{i,t} \tag{10}$$

Fluctuations in nominal exchange rates generate FX transaction gains and losses for firms that have unhedged exposure to exchange rate fluctuations. Nominal exchange rates are known to be well-approximated by a random walk in levels, implying that changes in nominal exchange rates are close to serially uncorrelated. If firms' FX transaction gains and losses arise primarily from changes in these spot exchange rates, then FX transaction income should also be serially uncorrelated. However, for firms that fully or partially hedge their exposure to exchange rate risk using derivatives, their reported FX transaction income also includes a small component determined by differences in spot and forward exchange rates, as explained in Appendix A.2. Since differences between forward and spot exchange rates tend to be persistent, hedge accounting may lead to a small positive autocorrelation in reported FX transaction income for these firms.

The estimated coefficients ρ reported in Panel A of Table C1 are generally small in magnitude, and only the estimate for Japan is marginally statistically significant. Panel B adds firm fixed effects, which may help to remove any small, persistent component of some firms' FX transaction

income arising from hedge accounting. The estimated coefficients in Panel B are again small in magnitude and statistically insignificant. Overall, Table C1 documents that firms' FX transaction income exhibits weak serial correlation, as would be expected if these gains and losses arise primarily from serially uncorrelated changes in nominal exchange rates.

On the other hand, the *magnitude* of firms' FX transaction income is persistent. Panel A of Table reports estimates from a similar regression for the absolute value of firms' FX transaction income:

$$\frac{|FXTransactionIncome_{i,t}|}{Assets_{i,t}} = \alpha + \rho \frac{|FXTransactionIncome_{i,t-1}|}{Assets_{i,t-1}} + \varepsilon_{i,t} \tag{11}$$

The estimated coefficients are large and statistically significant. While it is difficult to predict the sign of firms' FX transaction income, firms that previously reported large gains or losses are likely to report future gains or losses of similar magnitude. Finally, Panel B of Table reports similar estimates using an indicator variable for whether the firm reports a non-zero value of FX transaction income in a given year:

$$1(FXTransactionIncome_{i,t} \neq 0) = \alpha + \rho \times 1(FXTransactionIncome_{i,t-1} \neq 0) + \varepsilon_{i,t} \tag{12}$$

The estimated coefficients are again large and statistically significant: firms that report *any* FX transaction gains or losses will likely do so again in the following year. Taken together, these results show that firms' exposure to FX transaction risk is persistent, both at the intensive margin (whether firms report any FX transaction gains or losses) and the extensive margin (the magnitude of these gains and losses).

Table C1. Persistence of FX Transaction Income: Levels

Panel A: no firm fixed effects

	FX Transaction Income / Assets (basis points)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged FX Transaction Income / Assets (basis points)	0.07	0.07	0.19*	0.003	−0.07	0.15
	(0.06)	(0.08)	(0.10)	(0.13)	(0.07)	(0.11)
Constant	−6.43***	−4.76**	−1.16	−1.05	−4.73	−2.51
	(1.37)	(1.88)	(1.96)	(9.32)	(4.32)	(3.78)
Observations	13,295	19,973	62,542	22,470	26,656	23,235
R^2	0.01	0.004	0.04	0.0000	0.005	0.02
Note:						*p<0.1; **p<0.05; ***p<0.01

Panel B: including firm fixed effects

	FX Transaction Income / Assets (basis points)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged FX Transaction Income / Assets (basis points)	−0.08	−0.06	0.15	−0.06	−0.11	−0.02
	(0.07)	(0.08)	(0.10)	(0.14)	(0.07)	(0.09)
Firm FEs?	Y	Y	Y	Y	Y	Y
Observations	13,295	19,973	62,542	22,470	26,656	23,235
R^2	0.18	0.14	0.08	0.08	0.08	0.19
Note:						*p<0.1; **p<0.05; ***p<0.01

Panel A reports estimates from the regression

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha + \rho \frac{FXTransactionIncome_{i,t-1}}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

for the six countries in our sample. α denotes a constant.
Panel B reports estimates for a similar regression including firm fixed effects α_i:

$$\frac{FXTransactionIncome_{i,t}}{Assets_{i,t}} = \alpha + \rho \frac{FXTransactionIncome_{i,t-1}}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

Standard errors are reported in parentheses and are double-clustered by firm and year.

Table C2. Persistence of FX Transaction Income: Exposure

Panel A: persistence of absolute value $|FXTransactionIncome_{i,t}|$

	FX Trans. Inc., Abs. Val. / Assets (basis points)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged FX Trans. Inc., Abs. Val. / Assets (basis points)	0.45***	0.50***	0.54***	0.39***	0.24***	0.42***
	(0.07)	(0.07)	(0.05)	(0.04)	(0.06)	(0.07)
Constant	13.88***	10.89***	6.36***	28.51***	36.58***	17.97***
	(1.46)	(0.99)	(0.71)	(3.94)	(8.99)	(3.04)
Observations	13,295	19,973	62,542	22,470	26,656	23,235
R^2	0.19	0.22	0.29	0.15	0.06	0.18
Note:						*p<0.1; **p<0.05; ***p<0.01

Panel B: persistence of indicator $1(FXTransactionIncome_{i,t} \neq 0)$

	1(FX Transaction Income ≠ 0)					
	USA	EUR	JPN	TWN	KOR	IND
	(1)	(2)	(3)	(4)	(5)	(6)
1(Lagged FX Transaction Income ≠ 0)	0.55***	0.79***	0.77***	0.58***	0.78***	0.72***
	(0.03)	(0.03)	(0.01)	(0.09)	(0.02)	(0.02)
Constant	0.44***	0.16***	0.12***	0.39***	0.21***	0.20***
	(0.03)	(0.02)	(0.01)	(0.09)	(0.02)	(0.02)
Observations	13,295	19,973	62,542	22,470	26,656	23,235
R^2	0.25	0.65	0.59	0.35	0.61	0.53
Note:						*p<0.1; **p<0.05; ***p<0.01

Panel A reports estimates from the regression

$$\frac{|FXTransactionIncome_{i,t}|}{Assets_{i,t}} = \alpha + \rho \frac{|FXTransactionIncome_{i,t-1}|}{Assets_{i,t-1}} + \varepsilon_{i,t}$$

for the six countries in our sample. $|FXTransactionIncome_{i,t}|$ denotes the absolute value of FX transaction income for firm i in year t. α denotes a constant. Panel B reports estimates from the regression

$$1(FXTransactionIncome_{i,t} \neq 0) = \alpha + \rho \times 1(FXTransactionIncome_{i,t-1} \neq 0) + \varepsilon_{i,t}$$

Here $1(FXTransactionIncome_{i,t} \neq 0)$ denotes an indicator variable taking the value 1 if firm i reports a non-zero value for FX transaction income in year t, and 0 if the firm reports a (non-missing) zero value for FX transactionn income. Standard errors are reported in parentheses and are double-clustered by firm and year.

D Appendix: Data Sources

This Appendix describes our data sets, starting with the firm-level accounting data in subsection D.1, then firm-level stock prices in subsection D.2, firm-level debt in subsection D.3, and industry-level international trade data in subsection D.4. Finally, subsection D.5 reports summary statistics.

D.1 Firm-Level Accounting Data

Our sample covers the euro area, India, Japan, South Korea, Taiwan, and the United States. Our set of euro area countries consists of Belgium, France, Germany, Italy, the Netherlands, and Spain. For these countries, we start our sample in 1999 after the initial adoption of the euro.

Accounting data for firms in the United States and Canada are obtained from the Compustat North America Fundamentals Annual file, while accounting data for firms in all other countries are obtained from the Compustat Global Fundamentals Annual file. We use only firm-year observations with consolidation format `consol == C` (consolidated) in the Compustat North America Fundamentals Annual file, but include observations with both `consol == C` or `consol == N` (non-consolidated) in the Compustat Global Fundamentals Annual file since many firm-year observations are available only in non-consolidated format. For both datasets, we use only observations with industry format `indfmt == INDL`, and we exclude observations with financial services industry format `indfmt == FS`. The time period of our sample covers fiscal years 1987 to 2020.

We then apply filters similar to those used elsewhere in the corporate finance literature:

1. We keep firm-year observations with non-missing fiscal year (`fyear`), non-missing industry (`sic`), and non-missing currency of document (`curcd`).

2. We exclude firms operating in the financial services and real estate industry (`6000 <= sic < 6800`) or in the utilities industry (`4900 <= sic < 5000`).

3. We keep only firm-year observations for which the fiscal year end month (`fyr`) corresponds to the most common fiscal year end month in each country:

- United States, Euro Area, Taiwan, and South Korea: December (`fyear == 12`)
- Japan and India: March (`fyear == 3`)

4. We drop firms that switch their currency of document (`curcd`) at any point in the sample.[28]

5. We keep only firm-year observations for which the country of the headquarters location (`loc`) and the country of incorporation (`fic`) are the same, and for which the currency of document (`curcd`) is the domestic currency of the country in which the firm is located and incorporated.[29]

6. To exclude very small firms, we first convert assets and sales from nominal local currency values to real U.S. dollars (using the implicit U.S. GDP price deflator `GDPDEF` obtained from the FRED database). We then exclude firm-year observations where assets are either missing or less than 5 million 2019 U.S. dollars. We also exclude firm-year observations where sales are either missing or less than 1 million 2019 U.S. dollars

7. We keep only firm-year observations for which total property, plant and equipment (PPE) net of depreciation (`ppent`) is non-missing and positive.

8. We exclude firm-year observations in the North America file for which the `cusip` field is missing, and firms in the Global file for which the `isin` field is missing.

9. We merge end-of-fiscal-year data on firm's stock price, common shares outstanding and market capitalization, all computed using data from the Security Daily files.

    - The Security Daily file contains a `gvkey` field which we use to map firm stock price data to firm-year observations in the Fundamentals Annual files. In some cases, there are multiple common stocks (identified by the `cusip` code in the North America file and

[28] The one exception is for firms headquartered in the euro area. Since firms do not all initially report their financial statements in euros immediately after its introduction in 1999, for each firm we discard annual observations before the firm first uses the euro as its currency of document. We then drop the firm from the sample only if it switches to a different functional currency after it initially switches to the euro.

[29] For the euro area, we keep firms that are headquartered and incorporated in different countries, as long as both countries are part of the six Euro Area countries we include in our sample.

the `isin` code in the Global file) which are mapped to the same `gvkey`. To identify a unique match in these cases, we keep only the stock-year observation from the Security Daily files for which the `cusip` or `isin` code matches the corresponding code listed in the Fundamentals Annual file.[30]

We drop firm-year observations which we are not able to match to the Security Daily file.

10. We remove extreme firm-year observations where assets, sales, or net PPE increase or decrease by a factor of 10 relative to the previous year. We also remove observations where the firm reports an operating loss (from operating income after depreciation, `oiadp`) which is larger in magnitude than the value of total assets reported at the end of the previous year.

11. Finally, we drop all observations for firms that are not present in the filtered sample for at least three consecutive years.

We winsorize all annual firm-level variables used in regressions at the [1%,99%] level. Since FX transaction income has a large number of zero observations, when winsorizing FX transaction income and any ratios constructed using this variable in the numerator, we compute the percentiles used in winsorization by excluding these zero observations.

In addition to the firm-level data from the Compustat Fundamentals Annual files, we use data on foreign sales obtained from the Refinitiv Worldscope Fundamentals Annual and Segments files. We use Worldscope observations with restated data (indicated by a value of `B` in the variable `freq`) when available, and original non-restated data (indicated by a value of `A` in `freq`) otherwise. We first match firm-year observations across the Compustat and Worldscope datasets by either CUSIP (for U.S. firms) or ISIN (for non-U.S. firms) codes, and by fiscal year. We are able to match over 90% of the total observations in our final Compustat dataset to an observation in Worldscope. We then compute the foreign sales share as the ratio of foreign sales (`ITEM7101` in the Worldscope

[30] In a small number of cases this process does not yield a unique match, because the `cusip` and `isin` fields in the Fundamentals Annual file are header fields containing the most recent security identifier used by the firm (rather than the historical security identifier used by the firm in each previous year). In these cases where we cannot identify a single unique match in the Security Daily file when multiple candidate matches are available, we exclude these firm-year observations from the sample.

Segments file) to total sales (`ITEM1001` in the Worldscope Fundamentals Annual file).[31] Foreign sales are available for only a fraction of the firm-year observations that appear in Worldscope. For our main Compustat sample, a non-missing value of the foreign sales share is available from Worldscope for roughly 60% of firm-year observations, while only 35% of firm-year observations have a positive value for the foreign sales share.

D.2 Firm-Level Stock Return Data

We use daily stock price data from the Compustat North America Security Daily file and the Compustat Global Security Daily file. The North America file uses CUSIP codes as stock identifiers, while the Global file uses ISIN codes as stock identifiers. We apply the following filters to the daily data file for each country in our sample:

1. We remove weekend observations.

2. We remove stocks with missing ISIN or CUSIP codes. For non-U.S. countries, we remove stocks where the first two digits of the stock's ISIN code do not match the ISO Alpha-2 code of the country.

3. We remove observations where prices are quoted in a currency (indicated by the `curcdd` variable) other than the country's domestic currency.

4. We remove observations where the share price (`prccd`) is missing. For non-U.S. countries, we also remove observations where shares outstanding (`cshoc`) is missing.[32]

5. We keep only observations for common stocks, indicated by the issue type code `tpci == 0`.

[31] If the value of sales reported in the Worldscope Fundamentals Annual file differs from the value of sales reported in the Compustat Fundamentals Annual file by more than 10% for a given firm-year observation, we set the foreign sales share as missing. Similarly, if foreign sales reported in Worldscope are negative or greater than total firm sales, we set the foreign sales share as missing.

[32] We do not apply this filter for U.S. observations for two reasons. First, the `cshoc` variable in the Compustat North America Security Daily file is poorly populated before 1999. Second, the Compustat North America Fundamentals Annual file contains year-end share price and shares outstanding fields which we can use to compute market capitalization, so we do not need to rely on the number of shares outstanding reported in the Security Daily file. For the Compustat Global Security Daily file, the `cshoc` variable is well-populated throughout the sample period, and the Compustat Global Fundamentals Annual file does not include share prices and shares outstanding.

6. We keep only observations where the share price (`prccd`), adjustment factor (`ajexdi`), and total return factor (`trfd`) variables needed to compute returns are all nonmissing and positive.[33]

7. We keep only observations where the price status code (`prcstd`) is nonmissing and indicates non-stale price data (`prcstd == 10` for non-U.S. countries, and `prcstd == 3` for the U.S.).

After filtering the daily stock price data, we compute a daily cumulative gross return index `cumretd` as:

```
cumretd = trfd * prccd / ajexdi
```
(13)

We then convert the data to monthly frequency by taking the last daily observation for each stock observed in each month. We use month-end values for share prices, shares outstanding, and market capitalization. We compute monthly returns by taking the percentage change in the daily cumulative return index `cumretd` from the end dates of the previous month to the current month.

D.3 Firm-Level Debt Data

We use detailed data on the value and currency of denomination of firms' debt liabilities from Capital IQ's Capital Structure Debt file. This dataset reports characteristics of firms' individual liabilities or narrowly-defined categories of liabilities (e.g. individual bond issuances, capital leases, etc.) collected from financial statements and other filings. We identify individual firms in the Capital Structure Debt file using both the `companyid` identifier and the `gvkey` field, since some firms identified by the `companyid` field are presented with duplicated observations corresponding to different `gvkey` values. Data are often reported for the same financial period (indicated by the `periodenddate` field) from multiple different filings (with the date of each filing indicated by the `filingdate` variable). For each firm-period-filing (indicated by a unique combination of the

[33]For the North America Security Daily file, the total return factor (`trfd`) appears to be filled with missing values for some stocks that never pay dividends. In cases where the total return factor is missing for all observations for a given stock, we fill missing values with 1. We also fill the first value of `trfd` for each stock with 1, if the original value is missing.

companyid, gvkey, periodenddate, and filingdate fields), we compute summary measures of firms' debt liabilities from the Capital Structure Debt file as follows:

1. We first convert all reported debt values to millions of units of the firm's reporting currency using the unittypeid field.[34]

2. Following Lou and Otto (2020), we drop any debt items for which the descriptiontext field contains the term "facility", because this indicates the total available value of credit lines and other sources of liquidity available to the firm, rather than amounts that have been previously drawn and must be paid back in the future.

3. We exclude firm-period-filings for which there is an individual debt item with negative reported value (dataitemvalue).

4. We compute the total outstanding amount of debt for each firm-period-filing by summing values over all individual debt items. We also compute the total outstanding amount of the firm's debt denominated in each individual currency (as indicated by the issuedcurrencyid field), as well as the share of debt denominated in each currency as a fraction of the firm's total debt.

In some cases, the different filings for the same firm-period yield different values for total debt.[35] We then select the filing that most closely matches the data reported in Compustat Fundamentals for each gvkey-datadate pair. After summarizing the Capital Structure Debt file data by firm-period-filing, we match each filing to the corresponding observation in the Compustat Fundamentals file using the common gvkey firm identifier, and matching each periodenddate reported in Capital IQ with the datadate reported in Compustat Fundamentals. We then keep only the filing where the difference between total debt computed from the Capital Structure Debt file and total debt

[34] unittypeid values of 0, 1, and 2 indicate data reported in actual units of currency (e.g. $), thousands of units of currency (e.g. $1,000), or millions of units of currency (e.g. $1,000,000), respectively.

[35] Some of these observations may correspond to filings where principal values of debt are reported in different currencies. The Capital Structure Debt file does not indicate the currency in which dataitemvalue is reported. By manually reviewing individual filings, we concluded that these values are generally reported in the same currency for each filing. However, this currency may differ from the currency in which Compustat Fundamentals data are reported for the same firm-year.

computed from the Compustat Fundamentals file (as the sum of debt in current liabilities `dlc` and long-term debt `dltt`) is the smallest; if there are multiple such filings, we keep the one with the earliest `filingdate`.[36] We discard any matches for which the total debt values computed from Capital Structure Debt file and Compustat Fundamentals differs by more than 10% of the firm's total assets reported in Compustat Fundamentals (field `at`).

After linking the Capital IQ debt summmary data to `gvkey-datadate` observations in Compustat Fundamentals, we then compute an upper bound on the share of the firm's total debt denominated in local currency as the sum of the following shares:

- The share of the firm's debt denominated in the firm's currency of document (`curcd` in the Compustat Fundamentals files), as explicitly indicated by the `issuedcurrencyid` field.[37]
- The share of the firm's debt with a missing code for currency of denomination `issuedcurrencyid`.
- The share of the firm's debt where the currency of denomination is listed as "Multi Currency" (`issuedcurrency = 514`).

We compute the share of the firm's debt denominated in foreign currency as 1 minus the local currency debt share.[38]

Capital IQ's coverage of our Compustat Fundamentals sample varies over time. Through the 2000 fiscal year, Capital IQ contains data for few firm-year observations in our sample. Coverage

[36] In a small number of cases, there are multiple `companyid`'s that are mapped to the same `gvkey` in the Capital Structure Debt file, so that the procedure described above yields more than one filing corresponding to the distinct `companyid`'s. In these cases, we verify that all of the firm-period-filing summary variables that we construct are the same across the different `companyid`'s.

[37] The `issuedcurrencyid` codes for currencies included in our sample are: 50 for euros, 72 for Indian rupees, 79 for Japanese yen, 85 for Korean won, 156 for Taiwanese dollars, and 160 for U.S. dollars.

[38] Our estimate of the local currency debt share is an upper bound on the true local currency debt share, since we treat any debt items with either missing information for currency of denomination or that are denominated in multiple currencies (e.g. for revolving credit facilities) as being denominated in the firm's local currency. Therefore, our estimate of the share of the firm's debt denominated in foreign currency is a lower bound on the true foreign currency debt share. All shares are computed using total debt values computed from Capital IQ data, so by construction the shares of debt denominated in each individual currency sum to 1 for each firm-year, even when there are discrepancies between total debt values reported in Capital IQ and Compustat Fundamentals. We include debt items with currency listed as "Foreign Currency" (without a specific currency specified) in the firm's foreign currency debt share, since these items are excluded when computing the firm's local currency debt share.

improves for all countries in our sample starting in 2001. From 2005 onwards, we are able to match a majority of firms appearing in each year to their debt capital structure data in Capital IQ.

D.4 Industry-Level International Trade Data

We use data from the World Input-Output Database (WIOD) to construct measures of exports, imports, and gross output for 56 industries in the six currency areas in our sample. The November 2016 Release of the WIOD provides estimates of annual gross trade flows between country-industry pairs (e.g. between the basic metals manufacturing sector in India and the auto manufacturing sector in Japan) from 2000 to 2014. The industry classification includes 56 industries (e.g. "Manufacture of motor vehicles, trailers and semi-trailers") and 5 final demand sectors. We first compute international trade summary statistics using input-output tables for each year. For each country-industry we compute imports as total purchases of intermediate goods from other countries, exports as total sales to other countries, and the ratio of net exports (imports minus exports) to gross output.[39] Finally, we compute the average of this ratio over the available years 2000-2014. This is the main country-industry international trade balance variable that we use throughout our analysis.

Mapping each firm observed in the Compustat Fundamentals file to one of the 56 WIOD industries poses several challenges. The industries in the WIOD 2016 Release are defined using International Standard of Industrial Classification (ISIC) Revision 4 codes. The Compustat Fundamentals file does not contain ISIC codes for each firm. It does contain North American Industry Classification System (NAICS) codes for each firm, and the U.S. Census Bureau provides a concordance table mapping 6-digit NAICS codes to 4-digit ISIC codes. However, three issues arise when attempting to link the NAICS codes provided in Compustat to ISIC codes on which the WIOD industries are based using these concordance tables. First, some individual 6-digit NAICS codes are mapped to multiple ISIC codes, which in turn are mapped to multiple WIOD industries. Second, many of the NAICS codes provided in Compustat's `naics` variable have fewer than 6 digits, requiring us to build additional concordance tables from each of the broader 2, 3, 4, and 5-digit

[39] For each euro area industry, we aggregate sales across all 19 euro area member countries, and exclude purchases and sales between member countries when computing imports and exports.

NAICS industries to a single WIOD industry. Third, Compustat contains industry codes from multiple different versions of NAICS (1997, 2002, 2007, 2012, and 2017).[40]

To address the first two problems, we build a concordance from all (2-digit through 6-digit) 2017 NAICS codes to WIOD industries. Our algorithm for mapping individual NAICS codes to unique WIOD is similar to the one used by Covarrubias, Gutierrez and Philippon (2020). We start from the official U.S. Census Bureau concordance table mapping each 6-digit 2017 NAICS code to one or more 4-digit ISIC codes. Next, we map each 4-digit ISIC code to a unique WIOD industry (based on the first two digits of the ISIC code). We then sequentially build concordance tables from each n-digit NAICS code (where $n = 2, 3, 4, 5, 6$) to a single WIOD industry using the following algorithm. For each individual n-digit NAICS code:

1. We collect all entries in the official 2017 NAICS-to-ISIC concordance table where the 6-digit NAICS code belongs to the given n-digit NAICS industry (or when $n = 6$, we collect all entries where the 6-digit NAICS code matches the given code).

2. Among the collected entries, we count the frequency with which the 6-digit NAICS codes are mapped to each WIOD industry.

    - If there is a single WIOD industry that appears most frequently among the collected entries, we map the n-digit NAICS code to that WIOD industry in our final concordance table.

    - If there are multiple WIOD industries that appear most frequently among the collected entries, we first truncate the last digit from the given n-digit NAICS code to construct a $(n-1)$-digit NAICS code. We then refer to our final concordance table from $(n-1)$-digit NAICS codes to WIOD industries to obtain the single WIOD industry that the truncated NAICS code is mapped to. We then map the original n-digit NAICS code to this WIOD industry in our final concordance table.

[40] We use versions of the Compustat Fundamentals files downloaded prior to June 2022, when 2022 NAICS codes began to be used.

We first build the concordance table for n = 2-digit 2017 NAICS codes. For each 2-digit NAICS code, there is a single WIOD industry that appears most frequently among the set of concordance table entries described in the algorithm above. Therefore, the "tiebreaking" rule between WIOD industries described above is never invoked, and we can construct the concordance table from 2-digit NAICS codes to WIOD industries, without referring to a non-existent concordance table using 1-digit NAICS codes. We then construct our concordance table from n = 3-digit NAICS codes to WIOD industries, using the concordance table for 2-digit NAICS codes when necessary. We continue this sequential procedure to produce all of the desired concordance tables from 2017 NAICS codes to WIOD industries.

To address the third problem - the fact that Compustat's `naics` variable contains NAICS codes from different NAICS versions (1997, 2002, 2007, 2012, and 2017) - we use the official Census Bureau concordance tables between NAICS versions. These tables map, for example, 6-digit 2012 NAICS codes to 6-digit 2017 NAICS codes. However, the official concordance tables do not provide a mapping between the 2- through 5-digit NAICS codes reported for many firms in Compustat. In addition, individual 6-digit NAICS industries in the earlier NAICS version are in some cases mapped to multiple 6-digit NAICS industries in the latter NAICS version. To expand our concordance table to cover all 2- through 5-digit NAICS codes in prior NAICS versions, we use the following algorithm.

1. We start by collecting all 6-digit NAICS codes that appears in the list of 2012 NAICS codes but not in our existing NAICS-to-WIOD industry concordance table (which initially contains the complete list of 2017 NAICS codes).

2. For each of these 6-digit 2012 NAICS codes, we use the official concordance table to obtain the corresponding set of 6-digit 2017 NAICS codes.

    - If our existing NAICS-to-WIOD industry concordance table maps all of these NAICS codes to the same WIOD industry, we update our NAICS-to-WIOD industry concordance table to map the given 6-digit 2012 NAICS code to this WIOD industry.

- If our existing NAICS-to-WIOD industry concordance table maps some of these NAICS codes to different WIOD industries, we manually determine the most appropriate WIOD industry to which the given 6-digit 2012 NAICS code should be matched, then update our NAICS-to-WIOD industry concordance table. The list of manual matches used across all NAICS versions is provided below.

3. We repeat the above steps to map each n-digit 2012 NAICS codes that does not appear in our existing NAICS-to-WIOD industry concordance table to a single WIOD industry (starting from $n = 5$ and working backwards sequentially to $n = 2$). At this stage, our existing NAICS-to-WIOD industry concordance table contains entries mapping each $(n + 1)$-digit 2012 NAICS code to a single WIOD industry. For each selected n-digit 2012 NAICS code that is not already present in this table, we obtain the set of $(n+1)$-digit 2012 NAICS codes in the table that match the first n digits.

   - If our existing NAICS-to-WIOD industry concordance table maps all of these NAICS codes to the same WIOD industry, we update our NAICS-to-WIOD industry concordance table to map the given n-digit 2012 NAICS code to this WIOD industry.
   - If our existing NAICS-to-WIOD industry concordance table maps some of these NAICS codes to different WIOD industries, we again manually determine the most appropriate WIOD industry to which the given n-digit 2012 NAICS code should be matched, then update our NAICS-to-WIOD industry concordance table.

Using this algorithm, we extend our NAICS-to-WIOD industry concordance table to include all 2- through 6-digit 2012 NAICS codes that are not present in the list of 2017 NAICS codes. We then apply the same algorithm to sequentially add any 2007 NAICS codes (using the official 2007 NAICS to 2012 NAICS concordance table), 2002 NAICS codes (using the official 2002 NAICS to 2007 NAICS concordance table), and 1997 NAICS codes (using the official 1997 NAICS to 2002 NAICS concordance table) that were not already present in the table. We also manually map 4 NAICS codes that appear in Compustat, but not in any of the official Census Bureau files; the

NAICS codes and corresponding WIOD industries are listed at the bottom of the table below.

NAICS Industry Code/Description	**NAICS Year**	**WIOD Industry Number/Description**
334119: "Other Computer Peripheral Equipment Manufacturing"	2007	17: "Manufacture of computer, electronic and optical products"
339111: "Laboratory Apparatus and Furniture Manufacturing"	2002	19: "Manufacture of machinery and equipment n.e.c."
525930: "Real Estate Investment Trusts"	2002	44: "Real estate activities"
51811: "Internet Service Providers and Web Search Portals"	2002	39: "Telecommunications"
4212-4229: industries within "Wholesale Trade" (excluding 4211: "Motor Vehicle and Motor Vehicle Parts and Supplies Wholesalers")	1997	29: "Wholesale trade, except of motor vehicles and motorcycles"
51419: "Other Information Services"	1997	40: "Computer programming, consultancy and related activities; information service activities"
5132: "Cable Networks and Program Distribution"	1997	38: "Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities"
5141: "Information Services"	1997	40: "Computer programming, consultancy and related activities; information service activities"
421: "Wholesale Trade"	1997	29: "Wholesale trade, except of motor vehicles and motorcycles"
513: "Broadcasting and Telecommunications"	1997	39: "Telecommunications"
514: "Information Services and Data Processing Services"	1997	40: "Computer programming, consultancy and related activities; information service activities"
337120: "Blind and Shade Manufacturing"	Unknown	22: "Manufacture of furniture; other manufacturing"
33713: "Wood Furniture Manufacturing"	Unknown	22: "Manufacture of furniture; other manufacturing"
33714: "Nonwood Furniture Manufacturing"	Unknown	22: "Manufacture of furniture; other manufacturing"
48122: "Nonscheduled Specialty Air Transportation"	Unknown	33: "Air transport"

D.5 Summary Statistics

The following tables present summary statistics for firm-year observations in each country. We consider two samples: either all firm-year observations in our sample (including those with missing FX transaction income) or the set of firms that report non-zero FX transaction risk for at least one year in the sample, which we refer to as the set of "exposed" firms. All level variables are reported in units of local currency, converted to a convenient scale for presentation (e.g. millions of U.S. dollars, billions of Japanese yen, etc.).

Summary statistics immediately highlight the contrast between the U.S. and the other countries. For example, among all the Japanese public firm-year data, approximately one-fourth of the FX transaction observations imply a risk of more than 26% of the firm's net income. The U.S. counterparts suggest a much smaller role for currency risk. Among all U.S. firms, one fourth of

the observations imply a risk above 0.1%. Among the U.S. firms reporting any FX transaction risk (including 0), three-quarters of the observations imply a risk of less than 4.6% of the firm's net income. And only 5 percent of the same observations imply a risk of more than 27% of the firm's net income. Among all the U.S. public firm-year data, 95% of the observations imply a risk of less than 7.1% of the firm's net income. Clearly, exchange rates matter for Japanese firms, but much less for U.S. firms. A large share of firms in India, South Korea, and Taiwan also appear exposed to FX transaction risk, while euro area firms appear closer to their U.S. counterparts.

Table D1. Summary Statistics: United States, All Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	69,057	69,057	2,010	6,200	1	2	7	51	242	1,131	9,609	31,025	80,684
Pre-Tax Income	69,055	69,050	161	769	-3,883	-550	-110	-6	6	65	819	3,814	9,465
Assets	69,057	69,057	2,625	8,898	4	6	11	61	272	1,313	12,475	42,564	158,112
Return on Assets (%)	69,055	69,050	-2.49	25.05	-238.25	-106.24	-51.05	-6.24	3.79	10.01	22.15	33.76	43.33
Profit Margin (%)	69,055	69,050	-23.10	119.44	-1,392.55	-663.81	-146.87	-7.20	3.63	10.61	26.72	44.94	57.73
Market / Book Ratio	68,896	68,896	2.03	1.61	0.41	0.61	0.80	1.12	1.50	2.28	5.21	8.80	18.64
Total Debt / Assets	68,812	59,897	0.26	0.24	0.00	0.00	0.00	0.05	0.22	0.39	0.71	1.09	1.51
Foreign Currency Debt / Assets	37,105	3,248	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.20
Foreign Sales Share	50,936	27,008	0.19	0.25	0.00	0.00	0.00	0.00	0.05	0.34	0.71	0.95	1.00
Cash / Assets	69,049	68,834	0.18	0.21	0.00	0.00	0.00	0.03	0.09	0.26	0.67	0.87	0.93
FX Transaction Income	15,747	15,286	-2	19	-223	-92	-21	-2	-0	0	9	45	150
FX Transaction Income / Assets (%)	15,747	15,286	-0.06	0.52	-7.36	-1.78	-0.76	-0.17	-0.03	0.06	0.56	1.37	3.27
FX Transaction Income / Sales (%)	15,747	15,286	-0.07	0.74	-8.91	-2.52	-0.91	-0.20	-0.03	0.08	0.69	2.07	8.07
|FX Transaction Income| / Assets (%)	15,747	15,286	0.27	0.45	0.00	0.00	0.00	0.04	0.12	0.30	1.07	2.18	7.36
|FX Transaction Income| / Sales (%)	15,747	15,286	0.35	0.66	0.00	0.00	0.00	0.05	0.15	0.37	1.36	3.39	8.91
|FX Transaction Income| / |Income| (%)	15,746	15,285	6.17	16.28	0.00	0.00	0.04	0.47	1.52	4.61	26.98	79.64	276.37

This table reports summary statistics for all firms in our sample located in the United States. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of U.S. dollars. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D2. Summary Statistics: United States, Exposed Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	29,066	29,066	3,142	7,949	1	3	16	105	468	2,221	16,593	42,205	80,684
Pre-Tax Income	29,065	29,063	276	1,011	-3,883	-599	-125	-4	17	140	1,657	5,811	9,465
Assets	29,066	29,066	4,093	11,472	4	8	20	123	539	2,495	21,973	55,841	158,112
Return on Assets (%)	29,065	29,063	0.58	21.41	-238.25	-90.87	-38.20	-2.79	5.03	10.93	22.22	32.83	43.33
Profit Margin (%)	29,065	29,063	-12.89	100.52	-1,392.55	-539.20	-75.83	-3.21	5.18	11.79	26.59	42.76	57.73
Market / Book Ratio	29,027	29,027	2.08	1.59	0.41	0.67	0.85	1.18	1.57	2.34	5.12	8.72	18.64
Total Debt / Assets	28,960	25,323	0.23	0.22	0.00	0.00	0.00	0.05	0.20	0.35	0.62	0.96	1.51
Foreign Currency Debt / Assets	17,205	2,569	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.13	0.20
Foreign Sales Share	23,152	19,175	0.32	0.25	0.00	0.00	0.00	0.11	0.29	0.49	0.79	0.99	1.00
Cash / Assets	29,061	29,020	0.18	0.20	0.00	0.00	0.01	0.04	0.11	0.26	0.63	0.83	0.93
FX Transaction Income	15,666	15,286	-2	19	-223	-92	-21	-2	-0	0	9	45	150
FX Transaction Income / Assets (%)	15,666	15,286	-0.07	0.52	-7.36	-1.79	-0.77	-0.17	-0.03	0.07	0.57	1.37	3.27
FX Transaction Income / Sales (%)	15,666	15,286	-0.07	0.74	-8.91	-2.52	-0.92	-0.21	-0.04	0.08	0.70	2.07	8.07
|FX Transaction Income| / Assets (%)	15,666	15,286	0.27	0.45	0.00	0.00	0.00	0.04	0.12	0.31	1.07	2.18	7.36
|FX Transaction Income| / Sales (%)	15,666	15,286	0.35	0.66	0.00	0.00	0.01	0.05	0.15	0.37	1.37	3.40	8.91
|FX Transaction Income| / |Income| (%)	15,665	15,285	6.20	16.31	0.00	0.00	0.04	0.48	1.54	4.64	26.98	80.19	276.37

This table reports summary statistics for exposed firms in our sample located in the United States. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of U.S. dollars. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D3. Summary Statistics: Euro Area, All Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	22,250	22,250	2,509	7,584	2	3	8	51	201	1,065	13,662	44,758	60,258
Pre-Tax Income	22,250	22,248	154	576	-1,686	-252	-34	-0	7	51	841	3,325	6,308
Assets	22,250	22,250	3,417	11,315	5	7	13	56	217	1,154	18,275	66,943	112,803
Return on Assets (%)	22,250	22,248	1.79	14.12	-111.51	-56.77	-24.07	-0.44	4.05	8.17	17.87	28.99	35.87
Profit Margin (%)	22,250	22,248	-3.26	43.59	-595.81	-251.97	-43.68	-0.49	4.09	9.11	22.00	37.63	66.69
Market / Book Ratio	22,250	22,250	1.52	0.95	0.50	0.62	0.79	1.01	1.23	1.66	3.28	5.83	16.27
Total Debt / Assets	22,243	21,117	0.23	0.17	0.00	0.00	0.00	0.08	0.21	0.33	0.54	0.74	0.95
Foreign Currency Debt / Assets	21,117	3,538	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.20	0.29
Foreign Sales Share	15,278	13,548	0.46	0.31	0.00	0.00	0.00	0.18	0.48	0.73	0.92	1.00	1.00
Cash / Assets	22,248	22,248	0.15	0.14	0.00	0.00	0.01	0.05	0.10	0.19	0.46	0.69	0.79
FX Transaction Income	22,223	14,581	-1	14	-272	-54	-9	-0	0	0	3	23	107
FX Transaction Income / Assets (%)	22,223	14,581	-0.05	0.47	-5.23	-1.70	-0.67	-0.07	0.00	0.01	0.47	1.34	3.25
FX Transaction Income / Sales (%)	22,223	14,581	-0.06	0.88	-18.59	-2.57	-0.84	-0.08	0.00	0.01	0.57	2.42	6.88
|FX Transaction Income| / Assets (%)	22,223	14,581	0.20	0.42	0.00	0.00	0.00	0.00	0.04	0.21	0.95	2.03	5.23
|FX Transaction Income| / Sales (%)	22,223	14,581	0.29	0.83	0.00	0.00	0.00	0.00	0.04	0.24	1.31	3.57	18.59
|FX Transaction Income| / |Income| (%)	22,221	14,581	5.71	17.62	0.00	0.00	0.00	0.00	0.57	3.69	26.79	89.02	298.18

This table reports summary statistics for all firms in our sample located in the Euro Area. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of euros. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D4. Summary Statistics: Euro Area, Exposed Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	19,377	19,377	2,711	7,872	2	3	9	59	229	1,226	14,828	45,286	60,258
Pre-Tax Income	19,377	19,376	162	589	-1,686	-280	-37	-0	8	61	894	3,475	6,308
Assets	19,377	19,377	3,669	11,672	5	7	14	65	246	1,339	20,820	68,272	112,803
Return on Assets (%)	19,377	19,376	1.83	14.01	-111.51	-56.85	-23.75	-0.38	4.14	8.19	17.62	28.76	35.87
Profit Margin (%)	19,377	19,376	-3.40	44.25	-595.81	-264.22	-43.02	-0.41	4.15	9.16	21.08	35.79	66.69
Market / Book Ratio	19,377	19,377	1.52	0.94	0.50	0.62	0.79	1.01	1.24	1.66	3.28	5.81	16.27
Total Debt / Assets	19,374	18,483	0.23	0.17	0.00	0.00	0.00	0.09	0.21	0.33	0.53	0.74	0.95
Foreign Currency Debt / Assets	18,515	3,426	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.21	0.29
Foreign Sales Share	13,756	12,541	0.48	0.30	0.00	0.00	0.00	0.23	0.50	0.74	0.93	1.00	1.00
Cash / Assets	19,375	19,375	0.15	0.14	0.00	0.00	0.01	0.05	0.10	0.20	0.46	0.69	0.79
FX Transaction Income	19,358	14,581	-2	15	-272	-59	-10	-0	0	0	4	25	107
FX Transaction Income / Assets (%)	19,358	14,581	-0.05	0.50	-5.23	-1.86	-0.74	-0.11	0.00	0.02	0.54	1.41	3.25
FX Transaction Income / Sales (%)	19,358	14,581	-0.07	0.94	-18.59	-2.79	-0.93	-0.12	0.00	0.03	0.66	2.57	6.88
|FX Transaction Income| / Assets (%)	19,358	14,581	0.23	0.45	0.00	0.00	0.00	0.00	0.06	0.25	1.03	2.13	5.23
|FX Transaction Income| / Sales (%)	19,358	14,581	0.33	0.89	0.00	0.00	0.00	0.00	0.07	0.29	1.47	3.66	18.59
|FX Transaction Income| / |Income| (%)	19,357	14,581	6.56	18.73	0.00	0.00	0.00	0.01	1.03	4.56	31.38	94.97	298.18

This table reports summary statistics for exposed firms in our sample located in the Euro Area. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of euros. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D5. Summary Statistics: Japan, All Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	66,244	66,244	191	518	1	2	4	16	41	128	823	3,067	6,323
Pre-Tax Income	66,244	66,225	8	26	-56	-11	-2	0	1	5	36	133	352
Assets	66,244	66,244	205	562	1	2	5	16	42	125	931	3,354	6,649
Return on Assets (%)	66,244	66,225	3.54	6.31	-54.35	-19.28	-5.97	1.24	3.51	6.50	12.82	19.78	24.63
Profit Margin (%)	66,244	66,225	3.67	7.99	-68.10	-26.46	-6.87	1.13	3.41	6.70	15.33	25.90	35.88
Market / Book Ratio	66,244	66,244	1.20	0.66	0.39	0.50	0.63	0.86	1.03	1.32	2.32	4.01	8.14
Total Debt / Assets	66,237	60,786	0.23	0.19	0.00	0.00	0.00	0.06	0.20	0.35	0.58	0.72	0.84
Foreign Currency Debt / Assets	37,379	736	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.12
Foreign Sales Share	38,374	18,173	0.15	0.22	0.00	0.00	0.00	0.00	0.00	0.25	0.64	0.82	0.89
Cash / Assets	66,244	66,244	0.18	0.13	0.01	0.02	0.04	0.09	0.15	0.24	0.45	0.61	0.73
FX Transaction Income	66,228	30,015	-0	1	-33	-3	-1	0	0	0	0	2	15
FX Transaction Income / Assets (%)	66,228	30,015	-0.01	0.34	-4.47	-1.22	-0.44	0.00	0.00	0.00	0.37	1.03	3.05
FX Transaction Income / Sales (%)	66,228	30,015	-0.01	0.43	-5.44	-1.45	-0.51	0.00	0.00	0.00	0.42	1.32	5.29
|FX Transaction Income| / Assets (%)	66,228	30,015	0.13	0.31	0.00	0.00	0.00	0.00	0.00	0.14	0.67	1.54	4.47
|FX Transaction Income| / Sales (%)	66,228	30,015	0.16	0.40	0.00	0.00	0.00	0.00	0.00	0.14	0.80	1.94	5.44
|FX Transaction Income| / |Income| (%)	66,209	30,010	5.96	23.61	0.00	0.00	0.00	0.00	0.00	3.07	26.53	102.20	956.21

This table reports summary statistics for all firms in our sample located in Japan. Sales, income, assets, market capitalization, FX transaction income are all reported in billions of Japanese yen. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D6. Summary Statistics: Japan, Exposed Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	53,168	53,168	218	559	1	2	5	18	48	155	980	3,314	6,323
Pre-Tax Income	53,168	53,152	9	28	-56	-13	-2	0	2	6	44	152	352
Assets	53,168	53,168	235	603	1	2	6	19	50	156	1,103	3,522	6,649
Return on Assets (%)	53,168	53,152	3.64	6.18	-54.35	-17.62	-5.73	1.30	3.59	6.57	12.79	19.77	24.63
Profit Margin (%)	53,168	53,152	3.86	7.92	-68.10	-24.34	-6.75	1.23	3.56	6.98	15.50	25.91	35.88
Market / Book Ratio	53,168	53,168	1.21	0.65	0.39	0.50	0.64	0.86	1.04	1.33	2.31	3.98	8.14
Total Debt / Assets	53,162	49,145	0.23	0.18	0.00	0.00	0.00	0.06	0.20	0.35	0.57	0.71	0.84
Foreign Currency Debt / Assets	30,721	710	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.12
Foreign Sales Share	32,095	17,990	0.18	0.22	0.00	0.00	0.00	0.00	0.10	0.30	0.67	0.83	0.89
Cash / Assets	53,168	53,168	0.18	0.12	0.01	0.02	0.04	0.09	0.15	0.24	0.44	0.60	0.73
FX Transaction Income	53,161	30,015	-0	1	-33	-4	-1	-0	0	0	1	3	15
FX Transaction Income / Assets (%)	53,161	30,015	-0.02	0.38	-4.47	-1.33	-0.52	-0.04	0.00	0.01	0.45	1.13	3.05
FX Transaction Income / Sales (%)	53,161	30,015	-0.01	0.48	-5.44	-1.60	-0.61	-0.04	0.00	0.01	0.51	1.53	5.29
|FX Transaction Income| / Assets (%)	53,161	30,015	0.17	0.34	0.00	0.00	0.00	0.00	0.03	0.19	0.78	1.66	4.47
|FX Transaction Income| / Sales (%)	53,161	30,015	0.20	0.44	0.00	0.00	0.00	0.00	0.02	0.21	0.92	2.18	5.44
|FX Transaction Income| / |Income| (%)	53,145	30,010	7.42	26.15	0.00	0.00	0.00	0.00	0.46	4.71	32.80	119.94	956.21

This table reports summary statistics for exposed firms in our sample located in Japan. Sales, income, assets, market capitalization, FX transaction income are all reported in billions of Japanese yen. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D7. Summary Statistics: Taiwan, All Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	24,583	24,583	13,709	39,892	69	105	299	1,199	2,960	8,551	54,449	269,231	379,712
Pre-Tax Income	24,583	24,583	861	3,119	-11,384	-2,160	-443	8	157	580	3,818	18,924	34,747
Assets	24,583	24,583	17,443	49,218	242	319	609	1,688	3,965	10,613	71,617	329,780	428,270
Return on Assets (%)	24,583	24,583	4.04	9.47	-40.57	-28.32	-12.94	0.36	4.46	9.14	18.59	26.23	32.82
Profit Margin (%)	24,583	24,583	3.47	20.64	-159.31	-93.25	-27.30	0.48	5.32	11.96	26.95	44.86	71.03
Market / Book Ratio	24,583	24,583	1.41	0.78	0.45	0.62	0.74	0.95	1.16	1.57	2.95	4.81	7.38
Total Debt / Assets	24,583	21,529	0.20	0.17	0.00	0.00	0.00	0.05	0.18	0.32	0.50	0.64	0.72
Foreign Currency Debt / Assets	22,512	2,447	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.13	0.21
Foreign Sales Share	13,725	11,136	0.44	0.37	0.00	0.00	0.00	0.04	0.42	0.82	1.00	1.00	1.00
Cash / Assets	24,583	24,583	0.22	0.16	0.00	0.01	0.03	0.10	0.18	0.31	0.56	0.73	0.78
FX Transaction Income	24,579	22,649	8	115	-2,934	-309	-84	-8	0	12	121	485	1,327
FX Transaction Income / Assets (%)	24,579	22,649	-0.00	0.74	-4.16	-2.50	-1.23	-0.23	0.00	0.27	1.15	2.01	5.87
FX Transaction Income / Sales (%)	24,579	22,649	-0.04	1.21	-13.28	-4.05	-1.79	-0.31	0.00	0.34	1.54	3.06	7.24
|FX Transaction Income| / Assets (%)	24,579	22,649	0.46	0.58	0.00	0.00	0.00	0.07	0.25	0.64	1.63	2.68	5.87
|FX Transaction Income| / Sales (%)	24,579	22,649	0.66	1.01	0.00	0.00	0.00	0.09	0.32	0.84	2.39	4.84	13.28
|FX Transaction Income| / |Income| (%)	24,579	22,649	14.37	31.93	0.00	0.00	0.00	1.04	4.13	12.44	66.23	163.30	341.03

This table reports summary statistics for all firms in our sample located in Taiwan. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of New Taiwan dollars. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D8. Summary Statistics: Taiwan, Exposed Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	24,328	24,328	13,625	39,796	69	106	302	1,200	2,950	8,523	53,297	271,941	379,712
Pre-Tax Income	24,328	24,328	857	3,120	-11,384	-2,160	-448	8	155	576	3,794	19,021	34,747
Assets	24,328	24,328	17,485	49,403	242	319	607	1,681	3,947	10,606	71,695	329,780	428,270
Return on Assets (%)	24,328	24,328	4.00	9.49	-40.57	-28.36	-12.99	0.33	4.41	9.12	18.59	26.23	32.82
Profit Margin (%)	24,328	24,328	3.37	20.60	-159.31	-94.05	-27.41	0.43	5.30	11.90	26.47	44.47	71.03
Market / Book Ratio	24,328	24,328	1.40	0.78	0.45	0.62	0.74	0.95	1.15	1.57	2.94	4.81	7.38
Total Debt / Assets	24,328	21,373	0.20	0.17	0.00	0.00	0.00	0.05	0.19	0.32	0.51	0.64	0.72
Foreign Currency Debt / Assets	22,281	2,447	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.13	0.21
Foreign Sales Share	13,579	11,116	0.45	0.37	0.00	0.00	0.00	0.05	0.42	0.82	1.00	1.00	1.00
Cash / Assets	24,328	24,328	0.22	0.16	0.00	0.01	0.03	0.10	0.18	0.31	0.56	0.73	0.78
FX Transaction Income	24,324	22,649	8	116	-2,934	-312	-85	-8	0	12	122	485	1,327
FX Transaction Income / Assets (%)	24,324	22,649	-0.00	0.74	-4.16	-2.50	-1.24	-0.23	0.00	0.28	1.15	2.02	5.87
FX Transaction Income / Sales (%)	24,324	22,649	-0.04	1.21	-13.28	-4.07	-1.79	-0.32	0.00	0.35	1.55	3.08	7.24
|FX Transaction Income| / Assets (%)	24,324	22,649	0.47	0.58	0.00	0.00	0.00	0.07	0.26	0.64	1.64	2.69	5.87
|FX Transaction Income| / Sales (%)	24,324	22,649	0.67	1.01	0.00	0.00	0.00	0.09	0.33	0.85	2.40	4.86	13.28
|FX Transaction Income| / |Income| (%)	24,324	22,649	14.52	32.06	0.00	0.00	0.00	1.11	4.23	12.63	66.84	163.55	341.03

This table reports summary statistics for exposed firms in our sample located in Taiwan. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of New Taiwan dollars. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D9. Summary Statistics: South Korea, All Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	29,212	29,212	846	2,759	4	6	14	51	132	386	3,503	17,618	30,719
Pre-Tax Income	29,212	29,212	32	146	-906	-150	-30	-2	4	17	159	882	1,455
Assets	29,212	29,212	974	3,273	8	16	28	69	149	431	4,113	19,871	34,195
Return on Assets (%)	29,212	29,212	0.53	14.78	-146.09	-62.02	-24.40	-1.55	2.83	7.27	16.26	23.85	77.16
Profit Margin (%)	29,212	29,212	-3.68	36.59	-493.32	-175.55	-51.00	-1.88	3.12	8.21	21.24	36.94	150.19
Market / Book Ratio	29,212	29,212	1.26	0.84	0.32	0.48	0.60	0.83	1.01	1.36	2.74	4.95	8.92
Total Debt / Assets	29,212	26,852	0.25	0.19	0.00	0.00	0.00	0.08	0.23	0.38	0.58	0.69	1.52
Foreign Currency Debt / Assets	21,367	7,251	0.02	0.05	-0.00	0.00	0.00	0.00	0.00	0.01	0.14	0.27	0.41
Foreign Sales Share	11,691	8,462	0.25	0.28	0.00	0.00	0.00	0.00	0.13	0.45	0.83	0.95	1.00
Cash / Assets	29,212	29,212	0.17	0.15	0.00	0.01	0.02	0.06	0.12	0.23	0.48	0.65	0.74
FX Transaction Income	29,212	27,646	-1	20	-561	-35	-6	-0	0	0	4	30	206
FX Transaction Income / Assets (%)	29,212	27,646	-0.04	1.05	-11.53	-3.49	-1.37	-0.19	0.00	0.17	1.17	2.76	9.40
FX Transaction Income / Sales (%)	29,212	27,646	-0.06	1.56	-24.68	-5.00	-1.80	-0.23	0.00	0.21	1.55	3.63	22.26
|FX Transaction Income| / Assets (%)	29,212	27,646	0.49	0.93	0.00	0.00	0.00	0.04	0.18	0.55	1.98	4.42	11.53
|FX Transaction Income| / Sales (%)	29,212	27,646	0.66	1.42	0.00	0.00	0.00	0.05	0.22	0.68	2.63	5.94	24.68
|FX Transaction Income| / |Income| (%)	29,212	27,646	18.67	57.54	0.00	0.00	0.00	0.61	3.32	12.89	88.88	234.39	1,565.83

This table reports summary statistics for all firms in our sample located in South Korea. Sales, income, assets, market capitalization, FX transaction income are all reported in billions of Korean won. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D10. Summary Statistics: South Korea, Exposed Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	28,917	28,917	853	2,773	4	6	14	50	132	388	3,551	17,744	30,719
Pre-Tax Income	28,917	28,917	32	147	-906	-152	-30	-2	4	17	160	882	1,455
Assets	28,917	28,917	981	3,289	8	16	28	69	149	432	4,152	20,130	34,195
Return on Assets (%)	28,917	28,917	0.48	14.82	-146.09	-62.30	-24.54	-1.61	2.80	7.24	16.17	23.85	77.16
Profit Margin (%)	28,917	28,917	-3.76	36.66	-493.32	-175.55	-51.36	-1.97	3.10	8.17	21.18	36.94	150.19
Market / Book Ratio	28,917	28,917	1.26	0.84	0.32	0.48	0.60	0.83	1.01	1.36	2.75	4.98	8.92
Total Debt / Assets	28,917	26,624	0.25	0.19	0.00	0.00	0.00	0.08	0.24	0.38	0.58	0.69	1.52
Foreign Currency Debt / Assets	21,220	7,249	0.02	0.05	-0.00	0.00	0.00	0.00	0.00	0.01	0.14	0.27	0.41
Foreign Sales Share	11,596	8,443	0.25	0.29	0.00	0.00	0.00	0.00	0.13	0.45	0.83	0.95	1.00
Cash / Assets	28,917	28,917	0.17	0.15	0.00	0.01	0.02	0.06	0.12	0.23	0.48	0.65	0.74
FX Transaction Income	28,917	27,646	-1	20	-561	-35	-6	-0	0	0	4	30	206
FX Transaction Income / Assets (%)	28,917	27,646	-0.04	1.06	-11.53	-3.52	-1.38	-0.19	0.00	0.18	1.18	2.77	9.40
FX Transaction Income / Sales (%)	28,917	27,646	-0.06	1.57	-24.68	-5.01	-1.81	-0.24	0.00	0.22	1.57	3.65	22.26
|FX Transaction Income| / Assets (%)	28,917	27,646	0.50	0.93	0.00	0.00	0.00	0.04	0.19	0.56	2.00	4.42	11.53
|FX Transaction Income| / Sales (%)	28,917	27,646	0.66	1.43	0.00	0.00	0.00	0.05	0.23	0.69	2.65	6.02	24.68
|FX Transaction Income| / |Income| (%)	28,917	27,646	18.86	57.80	0.00	0.00	0.00	0.66	3.40	13.07	89.51	234.39	1,565.83

This table reports summary statistics for exposed firms in our sample located in South Korea. Sales, income, assets, market capitalization, FX transaction income are all reported in billions of Korean won. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D11. Summary Statistics: India, All Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	26,352	26,352	19,770	61,692	72	127	303	1,258	3,733	12,251	76,164	385,610	668,190
Pre-Tax Income	26,352	26,351	1,566	7,157	-18,194	-7,057	-1,099	7	148	780	7,314	45,857	78,898
Assets	26,352	26,352	27,932	93,153	242	333	515	1,610	4,570	15,237	109,921	598,156	1,124,893
Return on Assets (%)	26,352	26,351	4.67	11.45	-72.70	-36.94	-12.93	0.43	4.51	10.20	22.29	33.48	48.05
Profit Margin (%)	26,352	26,351	1.06	33.76	-348.15	-169.92	-37.29	0.53	4.91	11.54	28.63	55.46	84.42
Market / Book Ratio	26,352	26,352	1.47	1.25	0.23	0.36	0.56	0.84	1.05	1.57	3.93	7.12	15.99
Total Debt / Assets	26,332	25,002	0.32	0.27	0.00	0.00	0.00	0.12	0.29	0.45	0.72	1.29	2.11
Foreign Currency Debt / Assets	24,602	5,537	0.02	0.06	0.00	0.00	0.00	-0.00	0.00	0.00	0.15	0.30	0.36
Foreign Sales Share	12,586	5,054	0.16	0.27	0.00	0.00	0.00	0.00	0.00	0.20	0.84	0.97	1.00
Cash / Assets	26,352	26,352	0.08	0.11	0.00	0.00	0.00	0.01	0.03	0.09	0.32	0.54	0.60
FX Transaction Income	26,279	18,044	-23	346	-6,929	-1,026	-151	-2	0	2	98	577	3,927
FX Transaction Income / Assets (%)	26,279	18,044	-0.03	0.74	-11.25	-2.66	-0.96	-0.05	0.00	0.06	0.86	2.08	5.20
FX Transaction Income / Sales (%)	26,279	18,044	-0.04	1.04	-15.51	-4.01	-1.22	-0.06	0.00	0.07	1.07	2.86	12.11
|FX Transaction Income| / Assets (%)	26,279	18,044	0.31	0.67	0.00	0.00	0.00	0.00	0.05	0.33	1.47	3.03	11.25
|FX Transaction Income| / Sales (%)	26,279	18,044	0.41	0.96	0.00	0.00	0.00	0.00	0.07	0.39	1.95	4.93	15.51
|FX Transaction Income| / |Income| (%)	26,278	18,043	10.53	36.01	0.00	0.00	0.00	0.00	0.76	5.57	49.41	174.16	498.19

This table reports summary statistics for all firms in our sample located in India. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of Indian rupees. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.

Table D12. Summary Statistics: India, Exposed Firms

	Obs	NonzeroObs	Mean	StdDev	Min	Q01	Q05	Q25	Q50	Q75	Q95	Q99	Max
Sales	23,866	23,866	21,146	63,560	72	139	350	1,442	4,231	13,528	81,731	391,595	668,190
Pre-Tax Income	23,866	23,865	1,669	7,387	-18,194	-8,177	-1,215	10	175	870	8,216	46,178	78,898
Assets	23,866	23,866	29,844	95,941	242	340	553	1,788	5,174	16,823	118,373	638,528	1,124,893
Return on Assets (%)	23,866	23,865	4.86	11.46	-72.70	-37.00	-12.61	0.53	4.72	10.46	22.52	33.48	48.05
Profit Margin (%)	23,866	23,865	1.37	33.39	-348.15	-168.77	-35.38	0.63	5.11	11.79	28.47	53.43	84.42
Market / Book Ratio	23,866	23,866	1.49	1.25	0.23	0.39	0.58	0.85	1.06	1.60	3.94	7.11	15.99
Total Debt / Assets	23,853	22,704	0.32	0.26	0.00	0.00	0.00	0.12	0.30	0.45	0.71	1.29	2.11
Foreign Currency Debt / Assets	22,282	5,443	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.30	0.36
Foreign Sales Share	11,897	4,959	0.16	0.28	0.00	0.00	0.00	0.00	0.00	0.22	0.85	0.98	1.00
Cash / Assets	23,866	23,866	0.08	0.11	0.00	0.00	0.00	0.01	0.04	0.10	0.33	0.54	0.60
FX Transaction Income	23,809	18,044	-26	363	-6,929	-1,116	-171	-4	0	3	113	603	3,927
FX Transaction Income / Assets (%)	23,809	18,044	-0.03	0.77	-11.25	-2.80	-1.06	-0.08	0.00	0.09	0.91	2.20	5.20
FX Transaction Income / Sales (%)	23,809	18,044	-0.04	1.10	-15.51	-4.38	-1.34	-0.09	0.00	0.10	1.16	3.06	12.11
|FX Transaction Income| / Assets (%)	23,809	18,044	0.34	0.69	0.00	0.00	0.00	0.00	0.08	0.38	1.57	3.06	11.25
|FX Transaction Income| / Sales (%)	23,809	18,044	0.45	1.00	0.00	0.00	0.00	0.00	0.10	0.45	2.10	5.07	15.51
|FX Transaction Income| / |Income| (%)	23,808	18,043	11.62	37.66	0.00	0.00	0.00	0.00	1.19	6.66	54.52	181.65	498.19

This table reports summary statistics for exposed firms in our sample located in India. Sales, income, assets, market capitalization, FX transaction income are all reported in millions of Indian rupees. "Obs" denotes the number of non-missing observations for each variable, "NonzeroObs" denotes the number of non-zero observations for each variable, and columns Q01 through Q99 report 1st through 99th percentiles computed across all firm-year observations. All statistics are computed after winsorizing variables at the $(1\%, 99\%)$ level.