

# Dividend Flows and the Foreign Exchange Rate\*

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## Abstract

A simple dividend-based currency strategy, which shorts a currency on the date its country's recent aggregate dividend payment by listed companies is large, exhibits a significant Sharpe ratio and alpha not explained by standard factors in the currency market. To understand this anomaly, I identify the significant price impact of predetermined dividend payments on exchange rates around payment dates. I propose a dividend repatriation channel where benchmark investors (ETFs and mutual funds) predictably repatriate a certain proportion of dividends received in local currency. I build a model in which heterogeneous financial intermediaries with limited risk-bearing capacity accommodate benchmark investors' currency demands stemming from dividend repatriation flows. In line with the model's implications, I find that the price impact of dividend flows on FX around the payment date is large when the intermediary capital ratio is low, CIP deviations are large, and FX implied volatilities are high. My findings have implications for currency-market elasticity, capital regulations, and FX regimes.

**Keywords:** FX, dividend repatriation, benchmark investor, intermediary constraint

**JEL Classifications:** F3, G12, G14, G2

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# 1 Introduction

How do capital flows impact the foreign exchange rate (FX)? This is a central question in international finance. The answer to this question reflects how the currency market functions, especially the interaction between the demand and supply in the currency market. The previous literature emphasizes capital flows' information content and how the information is incorporated into exchange rates (Evans and Lyons 2002, Lyons 2001). Recent developments highlight the key roles played by financial intermediaries with limited risk-bearing capacity in segmented capital markets (Camanho, Hau, and Rey 2022, Gabaix and Maggiori 2015, Itskhoki and Mukhin 2021).

My paper provides new insights into this question by examining the FX impact of dividend flows – a specific type of capital flow that are recurring, predictable, and informationless on the payment date. Dividend payments are predetermined: at the company level, all dividend information is released on the dividend announcement date, including the dividend amount and other dividend-related dates. Aggregated to the currency level, dividend payments are informationless on the payment dates. Standard asset pricing models imply the effects of flows on asset prices should be mainly on the announcement dates, while the effects on the actual realization dates should be small. Surprisingly, as my paper will show, the payment date effect of dividends is significant, while the anticipation effect before the payment date is limited, and the announcement date effect is negligible. Although dividends have been used in identifying price impact in stock markets (Hartzmark and Solomon 2022, Schmickler 2022), they have not been studied by international economists. My paper fills this gap.

Specifically, I present new facts on how dividend flows affect FX dynamics among G10 currencies. G10 currencies are ten of the most liquid and most traded currencies: Australian dollar (AUD), Canadian dollar (CAD), Euro (EUR),<sup>1</sup> Japanese yen (JPY), New Zealand dollar (NZD), Norwegian krone (NOK), British pound (GBP), Swedish krona (SEK), Swiss franc (CHF), United States dollar (USD).<sup>2</sup> G10 is an ideal empirical setting for identifying the price impact of dividend flows on FX for four reasons. First, G10 countries have large stock markets. Over the sample period from 2001 to 2022, the average stock-market-capitalization-

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<sup>1</sup>The euro area (aka. eurozone) consists of 19 countries that use the Euro: Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Greece, Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia and Lithuania. Starting January 1, 2023, Croatia became the 20th member of the eurozone.

<sup>2</sup>See Table A1 for the abbreviations of The G10 currencies and their countries/currency areas used in the paper. For the definition of G10 currencies, please refer to in Article I(2) in <https://www.occ.gov/news-issuances/news-releases/2014/nr-occ-2014-157e.pdf>. An alternative definition of G10 includes Danish krone (DKK). I do not include DKK as it is always pegged to EUR for my sample period.

to-GDP ratio ranges from 0.36 for New Zealand to 2.14 for Switzerland. Second, other countries' ownership of each G10 country's stock market is substantial. The sample average foreign ownership ranges from 17.6% in the United States to 60% in Switzerland. Third, G10 currencies have fewer confounding central bank direct interventions in the FX market than emerging market currencies. Fourth, G10 currencies are the most liquid currencies. In a counterfactual world without central bank interventions, the price impact of dividend flows on G10 currencies should be smaller than other currencies. In this sense, I interpret my estimates as a lower bound for the price impact for other currencies.

As G10 currencies are the most researched and traded currencies by market participants, one might expect predictable flows based on predetermined dividend payments to have negligible effects. However, this is not the case. As motivating evidence, I present a simple dividend-based currency strategy, which shorts a currency if its country's recent aggregate dividend payment is large, and closes the position the next day. The strategy aims to capture the local currency's depreciation pressure shortly after its dividend payment. This strategy can be implemented in real time, as dividend payments – both dates and amounts – are known beforehand. Surprisingly, I show this simple strategy has a significant Sharpe ratio and alpha that are not explained by standard factors in the currency market, including the dollar, carry, momentum, and value factors. The results are robust under different parameters and reasonable assumptions about transaction costs faced by institutional investors.

To understand this asset pricing puzzle, I identify empirically the magnitude of the price impact of dividends on the foreign exchange rate. My identification strategy exploits the fact that dividends are predetermined and hence informationless on payment dates. Therefore, these dividend payments should not contain contemporaneous information that affects the foreign exchange rate after its announcement, specifically around the payment date. I focus on the payment date on which the dividends are large, as their effects on foreign exchange rates should be the most prominent. The baseline panel regression includes controls, time fixed effects, and currency fixed effects. The control variables, i.e., stock market returns and FX implied volatilities, serve to account for alternative channels, such as the portfolio rebalancing channel described in [Camanho, Hau, and Rey \(2022\)](#), where global equity investors adjust their portfolio allocations in response to stock market returns, and such rebalancing is more intense under higher FX volatility. The time fixed effect, at the date level, addresses FX seasonality, and the month-end/quarter-end effect due to month-end/quarter-end rebalancing. The currency fixed effect controls for currency-specific trends throughout the sample.

Regressing the cumulative change of the foreign exchange rate on the large dividend indicator reveals a consistent pattern: upon and after its large dividend payment, the local currency depreciates against USD. Two days after the dividend payment date, the cumulative currency depreciation against USD is around 4.70 basis points. Eight days after the dividend payment date, the local currency has depreciated to 6.48 basis points, and it shows signs of slight reversion afterward. In contrast, the price effect before the payment date (aka. anticipation effect) is limited, even though the dividend payment is known and imminent. Moreover, the FX effects of dividends around the dividend announcement date are economically small and statistically insignificant. These empirical findings are robust under various identification strategies. However, they are in sharp contrast to the predictions of standard asset pricing models. First, as asset prices should only respond to new information, standard models suggest the effects should be largest on the announcement date. Second, standard models also imply the effects should be small around the payment date, otherwise, this implies (risky) arbitrage opportunity. Third, as forward-looking speculators should have pre-positioned in advance, we should also see FX movement before the dividend payment actually happens. Nevertheless, none of these predictions by standard models are supported by my empirical findings.

I build a model of currency demand and supply that explains the FX dynamics of exchange rates around dividend payment dates and dividend announcement dates. On one side, for dividends to move exchange rates shortly after the payment dates, a certain proportion of dividends must be repatriated and converted into other currencies. I propose a dividend repatriation channel, in which benchmark investors of global equities predictably repatriate dividends received in local currency shortly after receiving them. Benchmark investors include passive ETFs and mutual funds (i.e., index funds), which aim to track the performance (especially the total return) of their benchmark indices as closely as possible. More broadly, benchmark investors also include active funds practicing closet indexing ([Cremers and Petajisto 2009](#), [Cremers et al. 2016](#)). Benchmark investors have been playing an increasingly important role in the global equity market. As [Figure 1](#) shows, the market value of US-domiciled ETFs' foreign holdings as a percentage of the other G10 countries' stock market capitalization has grown from 0.7% in 2011 to 3.2% in 2020, more than quadruple in 9 years. In addition, US-domiciled mutual funds have grown from 1.93% in 2002 to 4.6% in 2011 to 6.6% in 2020.

Benchmark investors have particular incentives to repatriate dividends shortly after receiving them to minimize deviations from their benchmark equity indices, i.e., the tracking

errors. Here is the reason: the index methodologies of mainstream equity indices assume the reinvestment of cash dividends into the index itself pro rata on the ex-date. As a concrete example, suppose an index has a 20% allocation in pound-denominated stocks and a 80% allocation in non-pound-denominated stocks. On the ex-date of cash dividends in pounds, the index will retain only 20% of the cash dividends in pounds and reinvest them into pound-denominated stocks. The remaining 80% of cash dividends will be converted into other currencies and reinvested into non-pound-denominated stocks. Although equity indices prescribe dividends to be reinvested on the ex-date, benchmark investors only receive dividends on the payment date, which lags behind the ex-date. Therefore, benchmark investors have incentives to act quickly, as further delay may lead to increased tracking errors. Regarding the exact implementation of reinvestment, the fund manager can either repatriate to other currencies and reinvest directly into the underlying stocks or, more commonly, repatriate the dividends back to the fund's home currency and use futures to establish effective exposures, which is more cost-effective. In either case, a certain proportion of the dividends are predictably repatriated out of the currency that pays the dividends and converted into other currencies. Using detailed daily positions of ETFs, especially cash positions in different currencies, I present a case study that provides empirical evidence for the dividend repatriation channel.

On the other side of the currency market are financial intermediaries, including banks, dealers, and arbitrage capital like hedge funds and proprietary desks. Because the intermediaries have limited risk-bearing capacity, they need to be compensated to accommodate the currency demand from benchmark investors. Moreover, intermediaries have different levels of sophistication in parsing the FX implications of dividend payments, which results in different beliefs about future exchange rates. Some intermediaries (e.g., speculators) are attentive to dividend payments and have rational expectations of future exchange rates. Other intermediaries (e.g., uninformed liquidity providers) are less sophisticated. They do not understand the implications of dividend payments on exchange rates. Their expectation of the next period's exchange rate is always the long-run equilibrium exchange. With the presence of uninformed liquidity providers, predictable dividend flows will have a significant payment date effect, because for these intermediaries the dividend payments are as if they are unexpected, despite being public information before the payment dates. The speculators cannot correct all the mispricing because deploying their limited capital to conduct risky arbitrage is costly. In equilibrium, they do not aggressively take short positions far in advance. With reasonable calibration of the proportion of sophisticated vs unsophisticated

intermediaries, the model quantitatively explains the large payment date effect, the limited anticipation effect, and the negligible announcement date effect of dividends.

The model has further implications for the time variation of dividend flows' price impact on the foreign exchange rate. The model has further implications for the time variation of the price impact of dividend flows on the foreign exchange rate. Consistent with the model's predictions, I find that the price impact of dividend flows on FX around the payment date is large when the intermediaries' risk-bearing capacity is low, e.g., when the intermediary capital ratio is low, CIP deviations are large, and FX implied volatilities are high.

I conclude by discussing the implications of my findings on currency market elasticity, capital regulations, and FX regimes. A back-of-envelope calculation shows \$8.1 billion US dollars moves G10 against USD by 1%. At first glance, this falls in the ballpark of existing estimates in the literature and is consistent with the recent literature on the inelastic market hypothesis pioneered by [Gabaix and Koijen \(2021\)](#). However, the fact that dividend flows move the foreign exchange around the payment dates is more puzzling, as the model in [Gabaix and Koijen \(2021\)](#) predicts that most of the price effect should happen on the announcement date while the price effect on the payment date should be small if agents are forward-looking. My estimates also suggest one standard deviation (3.1%) decrease from the mean (7.38%) of the intermediary capital ratio is associated with a price impact twice as large. I also find evidence suggesting the price impact of dividends on FX is larger in the freely floating regime compared to other regimes.

The paper is structured as follows: after a brief literature review, [Section 2](#) introduces the datasets I use in the empirical analysis. As background knowledge, [Section 3](#) presents the stylized facts on dividends in the G10 countries. Serving as motivating evidence, [Section 4](#) presents a dividend-based currency strategy that has a significant Sharpe ratio and alpha not explained by standard FX factors. To understand this anomaly, [Section 5](#) identifies the FX dynamics around the payment dates, in addition to the announcement date effect. [Section 6](#) analyzes the underlying mechanism and proposes the dividend repatriation channel. It presents a model that explains the significant payment effect, the limited anticipation effect, and the negligible announcement effect of dividends. Consistent with the additional model implications, [Section 7](#) shows that the price impact of dividend flows on FX around the payment date is large when the intermediary risk-bearing capacity is low. [Section 8](#) discusses the implications of my estimates for FX elasticity, capital regulations, and FX regimes. [Section 9](#) concludes with a discussion with open questions for future research.

## 1.1 Related Literature

My paper is related to three strands of literature. First, my paper is related to the literature on capital flows and their impact on the foreign exchange rate. [Maggiore \(2022\)](#) provides a comprehensive review of the literature. Theoretically, [Evans and Lyons \(2002\)](#) present an exchange rate model highlighting the information content of order flows. [Gabaix and Maggiore \(2015\)](#) provides a theory of foreign exchange determination in which capital flows drive exchange rates by altering the balance sheets of intermediaries with limited risk-bearing capacity. [Itskhoki and Mukhin \(2021\)](#) show that financial shocks (i.e., noise-trader demand shock) are the only plausible shocks to explain exchange rate dynamics. [Hau and Rey \(2006\)](#) and [Camanho, Hau, and Rey \(2022\)](#) develop equilibrium models in which exchange rates, stock prices, and capital flows are jointly determined. They highlight the portfolio rebalancing channel of global equity investors. In contrast, my paper highlights informationless dividend flows impact FX shortly around payment dates, due to the dividend repatriation channel. Empirically, as capital flows are likely to be endogenous to exchange rates and financial conditions, most papers estimate the price impact of capital flows using one-off events and focus on the announcement date effect. [Hau, Massa, and Peress \(2010\)](#) use the redefinition of the MSCI Global Equity Index in 2001 and 2002, a switch of index weights from market capitalization to freely floating. They find countries with a relatively increasing equity representation have a relative currency appreciation on the announcement date of the index change. [Broner et al. \(2021\)](#) use the unexpected announcement of index inclusion into local-currency sovereign debt indexes of Citigroup WGBI and JP Morgan GBI-EM, and find that index-inclusion-induced inflow leads to an appreciation of the country’s currency in the two days following the announcement. However, they find no effect during the implementation period between 2 and 6 months after the announcement date. In contrast, [Raddatz, Schmukler, and Williams \(2017\)](#) find that large benchmark changes (such as upgrades and downgrades of countries) are associated with abnormal returns in asset prices and exchange rates around those events, both on the announcement and effective dates of these changes. Some other papers use more frequent events to estimate the price impact. [Camanho, Hau, and Rey \(2022\)](#) apply the granular instrumental variable (GIV) approach to funds’ rebalancing flows. [Aldunate et al. \(2022\)](#) use Chilean pension funds flows induced by a Chilean financial advisor’ market timing recommendations. In terms of the nature of flows, the closest paper to mine is [Pandolfi and Williams \(2019\)](#), which uses mechanical rebalancings induced by the J.P. Morgan Government Bond Index–Emerging Markets Global Diversified (GBI-EM Global Diversified) 10% index weight cap of any single country. This

feature may not be widely recognized compared to dividend payments, the latter of which are closely watched by market participants.<sup>3</sup> In addition to the reduced form approach, [Kojen and Yogo \(2020\)](#) propose a structural form approach based on a demand system of global investors.

Second, my paper is related to recent developments investigating the relationship between flows and prices, primarily in the stock markets. [Gabaix and Kojen \(2021\)](#) develop a theory of inelastic demand under rigid institutional investors' mandate and estimate the price elasticity of aggregate stock market demand using GIV. In their model, the largest effect happens upon news of flows, not when flows actually happen. Closely related to my paper is [Hartzmark and Solomon \(2022\)](#). They study the effect of dividends on the aggregate equity market. Despite being predetermined, dividends move the stock market due to the reinvestment channel. [Schmickler \(2022\)](#) finds that dividends generate payment date price pressure for peer stocks in the portfolio, but not on the announcement date. In contrast, I propose that dividend flows move the foreign exchange rate due to a different mechanism, i.e., the dividend repatriation channel. The existing literature related to dividend repatriation mostly focuses on corporate shareholders' repatriation of foreign subsidiaries' dividends, especially when there is a repatriation tax change or one-time tax holiday ([De Simone, Piotroski, and Tomy 2019](#), [Hanlon, Lester, and Verdi 2015](#)). This paper instead emphasizes the role of foreign portfolio investors, particularly benchmark investors such as ETFs and mutual funds, in regular dividend repatriation.<sup>4</sup>

Third, my paper is related to the literature on intermediary asset pricing, where financial intermediaries with limited risk-bearing capacity play a key role in FX determination. Theoretically, [He and Krishnamurthy \(2013\)](#) propose a model where the marginal investor is a financial intermediary. Empirically, [He, Kelly, and Manela \(2017\)](#) find that shocks to the equity capital ratio of financial intermediaries have significant explanatory power for cross-sectional variation in expected returns in many asset classes, including currencies. [Reitz and Umlandt \(2021\)](#) further refine the intermediary capital ratio for the currency markets using the balance sheet data of the top three foreign exchange dealers. [Du, Tepper, and Verdellhan \(2018\)](#) finds that banks' balance sheet constraints have a causal effect on asset prices, as reflected in deviations from the covered interest rate parity condition (CIP). Interpreted more generally, financial intermediaries also include arbitrage capital like proprietary desks, macro hedge funds, active investment managers, etc. Their limited risk-bearing capacity

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<sup>3</sup>Analysts at banks regularly distribute dividend information to their clients, e.g., hedge funds.

<sup>4</sup>Corporate shareholders' ownership of foreign subsidiaries is counted as direct investment rather than portfolio investment, according to the Balance of Payments.



leads to limits of arbitrage, pioneered by De Long et al. (1990), Shleifer and Vishny (1997), and Gromb and Vayanos (2002).

## 2 Data

The dividend information is from Compustat Global and the Center for Research in Security Prices (CRSP).<sup>5</sup> For countries other than the USA, I use Compustat Global, while I use CRSP for dividend information in the USA. The dividend information includes dividend size, announcement date, ex-date, and payment date. On few occasions when dividend payment dates coincide with weekends, I lump the dividends into the following business day. I focus on cash dividends and keep common/ordinary shares. For stocks with dual-listing or multiple currencies, I use their primary listing information.

The G10 currency market is a 24-hour market. In contrast, stock markets in each country have operating hours locally, and databases like Compustat Global and CRSP record date information in their respective time zones. The cutoff time in the standard sources of the foreign exchange rates may not necessarily align with the local stock market closing time. e.g., WM/Refinitiv FX Benchmark Rates have the cut-off time at London 4 p.m., while Bloomberg provides three pre-fixed cut-off times.<sup>6</sup> Misalignment of FX cut-off time and stock market closing time may lead to asynchronicity issues, especially in the daily frequency analysis.

To alleviate the concern of asynchronicity, I assemble a novel dataset of daily changes in foreign exchange rates of each currency, aligned with each country's local stock market closing time. To do so, I use the hourly spot exchange rate from WM/Refinitiv intraday fixing and snapshot the exchange rates at the closest hour to the stock market closing time, as Table 4 shows. The WMR Intraday Spot Rate service was launched in 2001. It provides hourly spot rates from Monday 06:00 in Hong Kong/Singapore until Friday 22:00 in the UK.<sup>7</sup> The foreign exchange rates are quoted against US dollars using market conventions.<sup>8</sup> In my analysis and throughout the paper, I express all exchange rates in units of USD (or

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<sup>5</sup>Omitted dividends may not be recorded in either database. However, this does not affect the dividend-based currency strategy or the identification, as the decision to skip a dividend is announced before the payment date.

<sup>6</sup>BGN closes 5 p.m. Friday EST (New York cut), BGNL closes at London 6 p.m. (London cut) and BGNT closes at Tokyo 8 p.m. (Tokyo cut). Both London and Tokyo cut close at 5 p.m. EST on Friday. Some emerging market currencies have their cut-time limited to when the local market closes.

<sup>7</sup>For more details, see [https://www.refinitiv.com/content/dam/marketing/en\\_us/documents/methodology/wm-refinitiv-methodology.pdf](https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/wm-refinitiv-methodology.pdf)

<sup>8</sup>That is, in units of local currency per USD, except for EUR, GBP, AUD, NZD.

a basket of currencies) per local currency. Therefore, a negative change means the local currency depreciates against USD. The sample period is from January 2001 to June 2023.

I construct three measures of FX change: against USD, against a value-weighted G10 basket, and against an equal-weighted G10 basket. In the value-weighted G10 basket for currency  $i$ , the weight of the currency pair  $j/i$  is proportional to the foreign country  $j$ 's ownership of the stock market of  $i$ , proxied by data from Coordinated Portfolio Investment Survey (CPIS).

The ETF daily positions are from ETF Global, which covers ETFs listed in the US. Starting from April 2017, ETFG Data is primarily sourced directly from fund sponsors, custodians, distributors, and administrators.<sup>9</sup> Its *Constituents* file contains actual holdings of the many ETFs at daily frequency, including cash, derivatives, and underlying. I use Morningstar for longer time series of ETF and mutual fund quarterly holdings.

Information on cross-border flows and positions is from Balance of Payments and International Investment Position, downloaded from the International Monetary Fund (IMF). In addition to standard items related to trade and current account surplus, I focus on items related to portfolio investments<sup>10</sup> of different countries. It reports the dollar value of a country's ownership in other countries' assets (e.g., equity and debt securities), and the dollar value of a country's assets being owned by other countries. In the financial account, flows such as net acquisition of financial assets (i.e., the purchase of other countries' assets) and net incurrence of liabilities (i.e., assets being purchased by other countries) are reported. In the capital account, investment income from portfolio investment, including dividends and interest, is reported. The bilateral ownership information of portfolio investment comes from the Coordinated Portfolio Investment Survey (CPIS) by the IMF.

### 3 Stylized Facts about Dividends

In this section, I present stylized facts about dividends in G10 currency areas, showing that they are predetermined, substantial, and concentrated. In this paper, G10 countries/currency areas refer to major countries that use G10 currencies. They are: Australia (AUS), Canada (CAN), Switzerland (CHE), Euro area (EUR), United Kingdom (GBR),

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<sup>9</sup>[https://wrds-www.wharton.upenn.edu/documents/1719/ETF\\_Global\\_Data\\_Package\\_-\\_U.S.\\_Listed\\_-\\_2021\\_-\\_1.1.21.pdf](https://wrds-www.wharton.upenn.edu/documents/1719/ETF_Global_Data_Package_-_U.S._Listed_-_2021_-_1.1.21.pdf)

<sup>10</sup>Portfolio investment is defined as cross-border transactions and positions involving debt or equity securities, other than those included in direct investment or reserve assets. See Sixth Edition of the IMF's Balance of Payments and International Investment Position Manual (BPM6).

Japan (JPN), Norway (NOR), New Zealand (NZL), Sweden (SWE), United States (USA).

**Dividends are predetermined.** At the company level, there are four important dates related to dividends: the announcement date, the ex-date, the record date, and the payment date. The announcement date is the date when a company announces its dividend information, including dividend amount and other dividend-related dates. The ex-date is the date on and after which shareholders who buy the stock will not receive a dividend. The record date is the date on which registered shareholders in the company's book will be entitled to receive dividends.<sup>11</sup> The payment date is the date when the dividend is actually paid to shareholders. I aggregate the companies' dividends to country/currency area level by payment date.

All dividend information is revealed on the dividend announcement date,<sup>12</sup> including dividend amount and other dividend-related dates, in all G10 countries/currency areas except Japan. For Japan, companies typically do not confirm the dividend amount before the ex-date, though the dividend guidance is usually available almost one year in advance. Therefore, on the actual payment date, the dividend is informationless. Table 2 shows the calendar days between the announcement date and the payment date for countries except Japan, and calendar days between the ex-date and the payment date for Japan. There is a big time gap - the average lead time is 58 days, with a median of 55 days. Such a time lag should be enough for the market to digest the information released on the announcement date.

**Dividends are substantial.** With aggregate dividend yields ranging from 2% to 5%, large stock market in G10 countries implies large aggregate dividend payments. Indeed, Table 1 shows the stock-market-capitalization-to-GDP ratio ranges from 0.36 in New Zealand to 2.14 in Switzerland over 2001 to 2022 sample period, while the dividend-to-GDP ratio ranges from 1.5% in Euro area to 3.7% in Australia.

Importantly, due to large foreign ownership (Table 1), dividends paid to foreign investors can be substantial. In fact, data from the Balance of Payments reveals this pattern. Table 3 summarizes the dividends paid to foreign portfolio investors and the dividends received from foreign portfolio investments. In BOP, these items are recorded as primary income. See Appendix A for detailed indicators. On an annual basis, dividends paid to foreign investors are comparable to portfolio investment flows, either in equity and debt. Specifically, the average dividends paid to foreign investors is \$36.7 billion, while the average purchase

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<sup>11</sup>Depending on the settlement cycle, the ex-date is typically one day before the record date.

<sup>12</sup>Even in rare circumstances where a company needs to skip a dividend payment, it will announce this decision on the announcement date.

of foreign equity is \$37.1 billion and the average purchase of foreign debt is \$64 billion. Compared with trade flows, dividends paid to foreign investors are also of the same order of magnitude.

**Dividends are concentrated.** Dividend payments are not evenly distributed throughout the years. As Figure 2 shows, dividends can be intense in some days, weeks, and months. e.g., the top 5% largest dividend payment dates contribute to a significant proportion of the total dividend payment in a year, ranging from 28% in the United States to more than 60% in Japan. When calculating how many days of the largest dividend payments contribute to more than 50% of total dividends within a currency-year, the number ranges from 2.5 days in Switzerland, to 18.5 days in the Euro Area, and up to 30.5 days in the US. Zooming out to the monthly level, dividend payments in the United States are concentrated in the last month of each quarter (March, June, September, December), while in the Euro area, they are concentrated in May. In Japan, dividends are concentrated in June and December.

There are several reasons for the concentration of dividends. First, due to traditions and customs in a country, companies may follow a similar fiscal-year calendar. For example, in Japan, most companies have a fiscal year-end on March 31, following the government fiscal year calendar. The similarity in corporate fiscal calendars leads to the concentration of dividend dates. Second, bigger companies pay larger dividends. With the company size being skewed, the dividends may be dominated by a few large companies. <sup>13</sup>

## 4 Dividend-Based Currency Strategy

In this section, I present a dividend-based currency strategy on G10 currencies. The strategy takes the following simple format: sell the currency if the country has large dividends in the past few days against USD and hold the position for one day. This strategy has a significant Sharpe ratio and alpha not explained by standard FX factors, including carry, dollar, momentum, and value factors, despite it only uses publicly available dividend payment information known ex-ante.

The log excess return of selling currency  $i$  against USD, and holding the position for one

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<sup>13</sup>For example, Taiwan Semiconductor Manufacturing Company Limited (TSMC) is the largest company primarily listed in the Taiwan Stock Exchange. As of 2022 year-end, its market capitalization is 379 billion New Taiwan dollars, 24% of the total stock market capitalization. Its quarterly dividend payments throughout 2022 sum up to 285 billion New Taiwan dollars, around 18% of the total dividend payment in the Taiwan stock market.

day is:

$$rx_{t+1}^k = f_t^k - s_{t+1}^k \approx -\Delta s_{t+1}^k + (i_t^{US} - i_t^k)$$

where  $s_t^k$  and  $f_t^k$  are log spot exchange rate and log 1-day forward exchange rate of currency  $k$  respectively, in terms of units of USD per local currency, i.e., currency  $k$  is the base currency.  $i_t^{US}, i_t^k$  is 1-day risk-free rate in the USA and country  $k$ , respectively. As my sample of WMR intraday hourly fixing does not contain 1-day forward exchange rate, I use  $f_t^k \approx s_t^k + i_t^{US} - i_t^k$  to approximate it, where the risk-free rates are (annualized) 3-month risk-free rates divided by 365.

With transaction costs, the log excess return of selling currency  $k$  against USD, and holding the position for one day is:

$$rx_{t+1}^k = f_t^{k,b} - s_{t+1}^{k,a} \approx -\Delta s_{t+1}^k + (i_t^{US} - i_t^k) - TC$$

where the transaction cost (TC) is the bid-ask spread of spot exchange rates. The bid-ask spreads from WMR are based on indicative quotes. They are too large compared to actual effective spreads in FX markets (see, e.g., [Lyons 2001](#), [Menkhoff et al. 2012](#)). As G10 currencies are the most liquid currencies in FX markets, they have very tight bid-ask spreads for institutional investors, mostly a fraction of 1 basis point. Moreover, large intermediaries may collect the bid-ask spread when trading with clients or trading at close to the mid-price in interdealer markets. Therefore, I assume a constant 1 basis point bid-ask spreads for G10 currencies in the below discussion.

The dividend-based currency strategy takes the following form: for each country/currency area  $k$  and date  $t$ , if in the previous  $l$  days, the combined dividend payments in the country  $k$  rank in its top  $p$ -percentile in the rolling 1-year window, then we sell currency  $k$  against USD, and hold the position for one day. If there are several currencies that satisfy this criterion, the strategy puts \$1 on each position.

Figure 3 shows the cumulative excess return of the dividend-based currency strategy in percentage points, for the parameters  $l = 2, p = 5\%$ . In other words, the strategy sells a currency against USD if the combined dividend payments in the previous 2 days rank in the top 5% percentile in the rolling 1-year window of that country. Over the sample period from 2001 to 2023, the strategy earns 4.4% return annually before the transaction cost (blue line), with 0.68 Sharpe ratio, despite it only takes positions on 25% of the trading days. After the transaction cost (orange line), the annualized return is 3.6% with Sharpe ratio being 0.56. Noticeably, the performance of the trading strategy is better after the Global

Financial Crisis (GFC) than before.

The top half of Table 5 shows the results are robust across different parameters of the lookback window  $l$ . Both the annualized returns and Sharpe ratio are statistically significant. Note that the strategy achieves this annualized returns by taking FX positions on  $\approx 30\%$  days of trading days. The standard errors of the Sharpe ratio are calculated using the formula in Lo (2002).

The bottom half of Table 5 further demonstrates that the dividend-based currency strategy generates alpha not explained by standard factors in the currency market. To show this, I run the following factor-spanning regression (Fama and French 2018) at the monthly frequency:

$$rx_t = \alpha + \beta_{DOL}DOL_t + \beta_{CAR}CAR_t + \beta_{MOM}MOM_t + \beta_{VAL}VAL_t + \epsilon_t \quad (1)$$

The  $rx_t$  are log excess returns of the dividend-based currency strategy aggregated to the monthly frequency. The dollar factor  $DOL_t$  is from Verdelhan (2018). The carry factor  $CAR_t$  is from Lustig, Roussanov, and Verdelhan (2011). The momentum factor  $MOM_t$  is from Menkhoff et al. (2012). The value factor  $VAL_t$  is from Asness, Moskowitz, and Pedersen (2013). As expected, the strategy has a significant loading on  $DOL_t$ , since it sells a currency against USD.<sup>14</sup> The strategy’s loadings on other factors are economically small and statistically insignificant. Importantly, the alpha is economically large and statistically significant. The monthly alpha is around 30bp. When annualized, the alpha accounts for almost all the annualized returns of the strategy.

## 5 Identification of the Price Impact of Dividend Flows

To understand the anomaly, in this section, I identify the price impact of dividends on exchange rates around the payment dates. I show that the local currency depreciates shortly after its country’s large dividend payments. In contrast, the anticipation effect before the payment date is limited. In addition, I show that the dividend announcement effect on exchange rates is insignificant.

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<sup>14</sup>The dollar-neutral version of the dividend-based strategy is available upon request.

## 5.1 Around Dividend Payment Dates

My identification strategy exploits the fact that dividends are predetermined hence informationless on payment dates. In fact, companies make dividend decisions using information up to their announcement dates. Therefore, dividends do not contain any contemporaneous information that affects exchange rates after its announcement, specifically around the payment date.

I focus on the payment date on which the dividends are large, as their effects on foreign exchange rates should be the most prominent. Specifically, let  $\mathbb{D}_{k,t}$  be the indicator for large dividends, i.e.,  $\mathbb{D}_{k,t}$  equals 1 if country/currency area  $k$  has a large dividend payment on date  $t$ . For concreteness, I define a large dividend as being among the top 5% largest within the currency-year on the payment date  $t$ .

The baseline panel regression is as follows:

$$\ln E_{k,t+h}^{US/LC} - \ln E_{k,t-1}^{US/LC} = \alpha_h + \beta_h \mathbb{D}_{k,t} + Controls + \gamma_k^{(h)} + \xi_t^{(h)} + \epsilon_{k,t}^{(h)}, \quad h = -10, \dots, 0, \dots, 10 \quad (2)$$

The left-hand side is the cumulative log change of the exchange rate of currency  $i$  against USD in basis points from date  $t - 1$  to  $t + h$ , with FX cut-off time aligned with the local stock market closing time. In the Online Appendix, I also use cumulative log change against a value-weighted and an equal-weighted G10 basket.  $t = -1$  is one day before the payment date, which I normalize the cumulative change to be 0. The parameters of interest are  $\beta_h$ 's on the dividend indicator  $\mathbb{D}_{k,t}$ . The *Controls* include local stock market returns and FX implied volatilities. For stock market returns, I use daily changes in each country's primary stock index.<sup>15</sup> For FX implied volatilities, I use the 6-month at-the-money (ATM) implied volatility for each currency against the USD.<sup>16</sup> The control variables serve to account for alternative channels, such as the portfolio rebalancing channel described in [Camanho, Hau, and Rey \(2022\)](#), where global equity investors adjust their portfolio allocations in response to stock market returns, and such rebalancing is more intense under higher FX volatility. The time fixed effect, at the date level, addresses FX seasonality<sup>17</sup> and the month-end/quarter-end

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<sup>15</sup>Specifically, S&P/ASX 200 Index (Australia), S&P/TSX Composite Index (Canada), Swiss Market Index (Switzerland), Euro Stoxx 50 (Euro area), FTSE 100 Index (United Kingdom), NIKKEI 225 (Japan), OBX STOCK Index (Norway), S&P/NZX 50 Index (New Zealand), OMX Stockholm 30 Index (Sweden), S&P 500 Index (United States).

<sup>16</sup>The results using other tenors of implied volatility are almost exactly the same.

<sup>17</sup>[Fei \(2023\)](#) documents the dollar depreciates by 54 basis points on average in the last 10 trade days of the calendar year and appreciates by 47 basis points in the first 10 trade days of the next year. [Tse \(2018\)](#) documents all the G10 currency futures yield negative returns in January and returns in April are positive.

effect due to month-end/quarter-end rebalancing. If the spillover effect of another country’s large dividend payment is similar across currencies, then the time fixed effect accounts for this as well. The currency fixed effect controls for currency-specific trends throughout the sample. Standard errors are clustered at the date level.

Table 6 compares the coefficients  $\beta_h$  estimated by the variants of Eq (2), which incrementally add controls and fixed effects. Panel *OLS* shows the estimates without any controls and fixed effects. Panel *OLS with Controls* shows the estimates controlling for stock market returns and FX implied volatilities. Panel *OLS with Controls and Time Fixed Effects* further controls for time fixed effects. Panel *Two-Way Fixed Effects with Controls* is the baseline regression results, which are plotted in Figure 4. Figure A1 further shows the comparison of coefficients under different specifications. All the specifications show a consistent pattern: upon and shortly after the dividend payment dates, the local currency depreciates against USD. Indeed, the cumulative currency depreciation against USD is 4.70 basis points two days after the dividend payment date. After eight days, the local currency depreciates against USD by 6.48 basis points. It shows signs of slight reversion afterward. In Section 6, I argue this depreciation pressure is due to the *dividend repatriation channel*, i.e., benchmark investors’ predictable repatriation of dividends from the dividend currency to other currencies shortly after receiving the dividend payments.<sup>18</sup>

In contrast, the anticipation effect before the dividend event  $t = 0$  is economically and statistically limited. The only statistically significant coefficient under the baseline specification is at  $t = -1$ . As dividend payments are public information and ex-ante known, the anticipation effect may be due to some investors’ pre-positioning by selling local currency in advance to take advantage of the benchmark investors’ dividend repatriation. Alternatively, some investors may conduct the FX spot transaction 1 or 2 days before the dividend payment date, as the settlement date for FX spot transactions is T+2, i.e., two business days after the trade date.<sup>19</sup> When cash dividends in local currency appear on their cash account, they can directly use it to settle the FX spot transaction. Empirically, we see the anticipation effect is limited.

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<sup>18</sup>Nevertheless, the response may be delayed in a few days as cash dividends may appear in an investor’s account with a lag, as shown by the example in Section 6.2.

<sup>19</sup>For USDCAD spot transactions, the settlement date is T+1, one business day after the trade date.



## 5.2 Around Dividend Announcement Dates

To study the FX dynamics around announcement dates of large dividends, I run a similar regression as in Eq (2), where  $t$  is the announcement date instead of the payment date. In other words, dividends at the company level are aggregated to the currency level by their announcement dates.  $\mathbb{D}_{k,t}$  equals to 1 if country/currency  $k$  has a large dividend announcement on date  $t$ . For consistency with the payment date results, I define a dividend announcement as being large if it is among the top 5% largest within the currency-year. The *Controls* include local stock market returns and FX implied volatilities. The time fixed effect and the currency fixed effect are included in the baseline regression as before.

It is worth noting that dividends having the same payment date may not have the same announcement date, and vice versa. Therefore, when aggregating dividends to the currency level, there may not be a simple correspondence between large dividend announcement dates and large dividend payment dates. Nevertheless, as big companies contribute the most to the dividends, the set of companies on large dividend announcement dates are highly correlated with the set of companies on large dividend payment dates.

Figure 5 shows the announcement date effect of dividends on the foreign exchange rate. In contrast to the payment date effect, the announcement date effect is economically small and statistically insignificant. Specifically, from ten days before to ten days after a large dividend announcement date, all point estimates of price impact are between -2 to +2 basis points, and none of them is significant.

## 5.3 Robustness

The identification strategy in Section 5.1 only uses dividend size on the payment date, which is known ex-ante before the payment date. By using only the dividend size information ex-ante known, it extracts the predictable component of dividend flows. Importantly, the baseline identification does not use the actual dividend repatriation flows, which may contain contemporaneous information. The similarity of the empirical results between *OLS* and *Two-Way Fixed Effects with Controls* in Table 6 assures that the potential confounding variables should be unimportant.

Nevertheless, in the case of further identification concerns,<sup>20</sup> I develop alternative identification strategies in Appendix D to confirm that the pattern revealed in Section 5.1 is robust.

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<sup>20</sup>One potential concern on the baseline regression Eq (2) is that it assumes the unspecified time-varying confounding variables affect all currencies in the same way, and hence can be absorbed by the time fixed effect.

The additional identification strategies include difference-in-difference (DiD) and synthetic controls, which can deal with the unspecified confounding variables in a more flexible way. As shown in Figure A3 and Figure A4, both methods confirm that dividends move the foreign exchange rate shortly after the payment dates.

## 6 Inspecting the Mechanism

In this section, I present a model that explains the FX dynamics of exchange rates around dividend payment dates and dividend announcement dates. On one side, I highlight the currency demand from the dividend repatriation channel by benchmark investors, due to the cash dividend treatment underlying mainstream equity index methodologies. On the other side, financial intermediaries with heterogeneous beliefs and limited risk-bearing capacity need to absorb the flows on their own balance sheets. Due to the time variation of their risk-bearing capacity, the price impact of dividend flows differs over time.

### 6.1 Treatment of Cash Dividends by Equity Indices

Equity index methodology pays particular attention to corporate actions. Related to my paper is its treatment of cash dividends. There are three kinds of returns associated with equity indices: price return, gross (total) return, and net (total) return. The price return is the change in the price index<sup>21</sup> level, which is the weighted average of the underlying price of constituents, without taking into account the regular cash dividends.<sup>22</sup> The gross return assumes the dividends are reinvested into the index itself. The net return further considers the dividend withholding tax for foreign investors, assuming the dividends are reinvested after the deduction of withholding tax. Importantly, equity indices do not have cash components. In the equity index calculation, the dividends are reinvested immediately on the ex-date.

The dividends are not only reinvested into the original stocks that pay the dividends. Instead, the dividends are reinvested to the entire portfolio pro rata.<sup>2324</sup> Formally, denote

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<sup>21</sup>Some index providers like FTSE Russell use the terminology *capital return* and *capital index*.

<sup>22</sup>A special cash dividend that is nonrecurring may affect the calculation of the price index.

<sup>23</sup>Note that the index weight of the stock paying the dividend changes before and after its dividend ex-date, as the ex-dividend price is lower than the cum-dividend price.

<sup>24</sup>For fund inflows/outflows, the proportional investing assumption is common in the literature of mutual funds like Lou (2012) and Chen (2022). Following this literature, Schmickler (2022) also assumes dividend payments are reinvested pro rata. Here, I emphasize the underlying reason, i.e., the specific treatment of cash dividends by the equity index methodology.

the total amount of dividends in index points divided by the index level by  $\alpha$ . On ex-date, each share count is scaled up by a factor of  $1/(1 - \alpha)$ . See [FTSE \(2023\)](#) Section 4, [MSCI \(2023\)](#) Section 2, and Appendix X.<sup>25</sup>

For the global equity indices, the underlying stocks are not denominated in a single currency. The treatment of cash dividends in the index calculation implies dividends will be repatriated abroad. For example, suppose an index has 20% allocation in the UK and 80% outside the UK. On the ex-date of a dividend paid by a UK company in GBP, the index calculation assumes that  $\approx 80\%$  of the dividend will be reinvested to stocks outside the UK (hence in currencies other than GBP), converted by the spot exchange rates on the ex-date.

## 6.2 Dividend Repatriation by Benchmark Investors

Benchmark investors like ETFs and mutual funds have benchmark indices to track, most of which are net (total) return indices. Passive ETFs and mutual funds aim to minimize the tracking errors against their benchmark indices. Even for active funds, closet indexing is common ([Cremers and Petajisto 2009](#), [Cremers et al. 2016](#)). As the equity index's pro-rata dividend reinvestment implies dividend repatriation, benchmark investors have particular incentives to repatriate dividends as well.

Despite equity indices prescribing dividends to be reinvested on the ex-date,<sup>26</sup> investors do not receive dividends until the payment date. Between the ex-date and the payment date, dividends are accrued to investors' accounts.<sup>27</sup> Accrued dividends are not reinvested and are in local currency. Therefore, compared with equity index treatment, accrued dividends will lead to tracking errors due to cash drag and FX fluctuations between the ex-date and the payment date. If a fund manager chooses to reinvest dividends in exactly the same way as the underlying index methodology on the ex-date, he will need to borrow money, which incurs additional funding costs. Alternatively, he can wait until dividends are paid and then act. Depending on the institutional setup, the dividends may appear on the fund's available cash account on or shortly after the payment date.<sup>28</sup> Once the cash hits the account, the

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<sup>25</sup>[Weiner \(2023\)](#) Chapter 3 provides an example showing how the dividend affects the shares count in index close file before the ex-date and index open file on the ex-date.

<sup>26</sup>Index methodologies prefer to assume all dividends are reinvested on the ex-date rather than incur the complications of allowing a time lag before reinvesting the declared dividends on the payment date. See [FTSE \(2023\)](#) Section 4.5.1.

<sup>27</sup>Dividend accrual is reflected in the fund NAV calculation and recorded under the receivables in the financial statement.

<sup>28</sup>[Hartzmark and Solomon \(2022\)](#) notices that cash may appear on investors' accounts even after the payment date due to institutional reasons.

fund manager has incentives to act fast, as further delay may lead to further tracking errors. Regarding the exact implementation of reinvestment, the fund manager can repatriate to other currencies and reinvest directly into the underlying stocks. Or, more commonly, he can repatriate the dividends back to the fund currency and use futures to establish effective exposures. Doing so is more cost-effective. In either case, a proportion of the dividends are predictably repatriated from the currency that pays the dividends and converted into other currencies.

I define the *dividend repatriation channel* as investors' predictable repatriation of dividends from the dividend currency to other currencies shortly after receiving the dividend payments. This channel differs from month-end or quarter-end rebalancing, as the timing is different, i.e., the dividend repatriation channel is in the near term. This also differs from the portfolio rebalancing due to risk-averse investors' portfolio optimization as in [Camanho, Hau, and Rey \(2022\)](#). In my paper, the dividend repatriation channel is due to benchmark investors' minimization of tracking errors against global equity indices. Such dividend repatriation is mechanical and hence informationless.

Figure 6 uses detailed daily positions from a specific ETF, First Trust Developed Markets ex-US AlphaDEX<sup>®</sup> Fund (FDT), to illustrate the dividend repatriation channel. Launched in April 2011 and issued by First Trust, FDT is a passive global equity ETF tracking NASDAQ AlphaDEX Developed Markets Ex-US Index. As of December 2022, its assets under management (AUM) are 419 million USD. It has relatively clean daily cash reporting in ETF Global and does not have frequent fund inflows/outflows (i.e., creation/redemption).<sup>29</sup> This case study provides a clear illustration of how the dividend repatriation channel works. Consider the period from November 30 to December 9, 2022. During this period, there are no fund inflows or outflows, no change in underlying stock positions, and no distributions to the ETF investors. Based on FDT's portfolio holdings and the dividend payment information, the fund should receive dividend payments in JPY from its portfolio holdings of Japanese companies from November 30 (Wednesday) to December 2 (Friday), with the dividend payment on December 1 (Thursday) being the largest. In the meantime, dividends received in other currencies are negligible. The JPY dividends appeared on its JPY cash account on December 5 (Monday), after which the JPY cash position decreased while the USD cash position increased by a similar amount. Note that the USDJPY spot transaction follows T+2 settlement rule, i.e., the cash is delivered at time T+2 for a spot transaction done at

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<sup>29</sup>ETF creation/redemption can either be in-kind, in-cash, or mixed, i.e., it may contain cash components in the basket. See [Koont et al. \(2023\)](#).

time  $T$ . Therefore, the “sell JPY/buy USD” trade should be conducted on December 5 for the JPY cash position to decline on December 7. Such trade affects the foreign exchange rate on December 5 (Monday), which is two business days after the large dividend payment on December 1 (Thursday). This time lag is consistent with the empirical results identified in the baseline regression Eq (2), i.e., the point estimates are statistically significant since  $t = 2$  in Table 6.

### 6.3 Financial Intermediaries with Limited Risk-Bearing Capacity

Accommodating benchmark investors’ currency demand are financial intermediaries. [Gabaix and Maggiori \(2015\)](#) and [Itskhoki and Mukhin \(2021\)](#) highlight the central role of financial intermediaries in FX determination. [He, Kelly, and Manela \(2017\)](#) and [Reitz and Umlandt \(2021\)](#) provides empirical evidence that financial intermediaries price FX. Importantly, financial intermediaries have limited risk-bearing capacity. Limited risk-bearing capacity may result from regulations ([Du, Tepper, and Verdelhan 2018](#)), risk management ([Fang and Liu 2021](#)), or margin constraints ([Garleanu and Pedersen 2011](#)). [Sandulescu, Trojani, and Vedolin \(2021\)](#) shows financial intermediaries’ risk-bearing capacity explains the time variation of international SDFs. As the risk-bearing capacity is limited and the balance sheet is constrained, for financial intermediaries to accommodate the currency demand, they require compensation to take the other side of the market,

Financial intermediaries are heterogeneous. They have different sophistication and different beliefs. They trade heavily among themselves. According to the latest BIS Triennial Central Bank Survey ([BIS 2022](#)), 46% of global turnover of FX are among reporting dealers<sup>30</sup>, and 22% are between reporting dealers with non-reporting banks<sup>31</sup>. If interpreting financial intermediaries more broadly to include arbitrage capital like hedge funds and proprietary desks, 7% of global FX turnover is between reporting dealers and hedge funds & proprietary trading firms.<sup>32</sup>

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<sup>30</sup>According to [BIS \(2022\)](#), reporting dealers are defined as financial institutions that participate as reporters in the Triennial Survey. These are mainly large commercial and investment banks and securities houses that (i) participate in the inter-dealer market and/or (ii) have an active business with large customers, such as large corporate firms, governments and non-reporting financial institutions; in other words, reporting dealers are institutions that actively buy and sell currency and OTC derivatives both for their own account and/or to meet customer demand.

<sup>31</sup>According to [BIS \(2022\)](#), non-reporting banks are smaller or regional commercial banks, publicly owned banks, securities firms or investment banks not directly participating as reporting dealers

<sup>32</sup>According to [BIS \(2022\)](#), hedge funds & proprietary trading firms are (i) Investment funds and various types of money managers, including commodity trading advisers (CTAs), which share (a combination of) the following characteristics: they often follow a relatively broad range of investment strategies that are

Unlike unexpected capital flows, in principle, dividend flows can be estimated ex-ante. This is because aggregate dividend payments are predetermined (Section 3) and a certain proportion of dividends are predictably repatriated shortly after dividend payment dates by benchmark investors (Section 6.2). Nevertheless, financial intermediaries may differ in their sophistication in collecting and processing this information. Therefore, they may have different beliefs on the FX implications. The model in Section 6.4 shows that heterogeneous intermediaries with limited risk-bearing capacity that meet the dividend repatriation flows from benchmark investors are the underlying reason why predetermined dividend flows move the exchange rate shortly after the payment dates.

## 6.4 Model

In this section, I present a partial equilibrium model of the currency market. This model explains the dynamics of exchange rates around dividend payment dates and dividend announcement dates. Additionally, the model has further implications for the time variation of the price impact of dividend payments.

Figure 7 summarizes the model ingredients graphically. There are two countries, the US and the UK. Denote the exchange rate  $E_t$  as units of USD per GBP, i.e., the strength of GBP. A negative change in  $E_t$  means GBP depreciates.

There are three periods  $t = 0, 1, 2$ . At time 0, UK companies announce the dividend payment in GBP, with the ex-date and the payment date both at time  $t = 1$ .<sup>33</sup> Time  $t = 2$  is the long-run equilibrium, where the exchange rate is expected to revert back to the steady state  $\bar{E}$  on average, i.e.,

$$\mathbb{E}_1[E_2] = \bar{E}, \quad Var_1[E_2] = \sigma_E^2 \quad (3)$$

Trading takes place over the time interval  $[0, 1]$  at equally spaced time points  $t_n = n\Delta, n = 0, \dots, N$  where  $N\Delta = 1$ .

There are four agents: a benchmark investor following the global equity index, a noise trader, and two types of financial intermediaries with limited risk-bearing capacity in the

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not subject to borrowing and leverage restrictions, with many of them using high levels of leverage; they often have a different regulatory mandate than “institutional investors” and typically cater to sophisticated investors such as high-net-worth individuals or institutions; and they often hold long and short positions in various markets, asset classes and instruments, with frequent use of derivatives for speculative purposes. (ii) Proprietary trading firms that invest, hedge, or speculate for their own account. This category may include specialized high-frequency trading (HFT) firms that employ high-speed algorithmic trading strategies characterized by numerous frequent trades and very short holding periods.

<sup>33</sup>For simplicity, I combine the ex-date and the payment date together. In some countries like Switzerland, the ex-date and the payment date are only a few days apart.

currency market.

The benchmark investor mechanically follows the equity index in order to minimize the tracking errors. The global equity index methodology prescribes the reinvestment of dividends into the entire portfolio pro rata, including both in the UK and the US. Upon the dividend payment from the UK in GBP at time  $t = 1$ , the benchmark investor repatriates a certain proportion out of the currency, i.e., dividend flow. To do so, the benchmark investor needs to sell  $f$  GBP and buy USD at time  $t = 1$ , where  $f$  is a constant known at time  $t = 0$ . The benchmark investor does not trade before the payment date as its benchmark equity index does not change.

The noise trader has a stochastic demand for currency at time  $t_n$ , independent of everything. It buys  $\eta_{t_n}$  GBP and sells the equivalent amount in USD, where  $\eta_{t_n} \sim N(0, \sigma_\eta^2)$ .  $\eta_{t_n}$  can be either positive or negative. If  $\eta_{t_n} < 0$ , it means the noise trader sells  $|\eta_{t_n}|$  GBP and buys the equivalent amount of USD. For simplicity of notation, assume that the strength of the noise trader's currency demand is such that  $Var_{t_{n-1}}[E_{t_n}] = \sigma_E^2$ , i.e., the volatility of exchange rates is constant over time. For this condition to hold, we need the parameter assumption  $\sigma_\eta = 1/(\gamma\sigma_E)$ .

The financial intermediaries are heterogeneous, with  $\lambda \in [0, 1)$  proportion being sophisticated type A (e.g., hedge funds),  $1 - \lambda$  proportion being unsophisticated type B (e.g., dealers).<sup>34</sup> Both type A and type B intermediaries are mean-variance investors with risk aversion  $\gamma$ . They maximize the following utility function to determine their demand for GBP at time  $t$ :<sup>3536</sup>

$$\max_x \mathbb{E}_t^i[(E_{t+1} - E_t)x] - \frac{\gamma}{2} Var_t[(E_{t+1} - E_t)x] = \mathbb{E}_t^i[(E_{t+1} - E_t)]x - \frac{\gamma\sigma_E^2}{2}x^2$$

This gives the following demand curve for GBP for the type  $i$  intermediary:

$$q_t^i = \frac{1}{\gamma\sigma_E^2} \mathbb{E}_t^i[E_{t+1} - E_t]$$

i.e., they trade off the expected return with the volatility, the latter of which can be interpreted as the holding cost of the position for the intermediaries.

<sup>34</sup>This modeling device is similar to [Hau \(2011\)](#), in which type A intermediaries are labeled as informed arbitrageurs and type B intermediaries are labeled as uninformed liquidity providers.

<sup>35</sup>For simplicity, I assume gross interest rates in both countries are equal to 1. In this model, currencies are synonyms for bonds.

<sup>36</sup>Here, the subscript  $t + 1$  means the next period following time  $t$ , i.e., the next period of  $t_n$  is  $t_{n+1}$ , the next period of  $t = 1$  is  $t = 2$ .

The two types of intermediaries differ in their beliefs of expectations of the future exchange rate. Type A intermediaries have rational expectations, in the sense that their expectation of the future exchange rate is correct:

$$\mathbb{E}_t^A[E_{t+1}] = \mathbb{E}_t[E_{t+1}] \quad (4)$$

In particular, type A intermediaries are attentive to the dividend payments forthcoming at  $t = 1$  and the associated dividend repatriation when they form their expectation of the next-period exchange rate  $\mathbb{E}_t[E_{t+1}]$ . Aggregating  $\lambda$  measure of type A intermediaries, their demand curve for currency depends on the exchange rate today and tomorrow, as in [Gabaix and Maggiori \(2015\)](#), [Itskhoki and Mukhin \(2021\)](#):

$$Q_t^A = \lambda q_t^A = \frac{\lambda}{\Gamma} \mathbb{E}_t(E_{t+1} - E_t) \quad (5)$$

where  $\Gamma = \gamma\sigma_E^2$  represents the (inverse) risk-bearing capacity of the financial intermediary sector, with smaller  $\Gamma$  being the larger risk-bearing capacity. Type A intermediaries will demand more GBP if they expect GBP to appreciate against USD, which makes buying GBP and selling USD a profitable trade. On the other hand, if they expect GBP to depreciate in the future due to the benchmark investor's selling at  $t = 1$ , they will sell GBP beforehand.

In contrast, type B intermediaries are less sophisticated. They do not understand the implications of dividend payments on exchange rates. Therefore, type B intermediaries' expectation of the next period's exchange rate is always the long-run equilibrium exchange rate,

$$\mathbb{E}_t^B[E_{t+1}] = \bar{E} \quad (6)$$

Aggregating  $1 - \lambda$  measure of type B intermediaries, their currency demand depends on the deviation of the exchange rate at time  $t$  against the long-run equilibrium exchange rate, as in [Camanho, Hau, and Rey \(2022\)](#):

$$Q_t^B = (1 - \lambda)q_t^B = \frac{1 - \lambda}{\Gamma} (\bar{E} - E_t) \quad (7)$$

Given the long-run equilibrium exchange rate  $\bar{E}$ , type B intermediaries' demand only depends on the exchange rate today. If the current exchange rate is lower than  $\bar{E}$ , type B intermediaries will buy GBP and sell USD.

The following proposition summarizes the equilibrium exchange rate dynamics and the intermediaries' positions of GBP:



**Proposition 1.** *In equilibrium, the exchange rate at time  $t_n = n\Delta, n = 0, \dots, N$  is*

$$E_{t_n} = \bar{E} - \lambda^{N-n}\Gamma f + \Gamma\eta_{t_n}; \quad \mathbb{E}[E_{t_n}] = \bar{E} - \lambda^{N-n}\Gamma f \quad (8)$$

*Before the payment date at time  $\{t_n\}_{n=0}^{N-1}$ , type A intermediaries gradually build up the short positions:*

$$Q_{t_n}^A = \lambda(-\lambda^{N-n-1}(1-\lambda)f - \eta_{t_n}); \quad \mathbb{E}[Q_{t_n}^A] = -\lambda^{N-n}(1-\lambda)f \quad (9)$$

*while type B intermediaries take long positions:*

$$Q_{t_n}^B = (1-\lambda)(\lambda^{N-n}f - \eta_{t_n}); \quad \mathbb{E}[Q_{t_n}^B] = \lambda^{N-n}(1-\lambda)f \quad (10)$$

*At the payment date  $t_N = 1$ , the benchmark investor sells GBP while both intermediaries buy:*

$$Q_1^A = \lambda(f - \eta_1), Q_1^B = (1-\lambda)(f - \eta_1); \quad \mathbb{E}[Q_1^A] = \lambda f, \mathbb{E}[Q_1^B] = (1-\lambda)f \quad (11)$$

Figure 8 plots the expected value of the exchange rate and positions of type A and type B intermediaries in equilibrium. Expecting GBP to depreciate as in Eq (8), type A intermediaries gradually build up short positions in GBP by selling GBP to type B intermediaries before the dividend payment date. Type B intermediaries are willing to buy GBP because their belief is different. They expect the next period exchange rate will revert back to the steady state  $\bar{E}$ , as specified in Eq (6). According to Eq (9), the size of short positions for intermediaries is larger when it is closer to the payment date. With the announcement date being far away from the payment date (Table 2), the size of short positions by intermediaries around the dividend announcement date is negligibly small. In contrast, the largest short position is taken by the type A intermediaries immediately before the dividend payment date. This is because deploying capital to take positions is costly, as reflected by the negative variance part in the mean-variance utility function. Since Type A intermediaries do not aggressively take short positions far in advance, we should observe a limited anticipation effect before the payment date. This is precisely what I show empirically in Section 5.

In the exchange rate dynamics related to dividends, the payment date effect, the anticipation effect, and the announcement date effect are of particular interest. The following proposition shows the magnitude of these two effects:

**Proposition 2.** *Define the payment date effect of dividend flows on the foreign exchange rate as the expected FX change upon the dividend payment date, i.e.,  $\mathbb{E}[E_1 - E_{t_{N-1}}]$ . Define the anticipation effect as the expected cumulative FX change from the announcement date to*

the date prior to payment date, i.e.,  $\mathbb{E}[E_{t_{N-1}} - \bar{E}]$ . Define the announcement date effect as the expected FX change upon the dividend announcement date, i.e.,  $\mathbb{E}[E_0 - \bar{E}]$ .

1. *Payment date effect:*

$$\mathbb{E}[E_1 - E_{t_{N-1}}] = -(1 - \lambda)\Gamma f \quad (12)$$

2. *Anticipation effect:*

$$\mathbb{E}[E_{t_{N-1}} - \bar{E}] = -\lambda\Gamma f \quad (13)$$

3. *Announcement date effect:*

$$\mathbb{E}[E_0 - \bar{E}] = -\lambda^N\Gamma f \quad (14)$$

As Proposition 2 shows, dividend flow moves the foreign exchange rate at the payment date. The magnitude of the payment date effect is increasing in the proportion of type B intermediaries  $(1 - \lambda)$ . In other words, the less the arbitrage capital (aka.  $\lambda$  proportion of type A), the more pronounced is the payment date effect. If every intermediary is a forward-looking arbitrageur, i.e.,  $\lambda = 1$ , there are no counterparties for them to trade with before the payment date on average, as the demand from the noise trader is 0 in expectation. The exchange rate before the payment date will immediately adjust for there to be no trade. In this case, the payment date effect will be zero. Therefore, to have a significant dividend payment date effect, we need type B intermediaries, which do not fully understand the implications of dividend payments on FX. When  $\lambda = 0$ , i.e., all intermediaries are type B, the model is equivalent to the model in which the capital flow  $f$  is unexpected. In this case, the price impact of capital flow is the largest at  $-\Gamma f$ .

In contrast, the announcement date effect increases with the proportion of type A intermediaries  $\lambda$ : the greater the amount of forward-looking arbitrage capital, the more pronounced the announcement date effect. In addition, the announcement date effect decreases with the time gap between the announcement date and the payment date  $N$ . Empirically, I show in Sections 5.1 and 5.2 that the payment date effect is economically large and statistically significant, while the announcement date effect is small and insignificant.

With a reasonably small  $\lambda$  and a large  $N$ , the model quantitatively explains the significant payment date effect, the limited anticipation effect, and the negligible announcement date effect, as illustrated in Figure 8. Here, for the calibration of  $\lambda$ , I use the point estimates in the baseline regression in Table 6 Panel *Two-Way Fixed Effects with Controls*. For the payment date effect, I take the point estimate with the largest magnitude at  $t = 8$ , which is 6.48 basis points. This is to account for the potential delayed response. As the anticipation effect

estimates are insignificant, I take the average of point estimates from  $t = -10$  to  $t = -2$  to increase precision. This gives 2.75 basis points. Therefore,  $\lambda = 2.75/(2.75 + 6.48) \approx 0.30$ .

If dividends are recurring events, why don't type B intermediaries learn from the FX dynamics and correct their beliefs? Firstly, inferring from the FX dynamics jointly with dividend payments requires expertise, which varies significantly among financial institutions. Secondly, financial intermediaries may have different objectives. In the model, in spite of the short-term loss from long positions in GBP before the payment date, type B intermediaries eventually profit from these positions as the exchange rate typically reverts to the steady state in the long run. Thirdly, since many other factors affect exchange rates, the signal-to-noise ratio of dividend payments is relatively low. The identified magnitude of the payment date effect of large dividend payments in Section 5 is around 5 to 10 basis points. In contrast, the daily volatility of G10 currencies (against USD) is 68 basis points in the sample period from January 2001 to June 2023. Therefore, learning this effect and correcting their priors may take a long time.

The model has further implications for the time variation of dividend flows' price impact on the foreign exchange rate. If the intermediary mix  $\lambda$  is relatively stable, the price impact of dividend flows depends on the time variation of (inverse) risk-bearing capacity parameter  $\Gamma := \gamma\sigma_E^2$ . The risk aversion  $\gamma$  can be interpreted as the balance sheet constraints of financial intermediaries, while  $\sigma_E^2$  stands for the FX market volatility. When the balance sheet constraints are tight, or the market volatility is high, the risk-bearing capacity of intermediaries will be low. I use the intermediary capital ratio and the CIP deviations to proxy for the balance sheet constraints, as the intermediary capital ratio is the cause while the CIP deviations are the result. I use the currency implied volatility to proxy for the FX market volatility, as it is forward-looking. I summarize the implications of time variation of dividend impact on the foreign exchange rate in the following proposition:

**Proposition 3.** *The price impact of dividend flows on the foreign exchange rate is larger, if*

1. *the intermediary capital ratio is lower*
2. *the CIP deviations are larger*
3. *the currency implied volatilities are higher*

## 7 Time-Variation in the Price Impact of Dividend Flows

In this section, I empirically test three implications of the limited risk-bearing capacity of financial intermediaries. I find that the price impact of dividend flows is larger when the intermediaries' risk-bearing capacity is lower, e.g., when the intermediary capital ratio is lower, the covered interest parity (CIP) deviations are larger, and the currency implied volatilities are higher.

Consistent with the pattern established in Section 5.1, I focus on the two-day cumulative change after dividend payments in this section. The short-run effect is closer to the essence of dividend repatriation as highlighted in Section 6.2. Other horizons give similar results, though the power of the test may decrease as the horizon increases. The main specification is similar to Eq (2), as follows:

$$\Delta_2 e_{k,t+2}^{US/LC} := \ln E_{k,t+2}^{US/LC} - \ln E_{k,t-1}^{US/LC} = \alpha + \beta DivOut_{k,t} + Controls + \gamma_k + \xi_t + \epsilon_{k,t+2} \quad (15)$$

The key variable  $DivOut_{k,t}$  is country  $i$ 's dividends paid out to foreign investors on date  $t$  normalized by the previous year-end local stock market capitalization. Both the numerator and denominator are in the local currency. Therefore, there is no foreign exchange rate involved in the construct of  $DivOut_{k,t}$ . Dividends paid out to foreign investors are calculated using total dividend payments from Compustat Global/CRSP, multiplied by the foreign ownership calculated in Appendix B. As Figure 9 shows, this calculation matches the dividends imputed from the Balance of Payments closely. Scaling by the foreign ownership is to control for its increasing trend, as higher foreign ownership implies potentially larger dividend repatriation flows  $f$ , given the same amount of dividend payments. Normalization by the previous year-end local stock market capitalization makes  $DivOut_{k,t}$  stationary, as both dividends and stock market capitalization have grown significantly over the past 20 years.

### 7.1 Intermediary Capital Ratio

The intermediary capital ratio can be used as a proxy for the balance sheet constraint of financial intermediaries. As in He, Kelly, and Manela (2017), I define intermediary capital ratio as the New York Fed's primary dealers' market equity divided by market equity plus their aggregate book debt. The New York Fed's primary dealers are the New York Fed's trading counterparties in implementing monetary policy. The primary dealers are large

financial institutions<sup>37</sup>, many of which are active in the G10 currency market. Therefore, their capital ratio should be relevant for the G10 currency market. Reitz and Umlandt (2021) refines the intermediary capital ratio for the currency markets using the balance sheet data of the top three foreign exchange dealers. Their measure is highly correlated with He, Kelly, and Manela (2017), with the correlation being 0.90 from 1999 to 2017, when Reitz and Umlandt (2021) sample ends. The results in this section are qualitatively and quantitatively similar if using Reitz and Umlandt (2021)’s measure.

Table 7 Panel B confirms Proposition 3.1. Column 1 reiterates the findings in Section 5 using continuous variable  $DivOut_{k,t}$  in Eq (15). The price impact coefficient implies 1% local stock market capitalization paid out to foreign investors as dividends will lead to the local currency depreciation against USD by 0.806% in two days time after the payment date. Column 2 and Column 3 are split sample regressions. Column 2 is over the subsample where the intermediary capital ratio is greater than the median. This is when the balance sheet constraint is looser. The estimated price impact coefficient is -0.192 and statistically insignificant. Column 3 is over the subsample where the intermediary capital ratio is smaller than the median. This is when the balance sheet constraint is tighter. The estimated price impact coefficient is -1.209 and statistically significant. Column 4 adds the interaction term between  $DivOut_{k,t}$  and the subsample dummy variable in addition to first-order terms, with fully saturated fixed effects. It shows that the difference in the price impact coefficient in Column 2 and Column 3 is economically large and statistically significant, i.e., when the capital ratio is lower, the price impact of dividend flows on the foreign exchange rate is larger.

## 7.2 Deviations from Covered Interest Rate Parity

Another proxy of the balance sheet constraints of financial intermediaries is the deviations from covered interest rate parity (CIP). Traditionally, CIP is a textbook example of no-arbitrage condition. It requires the US dollar interest rate in the cash market to be the same as the synthetic dollar interest rate, which borrows in foreign currency and use FX swap to transform into USD. Since the 2007-2008 Global Financial Crisis (GFC), the CIP

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<sup>37</sup>As of 2023, the primary dealers include ASL Capital Markets, Bank of Montreal, Bank of Nova Scotia, BNP Paribas Securities, Barclays Capital, BofA Securities, Cantor Fitzgerald & Co., Citigroup Global Markets, Daiwa Capital Markets America, Deutsche Bank Securities, Goldman Sachs & Co., HSBC Securities (USA), Jefferies, J.P. Morgan Securities, Mizuho Securities USA, Morgan Stanley & Co., NatWest Markets Securities, Nomura Securities International, RBC Capital Markets, Santander US Capital Markets, Societe Generale, TD Securities (USA), UBS Securities, Wells Fargo Securities

deviation has been persistent. [Duffie \(2017\)](#), [Du, Tepper, and Verdelhan \(2018\)](#) find this is the result of the post-GFC regulatory reforms in the banking sector, especially the non-risk-weighted capital requirements in the form of the leverage ratio or supplementary leverage ratio. Following the GFC, new regulations (e.g., the Basel III leverage ratio rule and the U.S. supplementary leverage ratio) were introduced that require banks to maintain a minimum capital ratio against all assets, regardless of their risk characteristics. This limits global banks' capacity to arbitrage. [Du, Hébert, and Huber \(2023\)](#) shows that CIP deviations are correlated with the other types of near-arbitrages, including bond-CDS basis, the CDS-CDX basis, the USD Libor tenor basis, 30-year swap spreads, the Refco-Treasury spread, the KfW-Bund spread, and the asset-swapped TIPS/Treasury spread. Therefore, I use CIP deviation as a barometer for the intermediaries' balance sheet constraints, or more broadly, the scarcity of arbitrage capital.

Following the literature, I measure the CIP deviation using the cross-currency basis against USD, i.e.,

$$x_t^k = i_t^{US} - (i_t^k - \rho_t^k)$$

where  $i_t^{US}$  is the US dollar interest rate in the cash market,  $(i_t^k - \rho_t^k)$  is the synthetic US dollar interest from the FX swap market.  $\rho_t^k = (s_t^k - f_t^k)^4$  is the annualized forward premium, where  $s_t^k$  is the log spot exchange rate and  $f_t^k$  is the log 3-month forward outright, both in terms of units of USD per local currency.

Table 7 Panel B confirms Proposition 3.2. Column 1 is the full sample results. Column 2 and Column 3 are split sample regressions. On the subsample where the absolute value of the CIP deviation is lower than the median within currency, the price impact coefficient is -0.302 and statistically insignificant. This is when the balance sheet constraints are more relaxed. On the subsample where the absolute value of the CIP deviation is higher than the median within currency, the price impact coefficient is -1.259 and statistically significant. This is when the balance sheet constraints are more stringent. Adding the interaction term between  $DivOut_{k,t}$  and the subsample dummy variable in addition to first-order terms, Column 4 confirms the difference in price impact coefficient in Column 2 and Column 3 is not only economically large but also statistically significant. That is to say, when the balance sheet constraints are more stringent, the price impact of dividend flows on the foreign exchange rate is larger.

### 7.3 Currency Implied Volatility

In addition to the risk aversion coefficient  $\gamma$ , the FX volatility  $\sigma_E$  also affects the intermediary risk-bearing capacity  $\Gamma$ . In reality, this can stem from financial intermediaries' risk management practice in the form of value-at-risk (VaR) constraints (e.g., [Fang and Liu \(2021\)](#)). VaR constraints are widely used in the financial industry, including banks, hedge funds, etc. As higher volatility translates into tighter VaR constraints, the intermediaries' risk-bearing capacity is lower.

The FX volatility in the model in Section 6.4 is next-period volatility. Therefore, to proxy  $\sigma_E$ , I use the FX implied volatilities which is forward-looking. I use 6-month tenor as it strikes a balance between short-term and long-term volatility. Using other tenors or realized volatility gives similar results.

Table 7 Panel C confirms Proposition 3.3. Column 1 is the full sample results, while Column 2 and Column 3 are the results for split sample regressions. When the implied volatility is lower than the median within currency, the price impact coefficient is -0.359 (Column 2). This is when the intermediary risk-bearing capacity is larger. When the implied volatility is higher than the median within currency, the price impact coefficient is -1.290 (Column 3). This is when the intermediary risk-bearing capacity is smaller. Adding the interaction term between  $DivOut_{k,t}$  and the subsample dummy variable in addition to first-order terms, Column 4 confirms the difference in price impact coefficient in Column 2 and Column 3, -0.931, is economically large but also statistically significant. Therefore, at a time when the currency implied volatility is higher, the price impact of dividend flows on the foreign exchange rate is larger.

## 8 Implications for International Finance

In this section, I discuss the implications of my paper. First, I provide a back-of-the-envelope calculation of the price multiplier in the FX market, compare it with other estimates in the literature, and link it to the inelastic market hypothesis developed by [Gabaix and Koijen \(2021\)](#). Second, I discuss how the price impact estimates are useful to shed light on intermediaries' capital requirements. Third, I present evidence that the price impact of dividend flows is larger in the free-floating FX regime than other regimes.

## 8.1 FX Elasticity

The price impact coefficient estimated using Eq (15) implies 1% of local stock market capitalization paid out to foreign investors in local currency as dividends will lead to the local currency depreciation against USD by 0.806% in two days time after the payment date (Table 7 Panel A Column 1). At the end of 2022, the average stock market capitalization in non-US G10 countries is 2,681 billion USD. Expressed in semi-multiplier,<sup>38</sup> this implies  $33(= 1\%/0.806 \times 2681)$  billion USD-equivalent dividends paid to foreign investors are associated with 1% G10 currency movement against USD.

However, not all dividends paid out to foreign investors in the local currency are repatriated in the short run. To have a sense of the magnitude of actual dividend repatriation flows, we need to estimate the *dividend repatriation intensity*. In Section 6.2, I argue the short-run effect of dividend payments on the foreign exchange rate is most likely due to benchmark investors' dividend repatriation channel. Using Morningstar data (Figure 1), as of 2020 year-end, US-domiciled ETFs hold 3.2% of the local stock market capitalization, average across non-US G10 countries. In addition, US-domiciled mutual funds hold 6.6% of the local stock market capitalization. In total, US-domiciled benchmark investors hold 9.8% of local stock market capitalization. Using the data underlying Table B, the foreign ownership across non-US G10 countries is 40.3% as of 2020.

Therefore,  $\approx 24.3\%(= 9.8\%/40.3\%)$  of the dividends paid to foreign investors are paid to the US-domiciled benchmark investors, who are likely to be repatriated out of the local currency.<sup>39</sup> With  $\approx 24.3\%$  dividend repatriation intensity of foreign investors extrapolated to 2022,<sup>40</sup> 33 billion USD dividends paid to foreign investors is translated to 8 billion USD dividend repatriation flows out of the local currency. To conclude, on average, dividend flows of  $0.30\%(= 1\%/0.806 \times 24.3\%)$  of local stock market capitalization move the G10 currency by 1%. In terms of semi-multiplier,  $\$8.1bn(= 1\%/0.806 \times 24.3\% \times 2681)$  move the G10 currency by 1% vis-à-vis USD.

Table 8 compares my estimates with the others in the literature. The existing papers often rely on ad-hoc normalization, including GDP, M2, market capitalization, etc. Therefore, I convert the numbers in these papers to the semi-multiplier, i.e., the dollar amount of flows

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<sup>38</sup>Semi-multiplier is defined as  $d \ln E/dQ$ , where  $E$  is the foreign exchange rate against USD and the capital flow  $Q$  is expressed in USD-equivalent amount.

<sup>39</sup>This back-of-the-envelope estimate ignores non-US based ETFs and mutual funds, though they are much smaller than US-domiciled counterparts. In addition, US-domiciled benchmark investors may keep a certain proportion of dividends reinvested in the local stock markets.

<sup>40</sup>Here, I extrapolate from 2020 to 2022 as my sample of US-domiciled ETFs/mutual funds from Morningstar ends in 2020Q4.



that can move the exchange rate by 1%. Though estimates differ in types of flows and currencies, my estimates generally fall in the ballpark of the existing ones in terms of order of magnitude. For the developed market (DM) currencies, the closest estimate to mine is [Camanho, Hau, and Rey \(2022\)](#). Recently, [Camanho, Hau, and Rey \(2022\)](#) uses GIV on rebalancing flow for mutual funds domiciled in the US, the UK, Eurozone, and Canada. They estimate that \$5.3bn to \$7.1bn equity flow is associated with 1% US dollar movement.<sup>41</sup> Their mutual fund rebalancing flows are unexpected flows, while the dividend flows I use are predetermined. [Hau, Massa, and Peress \(2010\)](#) uses the MSCI Global Equity Index redefinition from market capitalization to freely floating in 2001 and 2002, and estimates that \$2.6bn equity flow moves the exchange rate by 1% against USD over a 6-day window around the announcement date across 33 currencies (developed market currencies & emerging market currencies).<sup>42</sup> Their estimate is about the announcement date effect while my estimate is about the payment date effect. In [Evans and Lyons \(2002\)](#) estimate that a US\$1.9 billion FX order flow moves the Deutsche Mark (DEM) exchange rate against USD by 1%.<sup>43</sup> The order flows contain contemporaneous information about exchange rates while dividends do not.

For the emerging market (EM) currencies, [Pandolfi and Williams \(2019\)](#) uses the 10% cap rule in J.P. Morgan Government Bond Index–Emerging Markets Global Diversified (GBI-EM Global Diversified) that the benchmark weight of any single country cannot exceed 10% of the index at the beginning of each month, inducing monthly rebalancings for a purely mechanical reasons. Their estimate implies \$1.4bn move the local currency against USD by 1% on average across 16 EM currencies.<sup>44</sup> [Broner et al. \(2021\)](#) uses the unexpected announcement of index inclusion into local-currency sovereign debt indexes of Citigroup WGBI and JP Morgan GBI-EM, and estimates \$5bn inflow leads to 1% local currency appreciation against USD in the two days following the announcement.<sup>45</sup> However, they find no effect during the implementation period between 2 and 6 months after the announcement date. Recently, [Aldunate et al. \(2022\)](#) uses Chilean pension funds flows induced by a Chilean financial advisor’ uninformed market timing recommendations. Their estimate implies that

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<sup>41</sup>p5262-5264.

<sup>42</sup>p1699 estimates that an (uninformative) capital flow of US\$1 billion therefore amounts to an average appreciation of 0.38% against USD.

<sup>43</sup>p178: \$1 billion of net dollar purchases increases the Deutsche Mark price by 0.54 percent.

<sup>44</sup>p393 Table 6 estimates that 1% inflow, relative to the market value of the sovereign bonds, leads to a close to 0.42% appreciation against the dollar in the exchange rate. I scale back this estimate by the market value of the sovereign bonds \$60.12bn in their Table 1, i.e.,  $(1\%/0.42\%) \times (60.12 \times 1\%) = 1.4$ .

<sup>45</sup>p17 Fig. 11 estimates 1.1% inflow, relative to GDP, leads to a 1% appreciation in the local currency against USD. I scale back this estimate by the nominal GDP in USD of the event dates.

\$1.4bn produces a depreciation of the Chilean peso against US dollar by 1%.

## 8.2 Capital Regulation

Regulations on global banks affect their risk-taking appetite. Even for arbitrage capital like hedge funds to size up their positions, they often need funding from banks, hence taking space in banks' balance sheets. Since the Global Financial Crisis (GFC), regulations on intermediaries' balance sheets have tightened considerably (Du, Hébert, and Huber (2023)). This is consistent with the pattern we see in Figure A7 that dividends have a larger price impact on exchanges than pre-GFC.<sup>46</sup> As the CIP deviation can be used as a proxy for balance sheet constraints, this is also consistent with the pattern in Table 7 Panel B.

On the other hand, Table 7 Panel A shows that a higher intermediary capital ratio in terms of equity/asset ratio (He, Kelly, and Manela (2017)) helps alleviate the price impact of dividend flows on exchange rates. To quantify how the intermediary capital ratio affects the dividend price impact coefficient, I run the following regression with the term of capital ratio interacted with dividends paid out to foreign investors, in addition to first-order terms:

$$\Delta_2 e_{k,t+2}^{US/LC} = \alpha + (\beta_0 + \beta_1 CR_t) \times DivOut_{k,t} + Controls + \gamma_k + \xi_t + \epsilon_{k,t+2} \quad (16)$$

The parameters of interest are  $\beta_0, \beta_1$ . The results are reported in Table 7 Panel A Column 5. The sample average capital ratio  $\overline{CR}$  is 7.38%, while 1 standard deviation  $std(CR)$  is 3.1%. At  $\overline{CR}$ , the implied price impact coefficient is  $\beta = -2.123 + 20.513 \times 7.38\% = -0.609$ . At  $\overline{CR} - std(CR)$ , the implied price impact coefficient becomes  $\beta = -2.123 + 20.513 \times (7.38\% - 3.18\%) = -1.26$ . That is to say, one standard deviation decrease in the intermediary capital ratio will double the price impact of flows.

## 8.3 FX Regimes

How capital flows affect exchange rates may depend on the FX regimes. If a currency is in a non-free-floating regime, central banks may need to conduct foreign exchange interventions to maintain the FX regimes. In this section, I present evidence on how the price impact of dividends on the foreign exchange rate differ in different FX regimes.

Ilzetzki, Reinhart, and Rogoff (2019) classifies currencies into 15 fine classifications from 1940 to 2019. Relevant to G10 currencies are the following regimes: pre-announced peg

<sup>46</sup>The same pattern also holds if using  $DivOut_{k,t}$  as RHS variable instead of  $\mathbb{D}_{i,t}$ .

(2), de facto horizontal band  $\leq 2\%$  (6), de facto crawling band  $\leq 2\%$  (8), moving band  $\leq 2\%$  (11), managed floating (12) and freely floating (13). I extend the last observation of classification to date. As Figure 10 shows, over the sample period since 2001, AUD, EUR, JPY, and USD have always been in the freely floating regime, NZD has always been managed floating (anchoring to AUD), and NOK has always been de facto moving band  $\pm 2\%$  against Euro. CAD switched from de facto moving band ( $\pm 2\%$  band against US dollar) to freely floating in June 2002. GBP switched from de facto moving band ( $\pm 2\%$  band against Euro) to freely floating in January 2009. SEK switched from de facto horizontal band ( $\pm 2\%$  band against Euro) to de facto moving band ( $\pm 2\%$  band against Euro) in September 2008. CHF switched to pegging to Euro during September 2011 to January 2015, while in other time, de facto moving band ( $\pm 2\%$  band against Euro). In the sample, the number of observations in freely floating regime are similar to the number of observations in other regimes. Therefore, I estimate Eq(15) for non-freely-floating regimes vs freely floating regime.

Table 9 Column 1 is the full sample results. Column 2 and Column 3 are split sample regressions. On the subsample of non-freely-floating regimes, the price impact coefficient is -0.353 and statistically insignificant. On the subsample of the freely-floating regime, the price impact coefficient is -1.689 and statistically significant. Adding the interaction term between  $DivOut_{k,t}$  and the subsample dummy variable, Column 4 confirms the difference in price impact coefficient in Column 2 and Column 3 is not only economically large but also statistically significant. That is to say, the price impact of dividend flows on the exchange rate is larger in the freely floating regime than in other FX regimes.

## 9 Conclusion

In this paper, I show that predetermined dividends move the foreign exchange rate around the payment dates. In contrast, the anticipation effect before the payment date is limited and the announcement date effect is negligible. This empirical pattern informs us about the interaction between the benchmark investors and financial intermediaries. On the one hand, benchmark investors predictably repatriate dividends received in local currency shortly afterward. On the other hand, financial intermediaries with limited risk-bearing capacity and heterogenous beliefs give rise to FX dynamics.

Dividend payments are recurring and frequent events, compared to other one-off events like changes to indices. They can be a valuable tool in the international economists' toolbox. For example, in this paper, I use dividend flows to estimate their price impact on the foreign

exchange rate at different times and under different FX regimes. As a specific type of capital flow, its predeterminedness may serve as an instrument for other capital flows.

As the FX market is often claimed to be the largest and the deepest market in the world,<sup>47</sup> the price effect of dividend flows and other capital flows on exchange rates appears to be very big, given the magnitude of cross-border flows like trade flows.<sup>48</sup> This is similar in essence to the inelastic market hypothesis, pioneered by [Gabaix and Kojen \(2021\)](#). In models that feature financial intermediaries' roles in FX determination, it is intermediaries' limited risk-bearing capacity that determines the elasticity of the foreign exchange rate to capital flows. That being said, reconciling the price impact estimates with other cross-border macro variables in a quantitative model is left to future research.

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<sup>47</sup><https://www.cmegroup.com/education/courses/introduction-to-fx/what-is-fx.html>

<sup>48</sup>It is worth noting that a significant portion of trade flows are invoiced in USD. Therefore, their FX impact may not be as big at face value.

TABLE 1: STOCK MARKET SIZE AND FOREIGN OWNERSHIP

This table provides summary statistics about the size and foreign ownership of stock markets in G10 countries/currency areas, including Australia (AUS), Canada (CAN), Switzerland (CHE), Euro area (EUR), United Kingdom (GBR), Japan (JPN), Norway (NOR), New Zealand (NZL), Sweden (SWE), and the United States (USA). All numbers are the average of annual data from 2001 to 2022. *Stock Market to GDP* is the year-end stock market capitalization divided by nominal GDP, where the market capitalization data is from Bloomberg (after 2003) and the World Bank (before 2023). The nominal GDP is from the World Bank. *Foreign Ownership of Domestic Stock Market* is calculated from the Balance of Payments. Columns *by G10* and *by USA* under *Out of Foreign Ownership* are calculated from the Coordinated Portfolio Investment Survey (CPIS). See Appendix B for more details.

	STOCK MARKET TO GDP	DIVIDENDS TO GDP	FOREIGN OWNERSHIP OF DOMESTIC STOCK MARKET		
			OUT OF FOREIGN OWNERSHIP by G10	by USA	
AUS	1.03	3.7%	28.8%	93.3%	46.5%
CAN	1.16	2.7%	22.4%	96.8%	77.3%
CHE	2.14	3.3%	60.0%	96.9%	48.7%
EUR	0.55	1.5%	32.1%	90.0%	46.0%
GBR	1.19	2.8%	51.7%	89.2%	46.7%
JPN	0.92	1.7%	26.0%	93.5%	52.4%
NOR	0.64	1.8%	26.3%	95.5%	38.3%
NZL	0.36	1.5%	31.9%	96.2%	39.8%
SWE	1.23	2.6%	33.8%	93.7%	35.4%
USA	1.31	2.0%	17.6%	85.1%	-

TABLE 2: CALENDAR DAYS BETWEEN DIVIDEND ANNOUNCEMENT AND PAYMENT

This table shows the number of calendar days between the dividend announcement date and the dividend payment date at the firm level across G10 countries/currency areas. Dividend information is released on the dividend announcement date, including dividend size and other dividend-related dates except for Japan. For Japan, I calculate the number of calendar days between the ex-date and the payment date, as companies in Japan typically do not confirm the dividend amount before the ex-date, though the guidance of dividends is usually available almost one year in advance. The sample period is from January 2001 to June 2023.

	Observations	CALENDAR DAYS			
		Mean	p25	p50	p75
AUS	17,991	48.3	32	43	58
CAN	55,640	39.4	27	31	44
CHE	2,703	52.1	35	48	63
EUR	35,598	62.9	41	58	83
GBR	32,993	68.0	43	63	84
JPN	106,307	82.6	72	87	93
NOR	2,142	70.3	37	72	97
NZL	2,789	36.4	24	32	44
SWE	4,406	92.7	68	84	97
USA	133,672	43.1	28	37	52
All	394,241	58.0	32	55	80

TABLE 3: COMPARISON BETWEEN DIVIDEND AND PORTFOLIO FLOWS

This table compares average dividend flows with other financial flows and trade flows from the Balance of Payments (BOP) between 2001 and 2022. All numbers are in billions of USD. *Dividends on Equity To Foreign Investors* is investment income on equity and investment fund shares on the debit side (BMIPIPE), while *Dividends on Equity From Foreign Investors* is on the credit side (BXIPIPE). Under *Portfolio Investment of Equity*, *Net Acquisition of Assets* is a country's purchase of foreign countries' equity and investment fund shares (BFPAE), while *Net Incurrence of Liabilities* is foreign countries' purchase of a country's equity and investment fund shares (BFPLE). Similarly, under *Portfolio Investment of Debt*, *Net Acquisition of Assets* is a country's purchase of foreign countries' debt securities (BFPAD), while *Net Incurrence of Liabilities* is foreign countries' purchase of a country's debt securities (BFPLD). *Net Exports* is exports minus imports of goods and services (BGS). See Appendix A for more details on the indicators.

	DIVIDENDS ON EQUITY		PORTFOLIO INVESTMENT EQUITY		PORTFOLIO INVESTMENT DEBT		Net Exports
	To Foreign Investors	From Foreign Investment	Net Acquisition of Assets	Net Incurrence of Liabilities	Net Acquisition of Assets	Net Incurrence of Liabilities	
AUS	12.0	10.6	26.9	13.8	17.9	49.9	6.2
CAN	10.1	13.5	18.9	11.2	14.3	58.4	-2.9
CHE	22.0	12.7	7.9	-2.8	15.4	2.2	50.8
EUR	139.8	62.1	118.8	238.4	289.4	173.2	252.6
GBR	51.0	35.0	-6.8	8.7	37.9	142.3	-45.9
JPN	22.9	36.5	31.2	26.6	98.6	82.4	2.0
NOR	3.8	18.0	26.4	3.1	26.2	14.4	44.9
NZL	0.8	0.9	1.5	0.9	1.6	4.4	0.2
SWE	6.9	9.4	9.6	1.5	8.7	17.7	23.3
USA	98.3	160.7	137.2	91.5	130.5	525.8	-580.5

TABLE 4: FX CUT-OFF TIME AND STOCK MARKET CLOSING TIME

This table shows the primary stock market closing time of the regular trading hour in different countries/currency areas. The data is sourced from Bloomberg. The FX cut-off time is the closest hour equal to or immediately after the stock market closing time.

	TIME ZONE	STOCK MARKET CLOSE	FX CUT-OFF TIME
AUD	Australia/Sydney	16:00	16:00
CAD	U.S./Eastern	16:00	16:00
CHF	Europe/Zurich	17:20	18:00
EUR	Europe/Paris	17:30	18:00
GBP	Europe/London	16:30	17:00
JPY	Asia/Tokyo	15:00	15:00
NOK	Europe/Oslo	16:20	17:00
NZD	Pacific/Auckland	16:45	17:00
SEK	Europe/Stockholm	17:25	18:00
USD	U.S./Eastern	16:00	16:00



TABLE 5: PERFORMANCE OF DIVIDEND-BASED CURRENCY STRATEGY

This table presents the performance profiles for the dividend-based currency strategy under different parameters, before and after the transaction costs. The transaction cost, i.e., bid-ask spread, is assumed to be 1 basis point for all currencies at all times. The dividend-based currency strategy takes the following form: for each country/currency area  $k$  and date  $t$ , if in the previous  $l$  days, the combined dividend payments in the country  $k$  rank in its top  $p$ -percentile in the rolling 1-year window, then we sell currency  $k$  against USD, and hold the position for one day. If there are several currencies that satisfy this criterion, then the strategy puts \$1 on each position. The numbers in the brackets are t-statistics. Alpha, DOL, CAR, MOM, VAL are the coefficients from factor-spanning regression Eq (1) at the monthly frequency. The standard errors of the Sharpe ratio are calculated using Lo (2002).

Top $p = 5\%$	BEFORE TRANSACTION COSTS			AFTER TRANSACTION COSTS		
Lookback Period $l$	1 Day	2 Days	1 Week	1 Day	2 Days	1 Week
Panel A. Summary Statistics						
Mean	3.0 [2.65]	4.4 [3.25]	3.3 [2.16]	2.3 [2.08]	3.6 [2.66]	2.3 [1.51]
Sharpe Ratio	0.56 [2.65]	0.68 [3.25]	0.45 [2.16]	0.44 [2.08]	0.56 [2.66]	0.32 [1.51]
Zero Position Days	0.79	0.75	0.71	0.79	0.75	0.71
Panel B. Regressions $rx = a + b_1DOL + b_2CAR + b_3MOM + b_4VAL + e_t$						
Alpha	0.22 [2.32]	0.36 [3.22]	0.30 [2.49]	0.17 [1.78]	0.30 [2.65]	0.22 [1.85]
DOL	0.28 [5.42]	0.41 [6.91]	0.59 [9.19]	0.28 [5.41]	0.41 [6.94]	0.59 [9.24]
CAR	0.09 [1.64]	0.07 [1.11]	0.05 [0.68]	0.09 [1.59]	0.07 [1.03]	0.04 [0.58]
MOM	0.01 [0.22]	0.03 [0.58]	0.05 [0.86]	0.01 [0.23]	0.03 [0.60]	0.04 [0.87]
VAL	-0.07 [-1.57]	-0.08 [-1.42]	0.10 [1.74]	-0.07 [-1.56]	-0.08 [-1.40]	0.10 [1.79]

TABLE 6: PRICE IMPACT OF LARGE DIVIDENDS ON THE FOREIGN EXCHANGE RATE

This table compares estimates of the price impact of dividends on the foreign exchange rate using different identification strategies. Panel *OLS* reports  $\beta_h$  estimated from Eq (2), without controls and fixed effects. Panel *OLS with Controls* controls for stock market returns and FX implied volatilities. Panel *OLS with Controls and Time Fixed Effects* further adds time fixed effects. Panel *Two-Way Fixed Effects with Controls* is the baseline regression Eq (2), with controls, time fixed effects, and currency fixed effects. The standard errors are clustered at the date level. Panel *Difference-in-Difference* is estimated from the alternative identification strategy in Section D.2, where control group units are equally weighted. Panel *Synthetic Control* is estimated from the alternative identification strategy in Section D.2, where weights on the qualified controls are optimized from Eq (A7). The sample period is from January 2001 to June 2023.

		BUSINESS DAYS RELATIVE TO DIVIDEND PAYMENT DATE										
		0	1	2	3	4	5	6	7	8	9	10
<b>OLS</b>												
Coefficients		0.04	-1.77	-5.73**	-6.11**	-5.54*	-7.76**	-7.99**	-9.30**	-9.26**	-7.36	-5.89
Standard Errors		(1.46)	(2.14)	(2.58)	(3.01)	(3.27)	(3.61)	(3.92)	(4.25)	(4.44)	(4.72)	(5.07)
<b>OLS with Controls</b>												
Coefficients		0.13	-1.65	-5.60**	-5.97**	-5.38*	-7.58**	-7.81**	-9.12**	-9.05**	-7.15	-5.67
Standard Errors		(1.45)	(2.12)	(2.56)	(3.00)	(3.26)	(3.60)	(3.91)	(4.24)	(4.42)	(4.70)	(5.05)
<b>OLS with Controls and Time Fixed Effects</b>												
Coefficients		-1.47	-2.29	-4.70**	-5.18**	-4.83**	-6.32**	-5.83**	-6.20**	-6.48**	-5.03	-4.73
Standard Errors		(1.24)	(1.62)	(1.88)	(2.09)	(2.32)	(2.57)	(2.75)	(2.96)	(3.02)	(3.21)	(3.42)
<b>Two-Way Fixed Effects with Controls</b>												
Coefficients		-1.48	-2.30	-4.70**	-5.18**	-4.83**	-6.32**	-5.83**	-6.20**	-6.48**	-5.03	-4.73
Standard Errors		(1.24)	(1.62)	(1.88)	(2.09)	(2.31)	(2.57)	(2.75)	(2.96)	(3.02)	(3.21)	(3.41)
<b>Difference-in-Difference</b>												
Coefficients		-1.81	-4.84**	-6.54***	-7.15**	-8.21***	-9.16**	-10.02**	-10.76**	-12.55***	-11.91***	-11.57**
Standard Errors		(1.47)	(2.14)	(2.48)	(2.82)	(3.16)	(3.56)	(3.91)	(4.26)	(4.34)	(4.50)	(4.65)
<b>Synthetic Controls</b>												
Coefficients		-2.07	-4.57**	-5.76**	-6.22**	-9.10***	-9.72***	-10.52***	-11.83***	-12.51***	-12.45***	-11.99***
Standard Errors		(1.61)	(2.17)	(2.50)	(2.84)	(3.14)	(3.40)	(3.68)	(3.94)	(4.10)	(4.33)	(4.55)

(Continued on the next page)

TABLE 6 (CONTINUED): PRICE IMPACT OF LARGE DIVIDENDS ON THE FOREIGN EXCHANGE RATE

	BUSINESS DAYS RELATIVE TO DIVIDEND PAYMENT DATE										
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
<b>OLS</b>											
Coefficients	-2.63	-2.77	-2.64	-2.63	-1.80	-1.50	-1.81	-1.34	0.98	-	0.04
Standard Errors	(4.58)	(4.26)	(4.02)	(3.70)	(3.35)	(2.92)	(2.57)	(2.12)	(1.53)	-	(1.46)
<b>OLS with Controls</b>											
Coefficients	-2.37	-2.54	-2.42	-2.42	-1.62	-1.37	-1.69	-1.26	1.03	-	0.13
Standard Errors	(4.59)	(4.26)	(4.03)	(3.71)	(3.34)	(2.92)	(2.57)	(2.11)	(1.53)	-	(1.45)
<b>OLS with Controls and Time Fixed Effects</b>											
Coefficients	4.48	2.62	2.79	2.66	2.87	2.57	1.43	2.09	3.04**	-	-1.47
Standard Errors	(2.99)	(2.80)	(2.71)	(2.49)	(2.28)	(2.04)	(1.81)	(1.51)	(1.21)	-	(1.24)
<b>Two-Way Fixed Effects with Controls</b>											
Coefficients	4.52	2.66	2.82	2.69	2.89	2.59	1.44	2.10	3.04**	-	-1.48
Standard Errors	(2.99)	(2.80)	(2.70)	(2.48)	(2.28)	(2.04)	(1.81)	(1.51)	(1.21)	-	(1.24)
<b>Difference-in-Difference</b>											
Coefficients	0.58	1.87	3.00	2.39	4.99	4.52	3.67	4.03*	2.05	-	-1.81
Standard Errors	(4.32)	(4.08)	(3.85)	(3.51)	(3.19)	(2.85)	(2.50)	(2.08)	(1.54)	-	(1.47)
<b>Synthetic Controls</b>											
Coefficients	4.35	4.86	5.06	2.62	4.32	4.20	3.31	3.29*	1.18	-	-2.07
Standard Errors	(3.85)	(3.61)	(3.43)	(3.21)	(2.96)	(2.66)	(2.29)	(1.84)	(1.36)	-	(1.61)

(Continued from the previous page)

TABLE 7: TIME VARIATION OF PRICE IMPACT OF DIVIDEND FLOWS ON FX RATES

This table reports the price impact coefficients of dividends paid out to foreign investors on the foreign exchange rate in Eq(15). The variable  $DivOut_{k,t}$  is country  $k$ 's (normalized) dividends paid out to foreign investors on date  $t$ , calculated using total dividend payments from Compustat Global/CRSP multiplied by the foreign ownership, then normalized by the previous year-end its stock market capitalization, both in local currency. The controls include stock market returns and FX implied volatilities. Columns 1-4 are on different subsamples. For regressions with interaction terms with subsample indicators, the fixed effects and controls are fully saturated. Column 5 reports results in Eq (16). The standard errors are clustered at the date level. The sample period is from January 2001 to June 2023.

PANEL A. INTERMEDIARY CAPITAL RATIO					
$\Delta_2 e_{t+2}^{US/LC}$	(1) All	(2) CR $\geq$ p50	(3) CR < p50	(4) All	(5) All
$DivOut_{i,t}$	-0.806*** (0.259)	-0.192 (0.348)	-1.209*** (0.363)	-0.192 (0.348)	-2.123** (0.845)
$\mathbb{1}\{CR < p50\} \times DivOut_{i,t}$				-1.018** (0.503)	
CR $\times DivOut_{i,t}$					20.513* (11.643)
Observations	50463	25245	25218	50463	50463
Adjusted $R^2$	0.518	0.522	0.516	0.518	0.518
PANEL B. CIP DEVIATION					
$\Delta_2 e_{t+2}^{US/LC}$	(1) All	(2)  CIP  < p50	(3)  CIP  $\geq$ p50	(4) All	
$DivOut_{i,t}$	-0.806*** (0.259)	-0.302 (0.360)	-1.259*** (0.417)	-0.302 (0.360)	
$\mathbb{1}\{ CIP  \geq p50\} \times DivOut_{i,t}$				-0.957* (0.555)	
Observations	50463	24290	24749	49039	
Adjusted $R^2$	0.518	0.568	0.552	0.558	
PANEL C. CURRENCY IMPLIED VOLATILITY					
$\Delta_2 e_{t+2}^{US/LC}$	(1) All	(2) IV < p50	(3) IV $\geq$ p50	(4) All	
$DivOut_{i,t}$	-0.806*** (0.259)	-0.359 (0.311)	-1.290*** (0.429)	-0.359 (0.311)	
$\mathbb{1}\{IV \geq p50\} \times DivOut_{i,t}$				-0.931* (0.531)	
Observations	50463	24797	24425	49222	
Adjusted $R^2$	0.518	0.538	0.548	0.545	

TABLE 8: COMPARISON AMONG ESTIMATES OF FX SEMI-MULTIPLERS

This table compares my estimates using dividend flows with estimates in the existing literature, which are converted into semi-multiplier, i.e., the dollar value of capital flows that can move the exchange rate by 1%. See the footnotes in the main text for details of the conversion.

	SEMI-MULTIPLER		SAMPLE	
	Methodology	Est	Currencies	Freq
This paper	Dividend flows	8.1	G10	D
<a href="#">Camanho et al.</a>	GIV on MF rebalancing flows	7.1	USD, EUR, GBP, CAD	Q
<a href="#">Hau et al.</a>	MSCI Global Equity Index redefinition	2.6	33 DM & EM	D
<a href="#">Evans-Lyons</a>	Order flows	1.9	DEM	D
<a href="#">Pandolfi-Williams</a>	Cap 10% in GBI-EM Global Diversified Index induced rebalancing	1.4	16 EM	D
<a href="#">Broner et al.</a>	Addition to WGBI & GBI-EM	5.0	6 EM	D
<a href="#">Aldunate et al.</a>	Chilean FyF induced rebalancing	1.4	CLP	D

TABLE 9: PRICE IMPACT BY FOREIGN EXCHANGE REGIME

This table reports the price impact coefficients of dividends paid out to foreign investors on the foreign exchange rate in Eq(15) under different FX regimes. FX regimes are the fine classifications from Ilzetki, Reinhart, and Rogoff (2019). The variable  $DivOut_{k,t}$  is country  $k$ 's (normalized) dividends paid out to foreign investors on date  $t$ , calculated using total dividend payments from Compustat Global/CRSP multiplied by the foreign ownership, then normalized by the previous year-end its stock market capitalization, both in local currency. The controls include stock market returns and FX implied volatilities. The standard errors are clustered at the date level. The sample period is from January 2001 to June 2023.

	(1)	(2)	(3)	(4)
$\Delta_2 e_{t+2}^{US/LC}$	All	Non-Freely Floating	Freely Floating	All
$DivOut_{i,t}$	-0.806*** (0.259)	-0.353 (0.335)	-1.689*** (0.644)	-0.353 (0.335)
$\mathbb{1}\{\text{FreeFloat}\} \times DivOut_{i,t}$				-1.336* (0.721)
Observations	50463	24364	26099	50463
Adjusted $R^2$	0.518	0.645	0.470	0.567

FIGURE 1: U.S.-DOMICILED ETFs AND MUTUAL FUNDS:  
FOREIGN HOLDINGS AS SHARE OF THE LOCAL STOCK MARKET

This figure shows the market value of US-domiciled ETFs and mutual funds equity holdings as a percentage of each country's aggregate market capitalization. The holdings of US-domiciled ETFs and mutual funds are from Morningstar with asset class being Equity or REITs. For ETFs, the sample period is from 2011 to 2020. For mutual funds, the sample period is from 2002 to 2020. The year-end aggregate market capitalization for each country is from Bloomberg.

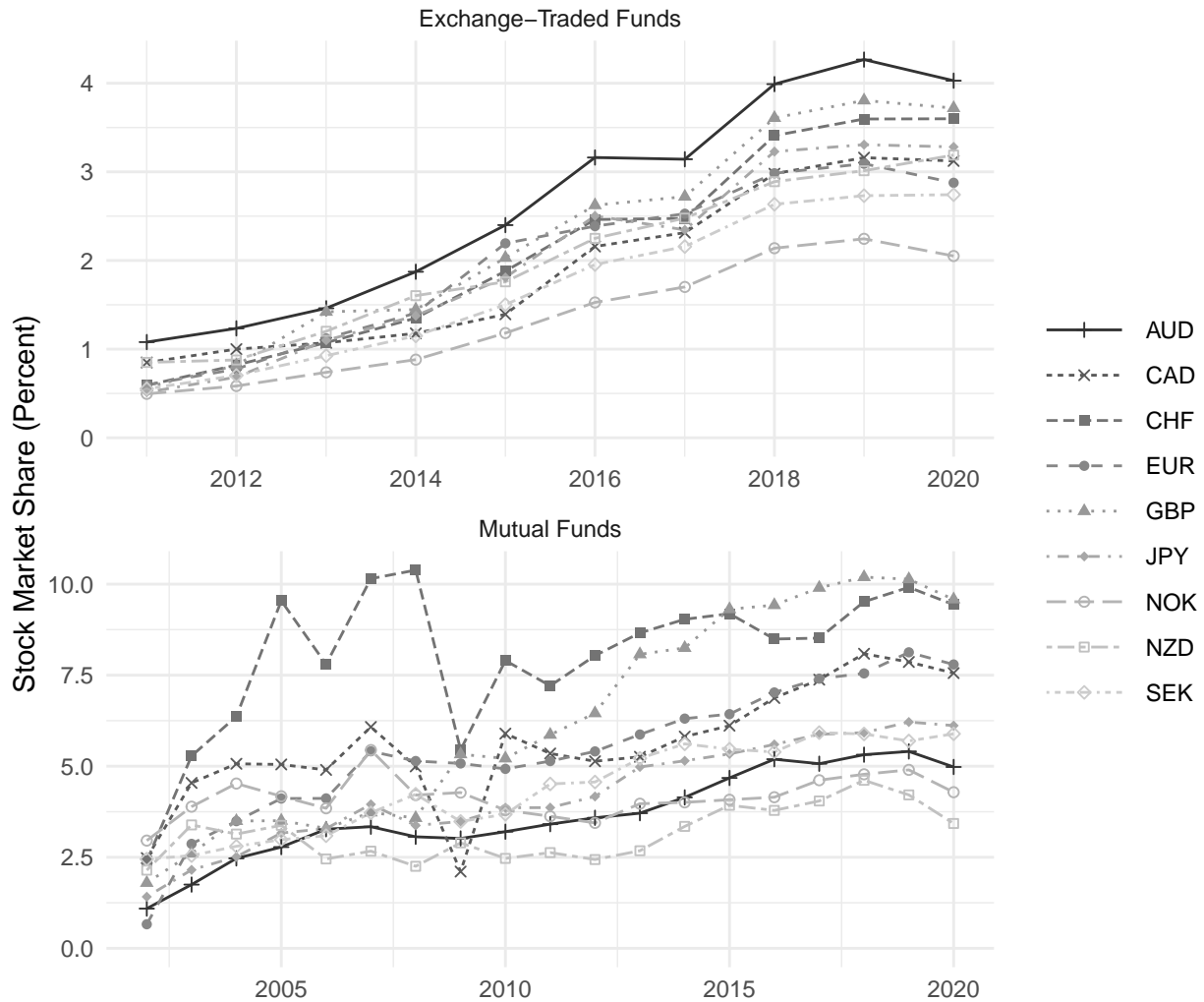


FIGURE 2: TIME-SERIES OF CASH DIVIDEND PAYMENTS

This figure shows the dividend payments in G10 countries/currency areas from January 2018 to December 2022. I focus on cash dividends and keep common/ordinary shares that are primarily listed in a country/currency area. Dividends are aggregated to payment dates and converted to billion USD using the prevailed exchange rates on the payment dates.

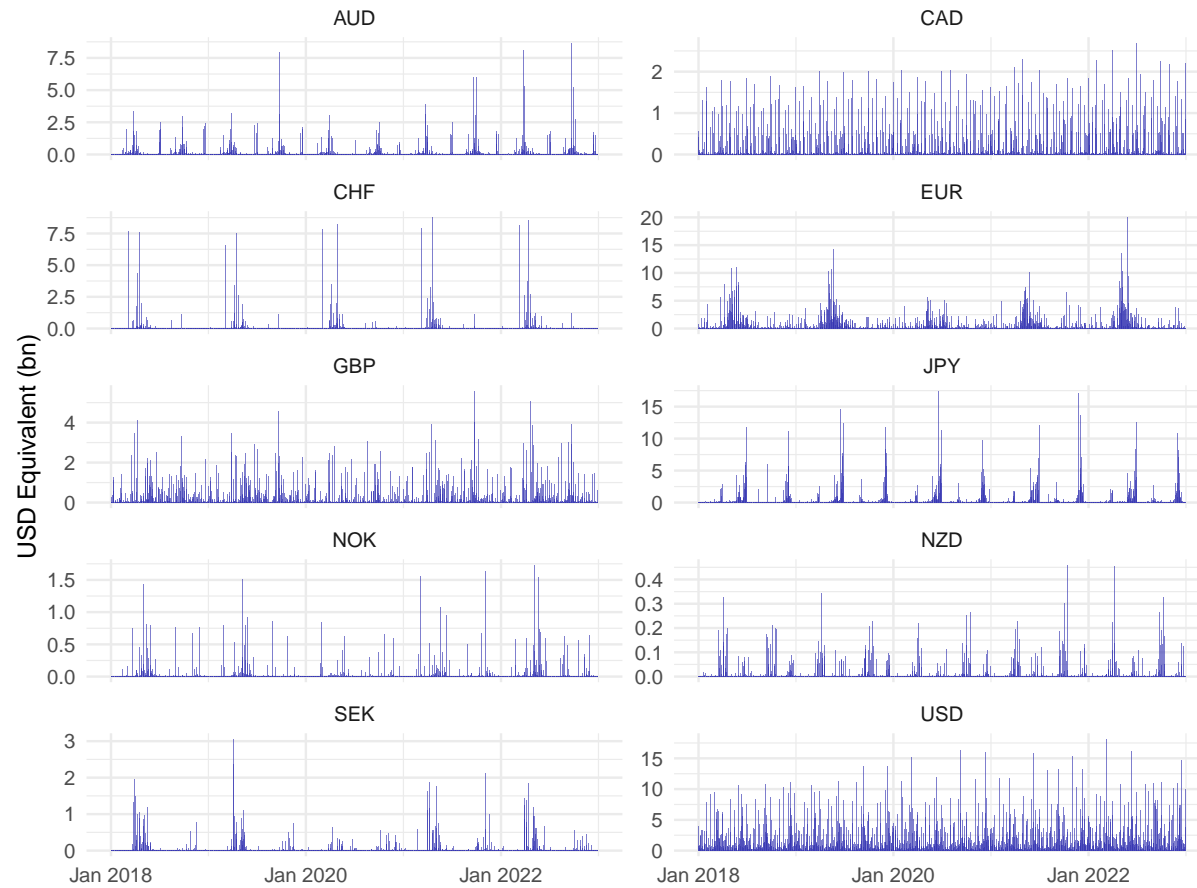




FIGURE 3: CUMULATIVE RETURN ON THE DIVIDEND-BASED CURRENCY STRATEGY

This figure shows the cumulative log returns of the dividend-based currency strategy in percentage points, both before the transaction cost (blue line) and after the transaction cost (orange line). The transaction cost, i.e., bid-ask spread, is assumed to be 1 basis point for all currencies at all times. The dividend-based currency strategy takes the following form: for each country/currency area  $k$  and date  $t$ , if in the previous  $l$  days, the combined dividend payments in the country  $k$  rank in its top  $p$ -percentile in the rolling 1-year window, then we sell currency  $k$  against USD, and hold the position for one day. If there are several currencies that satisfy this criterion, then each position is of \$1 size. The excess return on date  $t$  is calculated from summing across excess returns for each position. In this figure,  $l = 2, p = 5\%$ . The sample period is from January 2001 to June 2023.

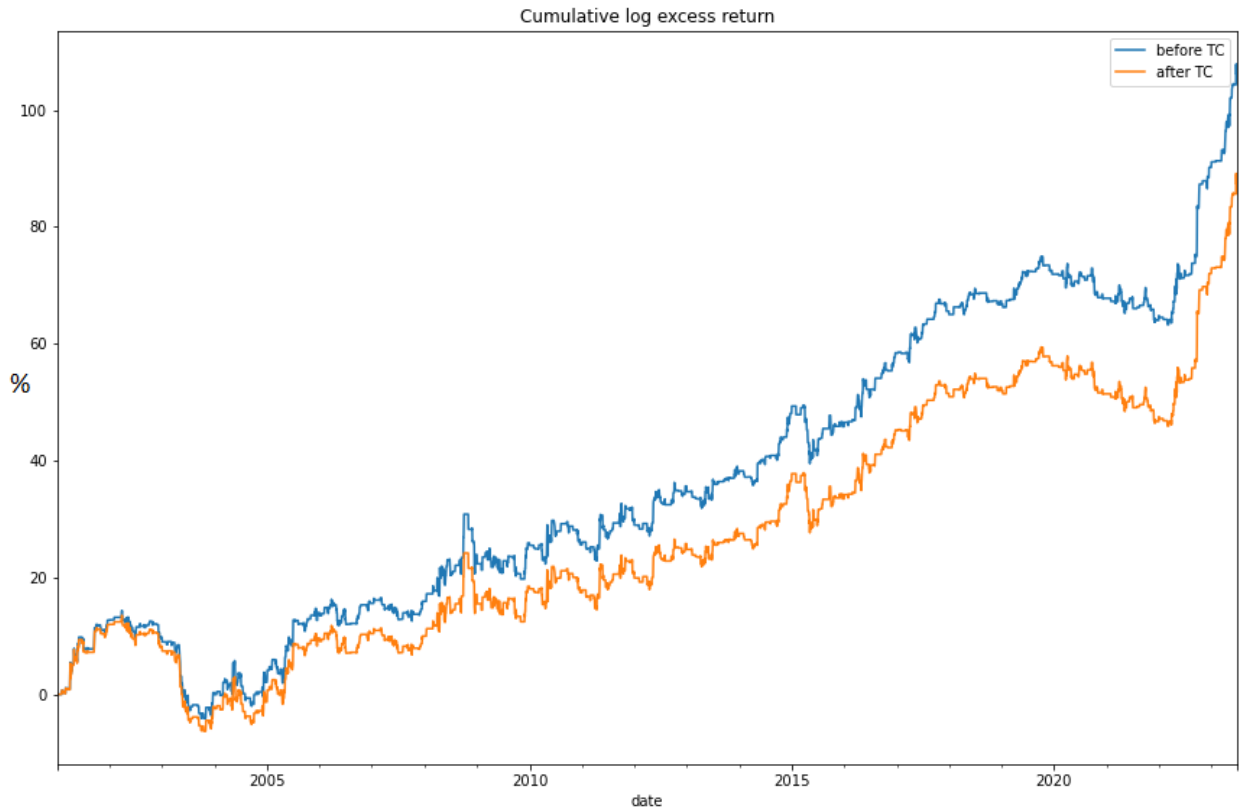


FIGURE 4: PRICE IMPACT OF LARGE DIVIDENDS ON THE FOREIGN EXCHANGE RATE AROUND DIVIDEND PAYMENT DATES

This figure shows the coefficients  $\beta_h$  estimated in the baseline regression Eq (2) with controls, the currency fixed effect, and the time fixed effect. Dividends are aggregated from the company level to the currency level by the payment dates. The controls include stock market returns and FX implied volatilities. The sample period is from January 2001 to June 2023. The standard errors are clustered at the date level.

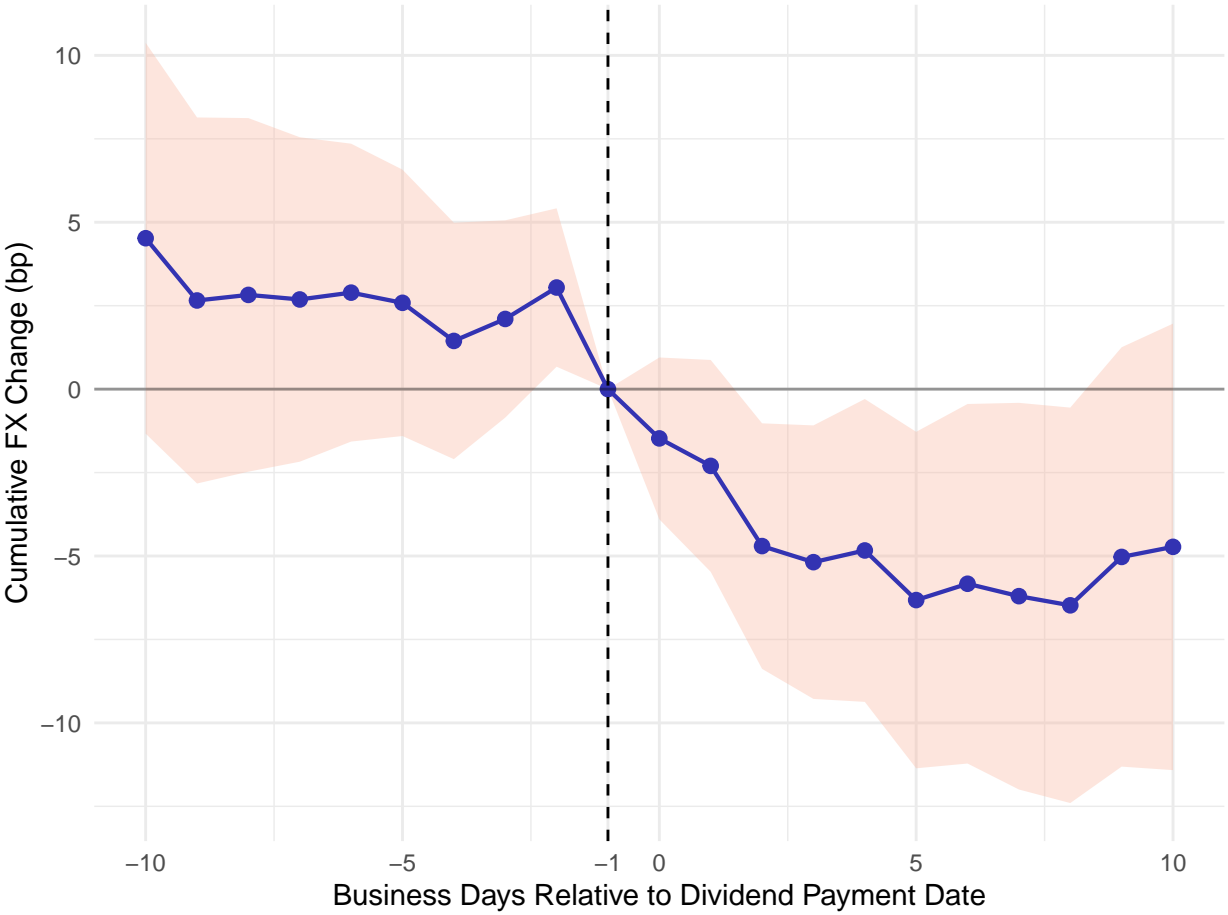


FIGURE 5: PRICE IMPACT OF LARGE DIVIDENDS ON THE FOREIGN EXCHANGE RATE AROUND DIVIDEND ANNOUNCEMENT DATES

This figure shows the coefficients  $\beta_h$  estimated in the baseline regression Eq (2), where  $t$  is the announcement date instead of the payment date. Dividends are aggregated from the company level to the currency level by the announcement dates. The regression includes controls, the currency fixed effect, and the time fixed effect. The controls include stock market returns and FX implied volatilities. The sample period is from January 2001 to June 2023. The standard errors are clustered at the date level.

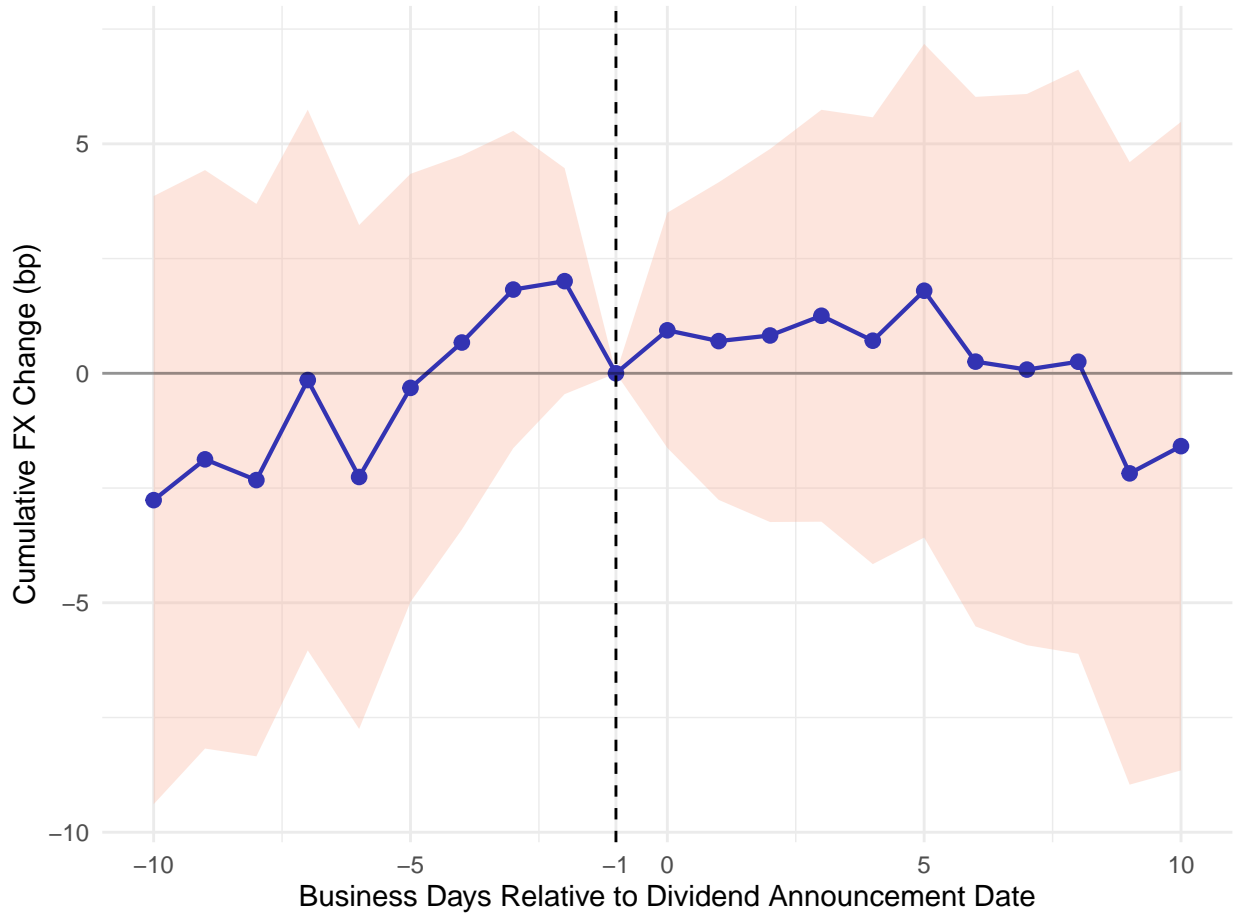


FIGURE 6: DIVIDEND REPATRIATION CHANNEL - A CASE STUDY

This figure shows the cash position evolution of First Trust Developed Markets ex-US AlphaDEX<sup>®</sup> Fund (FDT) from November 30, 2022 to December 9, 2022. During this period of time, there are no fund inflows or outflows, no changes in underlying stock positions, and no distributions to the ETF investors. Calculated from FDT's portfolio holdings and the dividend payment information, the fund should receive dividend payments in JPY (orange bar) from its portfolio holdings of Japanese companies from November 30, 2022 (Wednesday) to December 2, 2022 (Friday), with the dividend payment on December 1, 2022 (Thursday) being the largest. In the meantime, dividends received in other currencies are negligible. The JPY dividends appeared on FDT's JPY cash account (red line) on December 5, 2022 (Monday), after which the JPY cash position decreased while the USD cash position (blue line) increased by a similar amount.

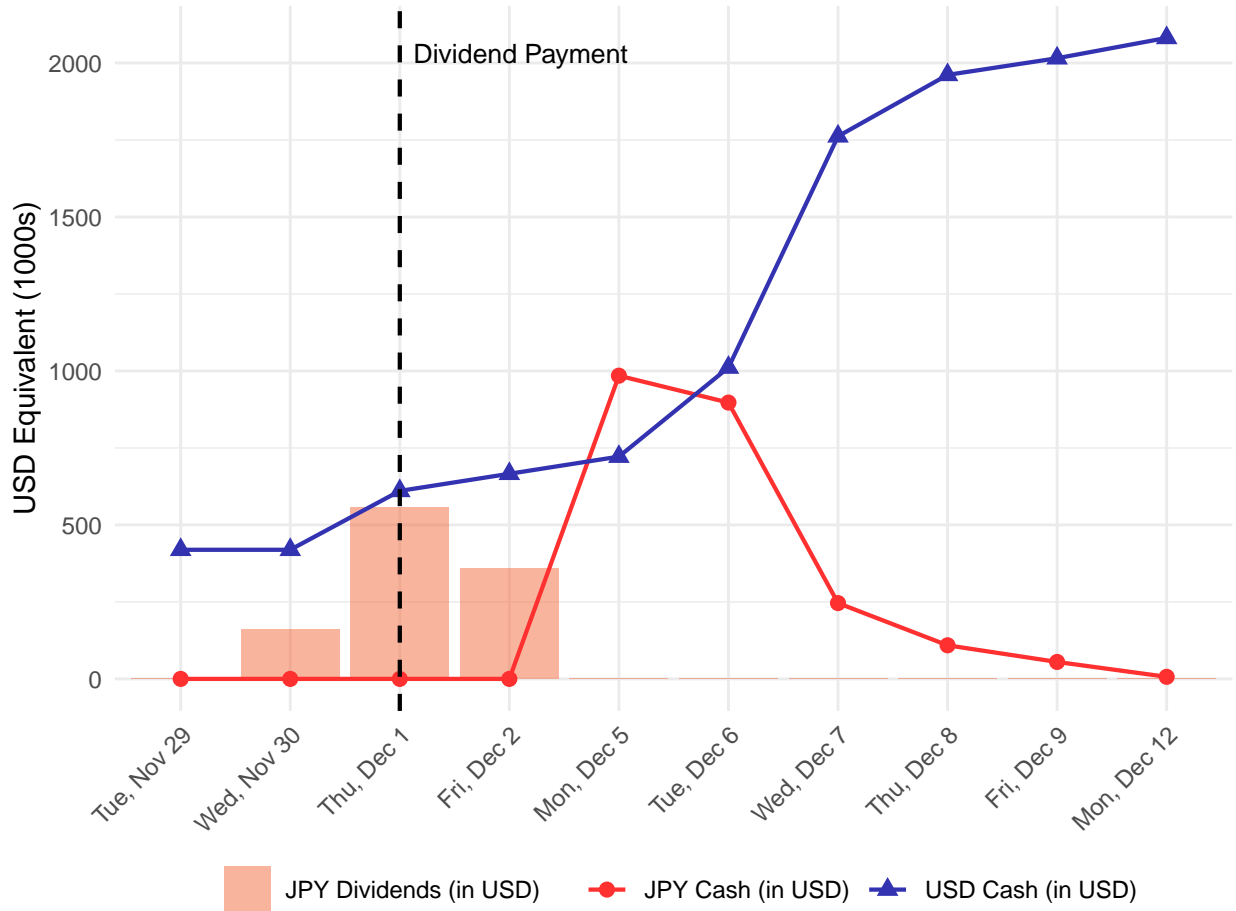


FIGURE 7: MODEL TIMELINE AND EQUILIBRIUM

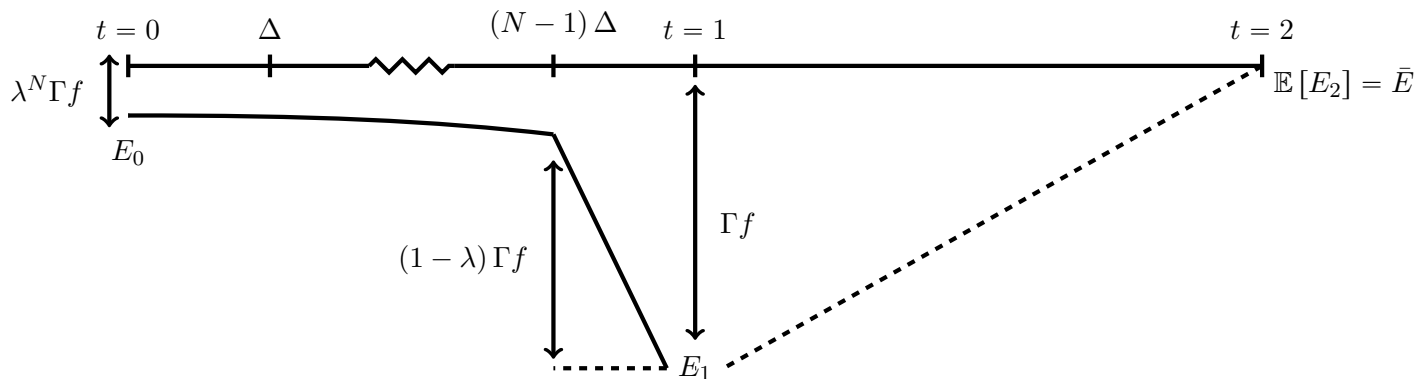
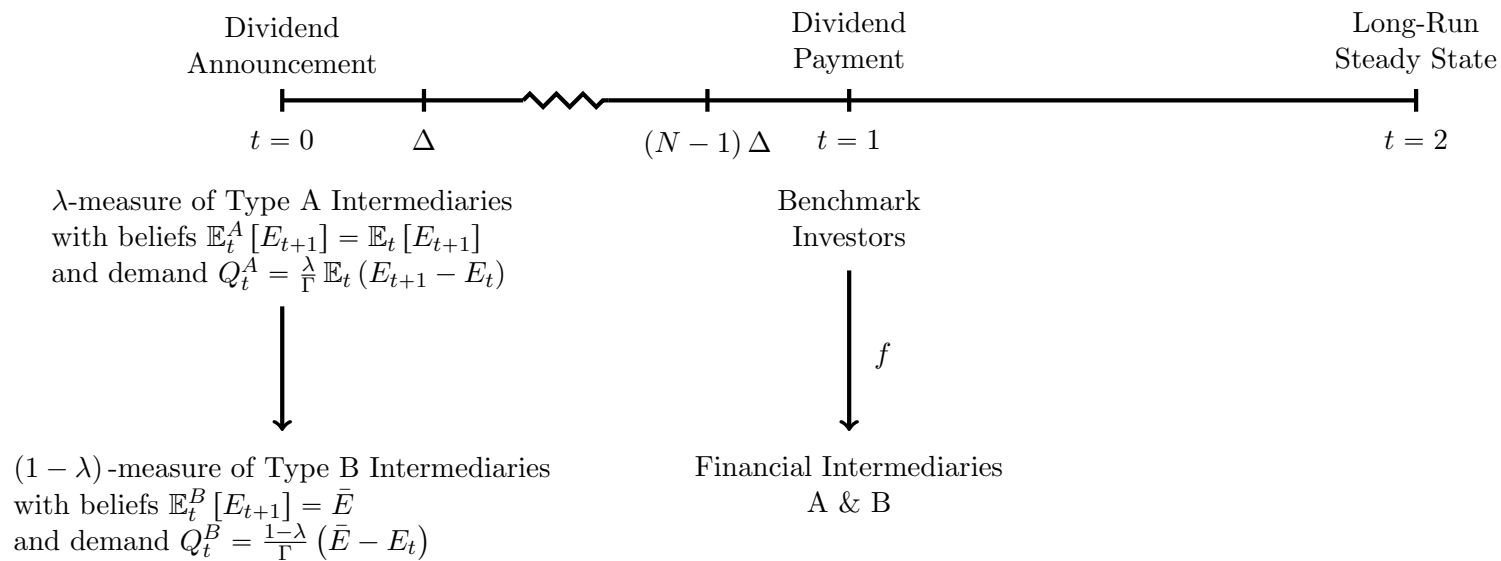


FIGURE 8: EQUILIBRIUM FX DYNAMICS AND POSITIONS OF INTERMEDIARIES

This figure shows the expected value of the exchange rate and positions of intermediaries in equilibrium, according to Eq (8)-(11). The parameters are  $\bar{E} = 1, N = 5, \Delta = 1/5, \lambda = 0.3, \Gamma = 0.01, f = 1$ . The calibration of  $\lambda$  is in the main text. Time  $t = 0$  is the dividend announcement date and time  $t = 1$  is the payment date. A negative change in the exchange rate  $E$  means GBP depreciates against USD. Negative  $Q$  means a short position in GBP.

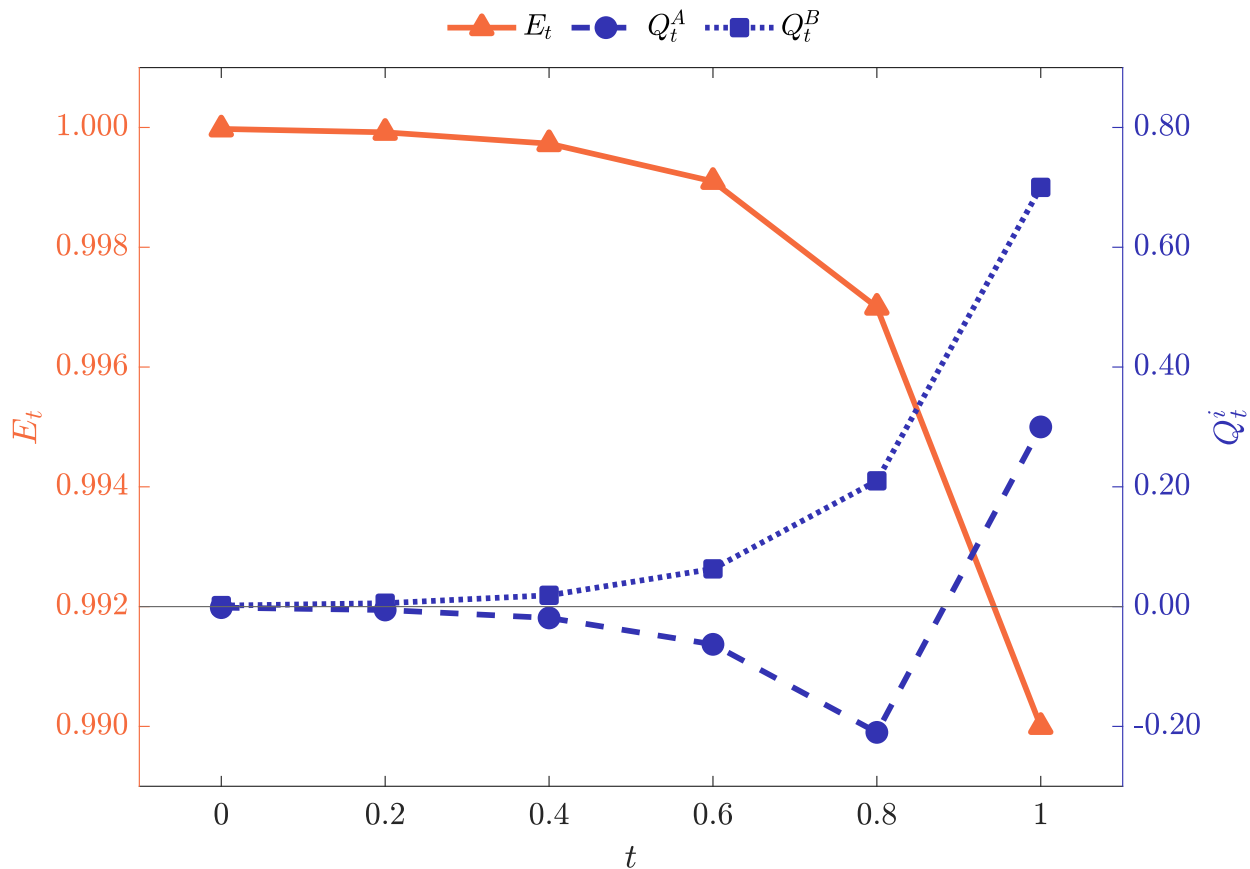


FIGURE 9: COMPARISON BETWEEN ESTIMATES OF DIVIDENDS TO FOREIGN INVESTORS: COMPUSTAT GLOBAL/CRSP VS. BALANCE OF PAYMENTS

This figure compares the dividends paid out to foreign investors, calculated from Compustat Global/CRSP vs imputed from the Balance of Payments, at an annual frequency in billion USD. Each dot in the figure represents currency-year. For the y-axis, dividends paid out to foreign investors calculated from Compustat Global/CRSP, I first aggregate dividend payments by payment date in each currency area, then I multiply by the foreign ownership calculated imputed from the Balance of Payments. For the x-axis, dividends paid out to foreign investors imputed from the Balance of Payments, I use Dividends on Equity Excluding Investment Fund Shares (BMIPIPED) if the country reports the data item. Otherwise, I use Investment Income on Equity and Investment Fund Shares (BMIPIPE), scaled by the ratio of ILPEEO/ILPE, where ILPEEO represents Equity Other Than Investment Fund Shares, and ILPE represents Equity and Investment Fund Shares, both under Liabilities of Portfolio Investment. See Appendix A for details on the indicators in the Balance of Payments. See Appendix B for details on the calculation of foreign ownership. The sample period is from 2001 to 2022.

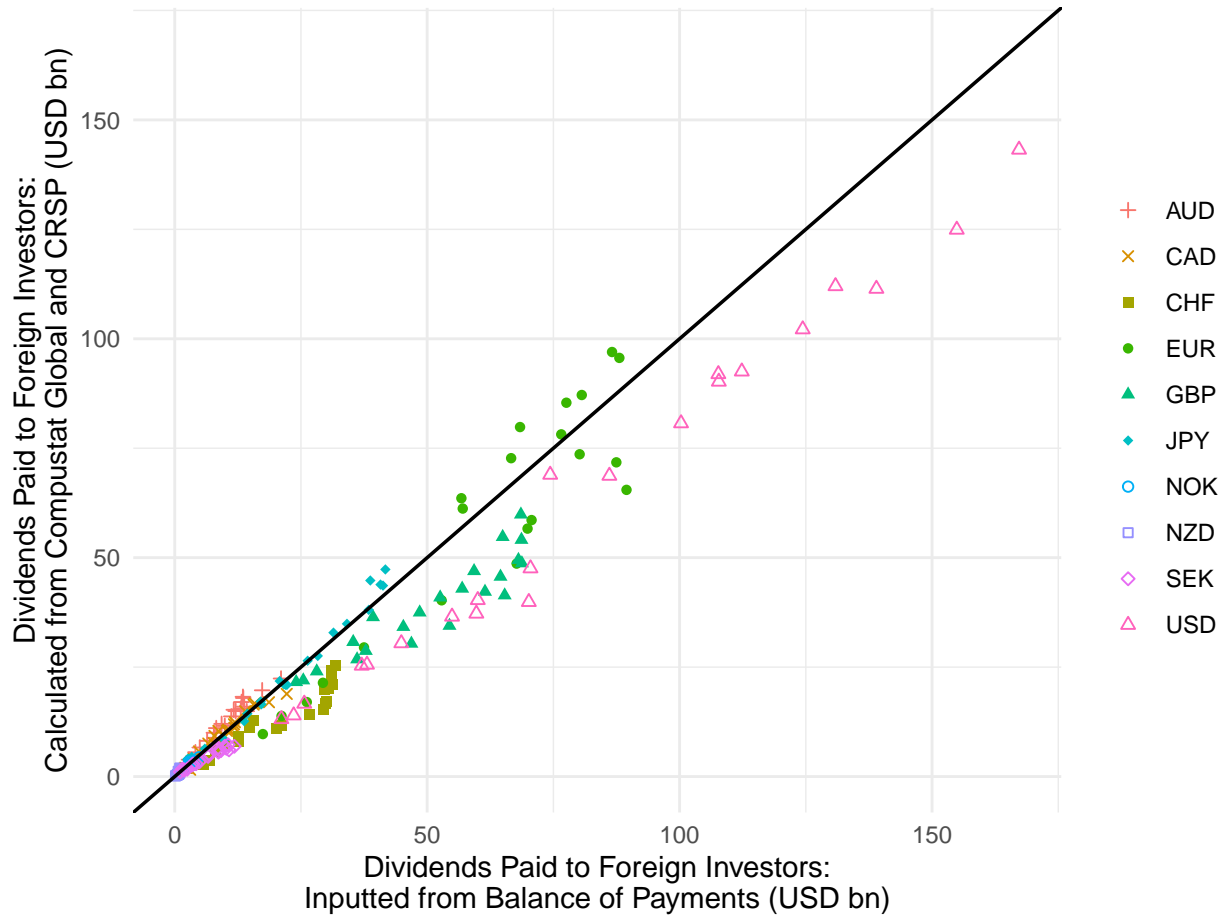
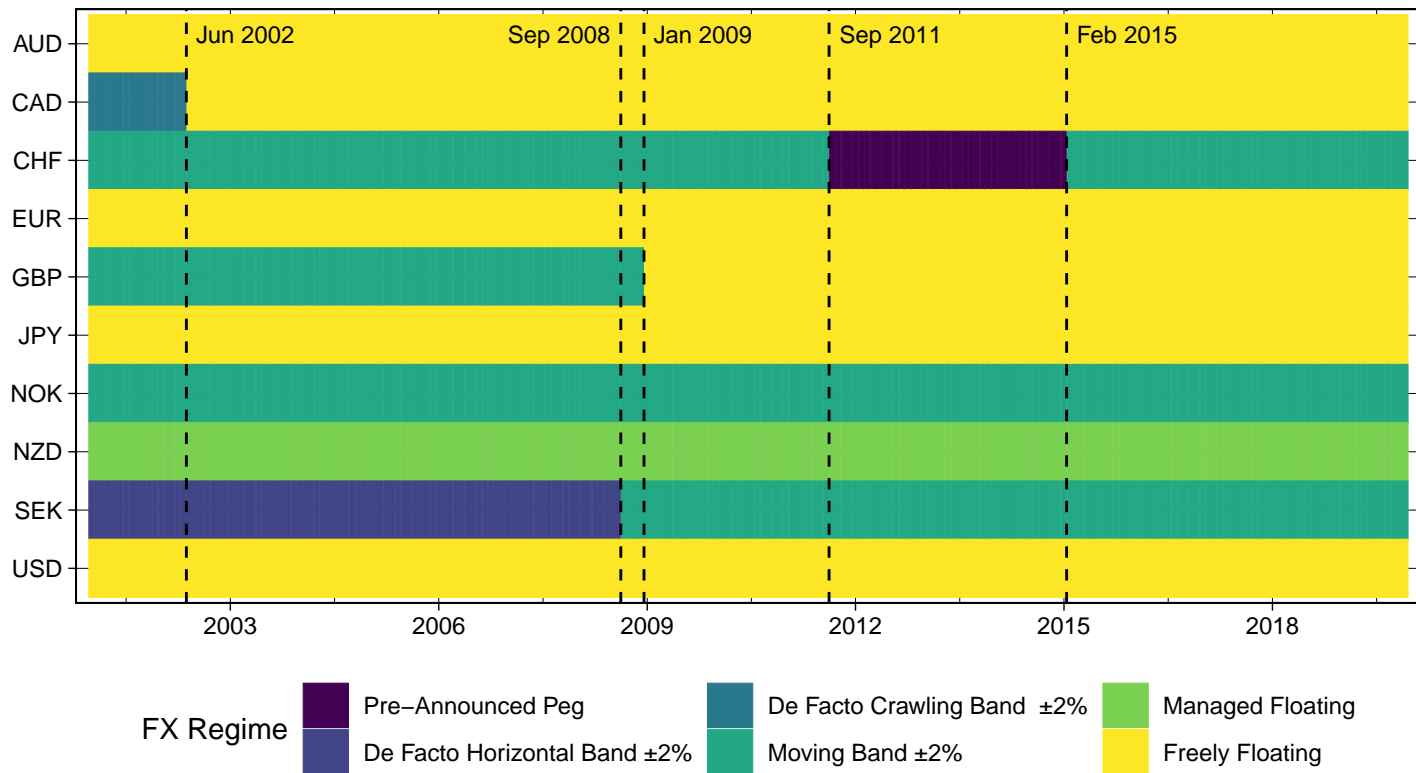


FIGURE 10: TIME-SERIES OF FX REGIMES

This figure reports the fine classification of FX regimes by [Izetzki, Reinhart, and Rogoff \(2019\)](#). AUD, EUR, JPY, USD have always been in the freely floating regime, NOK has always been managed floating (anchoring to AUD), and NOK has always been de facto moving band  $\pm 2\%$  against Euro. CAD switched from de facto moving band ( $\pm 2\%$  band against US dollar) to freely floating in June 2002. GBP switched from de facto moving band ( $\pm 2\%$  band against Euro) to freely floating in January 2009. SEK switched from de facto horizontal band ( $\pm 2\%$  band against Euro) to de facto moving band ( $\pm 2\%$  band against Euro) in September 2008. CHF switched to pegging to Euro during September 2011 to January 2015, while in other times, de facto moving band ( $\pm 2\%$  band against Euro).

55





# Appendix for “Dividend Flows and the Foreign Exchange Rate”

Jingtao ZHENG

<b>A Data Items From the Balance of Payments</b>	<b>56</b>
<b>B Calculation of Foreign Ownership</b>	<b>57</b>
<b>C Proofs</b>	<b>58</b>
<b>D Additional Identification Strategies</b>	<b>59</b>
<b>E Additional Results</b>	<b>62</b>

## **A Data Items From the Balance of Payments**

In this paper, I use the following data from the Balance of Payment. Below are the list of indicator codes and indicator names. Note all countries report all data items below. The more detailed the data items, the less likely a country is reporting it.

### **Dividends on Equity**

- Paid to foreign investors
  - BMIPIPE: Current Account, Primary Income, Investment Income, Portfolio Investment, Investment Income on Equity and Investment Fund Shares, Debit
  - BMIPIPED: Current Account, Primary Income, Investment Income, Portfolio Investment, Investment Income on Equity and Investment Fund Shares, Dividends on Equity Excluding Investment Fund Shares, Debit
- Received from foreign investments
  - BXIPIPE: Current Account, Primary Income, Investment Income, Portfolio Investment, Investment Income on Equity and Investment Fund Shares, Credit
  - BXIPIPED: Current Account, Primary Income, Investment Income, Portfolio Investment, Investment Income on Equity and Investment Fund Shares, Dividends on Equity Excluding Investment Fund Shares, Credit

### **Portfolio Investment**

- Asset: investment in foreign countries
  - IAPE: Assets, Portfolio Investment, Equity and Investment Fund Shares
  - IAPEEO: Assets, Portfolio Investment, Equity and Investment Fund Shares, Equity Securities Other Than Investment Fund Shares

- BFPAA: Financial Account, Portfolio Investment, Net Acquisition of Financial Assets, Equity and Investment Fund Shares
- BFPAD: Financial Account, Portfolio Investment, Net Acquisition of Financial Assets, Debt Securities
- Liability: investment by foreign countries
  - IAPE: Assets, Portfolio Investment, Equity and Investment Fund Shares
  - IAPEEO: Assets, Portfolio Investment, Equity and Investment Fund Shares, Equity Securities Other Than Investment Fund Shares
  - BFPLE: Financial Account, Portfolio Investment, Net Incurrence of Liabilities, Equity and Investment Fund Shares
  - BFPLD: Financial Account, Portfolio Investment, Net Incurrence of Liabilities, Debt Securities

### Others

- BGS: Current Account, Goods and Services, Net

## B Calculation of Foreign Ownership

In this section, I provide further details on the imputation of foreign ownership underlying Table 1 and the construction of  $DivOut_{k,t}$  in Eq (15).

Foreign ownership is calculated by external liabilities of equity securities other than investment fund shares in portfolio investment (ILPEEO) divided by the stock market capitalization. If the country does not report ILPEEO in the Balance of Payments (BOP), I impute it from external liabilities of equity and investment fund shares in portfolio investment (ILPE) scaled by the backfilled ILPEEO/ILPE ratio. Backfilled ILPEEO/ILPE ratio fills the missing values by the last non-missing values. If ILPEEO is missing throughout the sample, I use ILPE instead. In most countries, ILPEEO/ILPE ratio is high. The major exception is Eurozone, where on average ILPEEO/ILPE ratio is 42%.

The stock market capitalization data is from Bloomberg (after 2003) and the World Bank (before 2003). The Bloomberg market capitalization is calculated from all shares outstanding. It does not include ETFs and ADRs as they do not directly represent companies. Also, it includes only actively traded, primary securities on the country’s exchanges to avoid double counting. For years before 2003, I use data from the World Bank.

For the breakdown of foreign ownership into by G10 and by USA, I use data from the Coordinated Portfolio Investment Survey (CPIS). CPIS has bilateral equity holdings data, from which I can calculate a country’s external liabilities of equity by other G10 countries and by USA. Note CPIS equity holdings include both equity and investment fund shares, hence it is similar to ILPE in terms of concept. In cases where external equity liabilities aggregated from bilateral equity holdings in CPIS is larger ILPE reported in BOP, I scale down CPIS equity holdings proportionally. The foreign ownership of the stock market by other G10 countries is calculated from foreign ownership calculated in BOP, scaled by the ratio of equity held by other G10 (from CPIS) and ILPE (from BOP). The foreign ownership of the stock market by the USA is calculated similarly.

## C Proofs

*Proof.* At the payment date time 1, demand for both intermediaries is

$$Q_1^A = \frac{\lambda}{\Gamma} \mathbb{E}_1[E_2 - E_1] = \frac{\lambda}{\Gamma} (\bar{E} - E_1), \quad Q_1^B = \frac{1-\lambda}{\Gamma} (\bar{E} - E_1) \quad (\text{A1})$$

The GBP market clearing condition on the payment date  $t = 1$  is

$$Q_1^A + Q_1^B - f + \eta_1 = 0 \quad (\text{A2})$$

where  $-f$  is the benchmark investor's selling GBP to repatriate a certain proportion of dividends out of GBP, and  $\eta_1$  is the noise trader's demand for GBP. Plug in the demand curves for both types of intermediaries, Eq (5) and Eq (7), we have

$$\lambda \mathbb{E}_1[E_2] + (1-\lambda)\bar{E} - E_1 = \Gamma f + \Gamma(-\eta_1) \quad (\text{A3})$$

Plug Eq (3) into Eq (A3), we have the exchange rate on the payment date:

$$E_1 = \bar{E} - \Gamma f + \Gamma \eta_1$$

Plug this back into Eq (A1), we calculate the positions of GBP for both types of intermediaries

$$Q_1^A = \lambda(f - \eta_1), \quad Q_1^B = (1-\lambda)(f - \eta_1)$$

For exchange rates before the payment date, I use backward induction to solve the  $E_{t_n}$ , where  $t_n = n\Delta, n = 0, \dots, N-1$  and  $N\Delta = 1$ . For simplicity of notation, assume  $Var_{t_n}[E_{t_{n+1}}] = \sigma_E^2$ . For this to hold, we need the parameter assumption that  $\sigma_\eta = 1/(\gamma\sigma_E)$ .

The demand for GBP from both type A and type B intermediaries is

$$Q_{t_n}^A = \frac{\lambda}{\Gamma} \mathbb{E}_{t_n}[E_{t_{n+1}} - E_{t_n}], \quad Q_{t_n}^B = \frac{1-\lambda}{\Gamma} (\bar{E} - E_{t_n}) \quad (\text{A4})$$

Plug into the GBP market clearing at time  $t_n$

$$Q_{t_n}^A + Q_{t_n}^B + \eta_{t_n} = 0 \quad (\text{A5})$$

we have

$$\lambda \mathbb{E}_{t_n}[E_{t_{n+1}} - E_{t_n}] + (1-\lambda)(\bar{E} - E_{t_n}) + \Gamma \eta_{t_n} = 0$$

which gives

$$E_{t_n} = (1-\lambda)\bar{E} + \lambda \mathbb{E}_{t_n}[E_{t_{n+1}}] + \Gamma \eta_{t_n}$$

Iterated forward, we have

$$\begin{aligned}
E_{t_n} &= (1 - \lambda)\bar{E} + \lambda\mathbb{E}_{t_n}[E_{t_{n+1}}] + \Gamma\eta_{t_n} \\
&= (1 - \lambda)\bar{E} + \lambda\mathbb{E}_{t_n}[(1 - \lambda)\bar{E} + \lambda\mathbb{E}_{t_{n+1}}[E_{t_{n+2}}] + \Gamma\eta_{t_{n+1}}] + \Gamma\eta_{t_n} \\
&= (1 - \lambda)\bar{E}(1 + \lambda) + \lambda^2\mathbb{E}_{t_n}[E_{t_{n+2}}] + \Gamma\eta_{t_n} \\
&= (1 - \lambda)\bar{E}(1 + \lambda + \dots + \lambda^{k-1}) + \lambda^k\mathbb{E}_{t_n}[E_{t_{n+k}}] + \Gamma\eta_{t_n} \\
&= (1 - \lambda)\bar{E}(1 + \lambda + \dots + \lambda^{N-n-1}) + \lambda^{N-n}\mathbb{E}_{t_n}[E_{t_N}] + \Gamma\eta_{t_n} \\
&= (1 - \lambda)\bar{E}\frac{1 - \lambda^{N-n}}{1 - \lambda} + \lambda^{N-n}(\bar{E} - \Gamma f) + \Gamma\eta_{t_n} \\
&= \bar{E} - \lambda^{N-n}\Gamma f + \Gamma\eta_{t_n}
\end{aligned}$$

Plug this exchange rate dynamics back into Eq (A4), we solve for the demand of both intermediaries at times before the payment date:

$$\begin{aligned}
Q_{t_n}^A &= \frac{\lambda}{\Gamma}\mathbb{E}_{t_n}[-\lambda^{N-n-1}\Gamma f + \Gamma\eta_{t_{n+1}} + \lambda^{N-n}\Gamma f - \Gamma\eta_{t_n}] = -\lambda^{N-n}(1 - \lambda)f - \lambda\eta_{t_n} \\
Q_{t_n}^B &= \frac{1 - \lambda}{\Gamma}(\bar{E} - (\bar{E} - \lambda^{N-n}\Gamma f + \Gamma\eta_{t_n})) = (1 - \lambda)\lambda^{N-n}f - (1 - \lambda)\eta_{t_n}
\end{aligned}$$

Lastly, for the volatility of the next-period exchange rate to be constant at  $\sigma_E$ , we simply need the parameter assumption that  $\sigma_\eta = 1/(\gamma\sigma_E)$ , as

$$Var_{t_n}[E_{t_{n+1}}] = \Gamma^2\sigma_\eta^2 = (\gamma\sigma_E^2)^2\sigma_\eta^2 = \sigma_E^2$$

This completes the proof of Proposition 1.

The proof of Proposition 2 is straight-forward.

By the definition of the payment date effect,

$$\mathbb{E}[E_1 - E_{t_{N-1}}] = (\bar{E} - \Gamma f) - (\bar{E} - \lambda\Gamma f) = -(1 - \lambda)\Gamma f$$

By the definition of the anticipation effect,

$$\mathbb{E}[E_{t_{N-1}} - \bar{E}] = \mathbb{E}[(\bar{E} - \lambda\Gamma f + \Gamma\eta_{t_{N-1}}) - \bar{E}] = -\lambda\Gamma f \quad (\text{A6})$$

By the definition of the announcement date effect,

$$\mathbb{E}[E_0 - \bar{E}] = (\bar{E} - \lambda^N\Gamma f) - \bar{E} = -\lambda^N\Gamma f$$

This completes the proof of Proposition 2. □

## D Additional Identification Strategies

The baseline identification strategy in Section 5 assumes that unspecified time-varying confounding has the same effect on all currencies and hence can be absorbed by the time effect. However, different currencies may have heterogeneous loadings on the underlying factor. For example, the

commodity price increase may benefit commodity-exporting countries' terms of trade and currencies. In addition, instead of being constant, the effect of the underlying confounding factors may be time-varying. Below, I develop alternative strategies to confirm that the baseline results are robust under various identification strategies, i.e., the foreign exchange rate depreciates shortly after the dividend payment dates, while the anticipation effect before the payment date is limited.

## D.1 Difference-in-Difference

In this section, I present the results estimated by difference-in-difference (DiD). This is a special case of the synthetic controls in Section D.2 in the sense that DiD puts equal weights on the control group currencies. See Section D.2 for the definitions of the treated currency and the control group currencies. The standard errors are two-way clustered at currency level and date level. Figure A3 shows the results, which confirm the same pattern as in Section 5.1.

I also apply the method to each currency individually. Figure A5 shows the price impact estimates for each G10 currency against USD. When estimated individually, for many currencies we do not have enough power. Nevertheless, the point estimates suggest that the patterns of depreciation pressure after the dividend payment date are present for most currencies.

## D.2 Synthetic Controls

In this section, I develop an alternative identification strategy using the idea of synthetic control (e.g., Abadie (2021)), which carefully chooses a linear combination of control group currencies that best replicates the movements of the treated currency. By taking the difference between the treated currency and this linear combination, one can take out the unspecified confounding variables in a flexible way. In addition, as taking the difference absorbs the noisy variation in the estimation, this method results in a more precise estimate,

Specifically, I define a dividend event as a currency-day pair  $(k_0, t_0)$  where the country  $k_0$  has a top 5% largest dividend within the currency-year on the payment date  $t_0$ . Denote the event date by  $t = 0$  and all days relative to it are in trading days. One concern of the discretization of dividend indicator  $\mathbb{D}_{k,t}$  is that dividend payments immediately below the size threshold are classified as nonevents, which may pollute the comparison of the treated and the controls. To address this concern, I incorporate a buffer in defining the control group units, i.e., instead of the top 5% size threshold when defining treated currencies, the controls are currencies that do not have the top 10% largest dividend payments within currency-year over the event window, from -10 days to +10 days. The results are robust to both choices of size threshold and buffers.

Among the control group currencies  $\mathcal{C}$ , I randomly select one  $p_0$  as the placebo. Denote the remaining control group currencies as  $\mathcal{C}'$ . I find non-negative weights  $\{w_k\}_{k \in \mathcal{C}'}$  that sum up to 1, and the linear combination of currencies best tracks the movement of treated currency  $k_0$  over the estimation window  $[-70, -11]$ . In other words, the synthetic control weights are calculated from the following optimization problem:

$$\min_{\{w_k\}_{k \in \mathcal{C}'}} \sum_{t=-70}^{-11} \left| \Delta \ln E_{k_0,t}^{US/LC} - \sum_{k \in \mathcal{C}'} w_k \Delta \ln E_{k,t}^{US/LC} \right|^2 \quad (\text{A7})$$

s.t.

$$\sum_k w_k = 1, w_k \geq 0, \forall k \in \mathcal{C}'$$

where the foreign exchange rates are snapshots at the local stock market closing time of the treated currency  $k_0$ . With estimated weights, I compare the cumulative FX movement of the treated currency with the synthetic control over the event window  $[-10,10]$  for the dividend event  $(k_0, t_0)$ , where I normalize the pre-event  $t=-1$  to be 0. The treatment effect is as follows:

$$\Delta_h e_{k_0,t} - \sum_{k \in \mathcal{C}'} w_k \Delta_h e_{k,t}, \quad h = -10, \dots, 0, \dots, 10 \quad (\text{A8})$$

where  $\Delta_h e_{k,t} = \ln E_{k,t+h}^{US/LC} - \ln E_{k,t-1}^{US/LC}$  is the  $h$ -day cumulative log change of the foreign exchange rate. The placebo effect for this event is calculated similarly, with the synthetic control weights optimized for the placebo itself using the same procedure as in Eq (A7). The foreign exchange rates involved are cut at the local stock market closing time of the placebo currency  $p_0$ .

$$\Delta_h e_{p_0,t} - \sum_{k \in \mathcal{C}'} w_k^{(p_0)} \Delta_h e_{k,t}, \quad h = -10, \dots, 0, \dots, 10 \quad (\text{A9})$$

The average treatment effect (ATT) is the average of Eq (A8) across all events. The standard errors are calculated from the placebo effect in Eq (A9) across all events.

Figure A2 illustrates how this method works. August 5, 2022 is a dividend event date ( $t = 0$ ) for the UK, as it has a large dividend payment of  $\approx 1.9$  billion GBP on this date, among which 1.1 billion is Vodafone's dividend.<sup>49</sup> Over the event window  $[-10,10]$  trading days, the qualified controls include AUD, CHF, EUR, JPY, NOK, NZD, SEK, as their countries do not have top 10% dividend payments over the trading days  $t = -10$  to  $t = +10$ . As SEK is selected as the placebo randomly, the remaining control group  $\mathcal{C}'$  includes AUD, CHF, EUR, JPY, NOK, NZD. Solving the optimization problem (A7) gives the following best mimicking linear combination over the estimation window from  $t = -70$  to  $t = -11$ : 15.7% AUD + 15.0% CHF + 30.6% EUR + 14.3% JPY + 9.0% NOK + 15.4% NZD. As Figure A2 shows, the synthetic control tracks the day-to-day movement of the treated currency well during the estimation window. The underlying identification assumption is that going forward into the event window, the synthetic control captures the unspecified confounding factors in a flexible way.

Figure A4 Panel A shows the average treatment effect. It confirms the pattern in Section 5.1. Upon and after the country's large dividend payment dates, the local currency starts to depreciate against USD. The price effect of exchange rates before the dividend payment, i.e., the anticipation effect, is limited and statistically insignificant. In contrast, a placebo currency does not have large dividend payments during the event window. Therefore, there should be no depreciation pressure on its exchange rate. Figure A4 Panel B confirms this is indeed the case.

Figure A6 shows the estimates applies the difference-in-difference methodology in Section D.2 to each currency pair.

One concern of using the synthetic control or DiD is the violation of Stable Unit Treatment Values Assumption (SUTVA) assumption. Repatriation of the treated currencies to the control

<sup>49</sup>For the financial year ending 31 March 2017 and beyond, Vodafone's dividends have been declared in EUR and paid in Euro, GBP and USD. See <https://investors.vodafone.com/individual-shareholders/dividends>

group currencies may cause control group currencies to appreciate against US dollars. Moreover, different foreign exchange rates influence each other through general equilibrium forces. To address the spillover concern, I conduct regression analysis to ensure the spillover effect is small. Specifically, I run the following regression:

$$\ln E_{k,t+h}^{US/LC} - \ln E_{k,t-1}^{US/LC} = \alpha_h + \beta_h \mathbb{D}_{k,t} + \gamma_h \mathbb{D}_{-k,t} + Controls + \gamma_k^{(h)} + \epsilon_{k,t+h} \quad (\text{A10})$$

where the indicator  $\mathbb{D}_{k,t} = 1$  if country  $k$  has a large dividend payment on date  $t$ , while indicator  $\mathbb{D}_{-k,t} = 1$  if any other country has a large dividend payment. As the time fixed effect will absorb  $\mathbb{D}_{-k,t}$ , I only include the currency fixed effect in Eq (A10). As before, the controls include stock market returns and FX implied volatilities. Table A2 reports own-effect  $\beta_h$  and cross-effect  $\gamma_h$ . As we can see,  $\beta_h$  estimated is similar to Table 7. In the meantime, the cross-effect  $\gamma_h$ , i.e., other countries' dividend payment on country  $k$ 's exchange rate against USD is insignificant.

## E Additional Results

### E.1 Price Impact of Dividends on FX: Pre-GFC vs. Post-GFC

Figure A7 compares before and after the GFC. This figure compares the coefficients  $\beta_h$  estimated by Eq (2) in the subsample before and after the 2007–2008 Global Financial Crisis (GFC). I define the pre-GFC subsample as before December 2007, and the post-GFC subsample as after June 2009, inclusive.<sup>50</sup> As the point estimates indicate, the local currency depreciates more against USD after the country's large dividend payments in the post-GFC subsample.<sup>51</sup> For example, two days after a country's large dividend payment, its currency depreciates 7.4 basis points vis-à-vis USD in the post-GFC period on average, while before the financial crisis, it only depreciates 1.5 basis points.

From the lens of the model, there are two reasons for the increase in the price impact of dividend payments on the foreign exchange rate. On the one side, with the development of financial integration and passive investing, there is a substantial increase of foreign ownership by benchmark investors like ETFs and mutual funds, which makes the dividend repatriation channel stronger. That is to say, for the same amount of dividend payments in local currency, the dividend repatriation flows  $f$  out of this currency is larger. In fact, as Figure 1 shows, average across the other G10 countries, the market value of US-domiciled ETFs' holdings as a percentage of the local stock market capitalization grows from 0.7% in 2011 to 3.2% in 2020, more than quadruple in 9 years. Meanwhile, US-domiciled mutual funds grow from 1.93% in 2002 to 4.6% in 2011 to 6.6% in 2020. On the other side, after the 2007-2008 financial crisis, more stringent regulations on financial intermediaries have made their balance sheet constraints tighter. Therefore, financial intermediaries need more compensation to bear the same amount of risk, i.e.,  $\Gamma$  increase.

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<sup>50</sup>Per NBER business cycle dating, the peak of the financial crisis is December 2007, and the trough month is June 2009.

<sup>51</sup>The standard errors in the pre-GFC subperiod are too large to conclude the differences are statistically significant.

TABLE A1: G10 CURRENCIES AND STOCK MARKETS

This table lists the abbreviations for G10 currencies and their countries/currency areas used in the paper. It also lists their primary stock market index from which I calculate the local stock market returns.

COUNTRY/CURRENCY AREA		CURRENCY		STOCK MARKET INDEX	
Abbrv	Name	Abbrv	Name	Abbrv	Name
AUS	Australia	AUD	Australian dollar	ASX200	S&P/ASX 200 Index
CAN	Canada	CAD	Canadian dollar	TSX	S&P/TSX Composite Index
CHE	Switzerland	CHF	Swiss franc	SMI	Swiss Market Index
EUR	European Union	EUR	Euro	SX5E	Euro Stoxx 50
GBR	United Kingdom	GBP	Pound sterling	FTSE100	FTSE 100 Index
JPN	Japan	JPY	Japanese yen	NI225	Nikkei 225 Index
NOR	Norway	NOK	Norwegian krone	OBX25	OBX Stock Index
NZL	New Zealand	NZD	New Zealand dollar	NZX50	S&P/NZX 50 Index
SWE	Sweden	SEK	Swedish krona	OMXS30	OMX Stockholm 30 Index
USA	United States	USD	U.S. dollar	SP500	S&P 500 Index



TABLE A2: OWN-EFFECT AND CROSS-EFFECT OF DIVIDENDS ON EXCHANGE RATES

This table reports the coefficients  $\beta_h$  and  $\gamma_h$  in Eq (A10).

	DAYS RELATIVE TO DIVIDEND PAYMENT DATE										
	0	1	2	3	4	5	6	7	8	9	10
<b>No FE</b>											
Coefficients $\beta$	-0.057	-1.470	-5.046**	-5.410**	-4.958*	-7.263**	-7.490**	-8.666**	-8.794**	-7.060*	-5.781
Standard Errors	(1.352)	(1.941)	(2.323)	(2.705)	(2.933)	(3.237)	(3.506)	(3.802)	(3.944)	(4.187)	(4.505)
Coefficients $\gamma$	0.848	-0.817	-2.510	-2.547	-1.925	-1.457	-1.471	-2.061	-1.166	-0.421	0.504
Standard Errors	(1.153)	(1.751)	(2.189)	(2.554)	(2.871)	(3.138)	(3.383)	(3.637)	(3.895)	(4.123)	(4.338)
<b>Currency FE</b>											
Coefficients $\beta$	-0.059	-1.471	-5.047**	-5.409**	-4.956*	-7.260**	-7.487**	-8.665**	-8.792**	-7.056*	-5.777
Standard Errors	(1.352)	(1.941)	(2.324)	(2.705)	(2.932)	(3.236)	(3.504)	(3.800)	(3.943)	(4.186)	(4.503)
Coefficients $\gamma$	0.839	-0.828	-2.522	-2.560	-1.939	-1.471	-1.484	-2.074	-1.179	-0.433	0.493
Standard Errors	(1.153)	(1.751)	(2.189)	(2.554)	(2.871)	(3.138)	(3.383)	(3.638)	(3.895)	(4.123)	(4.338)

FIGURE A1: PRICE IMPACT OF LARGE DIVIDENDS ON EXCHANGE RATES

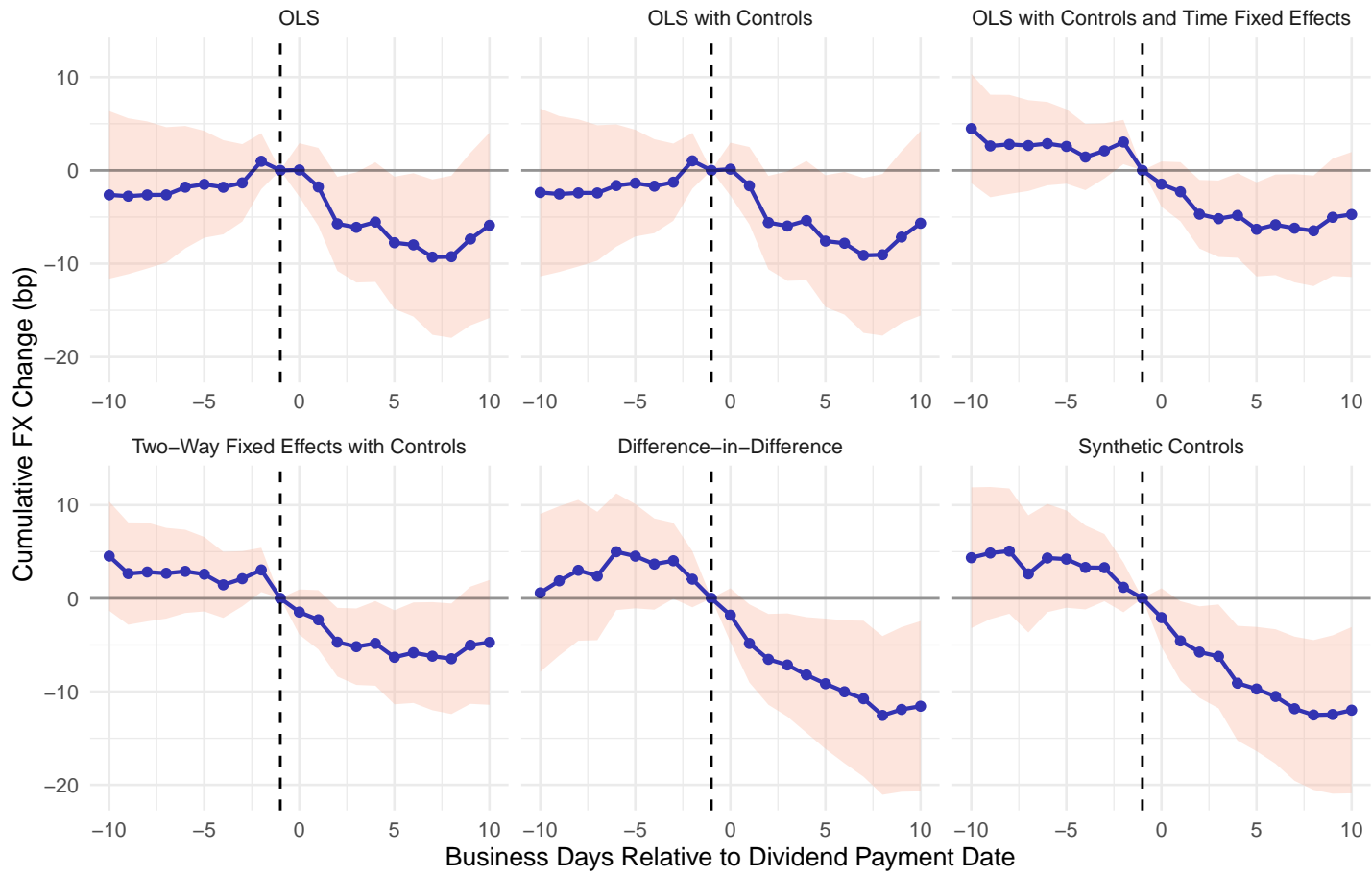


FIGURE A2: ILLUSTRATION OF THE SYNTHETIC CONTROL METHODOLOGY

This figure illustrates the methodology of estimating the synthetic control, i.e., the best linear combination of control group currencies that best mimics the movement of the treated currency in the estimation window  $[-70,-11]$ . The treated unit is the currency that has a top 5% largest dividend payment within a currency-year on the event date. The control group currencies are defined as currencies that do not have top 10% largest dividend payments within a currency-year over the  $[-10,10]$  event window. One currency from the control group units is randomly selected to be the placebo. The remaining control group currencies are used for estimation in Eq (A7).

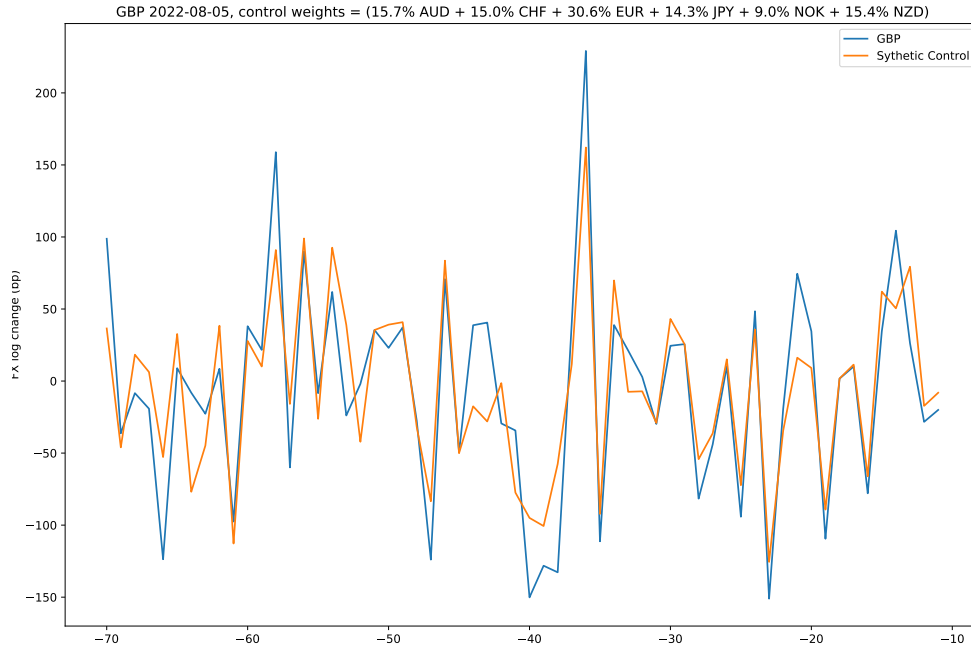


FIGURE A3: PRICE IMPACT OF LARGE DIVIDENDS ON EXCHANGE RATES:  
ESTIMATES FROM DIFFERENCE-IN-DIFFERENCE

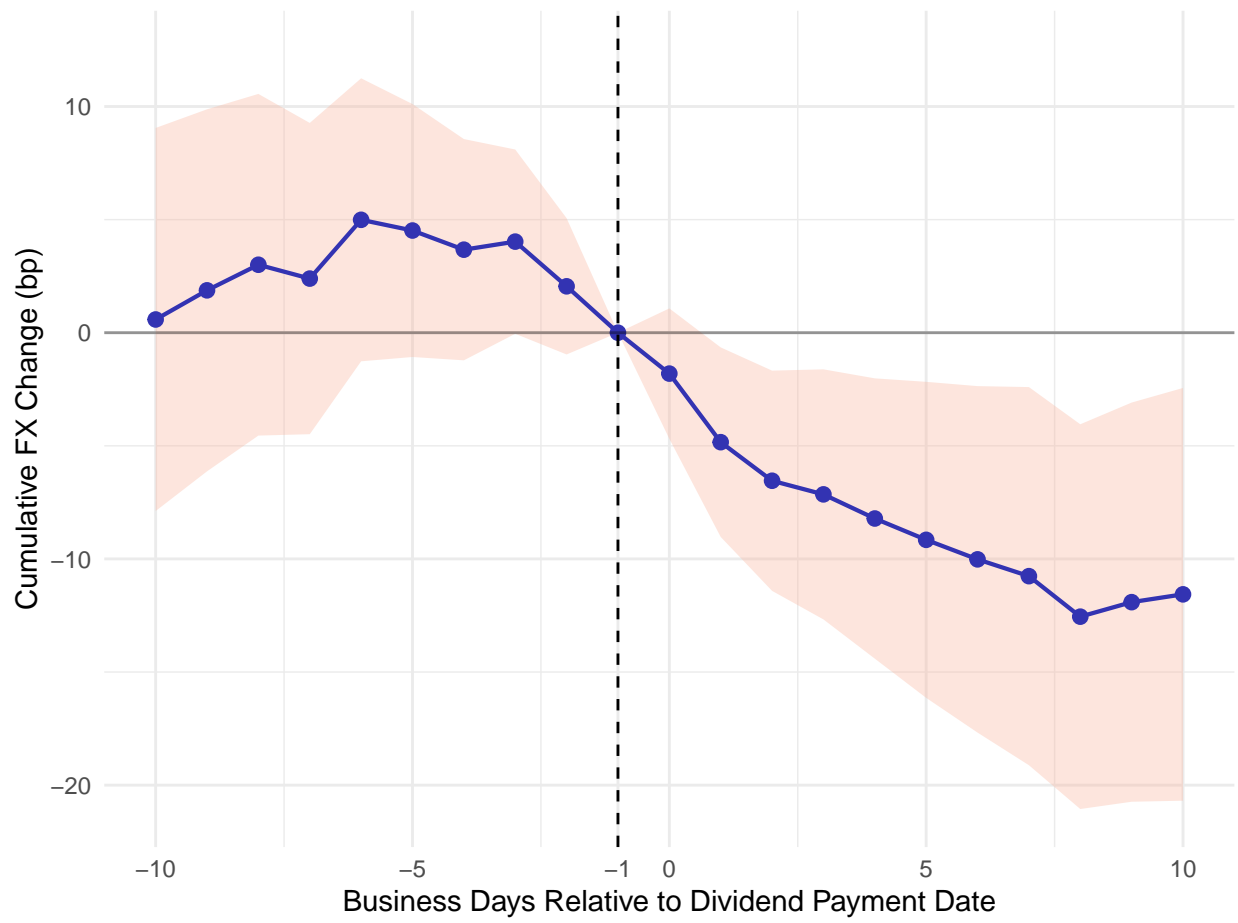


FIGURE A4: PRICE IMPACT OF LARGE DIVIDENDS ON EXCHANGE RATES:  
ESTIMATES FROM SYNTHETIC CONTROLS

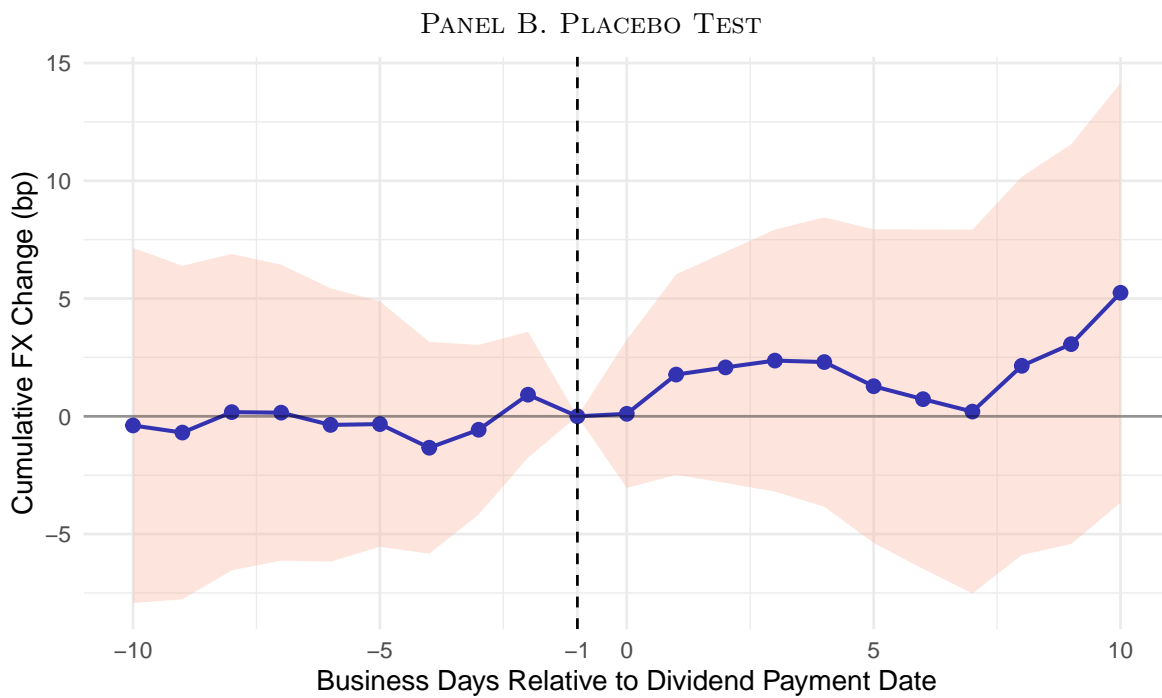
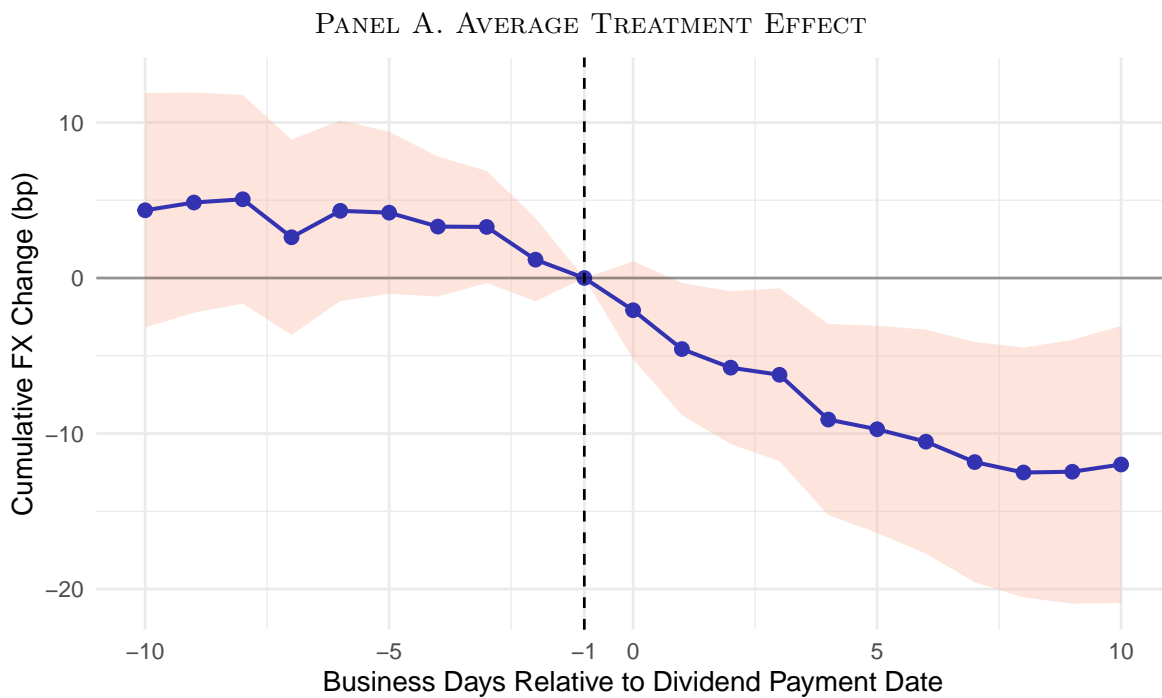


FIGURE A5: PRICE IMPACT OF LARGE DIVIDENDS ON EXCHANGE RATES:  
ESTIMATES FROM DID BY CURRENCY

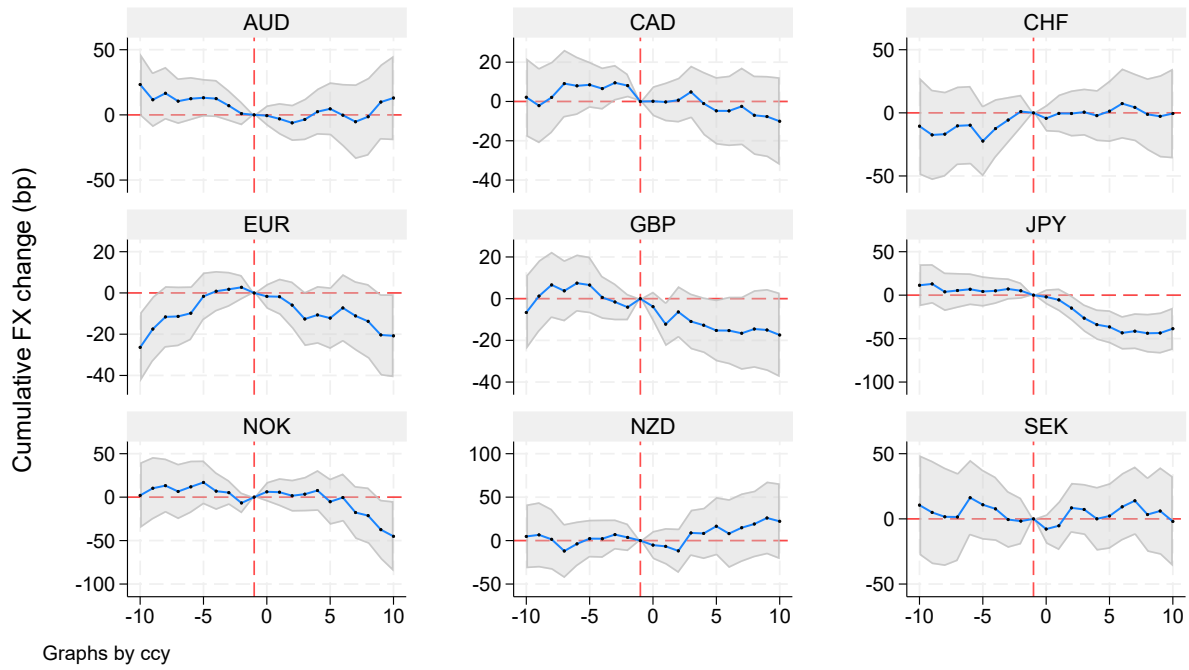


FIGURE A6: PRICE IMPACT OF LARGE DIVIDENDS ON EXCHANGE RATES  
ESTIMATES FROM SYNTHETIC CONTROLS BY CURRENCY

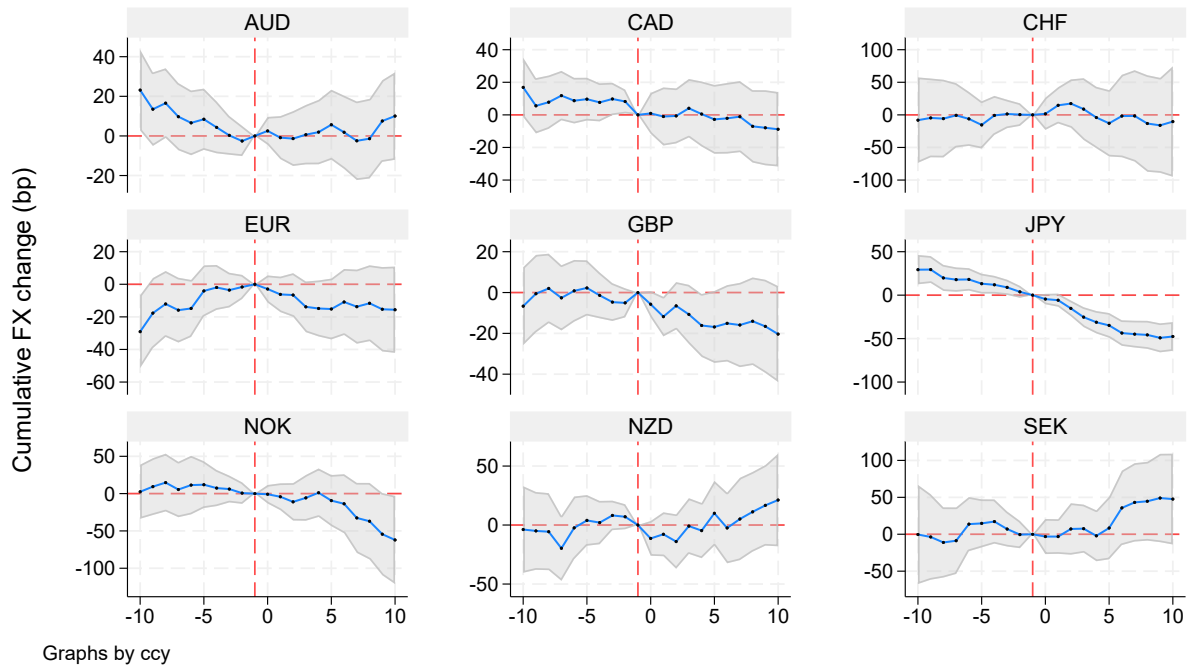
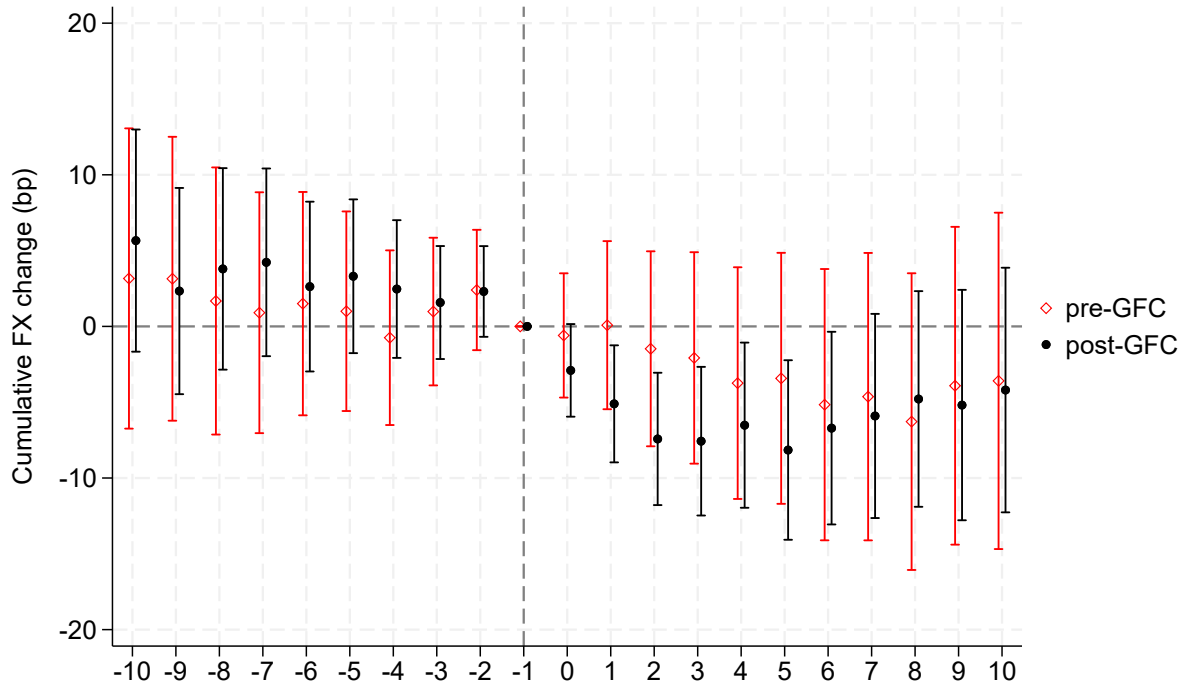


FIGURE A7: PRICE IMPACT OF LARGE DIVIDENDS ON EXCHANGE RATES:  
PRE-GFC VS. POST-GFC

This figure compares the coefficients  $\beta_h$  in the baseline regression Eq (2) with controls and two way fixed effects, estimated separately before and after the 2007–2008 Global Financial Crisis (GFC). The pre-GFC subsample is from January 2001 to December 2007, and post-GFC subsample is from June 2009 to June 2023, inclusive. The standard errors are clustered at the date level.





## References

- Abadie, Alberto. 2021. “Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects.” *Journal of Economic Literature* 59 (2):391–425.
- Aldunate, Felipe E., Zhi Da, Borja Larrain, and Clemens Sialm. 2022. “Non-Fundamental Flows and Foreign Exchange Rates.” Working Paper 30753, National Bureau of Economic Research.
- Asness, Clifford S., Tobias J. Moskowitz, and Lasse Heje Pedersen. 2013. “Value and Momentum Everywhere.” *Journal of Finance* 68 (3):929–985.
- BIS. 2022. “OTC foreign exchange turnover in April 2022.” [https://www.bis.org/statistics/rpfx22\\_fx.pdf](https://www.bis.org/statistics/rpfx22_fx.pdf). Accessed: 2013-10-16.
- Broner, Fernando, Alberto Martin, Lorenzo Pandolfi, and Tomas Williams. 2021. “Winners and losers from sovereign debt inflows.” *Journal of International Economics* 130:103446.
- Camanho, Nelson, Harald Hau, and H elene Rey. 2022. “Global Portfolio Rebalancing and Exchange Rates.” *Review of Financial Studies* 35 (11):5228–5274.
- Chen, Huaizhi. 2022. “Cash Induced Demand.” Working Paper 3067663, Social Science Research Network.
- Cremers, K. J. Martijn and Antti Petajisto. 2009. “How Active Is Your Fund Manager? A New Measure That Predicts Performance.” *Review of Financial Studies* 22 (9):3329–3365.
- Cremers, Martijn, Miguel A. Ferreira, Pedro Matos, and Laura Starks. 2016. “Indexing and active fund management: International evidence.” *Journal of Financial Economics* 120 (3):539–560.
- De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldmann. 1990. “Noise Trader Risk In Financial Markets.” *Journal of Political Economy* 98 (4):703–738.
- De Simone, Lisa, Joseph D. Piotroski, and Rimmy E. Tomy. 2019. “Repatriation Taxes and Foreign Cash Holdings: The Impact of Anticipated Tax Reform.” *Review of Financial Studies* 32 (8):3105–3143.
- Du, Wenxin, Benjamin H ebert, and Amy Wang Huber. 2023. “Are Intermediary Constraints Priced?” *Review of Financial Studies* 36 (4):1464–1507.
- Du, Wenxin, Alexander Tepper, and Adrien Verdelhan. 2018. “Deviations from Covered Interest Rate Parity.” *Journal of Finance* 73 (3):915–957.
- Duffie, Darrell. 2017. “Post-Crisis Bank Regulations and Financial Market Liquidity.” Paolo Baffi Lecture on Money and Finance, Bank of Italy.
- Evans, Martin D. D. and Richard K. Lyons. 2002. “Order Flow and Exchange Rate Dynamics.” *Journal of Political Economy* 110 (1):170–180.
- Fama, Eugene F. and Kenneth R. French. 2018. “Choosing factors.” *Journal of Financial Economics* 128 (2):234–252.
- Fang, Xiang and Yang Liu. 2021. “Volatility, intermediaries, and exchange rates.” *Journal of Financial Economics* 141 (1):217–233.
- Fei, Yusheng. 2023. *The Year-End Effect in the Foreign Exchange Market*. Ph.D. thesis, University of Chicago.
- FTSE. 2023. “FTSE Global Equity Index Series Guide to Calculation v3.5.” [https://www.lseg.com/content/dam/ftse-russell/en\\_us/documents/ground-rules/ftse-global-equity-index-series-guide-to-calc.pdf](https://www.lseg.com/content/dam/ftse-russell/en_us/documents/ground-rules/ftse-global-equity-index-series-guide-to-calc.pdf). Accessed: 2013-10-15.

- Gabaix, Xavier and Ralph S. J. Koijen. 2021. “In Search of the Origins of Financial Fluctuations: The Inelastic Markets Hypothesis.” Working Paper 28967, National Bureau of Economic Research.
- Gabaix, Xavier and Matteo Maggiori. 2015. “International Liquidity and Exchange Rate Dynamics.” *Quarterly Journal of Economics* 130 (3):1369–1420.
- Garleanu, Nicolae and Lasse Heje Pedersen. 2011. “Margin-based Asset Pricing and Deviations from the Law of One Price.” *Review of Financial Studies* 24 (6):1980–2022.
- Gromb, Denis and Dimitri Vayanos. 2002. “Equilibrium and welfare in markets with financially constrained arbitrageurs.” *Journal of Financial Economics* 66 (2-3):361–407.
- Hanlon, Michelle, Rebecca Lester, and Rodrigo Verdi. 2015. “The effect of repatriation tax costs on U.S. multinational investment.” *Journal of Financial Economics* 116 (1):179–196.
- Hartzmark, Samuel M. and David H. Solomon. 2022. “Predictable Price Pressure.” Working Paper 30688, National Bureau of Economic Research.
- Hau, Harald. 2011. “Global versus local asset pricing: A new test of market integration.” *The Review of Financial Studies* 24 (12):3891–3940.
- Hau, Harald, Massimo Massa, and Joel Peress. 2010. “Do Demand Curves for Currencies Slope Down? Evidence from the MSCI Global Index Change.” *Review of Financial Studies* 23 (4):1681–1717.
- Hau, Harald and Helene Rey. 2006. “Exchange Rates, Equity Prices, and Capital Flows.” *Review of Financial Studies* 19 (1):273–317.
- He, Zhiguo, Bryan Kelly, and Asaf Manela. 2017. “Intermediary asset pricing: New evidence from many asset classes.” *Journal of Financial Economics* 126 (1):1–35.
- He, Zhiguo and Arvind Krishnamurthy. 2013. “Intermediary Asset Pricing.” *American Economic Review* 103 (2):732–770.
- Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. 2019. “Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?” *Quarterly Journal of Economics* 134 (2):599–646.
- Itskhoki, Oleg and Dmitry Mukhin. 2021. “Exchange Rate Disconnect in General Equilibrium.” *Journal of Political Economy* 129 (8):2183–2232.
- Koijen, Ralph S. J. and Motohiro Yogo. 2020. “Exchange Rates and Asset Prices in a Global Demand System.” Working Paper 27342, National Bureau of Economic Research.
- Koont, Naz, Yiming Ma, Lubos Pastor, and Yao Zeng. 2023. “Steering a Ship in Illiquid Waters: Active Management of Passive Funds.” Working Paper 27342, National Bureau of Economic Research.
- Lo, Andrew W. 2002. “The Statistics of Sharpe Ratios.” *Financial Analysts Journal* 58 (4):36–52.
- Lou, Dong. 2012. “A Flow-Based Explanation for Return Predictability.” *Review of Financial Studies* 25 (12):3457–3489.
- Lustig, Hanno, Nikolai Roussanov, and Adrien Verdelhan. 2011. “Common Risk Factors in Currency Markets.” *Review of Financial Studies* 24 (11):3731–3777.
- Lyons, Richard K. 2001. *The Microstructure Approach to Exchange Rates*. The MIT Press.
- Maggiori, Matteo. 2022. “International macroeconomics with imperfect financial markets.” In *Handbook of International Economics*, vol. 6. Elsevier, 199–236.

- Menkhoff, Lukas, Lucio Sarno, Maik Schmeling, and Andreas Schrimpf. 2012. “Currency momentum strategies.” *Journal of Financial Economics* 106 (3):660–684.
- MSCI. 2023. “MSCI Index Calculation Methodology, August 2023.” <https://www.msci.com/index/methodology/latest/IndexCalc/>. Accessed: 2013-10-15.
- Pandolfi, Lorenzo and Tomas Williams. 2019. “Capital flows and sovereign debt markets: Evidence from index rebalancings.” *Journal of Financial Economics* 132 (2):384–403.
- Raddatz, Claudio, Sergio L. Schmukler, and Tomás Williams. 2017. “International asset allocations and capital flows: The benchmark effect.” *Journal of International Economics* 108:413–430.
- Reitz, Stefan and Dennis Umlandt. 2021. “Currency returns and FX dealer balance sheets.” *Journal of International Economics* 133:103541.
- Sandulescu, Mirela, Fabio Trojani, and Andrea Vedolin. 2021. “Model-Free International Stochastic Discount Factors.” *Journal of Finance* 76 (2):935–976.
- Schmickler, Simon Niklas Maria. 2022. *Essays on Institutional Trading and Liquidity*. Ph.D. thesis, Princeton University.
- Shleifer, Andrei and Robert W. Vishny. 1997. “The Limits of Arbitrage.” *Journal of Finance* 52 (1):35–55.
- Tse, Yiuman. 2018. “Return seasonality in the foreign exchange market.” *Applied Economics Letters* 25 (1):5–8.
- Verdelhan, Adrien. 2018. “The Share of Systematic Variation in Bilateral Exchange Rates.” *Journal of Finance* 73 (1):375–418.
- Weiner, Scott M. 2023. *The Complete Guide to ETF Portfolio Management: The Essential Toolkit for Practitioners*. McGraw Hill.