When a Market Changes Hands

Dollar Funding and the Price of a Domestic Safe Asset

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Abstract

A government bill's convenience yield can include its foreign holders' cheaper funding. Foreign investors swap dollars into local currency at an implied interest rate below the money-market rate. In Israel, this rate falls when domestic institutions' hedges mature, and at high foreign ownership a 100-basis-point fall lowers three-month bill yields by 21 basis points. In January–September 2022, with the policy rate averaging 0.7%, the bills yielded 51 basis points below the money-market rate, 20 attributed to cheaper funding. Yields rose when a tax change removed foreign investors. Mexican and Japanese bills follow swap-implied rates more closely at higher foreign ownership.

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Government bills often yield less than a benchmark money-market rate, and the gap is called the bills' convenience yield. The standard explanation attributes the convenience yield to the safety and liquidity that investors value in the bills (Krishnamurthy and Vissing-Jorgensen (2012), Nagel (2016)). That reading assumes that the bills' holders could otherwise earn the benchmark rate, so that the gap is what they give up for the bills' services. We show that part of the gap can come from foreign investors financing the bills more cheaply than local investors. A foreign investor can obtain local currency by swapping dollars for it, and the swap carries an implied local-currency interest rate. The swap-implied rate can lie below the benchmark when covered interest parity fails. When foreign investors hold a large share of a bill market, the bill's yield moves with the swap-implied rate, and the measured convenience yield rises although the bill is no safer and no more liquid than before.

Makam, the bills issued by the Bank of Israel, show the mechanism at work. From July 2020 to December 2021 the Bank of Israel's policy rate was 0.1%. The convenience yield of U.S. Treasury bills rises with the level of interest rates and is close to zero when interest rates are close to zero (Nagel (2016)). Yet the three-month Makam yield was below zero in 26 of the 77 weeks, while TELBOR, the Israeli interbank rate and our benchmark, stayed positive in every week. A domestic bank does not hold a bill with a negative yield when a deposit at the same central bank pays a positive rate. Foreign investors held 28% of the bills, and the swap-implied shekel rate was negative in 73 of the 77 weeks.

Domestic banks and foreign investors can both hold Makam, and each compares the bill with a different rate. A domestic bank can leave its shekels on deposit at the Bank of Israel at about the policy rate, which TELBOR tracks closely. For a bank, Makam therefore competes with a deposit that pays about TELBOR. A foreign investor exchanges dollars for shekels today and agrees to exchange the shekels back at a fixed rate later, in an FX swap.[1] The two exchange rates in the swap, together with the dollar interest rate, imply an interest rate on the shekels that the investor holds. We call this swap-implied rate the *foreign funding rate*. Covered interest parity says the foreign funding rate should equal TELBOR. Parity has failed persistently since 2008 (Du, Tepper, and Verdelhan (2018)), and in every period we study the foreign funding rate averaged less than both TELBOR and the Makam yield. Makam can then yield less than TELBOR and still pay foreign investors more than the foreign funding rate. The Israeli data show the bill purchase and the hedge together. Foreign institutions with dollar forward positions made 87% of foreign purchases of Makam from June 2020 to

[1] An FX swap is one contract with two legs. In the near leg the investor sells dollars for shekels at today's exchange rate. In the far leg the investor buys the dollars back at a forward exchange rate that is fixed today, so the investor bears no currency risk.

August 2022, and in a week in which such an institution bought Makam the institution also bought dollars forward.

Foreign investors built up large holdings of Makam twice, and each time the Makam yield moved from TELBOR toward the foreign funding rate. From January 2010 to June 2011 foreign investors held 22% of Makam on average, and the bills yielded 18 basis points less than TELBOR. Foreign investors then left, and from 2013 to 2017, when foreign investors held at most 6% of Makam, the bills yielded about TELBOR. From January to September 2022, when foreign investors held 46%, the bills yielded 51 basis points less than TELBOR and 44 basis points more than the foreign funding rate. Weekly changes in the Makam yield show the same pattern. We regress weekly changes in the Makam yield on weekly changes in the foreign funding rate and in TELBOR, and we call the coefficient on the foreign funding rate *foreign-rate pass-through*. At the 2018 to 2019 foreign share of 9%, foreign-rate pass-through at three months is close to zero. At the 2022 foreign share of 46%, foreign-rate pass-through is 26 basis points per 100 basis points.

To establish causality, we use two designs, each of which moves one part of the mechanism for a reason unrelated to the Makam market. The first design moves the foreign funding rate while foreign investors hold the bills. Israeli long-term institutional investors, such as pension funds, hold foreign assets in dollars and hedge these assets by selling dollars forward for a few months at a time. When a hedge matures the institution still holds its foreign assets, so the institution renews the hedge with a new FX swap in which the institution buys dollars today and sells dollars forward. Each renewal adds to the supply of forward dollars and lowers the forward price of the dollar relative to today's price. Foreign investors buy dollars forward at that price, so a lower forward price is a lower foreign funding rate. The Bank of Israel's foreign-exchange data give the maturity date of every hedge, which is fixed when the hedge is written. We call the dollar amount of hedges that mature in a week, under contracts written at least 90 days earlier, the *hedge calendar*, and we use the hedge calendar as an instrument for the foreign funding rate. The identifying assumption is that the hedge calendar affects the Makam yield only through the foreign funding rate. In the weeks in which foreign investors held 20% or more of Makam, which we call the weeks of high foreign ownership, a 100-basis-point fall in the foreign funding rate lowers the three-month Makam yield by 21 basis points and the six-month Makam yield by 24 basis points. We call this response *funding-rate exposure*.

The second design removes the foreign investors. In July 2011 Israel ended nonresidents' tax exemption on securities issued with a maturity of up to one year, which included every Makam bill, and left the exemption in place on government bonds issued with longer maturities. A foreign investor funds a Makam bill and an exempt bond at the same foreign funding rate,

so the comparison of the two yields holds the foreign funding rate fixed. Foreign holdings of Makam fell from ILS 42.6 billion to ILS 2.6 billion within a year, domestic holders bought the bills, and Makam yields rose by 12.8 basis points relative to exempt bonds with a similar time left to maturity. The rise is of the same order as TELBOR minus the Makam yield, which averaged 18 basis points before the change. The price of the bill therefore depends on who holds the bill.

How much of TELBOR minus the Makam yield is cheaper funding? In our model foreign investors hold more Makam when the Makam yield rises relative to the foreign funding rate, and domestic investors hold more when the Makam yield rises relative to TELBOR. Neither group holds unlimited amounts. The Makam yield is then a weighted average of TELBOR and the foreign funding rate plus a term that depends on neither rate, and the weight of the foreign funding rate is funding-rate exposure. Funding-rate exposure times the gap between TELBOR and the foreign funding rate is then the part of TELBOR minus the Makam yield that the foreign funding rate accounts for, and we call the product the funding term. From January to September 2022 Makam yielded 51 basis points less than TELBOR, and TELBOR exceeded the foreign funding rate by 95 basis points. Funding-rate exposure of 21 basis points per 100 basis points attributes 20 of the 51 basis points to foreign investors' cheaper funding. From January 2010 to June 2011 Makam yielded 18 basis points less than TELBOR. The same funding-rate exposure, applied in the weeks of those months in which foreign investors held 20% or more of Makam, accounts for 16 of the 18 basis points. The attribution takes the foreign investors in the market as given.

The level of interest rates does not account for the 51 basis points. In the months in which foreign investors held less than 10% of Makam, TELBOR minus the Makam yield rises by about 4.6 basis points per percentage point of the policy rate, as the convenience yield of U.S. Treasury bills rises with the level of interest rates (Nagel (2016)). From January to September 2022 the policy rate averaged 0.7%. From January to September 2024, when foreign investors held 3% of Makam and the policy rate was 4.5%, the level of the policy rate accounts for 18 of the 24 basis points by which Makam yielded less than TELBOR.

The hedge calendar also identifies *price impact*, the fall in the Makam yield per ILS billion that foreign investors add to their holdings. The year-end pause in foreign buying checks price impact on an episode that the hedge-calendar estimates do not use. Foreign buying pauses at the end of each year, and the three-month Makam yield then rises by 7.4 basis points, against the 6.7 basis points that price impact implies.

The rise of foreign-rate pass-through with foreign ownership is not specific to Israel. In the model a bill's yield follows the foreign funding rate wherever hedged, dollar-funded investors hold a large share of a local bill market. We estimate foreign-rate pass-through for

Mexican and Japanese government bills. Mexico has the longest record of foreign holdings of a government bill. The Mexican Treasury issues the bills, where the central bank issues Makam, and foreign ownership rose and fell in different years from Israel's episodes. Japan is the largest bill market in which foreign investors came to hold most of the bills. In both markets foreign-rate pass-through rises with foreign ownership. For Japan, foreign-rate pass-through times the gap between the yen overnight-index-swap rate and the foreign funding rate is about 17% of the gap between the overnight-index-swap rate and the bill yield from 2016 to 2024.

Part of what is read as the convenience yield of Makam is therefore the cheaper funding of the bills' foreign holders. For a central bank, the result means that its own bill can drift from its policy rate when foreign funding conditions change. The drift matters for the short-rate disconnect, the gap between policy rates and bill yields (Lenel, Piazzesi, and Schneider (2019)), and for how central banks implement monetary policy (Duffie and Krishnamurthy (2016)). For an issuer, borrowing in the local currency does not insulate the bill from foreign funding conditions. The foreign investors hedge the currency, yet the cost of financing the hedged position enters the bill's yield, much as unhedged foreign holders of local-currency debt transmit movements in the exchange rate to the yield of that debt (Carstens and Shin (2019), Hofmann, Shim, and Shin (2020)).

The paper adds to work that measures the convenience of safe debt from the spread between money-market rates and bill yields (Krishnamurthy and Vissing-Jorgensen (2012), Nagel (2016), d'Avernas and Vandeweyer (2024)) and from hedged spreads across currencies (Du, Im, and Schreger (2018), Krishnamurthy and Lustig (2019), Jiang, Krishnamurthy, and Lustig (2021), Diamond and Van Tassel (2025)). Local-currency sovereign yields swapped into dollars also measure sovereign credit risk (Du and Schreger (2016)), and the convenience of government bonds is tied to exchange rates (Engel and Wu (2023)). Other work prices Treasuries against the financing rates and balance-sheet costs of the intermediaries that hold them (He, Nagel, and Song (2022), Du, Hébert, and Li (2023), Klingler and Sundaresan (2023), Fleckenstein and Longstaff (2024)). We show that part of such a spread can reflect the dollar funding cost of the bill's foreign holders, and we add a second benchmark rate, the foreign funding rate, whose weight in the bill's yield rises with foreign ownership.

Demand systems value assets against a single outside asset (Koijen and Yogo (2019), Gabaix and Koijen (2021)), investors with finite demand elasticities jointly set yields (Vayanos and Vila (2021)), and global arbitrageurs carry shocks to bond yields and exchange rates across currencies (Greenwood, Hanson, Stein, and Sunderam (2023), Gourinchas, Ray, and Vayanos (2025)). We give each group of holders its own observed benchmark, so a change in

the investor base changes which rate the price follows as well as how the price responds to demand.

Who holds sovereign debt matters for its price and for the transmission of foreign shocks (Pandolfi and Williams (2019), Fang, Hardy, and Lewis (2025), Faia, Lewis, and Zhou (2025), Jansen, Li, and Schmid (2024)), and the foreign holders of Makam are balance-sheet-constrained intermediaries of the kind that intermediary asset pricing studies (He and Krishnamurthy (2013)). Stein and Wallen (2025) show that the response of Treasury bill yields to supply depends on which holders are marginal, and Fleckenstein, Klingler, and Longstaff (2026) show that money market funds move the prices of agency floating-rate notes. In Stein and Wallen's setting the benchmark, the rate on the Federal Reserve's overnight reverse repurchase facility, is set by the central bank. The foreign funding rate moves apart from the policy rate, so Makam also lets us measure which rate the yield follows, and in Makam a minority whose holdings respond to the yield can move it.

The capacity of arbitrageurs and the hedging demand they meet govern deviations from covered interest parity (Ivashina, Scharfstein, and Stein (2015), Du, Tepper, and Verdelhan (2018), Avdjiev, Du, Koch, and Shin (2019), Cenedese, Della Corte, and Wang (2021), Rime, Schrimpf, and Syrstad (2022), Ben Zeev and Nathan (2024b), Anderson, Du, and Schlusche (2025)). Kubitza, Sigaux, and Vandeweyer (2025) show that the cost of rolling over currency hedges shifts euro-area investors' demand for dollar bonds, and they instrument the deviation from covered interest parity with idiosyncratic shifts in investors' currency positions. We instrument with the hedge calendar, built from hedges written months earlier, and study the asset held by the investor on the other side of the hedge, a local bill.

Section 1 describes the market and the data. Section 2 documents that foreign-rate pass-through rises with foreign ownership in both episodes and considers alternative explanations. Section 3 presents the model and states what each causal test identifies. Section 4 reports the causal evidence from the hedge calendar and from the 2011 tax change. Section 5 measures the size of the funding channel and sets the funding term beside the level of interest rates. Section 6 estimates foreign-rate pass-through by foreign share in Mexican and Japanese government bills. Section 7 develops the implications for monetary implementation and local-currency borrowing, and Section 8 concludes.

1. The market and the data

1.1. The asset and its investors

Makam are shekel-denominated zero-coupon bills that the Bank of Israel sells at tenders, its auctions of new bills, with original maturities of up to one year. After issuance, the bills trade in the secondary market on the limit-order book of the Tel Aviv Stock Exchange (TASE). Because the bills have a relatively short maturity, an investor who wants to keep a position must keep buying new bills as old ones mature. An investor who wants to exit the market can sell, let its bills mature without replacing them, or mix the two.

We distinguish foreign investors from three groups of domestic holders, which are banks, mutual funds, and long-term institutional investors. Long-term institutional investors are pension funds, retirement savings funds, and insurance companies, and we also call them domestic institutions. They hold foreign assets and hedge those assets in the swap market. Foreign investors are the holders that the Bank of Israel classifies as nonresidents. The mechanism we study concerns the nonresidents that fund in dollars and hedge the currency, and Section 1.2 shows that nonresidents with dollar forward positions make most nonresident purchases of Makam. These nonresidents include the large international banking groups that conduct covered-interest-parity arbitrage across the major currencies (Rime, Schrimpf, and Syrstad (2022)).

Foreign ownership rose most in short maturities. From January 2017 to August 2022, foreign investors' share of government debt with up to one year to maturity rose from 4% to 41%, while their share of longer government bonds rose only from 10% to 16% (Internet Appendix Figure IA.5).

The domestic holders hold Makam for different reasons. Banks hold Makam as one use of their shekel liquidity, alongside deposits at the Bank of Israel and other domestic money-market assets. Mutual funds hold Makam under mandates that range from cash management to passive exposure to foreign equities. For example, many Israeli funds that track foreign equity indices obtain the exposure through index futures or total-return swaps and hold most of their assets in short-term shekel instruments, including Makam. The short-term instruments also serve as collateral for the derivatives, so these funds need short-term shekel assets whatever the Makam yield.[2] Long-term institutional investors hold Makam alongside deposits, government bonds, and other assets.

[2]In December 2021 these funds held 42% of their assets in Makam, 46% in bank deposits and cash, and 4% in foreign stocks and exchange-traded funds (Internet Appendix Section IA.1.8). Fund portfolios come from Praedicta, a commercial provider of Israeli mutual-fund data, and, for retirement savings funds, from Gemel-Net, the public database of Israel's Capital Market, Insurance and Savings Authority (Internet Appendix Section IA.1.1).

1.2. Data

We measure Makam ownership from the holder statistics that the Bank of Israel publishes, which give month-end Makam holdings at market value by sector, together with total outstanding.[3] We measure ownership from holdings rather than trades. Changes in holdings reflect tender purchases, trades in every venue, redemptions, and valuation. A record of trades alone would miss an investor that exits by letting its bills mature, because a maturing bill is not a trade.

Trade-level data then show how the holdings change. The Bank of Israel's confidential data on foreign transactions, which run from 2017 through August 2022, record foreign investors' tender purchases, secondary purchases and sales, and redemptions in every venue. Foreign acquisitions are tender and secondary purchases minus secondary sales, before redemptions. From February 2020 to August 2022 the recorded foreign acquisitions come to ILS 177.0 billion. The bill-by-bill changes in foreign holdings over the same months imply ILS 183.0 billion (Internet Appendix Table IA.2). The Smart Money data, a commercial product of the TASE, report each security's daily purchases and sales in the secondary market by investor type. Tender records, which the TASE and the Bank of Israel publish, give each bill's issue and redemption dates. From January 2020, confidential Bank of Israel data on monthly holdings by bill and holder sector let us split each sector's monthly change into new bills, redemptions, revaluation, and net trades in outstanding bills (Internet Appendix Section IA.1.5).

For the swap market, the Bank of Israel's confidential foreign-exchange data record the client, dealer, dates, direction, and notional of every forward and FX swap. With the foreign-exchange data we identify domestic institutions' dollar hedges and follow their rollovers (Ben Zeev and Nathan (2024a,b)). For the 2011 tax change we have holdings by sector from the published holder statistics and security-level yields from public TASE price data.

We link the data on foreign transactions to the foreign-exchange data to see whether the nonresident buyers of Makam hedge with dollar forwards. The data on foreign transactions identify each nonresident account, and the foreign-exchange data name the counterparties of every forward and FX swap with an Israeli bank or institutional investor. The two data sets share no identifier, so we map each nonresident account to its parent institution and match parents to foreign-exchange counterparties by name. Foreign institutions with dollar

[3]For the months from January 2020 we use the report on Makam holdings by sector that the Bank of Israel introduced in May 2025, and for earlier months the earlier report. The May 2025 report classifies holders according to international standards and removes double reporting of nonresident holdings. On the weeks both reports cover, foreign-rate pass-through, which Section 2.2 defines, rises by 8.0 basis points per 10 percentage points of foreign ownership with the May 2025 report and by 8.1 with the earlier report (Section 2.2 and Internet Appendix Section IA.1.4).

forward positions made 87% of nonresident Makam purchases from June 2020 to August 2022. Nearly all the remaining purchases went through custodian and pooled client accounts, whose beneficial owners neither data set identifies. Within an institution, each shekel of net Makam purchases in a week comes with about 0.8 shekels of new forward dollar purchases in the same week ($t = 5.1$, clustered by institution and week, Internet Appendix Figure IA.2 and Section IA.1.3).[4] Of the new forward dollar purchases, 97% by notional are the far legs of FX swaps, in which the institution sells dollars for shekels at the start and buys the dollars back at maturity. The far legs alone give a slope of 0.8 ($t = 6.2$), and outright forwards give 0.04 ($t = 0.8$). The institution sold dollars for shekels in the near leg, so the institution's shekel position is dollar-funded as well as hedged. Most nonresident purchases of Makam are therefore made by institutions that fund in dollars and hedge the currency, the investors whose funding rate the model uses.

1.3. TELBOR and the foreign funding rate

Domestic banks value Makam against TELBOR, and hedged foreign investors value Makam against the foreign funding rate. We define the two rates, explain why each serves as its group's benchmark, and describe how we measure them.

Let $y_{t,\tau}$ denote the Makam yield at date t and remaining maturity τ, in years, and $r^D_{t,\tau}$ TELBOR at the same maturity. TELBOR, which the Bank of Israel publishes daily, is the Israeli interbank rate. Three-month TELBOR is the fixed rate in a shekel overnight-index swap on overnight TELBOR, which tracks the policy rate, so three-month TELBOR carries little bank credit risk. The shekel overnight-index swaps executed from April to October 2022 at maturities of 30 to 94 days all lie within 2.2 basis points of TELBOR at the same date and maturity, so quoted TELBOR matches the rates at which banks trade (Internet Appendix Section IA.1.2).

Each group of holders values Makam against its own benchmark, the rate on the group's next-best use of the money, and the two groups' benchmarks differ. A domestic bank that does not hold Makam can deposit its shekels at the Bank of Israel through the deposit tenders that the Bank of Israel conducts with banking corporations (Bank of Israel (2016)). The deposit earns about TELBOR. From January 2010 to June 2025, overnight TELBOR was within 1 basis point of the policy rate on 99% of days (Internet Appendix Figure IA.1). A foreign investor funded in dollars, however, has no such access. It can keep its money in dollar assets, or it can obtain shekels through an FX swap and hold Makam. A foreign investor that swaps dollars into shekels gives up the dollar interest rate and pays the cost of

[4] Without the institution-weeks in the rightmost bin of Internet Appendix Figure IA.2, the slope is 1.2 ($t = 5.9$).

the swap. The two together are the foreign funding rate, so the investor gains from Makam only when Makam yields more than the foreign funding rate. The model therefore treats TELBOR as the benchmark of domestic banks and the foreign funding rate as the benchmark of swap-funded foreign investors, with limited arbitrage between the two.

We construct the foreign funding rate independently of Makam prices. Let X_t be the spot exchange rate in shekels per dollar, $X_{t,\tau}$ the forward exchange rate in shekels per dollar for delivery at $t+\tau$, and $r^{\$}_{t,\tau}$ a dollar funding rate. With all rates quoted as simple annual rates, the foreign funding rate $r^{F}_{t,\tau}$, the shekel cost of borrowing dollars and hedging repayment, satisfies

$$1 + \tau r^{F}_{t,\tau} = \frac{X_{t,\tau}}{X_t}\left(1 + \tau r^{\$}_{t,\tau}\right). \tag{1}$$

The foreign funding rate is the synthetic shekel rate implied by covered interest parity (Du, Tepper, and Verdelhan (2018)), which we build from spot and forward exchange rates and the dollar overnight-index-swap rate from LSEG, a commercial data provider. We add a fixed spread of 26.161 basis points so that the dollar rate approximates the level of unsecured bank funding.[5]

The hedged spread on Makam, $y - r^F$, is the return to an investor that borrows dollars, buys shekels at spot, invests the shekels in Makam, and buys the dollars back forward. The trade has zero net cash flow today, and its payoff is positive whenever Makam yields more than the foreign funding rate, including when Makam yields less than TELBOR (Internet Appendix Section IA.1.2 lists the cash flows). We drop the subscripts t and τ where no confusion arises.

The paper uses three spreads. TELBOR minus the Makam yield, $r^D - y$, is positive when Makam yields less than TELBOR and is the measured convenience yield of Makam. The hedged spread is the Makam yield minus the foreign funding rate. TELBOR minus the foreign funding rate is Israel's deviation from covered interest parity, and we also call it the gap between TELBOR and the foreign funding rate. The three spreads satisfy an identity. TELBOR minus the foreign funding rate equals TELBOR minus the Makam yield plus the hedged spread, $r^D - r^F = (r^D - y) + (y - r^F)$. From January to September 2022, TELBOR minus the foreign funding rate averaged 95 basis points, the sum of 51 basis points of TELBOR minus the Makam yield and a hedged spread of 44 basis points.

[5]The spread is the fixed adjustment that the International Swaps and Derivatives Association (ISDA) set in March 2021 to convert three-month dollar LIBOR into compounded SOFR. The spread sets the level of the foreign funding rate and leaves its weekly changes almost unchanged.

1.4. Two episodes of foreign ownership

Foreign investors built up and then ran down large holdings of Makam twice, a decade apart (Figure 1, Panel A, and Table 1). Each time, domestic holders and the Bank of Israel's issuance supplied the bills that foreign investors bought, and domestic holders took the bills that foreign investors released. Table 2 tracks the changes holder by holder. Table 1 also reports outstanding dollar hedges, the dollars that domestic institutions have sold forward and not yet delivered, which Section 2.3 uses. In the first episode the foreign share rose from 2% in the third quarter of 2009 to 35% in the second quarter of 2011. The Bank of Israel supplied the bills by issuing more, and banks absorbed most of the bills that foreign investors released after the 2011 tax change (Section 4.2).

In the second episode banks supplied the bills first, the Bank of Israel supplied them from 2022 by issuing more, and mutual funds and long-term institutional investors bought the bills when foreign investors left. Between December 2019 and December 2021 Makam outstanding fell, so the ILS 37.1 billion that foreign investors added over those two years had to come from domestic holders, mostly banks. By January 2021 the five largest banks together held only ILS 0.4 billion of Makam (Internet Appendix Table IA.22, Panel E). Banks kept dealing in the bills, buying newly issued bills at tenders and selling outstanding ones, as dealers do in Treasury markets (Anbil et al. (2026)). Within the mutual-fund sector, funds that track foreign stock indices added ILS 8.2 billion of Makam from May 2020 to December 2021, while other mutual funds sold ILS 0.7 billion (Internet Appendix Table IA.22, Panel D).

From December 2021 to September 2022 Makam outstanding rose by ILS 29.4 billion, more than the ILS 19.2 billion that foreign investors added. The Bank of Israel described its larger tenders as a response to demand (Bank of Israel (2023)). From September to December 2022 Makam outstanding rose by a further ILS 65.0 billion, and TELBOR minus the three-month Makam yield fell by 93 basis points between the two month-ends.

In the exit, foreign investors left mainly by letting their bills mature without buying new ones (Internet Appendix Section IA.1.6). Foreign holdings fell by ILS 73.3 billion from the November 2022 peak to the trough in November 2024, but foreign net sales on the exchange came to only ILS 11.8 billion, about a sixth of the decline. Mutual funds and long-term institutional investors bought the bills.[6] Israel's credit risk changed little while foreign investors left, and the five-year credit default swap spread on its dollar government debt rose from 40 to 52 basis points from September–October 2022 to September 2023 (Internet Appendix Section IA.4.4). Foreign-rate pass-through fell back as foreign investors left (Section 2.2).

[6]Internet Appendix Sections IA.1.6 and IA.1.7 give the holder-level detail of both episodes.

2. Foreign ownership and the Makam yield

The Makam yield stayed close to TELBOR when foreign ownership was low and moved toward the foreign funding rate when foreign investors held more of the bills (Section 2.1). Foreign-rate pass-through rises with foreign ownership in both episodes (Section 2.2), and foreign holdings respond to the Makam yield and to the foreign funding rate (Section 2.3). Section 2.4 considers alternative explanations.

2.1. Makam between TELBOR and the foreign funding rate

Panel B of Figure 1 plots two three-month spreads in monthly averages from 2010, TELBOR minus the Makam yield and TELBOR minus the foreign funding rate. A low foreign funding rate did not by itself pull the Makam yield away from TELBOR. Between 2013 and 2017, when foreign investors held at most 6% of Makam, the quarterly average of TELBOR minus the foreign funding rate ranged from −17 to 44 basis points, while the quarterly average of TELBOR minus the Makam yield stayed between −3 and 2 basis points. From 2018 to 2019 the hedged spread on Makam averaged 28 basis points, foreign investors held 9% of Makam, and the Makam yield stayed at TELBOR.[7] TELBOR minus the Makam yield widened only after foreign ownership rose. TELBOR minus the Makam yield averaged 8 basis points from July 2020 to December 2021 and 51 basis points from January to September 2022 (Table 1).

From July 2020 to December 2021, when foreign investors held 28% of Makam on average (Table 1), the three-month Makam yield was below zero in 26 of the 77 weeks. TELBOR stayed positive in every week (Figure 2), so a domestic bank could always earn a positive rate at the Bank of Israel. The foreign funding rate was negative in 73 of the 77 weeks, and the Makam yield reached −15 basis points in a week when TELBOR stood at 10. A bank would not hold a bill with a negative yield when a deposit at the same central bank pays a positive rate, so a negative Makam yield points to holders whose benchmark rate was below TELBOR. Foreign investors were such holders, because the foreign funding rate was negative.

2.2. Foreign-rate pass-through and foreign ownership

When the foreign funding rate moves and TELBOR does not, how much does the Makam yield move? We call the response foreign-rate pass-through. If each group of holders values

[7] A global bank that funds in dollars compares the returns per unit of balance-sheet capacity across currencies. From 2018 to 2019, TELBOR minus the foreign funding rate averaged 27 basis points, against deviations of 22 in euros and 35 in yen. From July 2020 to December 2021 TELBOR minus the foreign funding rate averaged 30, against 0 and 4 (Internet Appendix Section IA.4.2). The shekel deviation was in line with the euro and the yen from 2018 to 2019 and far above both from July 2020, when foreign investors entered.

Makam against its own benchmark (Section 1.3), foreign-rate pass-through should rise with the foreign share. We regress the weekly change in the three-month Makam yield on the weekly changes in three-month TELBOR and the three-month foreign funding rate,

$$\Delta y_w = \alpha + \theta_D \, \Delta r_w^D + \theta_F \, \Delta r_w^F + \varepsilon_w, \tag{2}$$

where w indexes weeks, α is the intercept, ε_w is the regression error, and $\Delta y_w = y_w - y_{w-1}$ is the weekly change in the Makam yield, with the changes in the two rates defined in the same way.[8] Foreign-rate pass-through is θ_F, the response of the Makam yield to the foreign funding rate at given TELBOR, and θ_D is the response to TELBOR at a given foreign funding rate. Section 4.1 estimates funding-rate exposure, the causal counterpart of foreign-rate pass-through, with the hedge calendar as an instrument for the foreign funding rate.

Figure 3 plots foreign-rate pass-through against the foreign share in both of Israel's episodes of foreign ownership. Within each episode we group weeks by the foreign share at the end of the previous month and estimate equation (2) separately in each group, so that each group has its own intercept, coefficient on TELBOR, and pass-through. From 2018 to 2024 the groups are 10 percentage points wide. In both episodes foreign-rate pass-through is close to zero at low foreign ownership and high at high foreign ownership. From 2018 to 2024 foreign-rate pass-through was 26.3 basis points per 100 basis points ($t = 5.2$) when foreign investors held between 30% and 40%, and 26.5 ($t = 3.1$) when foreign investors held more. Below 30%, foreign-rate pass-through was between -1.3 and 7.1. From 2010 to 2012 the corresponding estimates are -1.8 below 30% and 33.6 ($t = 3.7$) above it (Internet Appendix Table IA.6). The diamond in the figure is funding-rate exposure from Section 4.1, and the gray line is funding-rate exposure in the calibration of Section 5.2.

We now let pass-through vary continuously with foreign ownership, by letting both responses in equation (2) depend on the foreign share. Let s_w denote the foreign share of Makam outstanding at the end of the month before week w, expressed as a fraction and measured as a deviation from its sample mean. We regress the weekly change in the Makam yield on the weekly changes in TELBOR and the foreign funding rate, on each of these changes multiplied by the foreign share, and on the foreign share itself,

$$\Delta y_w = \alpha + \lambda \, s_w + \Big(\theta_D + \gamma_D \, s_w\Big)\Delta r_w^D + \Big(\theta_F + \gamma_F \, s_w\Big)\Delta r_w^F + \varepsilon_w, \tag{3}$$

[8] The baseline maturity is three months. At that maturity TELBOR is the fixed rate in a shekel overnight-index swap, and TELBOR at six months and longer is built from forward-rate agreements on the three-month rate. The three-month maturity is also the standard benchmark for deviations from covered interest parity. Weighted by notional, the median original maturity of the dollar hedges that domestic institutions write or roll over is 96 days.

so pass-through is $\theta_F + \gamma_F s_w$. We call γ_F the ownership interaction. A positive γ_F means that pass-through rises with foreign ownership. The coefficient γ_D is the change in the response to TELBOR with the foreign share, and λ is the coefficient on the foreign share itself. We use the foreign share of all Makam rather than of three-month bills alone. Foreign investors shift their purchases across maturities toward the highest hedged spreads (Section 2.3), so the foreign demand that prices the three-month bill comes from foreign holders of every maturity.

In the baseline, estimated from January 2010 to September 2024, each additional 10 percentage points of foreign ownership adds 7.4 basis points to the response of the Makam yield to a 100-basis-point move in the foreign funding rate ($t = 3.3$, Table 3, column 1). At the 2018 to 2019 share of 9%, pass-through is -1 basis point per 100 basis points, essentially zero. At the 2022 share of 46% it is 26 (Table 3, Panel B).

The ownership interaction does not depend on any single year. A wild cluster bootstrap with the null imposed, clustered by calendar year, gives $p = 0.003$ for the ownership interaction. Omitting one calendar year at a time leaves the ownership interaction between 4.6 and 8.0 basis points per 10 percentage points (Internet Appendix Table IA.7, Panel A). Excluding March to June 2020, the months of the COVID-19 market turmoil, leaves the interaction at 6.9 ($t = 3.0$). The interaction estimated with the actual foreign-share series has a larger t-statistic than every one of the 154 series shifted in time by a year or more (Internet Appendix Table IA.20).[9]

A shock that moves all short rates together, such as the 2022 tightening, could drive the ownership interaction. Column 4 of Table 3 compares the Makam yield at four maturities within the same week, with a fixed effect for each week. Pass-through still rises with foreign ownership, by 9.3 basis points per 10 percentage points ($t = 3.9$), from 3 basis points per 100 basis points at the 2018 to 2019 share to 38 at the 2022 share.

The higher pass-through at high foreign ownership also survives a control for domestic institutions' dollar hedges, which leaves the ownership interaction at 7.2 ($t = 2.8$), and it does not depend on the vintage of the holder statistics.[10]

For the first episode we estimate the ownership regression (3) on the 29 monthly changes from January 2010 to June 2012. Column 5 of Table 3 uses monthly changes, the frequency at which the foreign share is measured. Foreign-rate pass-through rises with foreign ownership by 6.8 basis points per 10 percentage points ($t = 2.3$), close to 7.8 in the weekly sample from 2018 onward (Table 3, columns 2 and 5). The weekly estimates for 2010 to 2012 in Figure 3 show the same rise over the episode. Foreign entry from 2010 to 2011 coincided with monetary tightening, so the higher pass-through could reflect the level of rates. The

[9] Each shifted series is the foreign share moved circularly by 12 months or more.

[10] Internet Appendix Sections IA.1.4, IA.2.1, and IA.2.3 and Table IA.7 report the checks.

level of rates and foreign ownership separated in the second half of 2011. Foreign holdings of Makam fell by ILS 27.8 billion in those months while three-month TELBOR averaged 2.94%, its highest level in the episode (Table 1 and Table 2, Panel B).

2.3. What foreign investors respond to

If the foreign funding rate moves the Makam yield through foreign demand, foreign holdings should respond to the hedged spread. Foreign holdings rise with the Makam yield and fall with the foreign funding rate, and foreign purchases tilt toward the maturities with the highest hedged spread (Table 4).

A foreign investor's return on Makam is the hedged spread, the Makam yield minus the foreign funding rate. Investors may respond differently to the two rates, however, and a regression on the spread alone would force equal responses. The regression checks that foreign holdings move with the hedged spread, as foreign demand does in the model of Section 3. We therefore regress the monthly change in foreign holdings on the previous month's three-month Makam yield and three-month foreign funding rate as separate regressors, together with the previous month's foreign holdings and domestic institutions' dollar hedges,

$$\Delta F_t = \alpha_{p(t)} + \beta_y \, y_{t-1} + \beta_F \, r^F_{t-1} + \rho \, F_{t-1} + \beta_H \, H_{t-1} + \varepsilon_t, \tag{4}$$

where F_t is foreign holdings of Makam at the end of month t, and the rates are means over the last 7 days of the previous month, before the change in holdings.[11] The coefficients β_y and β_F are the responses to the two rates, ρ is the coefficient on lagged foreign holdings, and β_H is the coefficient on outstanding dollar hedges. Outstanding dollar hedges, H_{t-1}, are the dollars that domestic institutions have sold forward and not yet delivered. Outstanding dollar hedges measure the forward dollars that domestic institutions supply in the swap market where foreign investors fund their bills. The intercept $\alpha_{p(t)}$ differs across February 2018 to May 2020, June 2020 to December 2021, and January to August 2022.[12]

[11] The rates enter in levels because the foreign demand curve (6) relates the level of foreign holdings to the level of the rates. With the lagged level F_{t-1} in equation (4), holdings move each month only part of the way toward the level that the rates imply, as foreign investors build positions through tenders and the rollover of maturing bills. The bounds test of Pesaran, Shin, and Smith (2001), which is valid whether each series is stationary or has a unit root, rejects the absence of a relation among the levels of foreign holdings, the two rates, and outstanding dollar hedges (F-statistic of 10.6, against a 1% critical value of 5.61).

[12] The sample leaves out March and April 2020, when dollar funding markets were disrupted. Because the rates enter with a one-month lag, the April change in foreign holdings is paired with the foreign funding rate at the end of March.

Foreign holdings respond to both rates, in opposite directions (Table 4).[13] A Makam yield that is 100 basis points higher predicts a rise of ILS 4.0 billion in foreign holdings over the following month ($t = 2.4$). A foreign funding rate that is 100 basis points higher predicts a fall of ILS 6.7 billion ($t = -3.9$).[14]

A second regression extends the evidence to the months from January 2010 to September 2024. We regress the monthly change in foreign holdings on the same month's changes in TELBOR and the foreign funding rate, on each change multiplied by the demeaned foreign share, and on the foreign share. At the mean foreign share and at given TELBOR, a 100-basis-point rise in the foreign funding rate comes with a fall of ILS 4.8 billion in foreign holdings in the same month ($t = -4.2$, Newey–West with 3 lags, Internet Appendix Table IA.22, Panel A). The fall in holdings is the quantity side of foreign-rate pass-through. In the model, as foreign investors release bills, the Makam yield rises until domestic holders take the released bills or the Bank of Israel issues fewer bills.

Foreign investors also choose maturities by the hedged spread (Table 4, Panel B). For each investor group g, we estimate

$$q_{gmt} = \alpha_{gt} + \alpha_{gm} + \beta_g \left(y - r^F\right)_{m,t-1} + \varepsilon_{gmt} \tag{5}$$

over 55 months from 2018 to 2022, where q_{gmt} is the share of group g's secondary-market purchases in month t that falls in maturity bucket m, $(y - r^F)_{m,t-1}$ is the bucket's hedged spread in the previous month, α_{gt} and α_{gm} are month and bucket effects, β_g is the group's response to the hedged spread, and ε_{gmt} is the regression error. The maturity buckets are 1 to 3, 3 to 6, 6 to 9, and 9 to 12.6 months. The regression leaves out tenders because at a tender the Bank of Israel chooses which maturities are on offer, whereas the secondary market offers every outstanding maturity. Tenders made up 43% of gross foreign purchases from July 2020 to December 2021. A bucket whose hedged spread is one basis point higher receives 1.55 percentage points more of foreign secondary purchases in all venues ($t = 4.2$). The purchases of the domestic groups are observed on the exchange. On the exchange alone the foreign slope

[13] The other two coefficients describe how positions adjust. Each month foreign holdings close 43% of the distance to the level that the two rates and outstanding dollar hedges imply ($\rho = -0.43$). Each USD billion of domestic dollar hedges predicts a rise of ILS 0.34 billion in foreign holdings over the following month (β_H, $t = 6.3$), as those hedges are the other side of the swaps through which foreign investors fund their bills. Adding lagged TELBOR leaves the coefficient on the foreign funding rate at −6.6 billion per 100 basis points ($t = -4.2$, Internet Appendix Table IA.10).

[14] The rates are persistent, and persistent regressors can bias coefficients and t-statistics in a predictive regression (Stambaugh (1999)). A bootstrap that simulates the rates from a vector autoregression and keeps the correlation between their innovations and the regression error, with 4999 replications, puts the bias at −0.4 and −0.1. The bias-corrected coefficients are 4.5 and −6.6 (95% interval [−10.1, −2.8]), and the bootstrap p-value under the null of no response to the foreign funding rate is 0.004. The augmented regression of Amihud, Hurvich, and Wang (2009) gives t-statistics of 2.1 and −3.5.

is 0.77 ($t = 1.9$), and the slope of banks, which dealt in the bills that foreign investors bought (Section 1.4), is 1.14 ($t = 3.2$). Mutual funds, long-term institutional investors, and ETFs and market makers show no such slope. ETFs and market makers are a separate investor type in the Smart Money data. On the exchange the foreign slope exceeds the slopes of mutual funds, of long-term institutional investors, and of ETFs and market makers (t between 2.1 and 2.4).[15]

2.4. Alternative explanations

Explanations other than foreign funding could produce the facts of this section.

If domestic investors had come to value Makam's safety and liquidity more, the Makam yield would have fallen, Makam would have paid foreign investors less over their funding rate, and foreign investors would have sold the bills. From December 2019 to December 2021 foreign investors bought the bills, and domestic holders sold the bills to them (Section 1.4).

If the Israeli money market had become more closely tied to dollar funding over time, foreign-rate pass-through would have risen over time and stayed high. Foreign ownership rose and fell in both episodes, and foreign-rate pass-through fell back each time foreign investors left (Section 2.2). A linear time trend interacted with both rate changes leaves the ownership interaction at 7.3 ($t = 3.2$, Internet Appendix Table IA.7, Panel A).

If banks' departure from Makam had raised foreign-rate pass-through, by leaving fewer domestic holders ready to sell when the Makam yield falls, pass-through would follow the bank share and not the foreign share. Banks sold Makam while foreign investors bought from 2019 to 2021 (Section 1.4), so the two shares moved together in those years. Two facts separate the two shares. From 2010 to 2012 foreign-rate pass-through rose with foreign ownership, and in the 18 weeks in which foreign investors held more than 30% of Makam, banks held 13% of Makam. The foreign share and the bank share also did not move in lockstep. The residual from a regression of the foreign share on the bank share has a standard deviation equal to 60% of the standard deviation of the foreign share. Column 3 of Table 3 adds the lagged bank share and its interactions with both rate changes, and pass-through still rises by 9.0 basis points per 10 percentage points of foreign ownership ($t = 2.7$). The interaction of the bank share with the foreign funding rate is 2.9 ($t = 0.9$).[16]

[15] Internet Appendix Table IA.10 reports the predictive regression with lagged TELBOR added, the comparison of slopes on the exchange, and the rollover of maturing hedges, and Table IA.2 reports purchases by venue.

[16] The ownership interaction is similar from 2018 onward and with bank holdings measured in shekels. In the regression with week fixed effects (column 4), adding the control for bank holdings raises the ownership interaction from 9.3 to 12.1 ($t = 3.9$) and lowers the interaction of TELBOR with the foreign share from

If bills had become scarce, domestic holders would have held fewer bills as TELBOR minus the Makam yield widened. From December 2021 to September 2022 Makam outstanding rose by ILS 29.4 billion, more than the ILS 19.2 billion that foreign investors added (Section 1.4), so domestic holders held more bills while TELBOR minus the Makam yield widened.

If foreign demand for shekel assets in general had risen, foreign ownership would have risen across Israeli assets. The rise in foreign ownership was concentrated in short-term government debt. From January 2017 to August 2022 the foreign share of government debt with up to one year to maturity rose from 4% to 41%. The foreign share of Israeli equities rose from 16% to 20%, and the foreign share of corporate bonds stayed at or below 1% (Internet Appendix Figure IA.5).

If the level of interest rates set foreign-rate pass-through, the interaction of the rate changes with the level of TELBOR would take the place of the ownership interaction. Three-month TELBOR averaged 4.61% in 2023 while foreign investors left (Table 1). With each rate change also interacted with the previous week's TELBOR, foreign-rate pass-through still rises by 7.4 basis points per 10 percentage points of foreign ownership ($t = 3.2$). The interaction of the foreign funding rate with the level of TELBOR is close to zero ($t = 0.2$, Internet Appendix Table IA.8).

3. A model of funding rates and the Makam yield

This section presents a model of how the foreign funding rate affects the Makam yield. Foreign investors buy limited amounts of Makam when the Makam yield exceeds the foreign funding rate. Domestic investors sell Makam as the Makam yield falls below TELBOR. Market clearing makes the Makam yield depend on both rates and on the parts of demand and supply that do not respond to rates. The weight on the foreign funding rate is funding-rate exposure, and in the model funding-rate exposure rises with the foreign investor base.

The model has two uses. Foreign-rate pass-through, which Section 2 shows rising with foreign ownership, is a response to weekly changes. The model turns a response to changes into a statement about levels. The model gives the condition under which funding-rate exposure times the gap between TELBOR and the foreign funding rate is the part of TELBOR minus the Makam yield that the foreign funding rate accounts for. The model also links funding-rate exposure to price impact, the fall in the Makam yield per ILS billion added to foreign holdings, because the domestic supply slope enters both. The hedge-calendar test of

-15.9 to -22.1 ($t = -2.4$). At higher foreign ownership the Makam yield follows the foreign funding rate more and TELBOR less.

Section 4.1 estimates funding-rate exposure and price impact, and Section 5 compares the estimate of price impact with the year-end pause in foreign buying.

The model is a demand system in the sense of Koijen and Yogo (2019), with one change. Each group of holders values Makam against its own observed benchmark rate, where a standard demand system uses a single outside asset. Domestic banks compare Makam with deposits at the Bank of Israel, whose rate TELBOR tracks. Foreign investors compare the Makam yield with the foreign funding rate, the shekel cost of borrowing dollars and swapping the dollars into shekels. Neither group will hold unlimited amounts, so foreign investors stop buying while the hedged spread is still positive. When foreign investors are a small part of the market, domestic holders set the yield close to TELBOR.

The model has one period. An investor buys Makam today and holds it to maturity, so each quantity is a holding today and each rate is a rate to maturity. Consider Makam at a fixed maturity. Let y be the Makam yield, r^D TELBOR, and r^F the foreign funding rate, all in basis points. TELBOR minus the Makam yield is then $r^D - y$, which is positive when Makam yields less than TELBOR. Foreign holdings are F, domestic holdings D, and Makam outstanding S, all in ILS billion.

The model takes the two rates as given. The Bank of Israel sets TELBOR through its policy rate, and the swap market sets the foreign funding rate.[17] The model also takes as given the size of the foreign investor base and the parts of foreign demand, domestic demand, and issuance that do not respond to rates. The model determines the Makam yield, foreign holdings, domestic holdings, and Makam outstanding. We describe foreign investors, domestic investors, and the issuer in turn and then clear the market.

Foreign investors. Foreign investors hold more Makam when the Makam yield is higher and less when the foreign funding rate is higher. Foreign holdings are

$$F = a\,y - b\,r^F + u, \qquad a, b > 0. \tag{6}$$

The slope a is the rise in foreign holdings per basis point of Makam yield, and b is the fall per basis point of the foreign funding rate. The two slopes depend on how much balance-sheet capacity foreign investors devote to Makam. Let n be the size of the foreign investor base. Each unit of the base holds a_0 more Makam per basis point of Makam yield and b_0 less per basis point of the foreign funding rate, so $a = n\,a_0$ and $b = n\,b_0$. A larger base therefore meets the same change in rates with larger purchases, and both slopes rise in the same proportion. We use the foreign share of Makam as the measure of the base. The term u

[17] Internet Appendix Section IA.5.3 lets the foreign funding rate respond to foreign holdings of Makam.

collects everything else that shifts foreign demand. The model of this section does not impose $a = b$, the restriction that foreign demand depends only on the hedged spread $y - r^F$. The calibration of Section 5 imposes $a = b$.

The key assumption of the model is that foreign demand is finite at given rates. From 2018 to 2019 the hedged spread on Makam averaged 28 basis points while the Makam yield stayed at TELBOR (Table 1), so foreign investors stopped buying before the hedged spread fell to zero. The global banks that could arbitrage the hedged spread away pay a regulatory cost on every position they add to their balance sheets (Avdjiev, Du, Koch, and Shin (2019), Cenedese, Della Corte, and Wang (2021)), and Internet Appendix Section IA.5.2 derives equation (6) from such a cost.

Domestic investors. Domestic investors sell Makam as the Makam yield falls relative to TELBOR, and each investor can sell only the bills that it holds. Domestic investor j holds

$$D_j = \max\{0,\ \bar{D}_j - \delta_j(r^D - y)\}, \qquad \delta_j \geq 0. \tag{7}$$

The level $\bar{D}_j$ is investor j's holding when Makam yields the same as TELBOR, and δ_j is how much investor j sells per basis point of $r^D - y$. For a bank the alternative to Makam is a deposit at the Bank of Israel. For a mutual fund or a long-term institutional investor the alternative is a bank deposit or another shekel money-market asset whose rate moves with TELBOR. Once an investor's holding is gone, the investor supplies no further bills.[18] Summing over the investors that still hold Makam gives domestic holdings $D = \bar{D} - \delta(r^D - y)$, where $\bar{D}$ and δ are the sums of $\bar{D}_j$ and δ_j over those investors.

Supply. Makam outstanding is

$$S = \bar{S} + \phi\,(r^D - y), \qquad \phi \geq 0. \tag{8}$$

The term $\bar{S}$ is the part of Makam outstanding that the Bank of Israel sets independently of the yield, and ϕ is the rise in Makam outstanding per basis point of $r^D - y$.

Market clearing. Foreign and domestic holdings equal Makam outstanding, $F + D = S$. Domestic holders and the issuer together supply

$$B = \delta + \phi$$

[18] The bound reflects that Makam has no centralized securities-lending facility (Tel Aviv Stock Exchange (2026)).

additional bills per basis point of $r^D - y$, and we call B the domestic supply slope. In the data, δ comes mainly from banks, for which a deposit at the Bank of Israel is a close substitute for the bills, and from mutual funds and long-term institutional investors, and ϕ is the response of Makam outstanding through the Bank of Israel's tenders. Market clearing gives[19]

$$y = \frac{B\, r^D + b\, r^F + \bar{S} - \bar{D} - u}{a + B}. \tag{9}$$

The Makam yield is pulled toward two rates. Domestic holders and the issuer pull the Makam yield toward TELBOR, foreign investors pull the Makam yield toward the foreign funding rate, and each side pulls in proportion to how strongly its quantity responds. No single group of holders sets the yield. Domestic holders remain in the market when the Makam yield is well below TELBOR because some holdings do not respond to the yield. Funds that must hold shekel collateral are an example.[20]

In equation (9), TELBOR's weight is the domestic supply slope B, and the foreign funding rate's weight is the foreign slope b, both relative to $a + B$, the total response of holdings and supply to the Makam yield. When $a = b$ the weights sum to one, and the yield is a weighted average of the two rates plus the level terms $\bar{S} - \bar{D} - u$ divided by $a + B$. When the foreign investor base is small, b is small relative to B, and the weight of the foreign funding rate in the Makam yield is close to zero. From 2018 to 2019 TELBOR exceeded the foreign funding rate by 27 basis points, and with a weight close to zero the 27 basis points added almost nothing to TELBOR minus the Makam yield, which averaged -1 basis points. The hedged spread of 28 basis points persisted because the small foreign investor base held as much Makam as its balance sheets allowed.

TELBOR minus the Makam yield. Subtracting the equilibrium yield from TELBOR gives

$$r^D - y = \frac{b}{a + B}(r^D - r^F) + \frac{a - b}{a + B}\, r^D - \frac{\bar{S} - \bar{D} - u}{a + B}. \tag{10}$$

The first term is the foreign funding rate's weight in the Makam yield times the gap between TELBOR and the foreign funding rate. We call the first term the funding term. The funding term is positive whenever foreign investors fund more cheaply than domestic banks. The second term vanishes when $a = b$, that is, when foreign demand depends only on the hedged spread. The third term collects the level terms in demand and supply. A change in holders

[19] The linear forms give closed-form expressions. With nonlinear demand and supply, the slopes become local derivatives at the equilibrium, and the expressions below for funding-rate exposure and price impact hold with the local slopes. What matters is that each group values Makam against its own rate and that neither group will hold unlimited amounts.

[20] Internet Appendix Section IA.1.8 documents the portfolios of these funds.

can therefore change TELBOR minus the Makam yield without changing the bill's promised repayment or its safety and liquidity characteristics.

Funding-rate exposure and price impact. Equation (9) gives funding-rate exposure, and the market-clearing condition gives price impact. A change in the foreign funding rate moves the Makam yield by

$$\frac{\partial y}{\partial r^F} = \frac{b}{a+B} \equiv E, \tag{11}$$

which we call funding-rate exposure and denote by E. A shift up in foreign demand, a rise in u, moves the Makam yield by

$$\frac{\partial y}{\partial u} = -\frac{1}{a+B}. \tag{12}$$

Foreign holdings rise by less than the rise in u, because the lower yield reduces the part of foreign demand that responds to the yield. Whatever raises foreign holdings, the additional bills come from domestic holders and the issuer. Market clearing gives $F = \bar{S} - \bar{D} + B(r^D - y)$. Hold TELBOR, the level terms $\bar{S}$ and $\bar{D}$, and the set of domestic investors with positive holdings fixed. Any change in foreign demand or in the foreign funding rate that raises foreign holdings by dF then lowers the Makam yield by

$$-\frac{dy}{dF} = \frac{1}{B} \equiv P, \tag{13}$$

which we call price impact and denote by P, the fall in the Makam yield per ILS billion added to foreign holdings. Price impact contains neither foreign slope, so at a given domestic supply slope price impact does not change with the foreign investor base. Price impact changes when domestic holders leave, and one calculation of Section 5 allows for the change.

What the paper estimates. The paper estimates three objects. *Foreign-rate pass-through* is the least-squares response of the Makam yield to the foreign funding rate at given TELBOR, which Section 2 estimates. *Funding-rate exposure*, $E = b/(a+B)$, is the response of the Makam yield to a change in the foreign funding rate that comes with no other shift in the demand for Makam. *Price impact*, $P = 1/B$, is the fall in the Makam yield per ILS billion added to foreign holdings. Foreign-rate pass-through equals funding-rate exposure when changes in the foreign funding rate are uncorrelated with the other shifts in the demand for Makam and in the supply of Makam. The hedge calendar of Section 4.1 supplies such movements, so the hedge calendar identifies funding-rate exposure and price impact in the weeks of high foreign ownership. The tax change of Section 4.2 identifies the effect on the Makam yield of replacing foreign holders with domestic holders. Section 5 calibrates the

model to funding-rate exposure and price impact and attributes part of TELBOR minus the Makam yield to foreign investors' cheaper funding.

PROPOSITION 1: *Hold TELBOR, the foreign funding rate, and the level terms fixed. Suppose the foreign investor base grows, raising the foreign slopes a and b in the same proportion, while the same domestic investors keep positive holdings, so that the domestic supply slope $B > 0$ does not change. Then*

(i) Funding-rate exposure $b/(a+B)$ rises, and the weight of TELBOR, $B/(a+B)$, falls.

(ii) If foreign and domestic holdings are positive and the part of foreign demand that responds to rates, $ay - br^F$, is positive, the foreign share of Makam outstanding, F/S, rises.

(iii) The size of the response of the yield to a shift in foreign demand, $1/(a+B)$, falls, and price impact $1/B$ does not change.

Suppose instead that the domestic supply slope B falls at a given foreign investor base. Then

(iv) Funding-rate exposure, the size of the response of the yield to a shift in foreign demand, and price impact all rise.

The proposition says that the foreign funding rate matters for the Makam yield in proportion to how much of the market's response to rates comes from foreign investors. A shift in foreign demand of one shekel adds less than one shekel to foreign holdings, so the response per shekel of the shift, $1/(a+B)$, is smaller than price impact, $1/B$. With $a = b$, the condition in part (ii) is that the hedged spread is positive. Parts (i) and (ii) together say that funding-rate exposure and the foreign share rise together as the foreign investor base grows. Section 2 finds the least-squares counterpart. Foreign-rate pass-through is higher at higher foreign shares (Figure 3 and Table 3). By part (iii), price impact, $1/B$, does not depend on the foreign investor base. Section 4.1 estimates price impact with the hedge calendar. Part (iv) describes bank exit (Section 1.4). When a domestic holder's holding reaches zero, the holder drops out of δ, the domestic supply slope falls, and funding-rate exposure and price impact rise together. The proof is in Internet Appendix Section IA.5.1.

Funding-rate exposure can therefore rise with the foreign share because a larger foreign investor base buys more after the same fall in the foreign funding rate (part (i)) and because domestic holders part with bills less readily once banks have left (part (iv)), and Internet Appendix Section IA.5.2 discusses the two reasons in the two episodes. In the data, foreign-rate pass-through rises with the foreign share (Section 2.2), the response of the Makam yield to TELBOR falls as the foreign share rises (Table 3, column 4), the Makam yield fell below zero while TELBOR was positive (Section 2.1), and foreign holdings rise with the Makam yield and fall with the foreign funding rate (Section 2.3), as the model implies.

4. Causal evidence

The facts of Section 2 are correlations. The mechanism has two parts, the foreign funding rate and the foreign investors who fund at that rate, and each test moves one part. In the second episode the hedge calendar moves the foreign funding rate while foreign investors hold the bills (Section 4.1). At the end of the first episode the 2011 tax change shifts foreign demand away from Makam (Section 4.2). For each test we describe the source of variation and the identifying assumption before the estimates.

4.1. The hedge calendar

The first test asks whether the foreign funding rate moves the Makam yield. The test uses the hedge calendar, the dollar amount of domestic institutions' currency hedges that are scheduled to mature in a week under contracts written at least 90 days earlier. In the model, the response of the Makam yield to the foreign funding rate at given TELBOR is funding-rate exposure, $E = b/(a + B)$ (equation (11)). The foreign-rate pass-through of Section 2 does not identify funding-rate exposure, because the foreign funding rate is itself a price, set in the swap market, and the foreign funding rate and the demand for Makam can move together. Foreign investors who buy Makam also buy dollars forward, and the forward purchases raise the foreign funding rate. Internet Appendix Section IA.5.3 derives what least squares and the hedge calendar measure when foreign purchases move the foreign funding rate. A global shortage of dollars moves the foreign funding rate and can lead foreign investors to sell Makam for reasons unrelated to the foreign funding rate. The test therefore needs movements in the foreign funding rate that come with no other shift in the demand for Makam, and the hedge calendar is the source of such movements. The sample is the 234 weeks from the week ending 25 January 2018 to the week ending 25 August 2022, which cover the rise of foreign ownership in the second episode.[21]

The rollover of maturing hedges lowers the foreign funding rate. Domestic institutions hedge their foreign assets by selling dollars forward, on contracts whose maturity dates are fixed when the contracts are written. The institutions keep their foreign assets when a hedge matures, and the institutions roll maturing hedges over with new FX swaps. In the near leg of the new swap the institution buys the dollars that it owes under the maturing contract. In the far leg the institution sells dollars forward again, and the far leg extends the hedge. A foreign investor that obtains shekels through an FX swap takes the other side of such a

[21]The hedge calendar has no first stage from 2023 to 2024 ($F = 0.1$), and from 2010 to 2011 the first stage is weak once the timing of rate decisions is controlled for ($F \leq 2.2$), so the test uses the weeks from January 2018 to August 2022 (Internet Appendix Table IA.22, Panel C).

swap. The foreign investor sells dollars in the near leg and buys dollars forward in the far leg. A week in which institutions roll over more hedges is therefore a week in which institutions supply more forward dollars against spot dollars. The larger supply lowers the forward price of the dollar relative to the spot price, and a lower forward price relative to the spot price is a lower foreign funding rate (Ben Zeev and Nathan (2024b), Bush (2023)).

The hedge calendar measures the hedges that are due for rollover. The hedge calendar Z_w is the dollar amount of institutions' forward sales of dollars that are scheduled to mature in week w under contracts written at least 90 days, one quarter, before the start of week w. The trade date of every contract in the hedge calendar therefore precedes the weeks in which we measure rates and purchases. Far legs of FX swaps make up 87% of the hedge calendar, and outright forward contracts make up the rest. In the weeks from January 2019 to August 2022, each dollar of hedges that matures in a week comes with 84 cents of new FX swaps in which institutions buy dollars in the near leg and sell dollars forward, in the week of maturity or the week before ($t = 10.5$, Internet Appendix Table IA.10).

We estimate two pairs of equations, one pair for the foreign funding rate and one pair for foreign holdings,

$$\begin{aligned} r^F_w - r^F_{w-3} &= \pi_r Z_w + \zeta_r' C_w + v_w, \\ y_w - y_{w-3} &= E\left(r^F_w - r^F_{w-3}\right) + \zeta_y' C_w + \varepsilon_w, \qquad (14) \\ F_w - F_{w-3} &= \pi_F Z_w + \zeta_F' C_w + v^F_w, \\ y_w - y_{w-3} &= -P\left(F_w - F_{w-3}\right) + \zeta_P' C_w + \varepsilon^P_w, \qquad (15) \end{aligned}$$

where y_w, r^F_w, and F_w are the Makam yield, the foreign funding rate, and foreign holdings of Makam in week w, Z_w is the hedge calendar, and C_w is the vector of controls. The coefficients π_r and π_F are the first-stage responses, the vectors ζ_r, ζ_y, ζ_F, and ζ_P hold the coefficients on the controls, and v_w, ε_w, v^F_w, and ε^P_w are regression errors. The three weeks $w-2$ to w cover the rollover of the maturing hedges, and we call the three weeks the pricing window. Each difference is the change over the pricing window. We measure the change in foreign holdings, $F_w - F_{w-3}$, from transactions. Foreign acquisitions are tender and secondary purchases minus secondary sales, and the change in foreign holdings is foreign acquisitions minus foreign redemptions, each summed over the pricing window. The first equation of each pair is the first stage. We estimate the second equation of each pair by two-stage least squares with the hedge calendar Z_w as the instrument. The coefficient E is funding-rate exposure, the instrumented counterpart of the least-squares θ_F of equation (2), and the coefficient P is price impact.

The estimates are causal under three assumptions. The schedule of maturities predates the pricing window. Every contract in the hedge calendar was written at least 90 days before week w, so the hedge calendar contains no hedging decision that responds to news about Makam during the pricing window. Conditional on the controls C_w, the hedge calendar is unrelated to other shocks to the demand for Makam or to issuance. The hedge calendar also affects the Makam yield only through the foreign funding rate, which rules out that the settlement of the maturing hedges or the financing of the rollover shifts the demand for Makam directly. Under these assumptions, the response of the Makam yield divided by the response of the foreign funding rate is funding-rate exposure, E (equation (11)). The fall in the Makam yield divided by the rise in foreign holdings is price impact, P (equation (13)). Price impact rests on fewer assumptions than funding-rate exposure. Market clearing gives $dF = -B\,dy$ for every shift in foreign demand, so the second ratio equals $1/B$ whether the hedge calendar moves foreign demand through the foreign funding rate or directly (Internet Appendix Section IA.5.3). Internet Appendix Table IA.15 reports the responses of foreign acquisitions, redemptions, and holdings to the hedge calendar and the fall in the Makam yield per ILS billion of each.

A global bank that takes the other side of a rollover receives shekels in the near leg, but the swap does not require the bank to hold Makam. In the model the bank buys Makam because the rollover lowers the foreign funding rate and so raises the hedged spread, and funding-rate exposure measures that response. With foreign institutions' own maturing swaps added to the controls, three-month funding-rate exposure is 21 basis points per 100 basis points and the common price impact is 2.97 basis points per ILS billion (Internet Appendix Table IA.13).

The controls C_w absorb the predictable part of the dates on which hedges mature. The controls are month-of-year and week-of-month effects, indicators for tender, month-end, and quarter-end weeks, an indicator for 2022, foreign and bank holdings of Makam before the pricing window, and the changes in rates in the week before the pricing window. The controls also include the hedge calendar 13 weeks ahead, built only from contracts written before the pricing window. Domestic institutions' hedging grew over the sample, so weeks with large maturities are also weeks in a period of large hedge books, and the hedge calendar 13 weeks ahead absorbs that slow movement. Every regression also controls for the change in TELBOR over the pricing window. Internet Appendix Section IA.4.5 lists every control. We call this set of controls the baseline controls.

In the model of Section 3 funding-rate exposure depends on the size of the foreign investor base (Proposition 1), so we estimate equations (14) and (15) separately for weeks of low and of high foreign ownership. One joint regression lets every coefficient differ between the two

groups of weeks and gives a t-statistic for each difference. Weeks of low foreign ownership are the 128 weeks in which foreign investors held less than 20% of Makam at the last month-end before week $w-3$. Weeks of high foreign ownership are the 106 weeks in which foreign investors held 20% or more. The threshold of 20% is a boundary between two of the groups of weeks in Figure 3. Foreign investors held 9.9% of Makam on average in the weeks of low foreign ownership and 33.5% in the weeks of high foreign ownership.

In the weeks of high foreign ownership the hedge calendar moves the foreign funding rate, foreign holdings, and the Makam yield (Table 5, Panel A, column 2). Each USD billion in the hedge calendar lowers the three-month foreign funding rate by 12.3 basis points ($t=-4.5$, first-stage $F=20.5$) and raises foreign holdings of Makam by ILS 0.82 billion ($t=3.4$, $F=11.5$).[22] The three-month Makam yield falls by 2.53 basis points at given TELBOR ($t=-3.9$), and the six-month Makam yield falls by 2.28 basis points ($t=-4.8$, Internet Appendix Table IA.14). Figure 4 plots the first stage for the foreign funding rate and the response of the three-month Makam yield in the 106 weeks of high foreign ownership.

Funding-rate exposure is the fall in the Makam yield divided by the fall in the foreign funding rate. At three months, a 100-basis-point fall in the foreign funding rate lowers the Makam yield by 21 basis points at given TELBOR. The 95% confidence set of Anderson and Rubin (1949), which is valid whatever the strength of the first stage, is $[12, 33]$. At six months, funding-rate exposure is 24 basis points per 100 basis points, with an Anderson–Rubin set of $[14, 45]$ (Internet Appendix Table IA.14). The test that funding-rate exposure is equal at the two maturities has $p=0.531$. Foreign-rate pass-through over the same weeks, estimated by least squares, is 25 basis points per 100 basis points at three months ($t=6.7$), inside the confidence set of funding-rate exposure.

Price impact is the fall in the Makam yield divided by the rise in foreign holdings. Per USD billion in the hedge calendar, foreign acquisitions rise by ILS 0.94 billion, ILS 0.30 billion at tenders and ILS 0.64 billion in net purchases of outstanding bills. Foreign redemptions rise by ILS 0.12 billion ($t=0.9$), so foreign holdings rise by ILS 0.82 billion. Three weeks after the pricing window foreign holdings are ILS 1.20 billion higher per USD billion in the hedge calendar ($t=4.4$), so the rise in foreign holdings is not reversed.

An additional ILS billion of foreign holdings lowers the three-month Makam yield by 3.07 basis points, with an Anderson–Rubin set of $[1.65, 6.44]$, and the six-month Makam yield by 2.72 basis points, with a set of $[1.53, 6.29]$ (Internet Appendix Table IA.14). For the calibration of Section 5 we impose one price impact on the three- and six-month equations

[22] At a monthly frequency, foreign net purchases rise by ILS 0.92 billion per standard deviation of the hedges scheduled to mature in a month ($t=3.0$), and the relation also appears in exchange records alone ($t=3.4$). Within the month, foreign tender purchases come in the week before the hedges mature ($t=2.4$) and secondary-market purchases in the week they mature ($t=2.1$, Internet Appendix Table IA.22, Panel B).

and let every other coefficient differ between the two maturities. The test that the three- and six-month price impacts are equal has $p = 0.686$. The common price impact is 2.90 basis points per ILS billion added to foreign holdings ($t = 3.8$), with an Anderson–Rubin set of $[1.83, 6.11]$ (Table 5, Panel B).[23] Per ILS billion of foreign acquisitions, the common fall in the Makam yield is 2.55 basis points, with a set of $[1.65, 4.45]$ (Internet Appendix Table IA.15).

The hedge calendar moves the Makam yield only when foreign investors hold a large share of Makam. In the weeks of low foreign ownership each USD billion in the hedge calendar raises the three-month Makam yield by 0.14 basis points ($t = 0.3$), against a fall of 2.53 basis points in the weeks of high foreign ownership (Table 5, columns 1 and 2). The response of the Makam yield in the weeks of high foreign ownership minus the response in the weeks of low foreign ownership is -2.67 basis points at three months ($t = -3.3$) and -2.27 basis points at six months ($t = -2.9$, Internet Appendix Table IA.14). None of the 43 hedge calendars shifted by 5 to 26 weeks in either direction produces a three-month difference as large.

The foreign funding rate responds less to the hedge calendar in the weeks of low foreign ownership, and the smaller response does not account for the difference in the response of the Makam yield. In the weeks of low foreign ownership the three-month foreign funding rate falls by 4.5 basis points per USD billion in the hedge calendar ($t = -1.3$, first-stage $F = 1.7$), and foreign holdings rise by ILS 0.43 billion ($t = 1.9$, $F = 3.8$). In the 36 weeks in which foreign investors held at least 20% and less than 30% of Makam, the foreign funding rate falls by about as much, 5.3 basis points per USD billion, and the three-month Makam yield falls by 2.78 basis points per USD billion ($t = -3.0$, and $t = -2.8$ for the difference from the weeks of low foreign ownership, Internet Appendix Table IA.21). The hedge calendar identifies funding-rate exposure and price impact for the weeks of high foreign ownership.

The response comes from foreign investors. In the weeks of high foreign ownership each foreign institution buys ILS 56 million more Makam per USD billion in the hedge calendar ($t = 4.8$), and 16.5 foreign institutions were active on average in a week of high foreign ownership, against 6.9 in a week of low foreign ownership (Internet Appendix Table IA.20).[24]

On the exchange, long-term institutional investors and mutual funds sell the bills that foreign investors buy, ILS 0.33 billion ($t = -4.8$) and ILS 0.22 billion ($t = -2.7$) per USD billion in the hedge calendar in the weeks of high foreign ownership (Internet Appendix Table IA.16). Banks buy ILS 0.22 billion on the exchange ($t = 3.3$) and do not add to their

[23] The estimate for the two maturities stacks the three- and six-month regressions, each with its own controls, and the Anderson–Rubin set inverts the test that the common reduced-form coefficient is zero, with 8 Newey–West lags (Internet Appendix Section IA.4.5).

[24] An institution is the parent institution of a nonresident account, and an institution is active in week w when the institution has a transaction record in weeks $w - 15$ to $w - 3$.

holdings, which fall by ILS 0.13 billion a month per USD billion in the hedge calendar of the month ($t = -1.2$, Internet Appendix Section IA.4.7).

Internet Appendix Section IA.4.6 reports ten variants of the baseline. Across the variants three-month funding-rate exposure lies between 18 and 31 basis points per 100 basis points, and the common price impact lies between 2.37 and 3.43 basis points per ILS billion. The variants add the valuation of the maturing hedges, stock returns at the time the maturing contracts were written, and the foreign institutions' own maturing swaps to the controls, move the threshold for the foreign share and the minimum contract age, and change the control for Makam issuance. A further variant adds the S&P 500 return and the change in the VIX index over the pricing window to the controls. With the two controls, funding-rate exposure estimated jointly on the three- and six-month yields is 23 basis points per 100 basis points, with an Anderson–Rubin 95% set from 12 to 43, against 22 without them, and the common price impact is 2.92 basis points per ILS billion. With the hedge calendar winsorized at its 5th and 95th percentiles, the joint funding-rate exposure is 24 basis points per 100 basis points, with a set from 14 to 39, and the common price impact is 2.91 basis points per ILS billion.

The response of the Makam yield also extends beyond six months. With the foreign share dated at the end of the previous month, which gives 109 weeks of high foreign ownership, each USD billion in the hedge calendar lowers the yield of Makam with eleven months to maturity by 1.42 basis points ($t = -4.1$, Internet Appendix Table IA.22, Panel C).

4.2. The 2011 tax change

The second test asks whether the Makam yield depends on who holds the bills. In the model the Makam yield returns toward TELBOR when foreign investors leave, because the bills pass to holders who value the bills against TELBOR. Foreign investors choose when to hold Makam. Foreign holdings respond to the Makam yield, and the shocks that move the Makam yield can also move foreign holdings. A comparison of yields between periods of high and low foreign ownership therefore does not show that the holders changed the price. The test needs a change in holders that the price of Makam did not cause. The end of the first episode provides the change. In July 2011 Israel ended nonresidents' tax exemption on Makam, which drove foreign investors out, and left the exemption in place on government bonds of the same remaining maturity.

Until 2011 nonresidents were exempt from Israeli tax on government securities. Between 2009Q3 and 2011Q2 foreign investors raised their share of Makam from 2% to 35%. On 27 January 2011, the government announced that the exemption would end for securities

with an original maturity of up to one year, including every Makam bill. The change was implemented on 7 July 2011, and foreign investors still held ILS 42.6 billion of Makam at the end of June. Government bonds issued at longer maturities kept the exemption even after their remaining maturity fell below one year. The July change covered interest and discount income. An amendment to the Income Tax Ordinance published on 16 November 2011 also ended the exemption on capital gains from selling these securities, from 16 December 2011 (State of Israel (2011)).

The tax change removed the foreign holders of Makam. Foreign holdings of Makam fell from ILS 42.6 billion in June 2011 to ILS 2.6 billion in June 2012 (Figure 5, Panel A). Banks added ILS 31.7 billion and domestic holders other than banks ILS 14.5 billion, while Makam outstanding rose by ILS 6.2 billion.

The tax rule selected securities by original maturity and not by yield. A bill issued with one year to maturity lost the exemption, and a bond issued years earlier with the same remaining maturity kept the exemption. Original maturity was fixed at issuance, so no security's treatment depended on the security's yield in 2011. The timing of the foreign exit did not follow the return on Makam either. Foreign investors left although the hedged spread on Makam was higher in the second half of 2011 than before the change (Table 1).

We compare Makam yields with the yields of exempt bonds of similar remaining maturity. The affected securities are the Makam bills. The identifying assumption is that the two groups of yields would have moved together had the exemption stayed in place, and that the exit of foreign investors from Makam did not move the yields of the exempt bonds. Two other measures of January 2011 could threaten the comparison. The Bank of Israel imposed a 10% reserve requirement on banks' FX swap and forward transactions with nonresidents, and it required nonresidents to report large daily transactions in Makam and short-term government bonds (Bank of Israel (2013)). Neither measure separates securities by original maturity. The reserve requirement falls on the currency hedge whatever shekel security the hedge finances, and the reporting requirement carries no charge. Makam yields did not rise relative to yields on exempt bonds in 2011Q1, when the reserve requirement took effect (Figure 5, Panel B).

The test shows whether foreign demand affects the Makam yield. A tax that falls only on nonresidents moves the Makam yield only if nonresident demand enters the price. If the price of a bill did not depend on who held the bill, the yield of Makam relative to the exempt bonds would not have changed as foreign investors left Makam. The model predicts that Makam yields rise relative to the yields of exempt bonds. Makam moved from foreign investors, who valued the bills against the foreign funding rate, to banks, who valued the bills against TELBOR. The exempt bonds kept the exemption, so the foreign funding rate kept its weight in exempt yields. TELBOR exceeded the foreign funding rate by 105 basis

points on average from January 2010 to June 2011 and by 150 from July to December 2011. A tax clientele, in which foreign investors require a higher pre-tax yield, predicts the same direction (Litzenberger and Rolfo (1984), Green and Ødegaard (1997)). The tax change therefore tests whether the holders of Makam matter for the Makam yield, and the hedge calendar of Section 4.1 tests the foreign funding rate itself.

We regress the yield of each security in each month on an indicator for affected securities after implementation, with security effects, calendar-month effects, and a maturity slope that differs by month,

$$y_{it} = \alpha_i + \alpha_t + \mu_t \tau_{it} + \gamma \, Affected_i \times Post_t + \varepsilon_{it}. \tag{16}$$

Here $Affected_i$ indicates Makam bills, $Post_t$ the months from July 2011 onward, τ_{it} remaining maturity, α_i security effects, α_t calendar-month effects, and μ_t the maturity slope in month t. The calendar-month effects absorb movements common to affected and exempt securities. Yields enter in levels, and the security effects absorb each security's mean yield.[25] The sample covers July 2009 to June 2012 and remaining maturities of one to twenty-four months, with 47 affected securities and 7 exempt bonds.

Makam yields rose by 12.8 basis points relative to the yields of exempt bonds after implementation (Table 6). With standard errors clustered by security and month, the t-statistic is 3.8, and a wild cluster bootstrap by security with the null imposed, suited to the small number of exempt bonds, gives $p = 0.015$. Most of the rise comes from Makam. Measured against TELBOR, Makam yields rose by 10 basis points from the six months ending with the announcement (August 2010 to January 2011) to the twelve months after implementation (July 2011 to June 2012), and yields of exempt bonds fell by 3 basis points (Internet Appendix Figure IA.3). The rise of 12.8 basis points is of the same order as the fall in TELBOR minus the Makam yield, which averaged 18 basis points from January 2010 to June 2011, 14 from July to December 2011, when foreign investors still held 25% of Makam, and -2 from January to June 2012, when foreign investors held 7% (Table 1). Under a tax clientele in which foreign investors stay the marginal holders, foreign investors keep the bills at a higher pre-tax yield. Foreign holdings instead fell to ILS 2.6 billion, banks bought the bills, and the Makam yield settled at TELBOR, the benchmark of banks.

The estimate does not depend on the specification. It is 10.9 basis points with a quadratic maturity curve that differs by month and 22.3 with a common maturity slope (Table 6). It lies between 10.7 and 16.6 basis points when each exempt bond is left out in turn and between 7.5 and 13.9 basis points in maturity windows of 1–12, 1–18, and 3–24 months (Internet

[25] Remaining maturity is a security's redemption date minus calendar time, so a maturity term common to all months is nearly absorbed by the security and month effects. The month-specific slope lets the shape of the yield curve change from month to month.

Appendix Table IA.9). It is 12.9 basis points when the sample starts in April 2010 (Internet Appendix Table IA.9) and 12.6 when the sample starts in July 2010 (Table 6, column 4), so the 2009 observations do not drive the estimate.

Quarter by quarter, the yield of Makam relative to exempt bonds moves opposite to foreign holdings. Panel B of Figure 5 replaces the post-implementation indicator in equation (16) with quarterly interactions on the same panel, relative to 2011Q2, the last quarter before implementation. As foreign investors entered, the yield of Makam relative to exempt bonds fell, and from 2010Q2 through 2011Q1 the quarterly coefficients lie between −6.5 and 1.3 basis points. After implementation, as foreign holdings ran off, the relative yield rose. Across the twelve quarters, the coefficients and quarterly foreign holdings of Makam have a correlation of −0.92 (Figure 5, Panel C). The fall before the announcement cannot come from a tax clientele. Until the announcement the two groups of securities were taxed alike, and the announced tax could only raise affected yields. The rise starts in the quarter after the announcement. The relative yield rises by 6.5 basis points between the announcement quarter and 2011Q2 and rises further as foreign holdings run off. Comparisons with 2011Q2 therefore understate the repricing that the announcement set off.

Per ILS billion that left foreign holdings, the Makam yield rose by less after the tax change than price impact in the weeks of high foreign ownership (Section 4.1). Proposition 1(iv) predicts the difference. Banks held 18% of Makam from January 2010 to June 2011 and 5% from July 2020 to December 2021 (Table 1). In 2011 banks still had bills to sell and took ILS 31.7 billion of the bills that foreign investors released, so the domestic supply slope B was larger and price impact $1/B$ smaller. The foreign exit after the tax change also took a year, and the hedge calendar measures the response of the Makam yield within a three-week window.

5. The size of the funding channel

This section measures how much of TELBOR minus the Makam yield the model attributes to foreign investors' cheaper funding. From January to September 2022, three-month TELBOR minus the three-month Makam yield averaged 51 basis points, and TELBOR exceeded the foreign funding rate by 95 basis points. How much of the 95 basis points enters the Makam yield depends on how strongly foreign demand responds to rates and on how readily domestic holders sell. The hedge calendar of Section 4.1 estimates funding-rate exposure and price impact, and the two estimates determine the foreign slope and the domestic supply slope. We calibrate the model of Section 3 to the two instrumented estimates and the restriction

$a = b$, and we multiply funding-rate exposure by the gap between TELBOR and the foreign funding rate.

5.1. What the two estimates identify

The calibration uses the model of Section 3 with $a = b$, so that foreign demand depends only on the hedged spread, the Makam yield minus the foreign funding rate. Foreign demand and the supply of bills to foreign investors are then

$$F = a\,(y - r^F) + u, \qquad F = \bar{S} - \bar{D} + B\,(r^D - y). \tag{17}$$

The first equation is equation (6) with $a = b$. The second equation is market clearing, with domestic holdings from equation (7) and Makam outstanding from equation (8). Holdings are in ILS billion and rates in basis points, so the foreign slope a and the domestic supply slope B are in ILS billion per basis point. When domestic holders and the issuer supply bills readily, B is large, and foreign investors acquire the bills that foreign demand calls for after a small fall in the Makam yield. When B is small, the same foreign demand requires a larger fall in the Makam yield. The foreign funding rate therefore has more weight in the Makam yield when a is large relative to B. In the regression of foreign holdings on the two lagged rates (Table 4, Panel A), the unrounded coefficients on the Makam yield and on the foreign funding rate sum to ILS -2.6 billion per 100 basis points, and the bootstrap 95% interval of the sum, from -5.9 to 4.6, contains zero.

The hedge calendar measures the two slopes through the two estimates. Funding-rate exposure, the change in the Makam yield per basis point of the foreign funding rate, is the weight of the foreign funding rate in the Makam yield, and the attribution of Section 5.2 uses funding-rate exposure alone. Price impact is the fall in the Makam yield per ILS billion added to foreign holdings. Domestic holders and the issuer supply the bills that foreign investors add, so price impact measures the domestic supply slope alone. Price impact separates the two slopes behind funding-rate exposure and gives the quantity implications of Section 5.4. The calibration uses three-month funding-rate exposure, because TELBOR minus the Makam yield in the attribution is the three-month spread. The calibration also uses $a = b$ and the common price impact of Section 4.1, measured per ILS billion added to foreign holdings. In the model,

$$E = \frac{a}{a + B}, \qquad P = \frac{1}{B}. \tag{18}$$

The two estimates therefore give the two slopes,

$$B = \frac{1}{P}, \qquad a = B\,\frac{E}{1-E}, \tag{19}$$

with E as a fraction, so that funding-rate exposure of 21 basis points per 100 basis points is $E = 0.21$. Foreign purchases of Makam can themselves raise the foreign funding rate. The feedback changes the first stages of the hedge calendar and cancels from the two ratios in equation (18) (Internet Appendix Section IA.5.3).

In the weeks of high foreign ownership, funding-rate exposure at three months is 21 basis points per 100 basis points, and the common price impact is 2.90 basis points per ILS billion (Table 5, column 2). The domestic supply slope is therefore $B = 0.345$, and the foreign slope is $a = 0.089$. A one-basis-point rise in the hedged spread raises foreign holdings by ILS 0.089 billion. A one-basis-point fall in the Makam yield relative to TELBOR draws ILS 0.345 billion of bills from domestic holders and the issuer. Both slopes are responses at the margin in the weeks of high foreign ownership. The slopes do not give the level of foreign holdings, which also depends on the term u. A rise in the part of Makam outstanding that does not respond to the yield, $\bar{S}$, moves the Makam yield by less than price impact, because foreign investors and domestic holders both absorb the additional bills. With TELBOR and the foreign funding rate fixed, an additional ILS billion of $\bar{S}$ raises the Makam yield by $1/(a+B) = 2.30$ basis points. Table 7 reports the calibration.

5.2. Attributing TELBOR minus the Makam yield

Market clearing turns the two slopes into weights on the two rates. With $a = b$, equation (10) becomes

$$r^D - y = E\,(r^D - r^F) - \frac{\bar{S} - \bar{D} - u}{a + B}. \tag{20}$$

The first term is the funding term, funding-rate exposure times the gap between TELBOR and the foreign funding rate. The second term collects the level terms in demand and supply. The second term rises with domestic holdings at a Makam yield equal to TELBOR, $\bar{D}$, and with the part of foreign demand that does not respond to rates, u, and it falls with the part of Makam outstanding that the Bank of Israel sets independently of the yield, $\bar{S}$. The demand for the safety and liquidity of the bills enters the second term through $\bar{D}$ and u. In the data the second term is the part of TELBOR minus the Makam yield that the funding term leaves.

From January to September 2022 the funding term averages 20 basis points (Table 7, Panel C). The model therefore attributes 20 of the 51 basis points to foreign investors' cheaper funding and leaves 31 basis points, the second term of equation (20). Over the Anderson–

Rubin set of funding-rate exposure, the funding term runs from 11 to 31 basis points. The attribution applies the funding-rate exposure of the weeks of high foreign ownership to January to September 2022 and takes the foreign investors in the market and the level terms as given.

Funding-rate exposure of 21 basis points per 100 basis points is estimated over the weeks of high foreign ownership, when foreign investors held 33.5% of Makam on average. From January to September 2022 foreign investors held 46%. Two further calculations scale the slopes with ownership, and each calculation is an assumption about how the slopes differ between the two foreign shares. The first calculation assumes that the foreign slope a is proportional to the foreign share and that the domestic supply slope B is fixed. Funding-rate exposure is then 26 basis points per 100 basis points, and the funding term is 25 basis points. The thin gray line in Figure 3 plots funding-rate exposure under the first calculation at each foreign share. The second calculation assumes in addition that B is proportional to the domestic share. Funding-rate exposure is then 30 basis points per 100 basis points, and the funding term is 29 basis points. The same product can be computed with least squares. Foreign-rate pass-through at the 2022 foreign share is 26 basis points per 100 basis points (Table 3), and foreign-rate pass-through times the gap between TELBOR and the foreign funding rate is 25 basis points. With the least-squares foreign-rate pass-through of the weeks of high foreign ownership in place of funding-rate exposure, the product is 24 basis points.

Figure 6 plots TELBOR minus the Makam yield month by month from January 2010 to October 2024, together with the funding term at funding-rate exposure of 21 basis points per 100 basis points, added to the policy-rate term of Section 5.3, in the months with a foreign share of 20% or more. TELBOR minus the Makam yield is largest in October 2022, at 134 basis points, and the funding term of October 2022 is 48 basis points. In both episodes the funding term rises and falls with TELBOR minus the Makam yield. The funding term is about as large as TELBOR minus the Makam yield from 2010 to 2011 and less than half as large in 2022. With funding-rate exposure scaled to each month's foreign share, the funding term of October 2022 is 63 basis points (Internet Appendix Figure IA.7).

5.3. The funding term and the level of interest rates

The convenience yield of U.S. Treasury bills rises with the level of interest rates (Nagel (2016)), and TELBOR minus the Makam yield could rise with the policy rate in the same way. We set the funding term beside the level of the policy rate. We regress the monthly mean of three-month TELBOR minus the three-month Makam yield, from January 2010 to October 2024, on the policy rate and on the product of the foreign share at the end of

the previous month and TELBOR minus the foreign funding rate (Table 8, Panel A). Alone, the policy rate has a coefficient of 5.81 basis points per percentage point ($t = 4.7$), and the product of the foreign share and TELBOR minus the foreign funding rate has a coefficient of 0.86 ($t = 4.3$). Together, with the foreign share, TELBOR minus the foreign funding rate, and the VIX index as controls, the two coefficients are 4.81 ($t = 4.6$) and 1.02 ($t = 3.2$). In monthly first differences the two coefficients are 1.36 ($t = 0.6$) and 1.23 ($t = 3.8$). The policy rate and the product each account for part of the level of TELBOR minus the Makam yield, and only the product accounts for its monthly changes.

Panel B of Table 8 reports the two terms by period. The policy-rate term is the fitted value of a regression of TELBOR minus the Makam yield on the policy rate, estimated on the 99 months in which foreign investors held less than 10% of Makam. The slope of that regression is 4.58 basis points per percentage point, close to the 4.81 of column 3 of Panel A, and the intercept is −2.9 basis points. The funding term is funding-rate exposure of 21 basis points per 100 basis points times TELBOR minus the foreign funding rate in the weeks in which foreign investors held 20% or more of Makam, and zero in the other weeks. From January to September 2022 the policy rate averaged 0.7%, the policy-rate term is 0 basis points, and the funding term is 20 of the 51 basis points of TELBOR minus the Makam yield. From October 2022 to December 2023 the policy-rate term is 16 and the funding term is 10 of 41 basis points. From January to September 2024, when foreign investors held 3% of Makam, the policy-rate term is 18 of 24 basis points and the funding term is 0. From January 2010 to June 2011 the policy-rate term is 6 and the funding term is 16 of 18 basis points. Figure 6 plots the policy-rate term and its sum with the funding term by month.

The funding term of 20 basis points uses the instrumented funding-rate exposure, which is below both foreign-rate pass-through estimated by least squares and funding-rate exposure scaled to the 2022 foreign share. The regressions of Panel A give larger funding terms. The coefficient on the product in column 2, at the 2022 foreign share of 46%, implies a funding term of 38 basis points from January to September 2022. The coefficients on the product and on TELBOR minus the foreign funding rate in column 3 together imply 31 basis points. With funding-rate exposure scaled to the 2022 foreign share the funding term is 25 and 29 basis points (Section 5.2). Without the fixed spread of 26.161 basis points that we add to the dollar rate, TELBOR exceeds the foreign funding rate by 121 basis points and the funding term is 25 basis points.

TELBOR minus the Makam yield less the policy-rate term and the funding term, the remainder of Table 8, is 31 basis points from January to September 2022 and 15 basis points from October 2022 to December 2023. The remainder fell as Makam outstanding rose. The Bank of Israel raised Makam outstanding by ILS 65.0 billion in the last quarter of 2022

and by ILS 160.3 billion between September 2022 and December 2023. From July 2011 to December 2012 the remainder is −12 basis points. Banks held 13% of Makam from July to December 2011 and 27% from January to June 2012 (Table 1), so the domestic supply slope was larger than in the weeks in which the hedge calendar measures funding-rate exposure, and by Proposition 1(iv) funding-rate exposure was lower than the fixed exposure that the funding term applies. The tax change also lowered the foreign demand that does not respond to rates, u, which lowers the second term of equation (20).

5.4. The year-end pause in foreign buying

The calibrated slopes have implications that the calibration does not use (Table 7, Panel D, and Internet Appendix Section IA.4.10). Foreign buying pauses at year-end for a reason unrelated to the hedge calendar, which gives a separate check on price impact. Global banks shrink their balance sheets at year-end, and the largest foreign buyers of Makam are international banking groups. Over the last three weeks of December, foreign acquisitions of Makam fall by ILS 2.3 billion ($t = -8.8$) at given changes in TELBOR and the foreign funding rate. In the same weeks of the other quarter-ends foreign acquisitions fall by ILS 0.5 billion ($t = -1.0$, Internet Appendix Figure IA.6 and Table IA.17). The calculation treats the fall in foreign acquisitions as an equal fall in foreign holdings, with foreign redemptions and the level terms of demand and supply unchanged. The common price impact, in basis points per ILS billion, times the fall in foreign acquisitions, in ILS billion, then gives the implied rise in the Makam yield in basis points,

$$P \times 2.3 = 2.90 \times 2.3 = 6.7. \tag{21}$$

The regression for the Makam yield holds the same two rate changes fixed. The three-month Makam yield rises by 7.4 basis points ($t = 3.8$) over the year-ends of 2017 to 2021, the years for which we observe foreign purchases, and by 8.6 basis points ($t = 3.2$) over the year-ends of 2017 to 2023. Over the Anderson–Rubin set of the common price impact, the predicted rise runs from 4.2 to 14.0 basis points. The rise in the Makam yield at year-end is close to the rise that price impact implies.

6. Evidence beyond Israel

Section 2 finds that foreign-rate pass-through rises with foreign ownership in Israel. We estimate the same ownership regression in Mexican and Japanese bills. Mexico has the longest record of foreign holdings of a government bill. Banco de México has published nonresident

holdings of the government's discount bills, Cetes, daily since 1994. The Mexican Treasury issues Cetes, where the central bank issues Makam. Foreign ownership of Cetes rose from 4% to 59% and fell back, in years unrelated to Israel's episodes. Japan is the largest bill market in which foreign investors came to hold most of the bills.

6.1. Mexican government bills

Foreign ownership is measured for Cetes themselves and not for government debt as a whole. The foreign share of Cetes averaged 4% from 2008 to 2009 and 59% from 2013 to 2014, and it fell back by 2021. We estimate regression (3) on weekly changes in the three-month Cetes yield. The domestic benchmark is the 91-day TIIE, the interbank equilibrium rate that Banco de México computes from banks' quotes. We build the three-month foreign funding rate from the same dollar rate as for Israel and from peso forward points. We interact the changes in both rates with the foreign share of Cetes outstanding at the end of the previous month.

Mexico reproduces the rise of foreign-rate pass-through with foreign ownership (Table 9 and Figure 7, Panel A). When weeks are grouped by the foreign share as in Figure 3, foreign-rate pass-through rises from 3.1 basis points per 100 basis points at foreign shares below 10% to 22.9 ($t = 5.5$) when foreign investors held more than 50% of Cetes. Foreign-rate pass-through rises by 2.9 basis points per 10 percentage points of foreign ownership ($t = 3.2$), against 7.4 in Israel. The foreign share counts every nonresident holder, including investors who do not fund in hedged dollars.[26] A smaller Mexican response fits a foreign base in which fewer holders fund in hedged dollars. Without the 2008 to 2009 crisis months the interaction is 2.2 ($t = 2.2$). It stays positive with winsorized changes in the foreign funding rate, and omitting one year at a time leaves it between 1.6 and 3.3 (Internet Appendix Section IA.6). The actual foreign share gives a larger t-statistic than 166 of the 169 series shifted by a year or more (Internet Appendix Table IA.20).

As in Israel, the bill yield lay between the foreign funding rate and the domestic benchmark, and foreign holdings followed the hedged spread. From 2011 to 2014, as foreign investors built their position, the three-month foreign funding rate averaged 3.46%, below the 91-day TIIE at 4.37%, and the Cetes yield, at 3.92%, lay between the two. The Cetes yield exceeded the foreign funding rate on 80 to 100% of trading days in each year of 2010 to 2015, as foreign ownership built up and peaked. In each year of 2017 to 2023, while foreign holdings fell, the Cetes yield exceeded the foreign funding rate on at most 21% of trading days.

[26] Banco de México staff describe foreign investors combining government-security holdings with dollar forwards to hedge currency exposure, and the Bank's monitoring of holdings alongside forward positions (Alfaro (2002)).

6.2. Japanese Treasury bills

The Bank of Japan's flow of funds records nonresidents' holdings of Japanese Treasury discount bills (Bank of Japan (2026)), and their share of the bills rose from 19% at the end of 2010 to 73% at the end of 2018 and stood at 56% at the end of 2024. We estimate regression (3) on 711 weekly changes in the three-month bill yield from 2010 to 2024. The domestic benchmark is the three-month yen overnight-index-swap rate, and the yen foreign funding rate is built from the dollar rate and yen forward points as for Israel and Mexico. We interact the change in each rate with the foreign share of the bills at the end of the previous quarter. Foreign-rate pass-through rises by 2.3 basis points per 10 percentage points of foreign ownership ($t = 3.0$, Table 9). Grouping weeks by the foreign share gives the same rising pattern as in Israel and Mexico (Figure 7, Panel B). Foreign-rate pass-through is -2 basis points per 100 basis points at the 2010 mean share of 17% and 10 at the 2019 mean share of 71%.

The Japanese bill yield is the yield at the weekly auction. With the benchmark and the foreign funding rate measured at the close before each auction, pass-through rises by 2.0 basis points per 10 percentage points ($t = 5.0$). The rise in pass-through with foreign ownership does not rest on any single year. Leaving out one year at a time, it ranges from 1.7 to 4.1 basis points per 10 percentage points, and leaving out 2020, the year in which the foreign funding rate moved most, gives 4.1 with a t-statistic of 3.1. The actual foreign share gives a larger t-statistic than every one of the 53 series shifted by a year or more.

Japan also lets us compute a funding term with foreign-rate pass-through in place of funding-rate exposure. For each year, the funding term is the foreign-rate pass-through evaluated at the year's mean foreign share times the year's mean of the daily gap between the yen overnight-index-swap rate and the foreign funding rate. The funding term of a period of several years is the mean of the yearly funding terms. Section 5.2 reports the same calculation for Israel. From 2016 to 2024, when foreign investors held more than 45% of Japanese bills, the funding term averaged 2 basis points, 17% of the 12-basis-point average gap between the yen overnight-index-swap rate and the bill yield. In 2019, the year with the highest mean foreign share, 71%, the funding term was 3 of 9 basis points. Without the fixed spread of 26.161 basis points that we add to the dollar rate, the funding term averaged 4 basis points from 2016 to 2024, 34% of the gap between the yen overnight-index-swap rate and the bill yield, and 6 basis points in 2019.

The Bank of Japan attributes movements in bill yields to dollar-funded investors who hold Japanese bills financed through FX swaps (Bank of Japan (2017, 2018, 2025)), the same position that foreign holders of Makam take. Borio, McCauley, McGuire, and Sushko (2016) and Iida, Kimura, and Sudo (2018) relate deviations from covered interest parity, the yen

basis among them, to the demand for dollar funding through FX swaps and to limits on arbitrage.

7. Implications

7.1. Monetary implementation

The central bank's own bill yielded less than zero while its policy rate was positive. From July 2020 to December 2021, as the foreign funding rate turned negative, the three-month Makam yield fell below zero while TELBOR remained positive (Figure 2). The Makam yield fell below zero even as Makam outstanding rose by ILS 22.0 billion from the end of June 2020 to the end of December 2021. A policy rate pins down the funding cost of institutions with access to the domestic money market, but a safe asset held by other investors can yield a different rate. When the policy rate is near zero, even a small difference can take the bill yield below zero. In the model the weight of TELBOR in the Makam yield, $B/(a+B)$, falls as the foreign investor base grows (Proposition 1), so a change in the policy rate moves the bill yield by less. Across maturities within a week, the response of the Makam yield to TELBOR is also lower when foreign ownership is higher (Table 3, column 4).

An investor-based account of a short-rate disconnect (Lenel, Piazzesi, and Schneider (2019)) makes monetary implementation depend on who finances and holds safe assets. Anbil et al. (2026) show that money market funds' supply of repo financing can constrain the Federal Reserve's balance-sheet reduction even when banks' reserve demand does not bind. Interest on reserves and access to reverse-repurchase facilities shape domestic money-market rates (Duffie and Krishnamurthy (2016)). Our evidence adds a cross-border channel, through which the central bank's own bill follows the funding rate of foreign holders.

7.2. Local-currency borrowing and foreign funding

An issuer that borrows in its own currency can still be exposed to foreign funding conditions through its investors, because the cost of financing a hedged position enters the bill's yield. How exposed the issuer is depends on the balance between the two sides of the market. Funding-rate exposure is high when the foreign slope is large relative to the domestic supply slope. A market with a large domestic supply slope can therefore have little exposure even with substantial foreign ownership. For the same reason, other domestic investors that sell readily can restore the domestic supply slope after banks leave, and so can issuance that responds more to TELBOR minus the Makam yield.

The issuer controls one part of the domestic supply slope. The Bank of Israel described its larger tenders of 2022 as a response to demand (Section 1.4). Issuance that rises with TELBOR minus the Makam yield is a positive ϕ in the model. A higher ϕ lowers funding-rate exposure and price impact. From September to December 2022, as Makam outstanding rose by ILS 65.0 billion, TELBOR minus the Makam yield fell by 93 basis points between the two month-ends.

Foreign funding conditions also change the issuer's interest expense. When foreign funding conditions widen the spread between interbank rates and bill yields, the issuer pays less interest although the bills provide no more safety or liquidity than before. The issuer's saving comes from foreign holders' cheaper funding.

8. Conclusion

Different investors can value the same safe bill against different benchmark rates. In the least-squares regressions, foreign-rate pass-through is higher at higher foreign shares in both Israeli episodes and in Mexican and Japanese Treasury bills. In the weeks of high foreign ownership, a 100-basis-point fall in the foreign funding rate lowers the three-month Makam yield by 21 basis points, and Makam yields rose relative to exempt bonds when a tax change removed foreign investors. A model calibrated to the hedge-calendar estimates attributes 20 of the 51 basis points by which Makam yielded less than TELBOR from January to September 2022 to foreign investors' cheaper funding. The level of the policy rate accounts for 0 of the 51 basis points, and for 18 of the 24 basis points by which Makam yielded less than TELBOR from January to September 2024.

The standard measure of a safe asset's convenience yield, the spread between money-market rates and the asset's yield, therefore includes the funding term alongside the demand for safety and liquidity. A bill that promises repayment in domestic currency can become exposed to foreign funding conditions without a change in that repayment. Even the central bank's own bill can move with the foreign funding rate at given TELBOR. Wherever hedged, dollar-funded investors hold a large share of a local bill market, as nonresidents do in Japanese Treasury bills, the convenience yield measured from the spread between money-market rates and bill yields can contain a funding term.

References

Alfaro, Samuel, 2002, Banco de Mexico's experience in measuring the risk position in Mexican pesos of foreign investors and its relevance for monetary policy, *IFC Bulletin* 12, 24–44.

Amihud, Yakov, Clifford M. Hurvich, and Yi Wang, 2009, Multiple-predictor regressions: Hypothesis testing, *Review of Financial Studies* 22, 413–434.

Anbil, Sriya, Alyssa Anderson, Ethan Cohen, and Romina Ruprecht, 2026, Beyond reserves: The Federal Reserve's balance sheet and the repo market, Finance and Economics Discussion Series 2026-041, Board of Governors of the Federal Reserve System.

Anderson, Alyssa, Wenxin Du, and Bernd Schlusche, 2025, Arbitrage capital of global banks, *Journal of Finance* 80, 2591–2638.

Anderson, T. W., and Herman Rubin, 1949, Estimation of the parameters of a single equation in a complete system of stochastic equations, *Annals of Mathematical Statistics* 20, 46–63.

Avdjiev, Stefan, Wenxin Du, Cathérine Koch, and Hyun Song Shin, 2019, The dollar, bank leverage, and deviations from covered interest parity, *American Economic Review: Insights* 1, 193–208.

Bank of Israel, 2013, *Annual Report 2012*, Chapter 7: The Balance of Payments (Bank of Israel, Jerusalem).

Bank of Israel, Markets Department, 2016, The monetary program for the liquidity month June 2016, Circular to the banking corporations no. H-0090-61-10, May 23 (in Hebrew; Bank of Israel, Jerusalem).

Bank of Israel, 2023, *Annual Report 2022*, Chapter 3: Inflation and Monetary Policy (Bank of Israel, Jerusalem).

Bank of Japan, 2017, *Financial System Report*, October.

Bank of Japan, Financial Markets Department, 2018, *Market Operations in Fiscal 2017*, July 6.

Bank of Japan, Financial Markets Department, 2025, *Market Operations in Fiscal 2024*, August.

Bank of Japan, Research and Statistics Department, 2026, *Flow of Funds Accounts*, Treasury discount bills by holder, quarterly.

Ben Zeev, Nadav, and Daniel Nathan, 2024a, Shorting the dollar when global stock markets roar: The equity hedging channel of exchange rate determination, *Review of Asset Pricing Studies* 14, 640–666.

Ben Zeev, Nadav, and Daniel Nathan, 2024b, The widening of cross-currency basis: When increased FX swap demand meets limits of arbitrage, *Journal of International Economics* 152, 103984.

Borio, Claudio, Robert N. McCauley, Patrick McGuire, and Vladyslav Sushko, 2016, Covered interest parity lost: Understanding the cross-currency basis, *BIS Quarterly Review*, September, 45–64.

Bush, Georgia R., 2023, Global banks and the impact on covered interest parity: An emerging market perspective, Working paper, Banco de México.

Carstens, Agustín, and Hyun Song Shin, 2019, Emerging markets aren't out of the woods yet, *Foreign Affairs*, March 15.

Cenedese, Gino, Pasquale Della Corte, and Tianyu Wang, 2021, Currency mispricing and dealer balance sheets, *Journal of Finance* 76, 2763–2803.

d'Avernas, Adrien, and Quentin Vandeweyer, 2024, Treasury bill shortages and the pricing of short-term assets, *Journal of Finance* 79, 4083–4141.

Diamond, William, and Peter Van Tassel, 2025, Risk-free rates and convenience yields around the world, *Journal of Finance*, forthcoming.

Du, Wenxin, Benjamin Hébert, and Wenhao Li, 2023, Intermediary balance sheets and the Treasury yield curve, *Journal of Financial Economics* 150, 103722.

Du, Wenxin, Joanne Im, and Jesse Schreger, 2018, The U.S. Treasury premium, *Journal of International Economics* 112, 167–181.

Du, Wenxin, and Jesse Schreger, 2016, Local currency sovereign risk, *Journal of Finance* 71, 1027–1070.

Du, Wenxin, Alexander Tepper, and Adrien Verdelhan, 2018, Deviations from covered interest rate parity, *Journal of Finance* 73, 915–957.

Duffie, Darrell, and Arvind Krishnamurthy, 2016, Pass-through efficiency in the Fed's new monetary policy setting, in *Designing Resilient Monetary Policy Frameworks for the Future* (Federal Reserve Bank of Kansas City), 21–102.

Engel, Charles, and Steve Pak Yeung Wu, 2023, Liquidity and exchange rates: An empirical investigation, *Review of Economic Studies* 90, 2395–2438.

Faia, Ester, Karen K. Lewis, and Haonan Zhou, 2025, Do investor differences impact monetary policy spillovers to emerging markets?, *Journal of International Economics* 156, 104100.

Fang, Xiang, Bryan Hardy, and Karen K. Lewis, 2025, Who holds sovereign debt and why it matters, *Review of Financial Studies* 38, 2326–2361.

Fleckenstein, Matthias, Sven Klingler, and Francis A. Longstaff, 2026, Fixed/floating interest rate parity, NBER Working Paper 35977.

Fleckenstein, Matthias, and Francis A. Longstaff, 2024, Treasury richness, *Journal of Finance* 79, 2797–2844.

Gabaix, Xavier, and Ralph S. J. Koijen, 2021, In search of the origins of financial fluctuations: The inelastic markets hypothesis, NBER Working Paper 28967.

Gourinchas, Pierre-Olivier, Walker Ray, and Dimitri Vayanos, 2025, A preferred-habitat model of term premia, exchange rates, and monetary policy spillovers, *American Economic Review* 115, 3788–3824.

Green, Richard C., and Bernt Arne Ødegaard, 1997, Are there tax effects in the relative pricing of U.S. government bonds?, *Journal of Finance* 52, 609–633.

Greenwood, Robin, Samuel Hanson, Jeremy C. Stein, and Adi Sunderam, 2023, A quantity-driven theory of term premia and exchange rates, *Quarterly Journal of Economics* 138, 2327–2389.

He, Zhiguo, and Arvind Krishnamurthy, 2013, Intermediary asset pricing, *American Economic Review* 103, 732–770.

He, Zhiguo, Stefan Nagel, and Zhaogang Song, 2022, Treasury inconvenience yields during the COVID-19 crisis, *Journal of Financial Economics* 143, 57–79.

Hofmann, Boris, Ilhyock Shim, and Hyun Song Shin, 2020, Bond risk premia and the exchange rate, *Journal of Money, Credit and Banking* 52, 497–520.

Iida, Tomoyuki, Takeshi Kimura, and Nao Sudo, 2018, Deviations from covered interest rate parity and the dollar funding of global banks, *International Journal of Central Banking* 14, 275–325.

Ivashina, Victoria, David S. Scharfstein, and Jeremy C. Stein, 2015, Dollar funding and the lending behavior of global banks, *Quarterly Journal of Economics* 130, 1241–1281.

Jansen, Kristy A. E., Wenhao Li, and Lukas Schmid, 2024, Granular Treasury demand with arbitrageurs, NBER Working Paper 33243.

Jiang, Zhengyang, Arvind Krishnamurthy, and Hanno Lustig, 2021, Foreign safe asset demand and the dollar exchange rate, *Journal of Finance* 76, 1049–1089.

Klingler, Sven, and Suresh Sundaresan, 2023, Diminishing Treasury convenience premiums: Effects of dealers' excess demand and balance sheet constraints, *Journal of Monetary Economics* 135, 55–69.

Koijen, Ralph S. J., and Motohiro Yogo, 2019, A demand system approach to asset pricing, *Journal of Political Economy* 127, 1475–1515.

Krishnamurthy, Arvind, and Hanno Lustig, 2019, Mind the gap in sovereign debt markets: The U.S. Treasury basis and the dollar risk factor, *Jackson Hole Economic Symposium Proceedings* (Federal Reserve Bank of Kansas City).

Krishnamurthy, Arvind, and Annette Vissing-Jorgensen, 2012, The aggregate demand for Treasury debt, *Journal of Political Economy* 120, 233–267.

Kubitza, Christian, Jean-David Sigaux, and Quentin Vandeweyer, 2025, The implications of CIP deviations for international capital flows, ECB Working Paper 3017.

Lenel, Moritz, Monika Piazzesi, and Martin Schneider, 2019, The short rate disconnect in a monetary economy, *Journal of Monetary Economics* 106, 59–77.

Litzenberger, Robert H., and Jacques Rolfo, 1984, An international study of tax effects on government bonds, *Journal of Finance* 39, 1–22.

Nagel, Stefan, 2016, The liquidity premium of near-money assets, *Quarterly Journal of Economics* 131, 1927–1971.

Pandolfi, Lorenzo, and Tomas Williams, 2019, Capital flows and sovereign debt markets: Evidence from index rebalancings, *Journal of Financial Economics* 132, 384–403.

Pesaran, M. Hashem, Yongcheol Shin, and Richard J. Smith, 2001, Bounds testing approaches to the analysis of level relationships, *Journal of Applied Econometrics* 16, 289–326.

Rime, Dagfinn, Andreas Schrimpf, and Olav Syrstad, 2022, Covered interest parity arbitrage, *Review of Financial Studies* 35, 5185–5227.

State of Israel, 2011, Income Tax Ordinance Amendment Law (No. 186), *Sefer HaChukim* 2321, 16 November 2011, 23–24 (in Hebrew).

Stambaugh, Robert F., 1999, Predictive regressions, *Journal of Financial Economics* 54, 375–421.

Stein, Jeremy C., and Jonathan Wallen, 2025, The imperfect intermediation of money-like assets, *Journal of Finance* 80, 3185–3221.

Tel Aviv Stock Exchange, 2026, *Periodic Report for 2025, Part A: Description of the Company's Business* (in Hebrew), Sections 1.1 and 1.17.8.

Vayanos, Dimitri, and Jean-Luc Vila, 2021, A preferred-habitat model of the term structure of interest rates, *Econometrica* 89, 77–112.

Table 1: The Makam market by period

Panel A. 2018–2024

	2018–2019	Jan–Jun 2020	Jul 2020–Dec 2021	Jan–Sep 2022	Oct–Dec 2022	2023	Jan–Sep 2024
Market size							
Makam outstanding (ILS bn)	107	111	96	128	164	282	261
Foreign holdings (ILS bn)	9	17	27	58	74	41	8
Swap market							
Outstanding dollar hedges (USD bn)	32	43	65	81	75	65	55
Holders (% of Makam outstanding)							
Foreign investors	9	16	28	46	45	15	3
Banks	36	23	5	4	5	22	15
Mutual funds	24	27	37	27	21	30	48
Long-term institutional investors	26	32	30	23	27	27	30
Other domestic	5	2	1	0	1	5	4
Three-month rates							
TELBOR (%)	0.18	0.14	0.09	1.02	3.40	4.61	4.46
TELBOR − foreign funding rate (bp)	27	71	30	95	179	85	57
TELBOR − Makam yield (bp)	−1	1	8	51	81	30	24
Hedged spread (bp)	28	70	22	44	98	55	33

Panel B. 2010–2013

	Jan 2010–Jun 2011	Jul–Dec 2011	Jan–Jun 2012	Jul 2012–Dec 2013
Market size				
Makam outstanding (ILS bn)	118	121	124	122
Foreign holdings (ILS bn)	28	31	9	1
Swap market				
Outstanding dollar hedges (USD bn)	8	11	9	11
Holders (% of Makam outstanding)				
Foreign investors	22	25	7	1
Banks	18	13	27	38
Mutual funds	21	24	29	29
Long-term institutional investors	18	14	15	15
Other domestic	20	23	23	17
Three-month rates				
TELBOR (%)	2.11	2.94	2.41	1.55
TELBOR − foreign funding rate (bp)	105	150	63	11
TELBOR − Makam yield (bp)	18	14	−2	1
Hedged spread (bp)	87	137	65	9

Notes: Entries are means over the weeks of each period, with holdings and outstanding dollar hedges at the end of the month before each week and rates as weekly means of daily data. Makam outstanding and holdings are at market value, and entries are rounded separately. Long-term institutional investors are retirement savings funds, pension funds, and insurance companies, and other domestic holders are the remainder of Makam outstanding. Outstanding dollar hedges are the dollars that domestic institutions have sold forward and not yet delivered. The foreign funding rate is the shekel cost of borrowing dollars at the dollar overnight-index-swap rate plus 26.161 basis points and hedging repayment at the three-month forward rate. The hedged spread is the Makam yield minus the foreign funding rate. Sources: Bank of Israel and LSEG.

Table 2: Changes in Makam holdings by holder

	Change in holdings (ILS bn)					Change in Makam outstanding (ILS bn)	Change in TELBOR − Makam yield (bp)
	Foreign	Banks	Mutual funds	Long-term institutional investors	Other domestic		
Panel A. 2018–2024							
Dec 2017–Dec 2019	+9.3	−7.7	+18.5	+11.0	−3.1	+28.0	+1
Dec 2019–Dec 2021	+37.1	−32.0	+1.7	−11.9	+0.1	−4.9	+11
Dec 2021–Sep 2022	+19.2	+7.3	−8.3	+11.0	+0.2	+29.4	+115
Sep 2022–Dec 2022	+0.9	+10.2	+22.6	+25.5	+5.8	+65.0	−93
Dec 2022–Sep 2024	−64.1	−8.7	+70.0	+24.0	+0.3	+21.5	0
Panel B. 2010–2013							
Dec 2009–Jun 2011	+38.3	−7.8	+3.8	−1.5	+5.2	+37.9	−15
Jun 2011–Dec 2011	−27.8	+19.7	+5.6	−1.9	+3.6	−0.8	−7
Dec 2011–Jun 2012	−12.2	+12.1	+5.0	+1.9	+0.3	+7.0	−20
Jun 2012–Dec 2013	−2.5	+6.6	−0.6	+3.5	−11.1	−4.1	+15

Notes: Each row reports changes between the ends of the two months shown. Holdings are Bank of Israel holder statistics at market value, and the five holder columns sum to the change in Makam outstanding up to rounding. Long-term institutional investors are retirement savings funds, pension funds, and insurance companies, and other domestic holders, mainly households and firms, are the remainder of Makam outstanding. TELBOR minus the three-month Makam yield at a month-end is its mean over the last seven days of the month. Source: Bank of Israel.

Table 3: Foreign-rate pass-through and the foreign share

Dependent variable: change in the Makam yield, Δy_w					
	(1) Baseline	(2) From 2018	(3) Bank share added	(4) Four maturities	(5) First episode, monthly
Sample	2010–24	2018–24	2010–24	2010–24	2010–12
Panel A. Rate responses (bp per 100 bp) and their interactions with the foreign share (per 10 pp)					
θ_F, foreign funding rate	2	6**	3	7**	−2
	(0.7)	(2.2)	(1.2)	(2.0)	(−0.8)
θ_D, TELBOR	71***	66***	72***	62***	78***
	(10.8)	(4.9)	(10.9)	(6.7)	(8.4)
γ_F, foreign funding rate × foreign share	7.4***	7.8***	9.0***	9.3***	6.8**
	(3.3)	(2.9)	(2.7)	(3.9)	(2.3)
γ_D, TELBOR × foreign share	−8.1	−4.1	−1.1	−15.9***	10.1
	(−1.5)	(−0.4)	(−0.1)	(−2.9)	(1.3)
Panel B. Foreign-rate pass-through at the stated foreign shares (bp per 100 bp)					
At the 2018–19 share (9%)	−1	−2	2	3	
At the January–September 2022 share (46%)	26	27	26	38	
Bank-share controls	No	No	Yes	No	No
Four maturities	No	No	No	Yes	No
Week fixed effects	No	No	No	Yes	No
Weeks (months in column 5)	747	346	747	620	29

Notes: This table reports estimates of equation (3). The dependent variable is the weekly change in the three-month Makam yield, except in column 4, which stacks the yields at 2, 4.5, 7.5, and 11 months with TELBOR and the foreign funding rate at each maturity, and in column 5, which uses monthly changes. The coefficients θ_F and θ_D are the responses to the foreign funding rate and to TELBOR at the mean foreign share, and γ_F and γ_D are their interactions with the foreign share, which is measured at the end of the previous month and demeaned. Column 3 adds the lagged bank share and its interactions with both rate changes, and its Panel B also sets the bank share at each period's mean. Newey–West t-statistics with 4 lags are in parentheses, with Driscoll–Kraay t-statistics in column 4 and 2 lags in column 5. Sources: Bank of Israel and LSEG. *, **, and *** denote significance at the 10, 5, and 1% levels, based on the t-statistics shown.

Table 4: What foreign investors respond to

Panel A. Monthly change in foreign holdings (ILS bn)

Makam yield$_{t-1}$, β_y (ILS bn per 100 bp)	4.0**
	(2.4)
Foreign funding rate$_{t-1}$, β_F (ILS bn per 100 bp)	−6.7***
	(−3.9)
Foreign holdings$_{t-1}$, ρ (ILS bn per ILS bn)	−0.43***
	(−5.8)
Outstanding dollar hedges$_{t-1}$, β_H (ILS bn per USD bn)	0.34***
	(6.3)
Period intercepts	Yes
Months	53

Panel B. Share of purchases in each maturity bucket (pp)

	(1) Foreign, all venues	(2) Foreign, exchange	(3) Banks	(4) Mutual funds	(5) Long-term institutional investors	(6) ETFs and market makers
Hedged spread$_{t-1}$, β_g (pp per bp)	1.55***	0.77*	1.14***	−0.12	−0.04	−0.29
	(4.2)	(1.9)	(3.2)	(−0.7)	(−0.3)	(−1.4)
Month and bucket fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Months	55	55	55	55	55	55

Notes: Panel A estimates equation (4) on 53 months in three periods, February 2018 to May 2020 without March and April 2020, June 2020 to December 2021, and January to August 2022, with an intercept for each period. Holdings are month-end market values, and the lagged rates are means over the last seven days of the previous month. Outstanding dollar hedges are domestic institutions' forward sales of dollars not yet delivered. Newey–West t-statistics with 3 lags are in parentheses. Panel B regresses each investor group's share of its Makam purchases in a remaining-maturity bucket of 1 to 3, 3 to 6, 6 to 9, or 9 to 12.6 months on the bucket's hedged spread in the previous month, measured at the bucket's midpoint, from February 2018 to August 2022. Column (1) uses foreign investors' secondary-market purchases in all venues from the Bank of Israel's data on foreign transactions, and columns (2) to (6) use purchases on the Tel Aviv Stock Exchange from the Smart Money data, whose investor types differ from the Bank of Israel holder sectors. t-statistics clustered by month are in parentheses. Sources: Bank of Israel, Tel Aviv Stock Exchange, and LSEG. *, **, and *** denote significance at the 10, 5, and 1% levels, based on the t-statistics shown.

Table 5: The hedge calendar and the Makam yield

	(1) Weeks of low foreign ownership (foreign share below 20%)	(2) Weeks of high foreign ownership (foreign share 20% or more)	(3) (2) minus (1)
Weeks	128	106	
Mean foreign share of Makam (%)	9.9	33.5	
Panel A. Three-month maturity			
Response of the foreign funding rate	−4.49	−12.31***	−7.83*
to the hedge calendar (bp per USD bn)	(−1.3)	(−4.5)	(−1.8)
First-stage F	1.7	20.5	
Response of foreign holdings	0.43*	0.82***	0.39
to the hedge calendar (ILS bn per USD bn)	(1.9)	(3.4)	(1.2)
First-stage F	3.8	11.5	
Response of the Makam yield	0.14	−2.53***	−2.67***
to the hedge calendar (bp per USD bn)	(0.3)	(−3.9)	(−3.3)
Funding-rate exposure, E		21***	
(bp per 100 bp)		(4.3)	
Anderson–Rubin 95% set		[12, 33]	
Foreign-rate pass-through, least squares	−4***	25***	29***
same weeks (bp per 100 bp)	(−3.0)	(6.7)	(7.3)
Price impact, P		3.07***	
(bp per ILS bn added to foreign holdings)		(3.4)	
Anderson–Rubin 95% set		[1.65, 6.44]	
Panel B. Common price impact, three and six months			
Common price impact, P		2.90***	
(bp per ILS bn added to foreign holdings)		(3.8)	
Anderson–Rubin 95% set		[1.83, 6.11]	

Notes: This table reports estimates of equations (14) and (15) on the 234 weeks from the week ending 25 January 2018 to the week ending 25 August 2022. The hedge calendar is the USD notional of domestic institutions' forward sales of dollars that mature in week w under contracts written at least 90 days before the start of week w. The foreign share that defines the columns is measured at the last month-end before week $w-3$, and columns (1) and (2) come from one regression with separate coefficients in the two groups of weeks. Changes in yields and rates run from week $w-3$ to week w, and the change in foreign holdings is tender and secondary purchases minus secondary sales and redemptions over weeks $w-2$ to w. Funding-rate exposure and price impact are two-stage least squares estimates with the hedge calendar as the instrument, and column (1) does not report them. Panel B stacks the three- and six-month regressions. Every regression includes the change in TELBOR at the maturity of the yield and the baseline controls of Section 4.1. Newey–West t-statistics with 8 lags are in parentheses. Sources: Bank of Israel and LSEG. *, **, and *** denote significance at the 10, 5, and 1% levels, based on the t-statistics shown. Stars are omitted on instrumented estimates whose first-stage F is below 10.

Table 6: Yields on affected and exempt securities after the 2011 tax change

Dependent variable: yield of security i in month t, y_{it}					
	(1) Baseline	(2) Quadratic curve	(3) Common slope	(4) From July 2010	(5) One bond left out
γ, affected × post (bp)	12.8***	10.9***	22.3***	12.6***	10.7 to 16.6***
	(3.8)	(4.9)	(4.1)	(3.6)	(3.8 to 4.7)
Bootstrap p-value	0.015	0.019	0.002	0.015	
Security and month effects	Yes	Yes	Yes	Yes	Yes
Maturity curve	Linear, by month	Quadratic, by month	Linear, common	Linear, by month	Linear, by month
Sample start	Jul 2009	Jul 2009	Jul 2009	Jul 2010	Jul 2009
Exempt bonds	All	All	All	All	One left out
Securities affected / exempt	47 / 7	47 / 7	47 / 7	35 / 6	47 / 6
Security-months	515	515	515	353	491–512

Notes: Each column estimates equation (16) on monthly yields of Makam and of exempt government bonds with one to twenty-four months to maturity, through June 2012. The coefficient γ is the change in Makam yields relative to the yields of exempt bonds after nonresidents' tax exemption on Makam ended on 7 July 2011. Column (5) reports the range over the 7 regressions that each leave out one exempt bond. t-statistics clustered by security and month are in parentheses, and bootstrap p-values come from a wild cluster bootstrap by security with the null imposed. Sources: Bank of Israel and the Tel Aviv Stock Exchange. *, **, and *** denote significance at the 10, 5, and 1% levels, based on the t-statistics shown.

Table 7: The calibration and the funding term

Panel A. Hedge-calendar estimates, weeks of high foreign ownership	
Weeks	106
Funding-rate exposure, three months (bp per 100 bp)	21
	[12, 33]
Funding-rate exposure, six months (bp per 100 bp)	24
	[14, 45]
Common price impact (bp per ILS bn added to foreign holdings)	2.90
	[1.83, 6.11]
Panel B. Calibrated slopes	
Foreign slope, a (ILS bn per bp)	0.089
Domestic supply slope, B (ILS bn per bp)	0.345
Rise in the Makam yield per ILS bn added to Makam outstanding, $1/(a+B)$ (bp)	2.30
Panel C. January–September 2022, three-month maturity (bp)	
TELBOR minus the foreign funding rate	95
TELBOR minus the Makam yield	51
Funding term	20
	[11, 31]
TELBOR minus the Makam yield less the funding term	31
Funding term, a proportional to the foreign share	25
	[15, 38]
Funding term, a proportional to the foreign share and B to the domestic share	29
	[18, 43]
Panel D. Year-end pause in foreign buying	
Fall in foreign acquisitions, last three weeks of December (ILS bn)	2.3
Rise in the Makam yield implied by the common price impact (bp)	6.7
	[4.2, 14.0]
Observed rise, year-ends 2017–2021 (bp)	7.4
	(3.8)
Observed rise, year-ends 2017–2023 (bp)	8.6
	(3.2)

Notes: This table calibrates the model of Section 3 with $a = b$ to the hedge-calendar estimates of Panel A. Panel B sets $B = 1/P$ and $a = B\,E/(1-E)$, equation (19). Panel C averages weekly means of daily three-month rates over the 39 weeks that start between 1 January and 30 September 2022. The funding term is funding-rate exposure times TELBOR minus the foreign funding rate, the first term of equation (20). The scaled rows multiply a by the foreign share at the end of the month before each week relative to 33.5%, the mean of the weeks of Panel A, and the last row also multiplies B by the corresponding ratio of domestic shares. Panel D controls for the changes in TELBOR and the foreign funding rate, and the implied rise is the common price impact times the fall in foreign acquisitions, equation (21). Brackets in Panel A are Anderson–Rubin 95% sets, and brackets in Panels C and D evaluate each row at the ends of the set of the estimate it uses. Newey–West t-statistics with 4 lags are in parentheses. Calculations use unrounded estimates. Sources: Bank of Israel and LSEG.

Table 8: TELBOR minus the Makam yield, the policy rate, and the funding term

Panel A. Dependent variable: TELBOR minus the Makam yield (bp), monthly

	(1) Levels	(2) Levels	(3) Levels	(4) First differences
Policy rate (%)	5.81***		4.81***	1.36
	(4.7)		(4.6)	(0.6)
Foreign share × (TELBOR − foreign funding rate)		0.86***	1.02***	1.23***
		(4.3)	(3.2)	(3.8)
Foreign share			13.37	−73.98**
			(1.1)	(−2.0)
TELBOR − foreign funding rate (bp)			−0.15*	−0.19***
			(−1.9)	(−2.6)
VIX			−0.01	0.13
			(−0.1)	(0.9)
R^2	0.21	0.65	0.74	0.48
Months	178	178	178	177

Panel B. Period means (bp unless stated)

					Funding term		
Period	Weeks	TELBOR minus the Makam yield	Policy rate (%)	Policy-rate term	Fixed exposure	Scaled exposure	Remainder
Jan 2010–Jun 2011	72	18	1.90	6	16	17	−4
Jul 2011–Dec 2012	78	5	2.58	9	8	9	−12
2013–2017	258	−1	0.46	−1	0	0	0
2018–2019	103	−1	0.18	−2	0	2	2
Jul 2020–Dec 2021	77	8	0.10	−2	5	5	5
Jan–Sep 2022	39	51	0.70	0	20	25	31
Oct 2022–Dec 2023	66	41	4.19	16	10	17	15
Jan–Sep 2024	39	24	4.50	18	0	1	6

Notes: Panel A regresses the monthly mean of TELBOR minus the Makam yield on the variables in the rows and a constant, from January 2010 to October 2024. Rates are three-month rates except the policy rate, and rates and the VIX are monthly means of daily data. The foreign share of Makam outstanding is measured at the end of the previous month, as a fraction. Newey–West t-statistics with 12 lags are in parentheses. Panel B averages weekly means of daily data over the weeks that start in each period and omits January to June 2020. The policy-rate term is the fitted value of a regression of TELBOR minus the Makam yield on the policy rate over the 99 months with a foreign share below 10%. The funding term is funding-rate exposure times TELBOR minus the foreign funding rate, with fixed exposure of 21 basis points per 100 basis points in weeks with a foreign share of 20% or more and zero in other weeks, or with scaled exposure implied by a foreign slope a proportional to each week's foreign share and a fixed domestic supply slope B. The remainder is TELBOR minus the Makam yield less the policy-rate term and the funding term with fixed exposure. Entries are rounded separately. Sources: Bank of Israel and LSEG. *, **, and *** denote significance at the 10, 5, and 1% levels, based on the t-statistics shown.

Table 9: Foreign ownership and foreign-rate pass-through across markets

	Israel Makam	Mexico Cetes	Japan T-bills
Change in the rate response per 10 pp of foreign ownership (bp per 100 bp)			
γ_F, foreign funding rate	7.4***	2.9***	2.3***
× foreign share	(3.3)	(3.2)	(3.0)
γ_D, domestic benchmark	−8.1	−1.7	9.2
× foreign share	(−1.5)	(−0.5)	(0.9)
Foreign-rate pass-through (bp per 100 bp)			
At the low foreign share	−1	3	−2
low foreign share (%)	9	4	17
At the high foreign share	26	19	10
high foreign share (%)	46	59	71
Benchmark rate	TELBOR	TIIE	Yen OIS
Sample	2010–24	2008–23	2010–24
Weeks	747	824	711

Notes: This table reports estimates of equation (3) on weekly changes in three-month bill yields. The domestic benchmarks are three-month TELBOR, the 91-day TIIE (the interbank equilibrium rate of Banco de México), and the three-month yen overnight-index-swap rate. The foreign share is measured at the end of the previous month for Israel and Mexico and of the previous quarter for Japan. The low and the high foreign shares are means over 2018–19 and January–September 2022 for Israel, 2008–2009 and 2013–2014 for Mexico, and 2010 and 2019 for Japan. Newey–West t-statistics with 4 lags are in parentheses. Sources: Bank of Israel, Banco de México, Bank of Japan, and LSEG. *, **, and *** denote significance at the 10, 5, and 1% levels, based on the t-statistics shown.

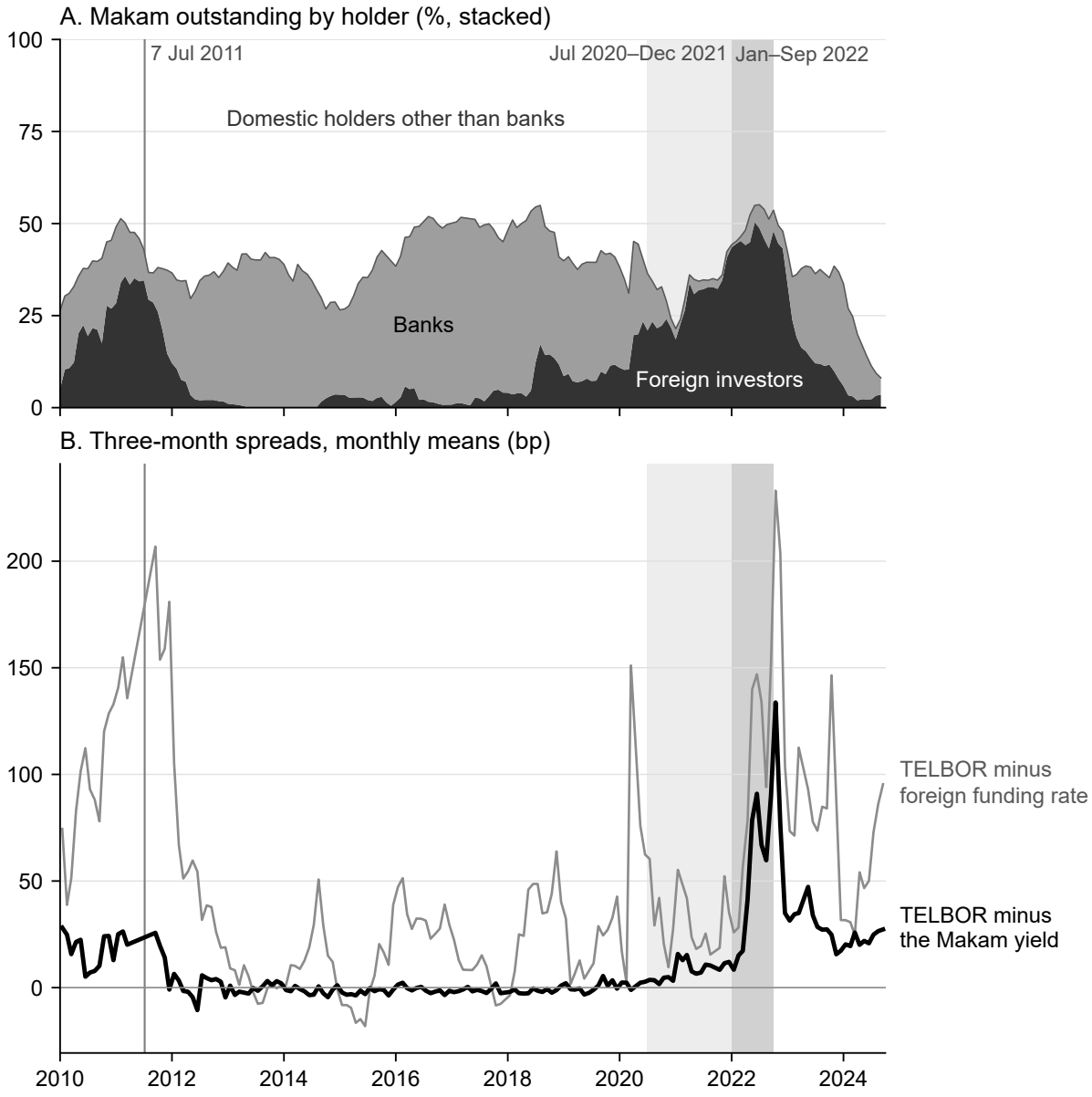


Figure 1: **Makam holders and three-month spreads, January 2010 to September 2024.** Holdings in Panel A are month-end market values, plotted at month-ends. Spreads in Panel B are monthly means of daily data, plotted at mid-month. Section 1.3 defines the foreign funding rate. The vertical line marks the end of nonresidents' tax exemption on Makam. The data come from the Bank of Israel and LSEG.

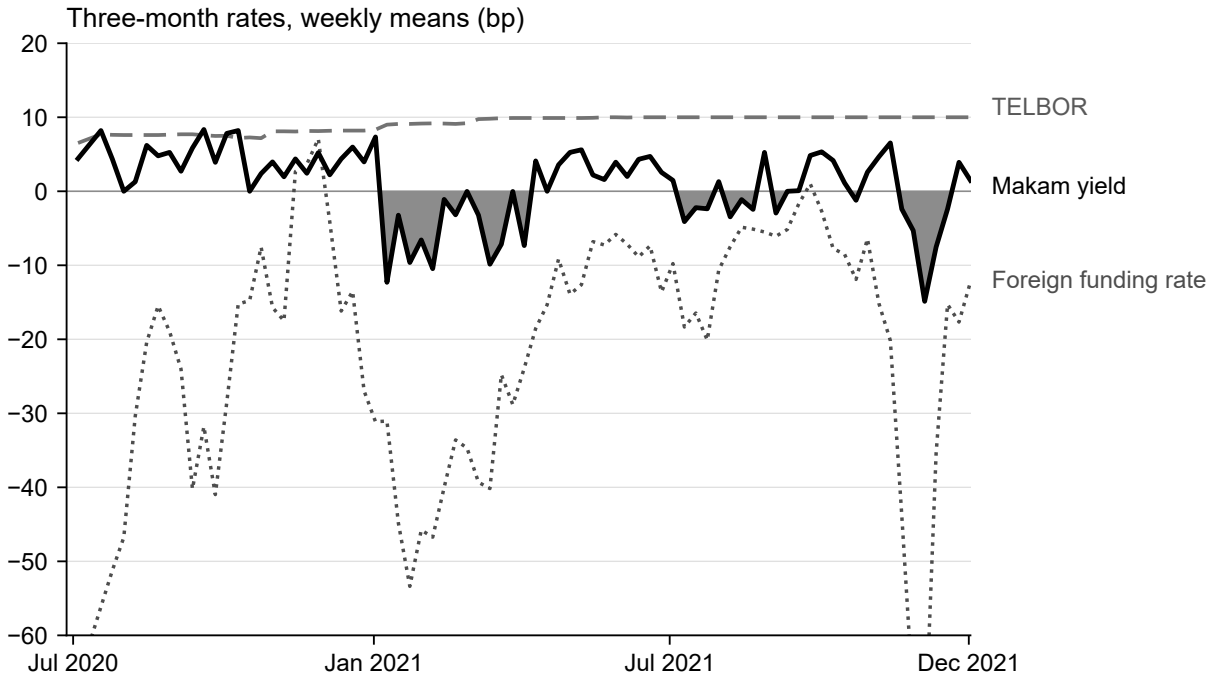


Figure 2: **Three-month rates, July 2020 to December 2021.** Gray shading marks the weeks in which the Makam yield is below zero. The vertical axis is cut at −60 basis points, and the foreign funding rate lies below that level in 3 weeks, with a minimum of −75 basis points. The data come from the Bank of Israel and LSEG.

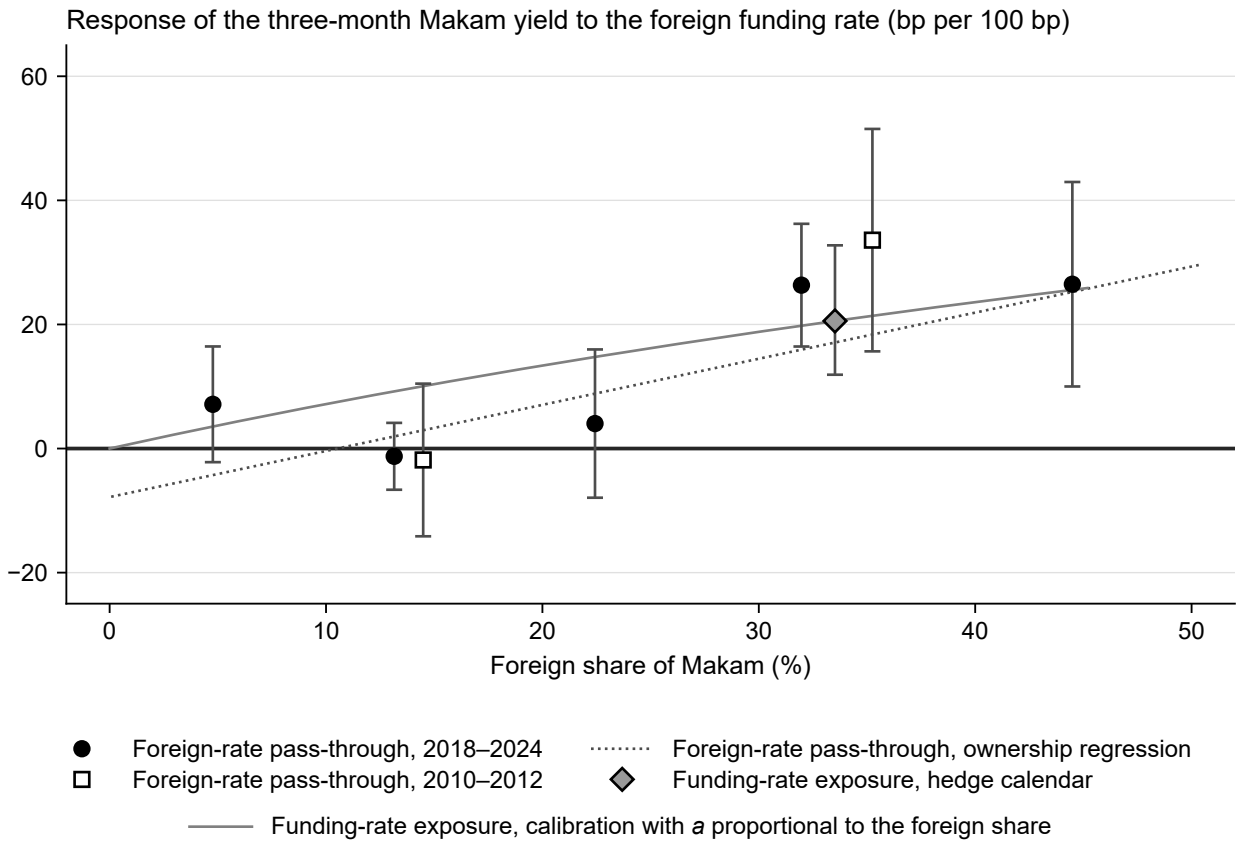


Figure 3: **Response of the Makam yield to the foreign funding rate against the foreign share of Makam.** Each estimate of foreign-rate pass-through comes from equation (2) on the weeks whose foreign share at the end of the previous month falls in one group, and sits at the group's mean share. The groups are 0–10, 10–20, 20–30, 30–40, and above 40% from 2018 to 2024 and below and above 30% from 2010 to 2012. Bars are 95% Newey–West intervals (4 lags). Funding-rate exposure from the hedge calendar sits at 33.5%, the mean foreign share of the weeks with a foreign share of 20% or more at the last month-end before week $w - 3$, with its Anderson–Rubin 95% set. The calibration holds the domestic supply slope B fixed. The data come from the Bank of Israel and LSEG.

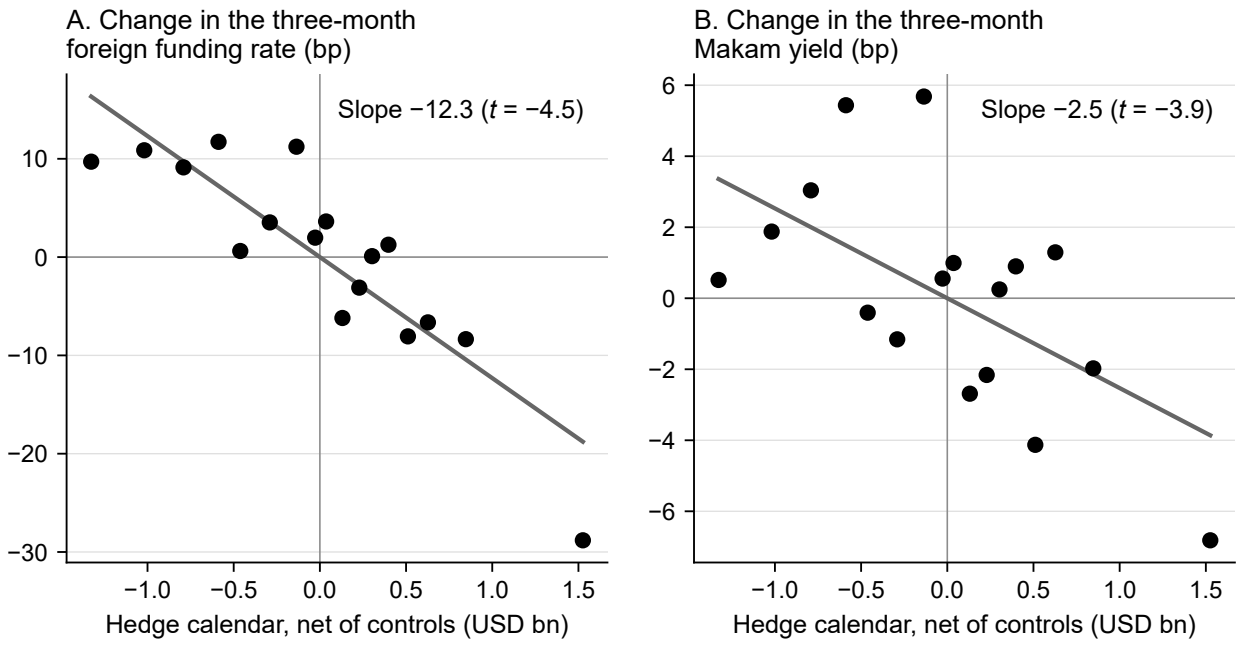


Figure 4: **The hedge calendar, the foreign funding rate, and the Makam yield, weeks ending 2 July 2020 to 25 August 2022.** The sample is the 106 weeks of high foreign ownership, those with a foreign share of 20% or more at the last month-end before week $w-3$. The hedge calendar is the USD notional of domestic institutions' forward sales of dollars that mature in week w under contracts written at least 90 days earlier. Changes run from week $w-3$ to week w. All three variables are residuals from regressions on the 33 baseline controls of Section 4.1, which include the change in TELBOR. Each dot is the mean of one of 17 bins of 6 to 7 weeks sorted by the residual hedge calendar. The line is the least-squares fit on the 106 weeks, with Newey–West t-statistics (8 lags). The data come from the Bank of Israel and LSEG.

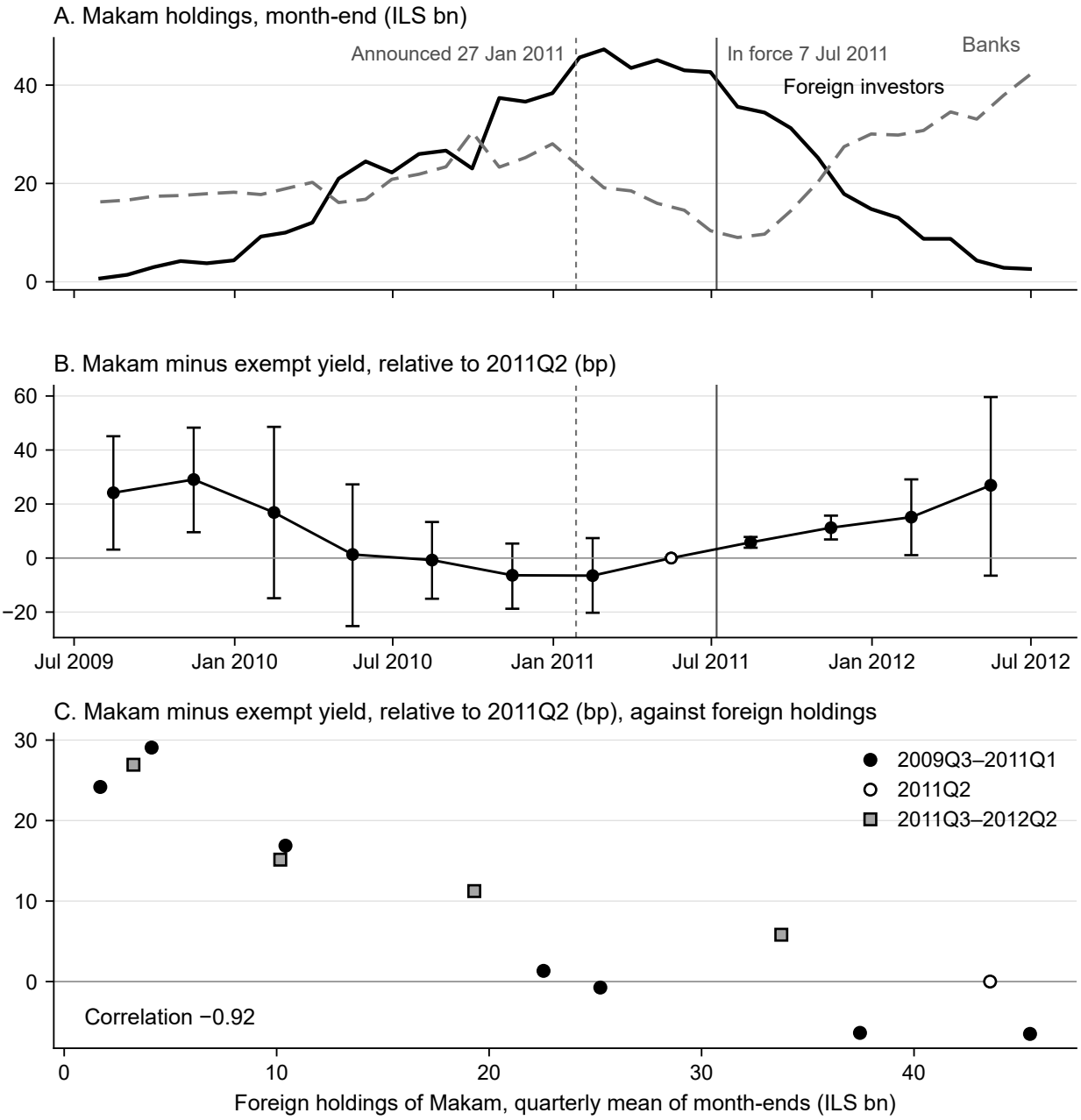


Figure 5: **Makam holdings and relative yields around the 2011 tax change, 2009Q3 to 2012Q2.** Panel B plots Makam yields minus the yields of exempt government bonds by quarter, relative to 2011Q2. Each point is the coefficient on a quarter indicator that replaces the post-implementation indicator in equation (16), with a 95% wild cluster bootstrap interval. Panel C plots these coefficients against foreign holdings of Makam in the same quarter. The dashed and solid vertical lines mark the announcement and the implementation of the end of nonresidents' tax exemption on Makam. The data come from the Bank of Israel and the Tel Aviv Stock Exchange.

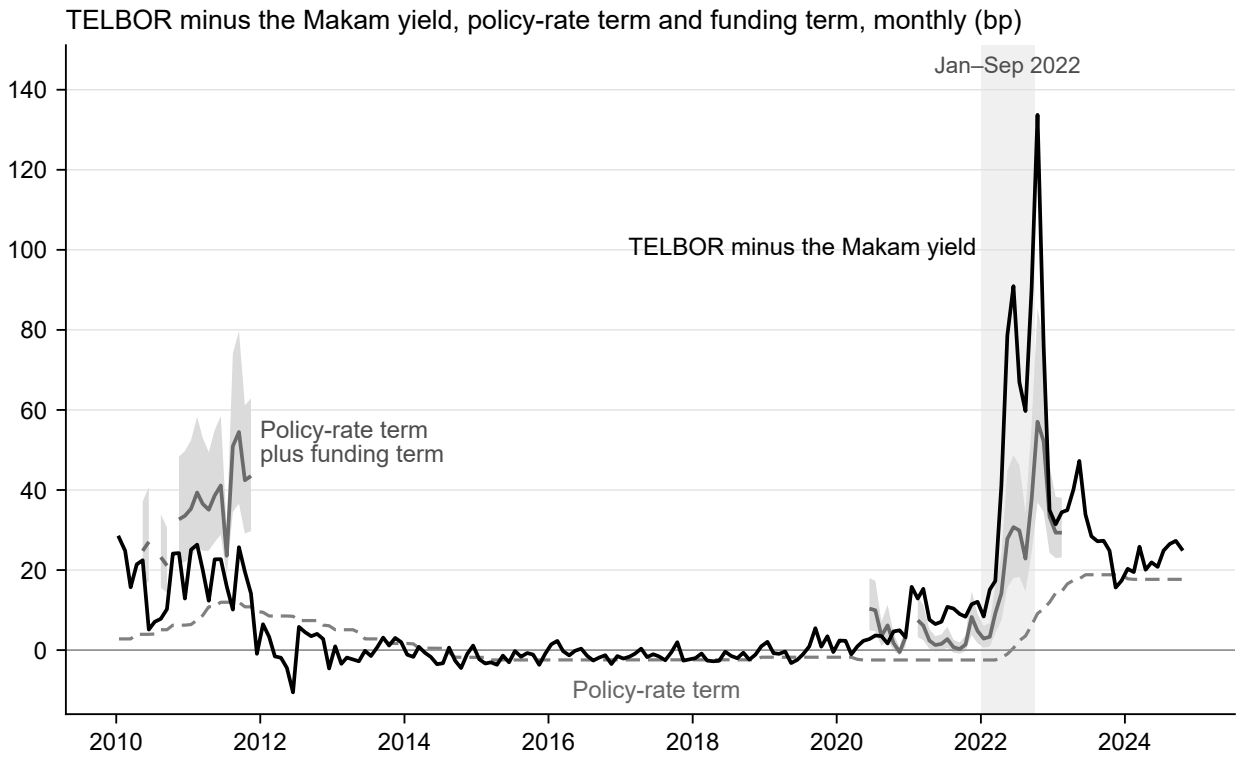


Figure 6: **TELBOR minus the Makam yield, the policy-rate term, and the funding term, January 2010 to October 2024.** Series are monthly means of daily data, plotted at mid-month. The policy-rate term is the fitted value of a regression of TELBOR minus the Makam yield on the policy rate over the 99 months with a foreign share below 10%. The dashed line is the policy-rate term. The solid gray line adds the funding term, funding-rate exposure of 21 basis points per 100 basis points times TELBOR minus the foreign funding rate, and is drawn only in months with a foreign share of 20% or more. The band evaluates the funding term at the ends of the Anderson–Rubin 95% set of funding-rate exposure. The Bank of Israel's Makam yield curve ends in October 2024. The data come from the Bank of Israel and LSEG.

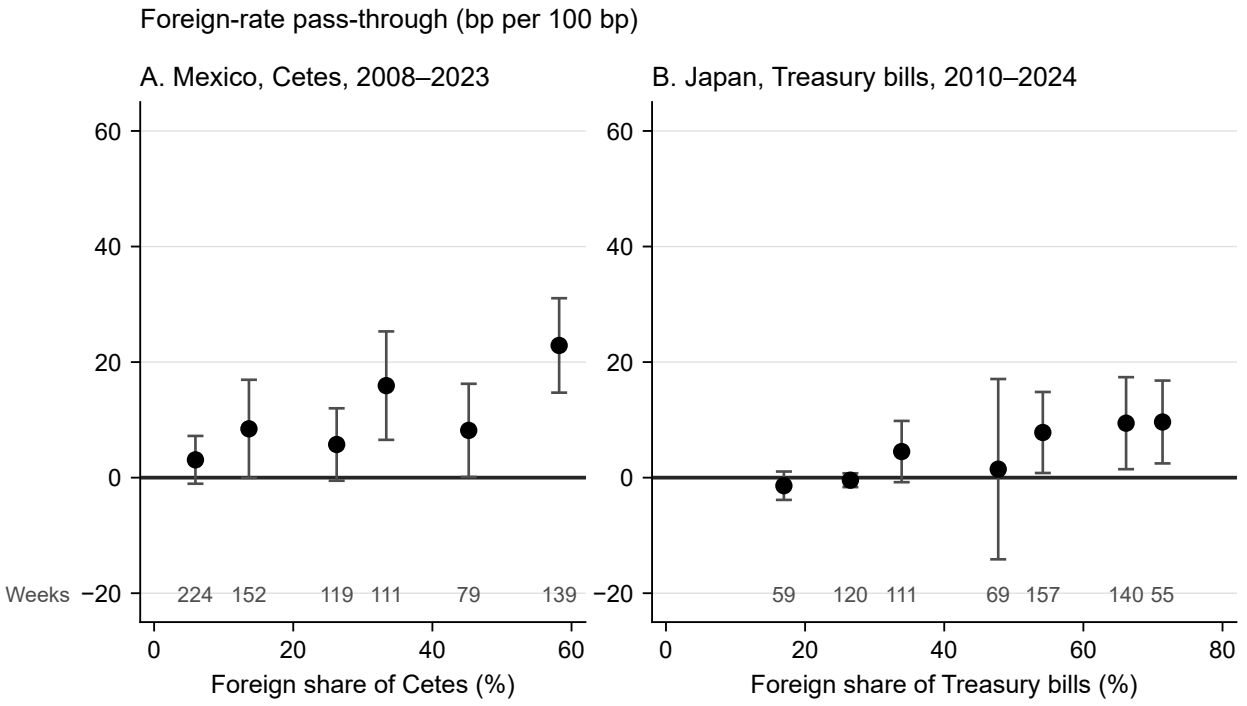


Figure 7: **Foreign-rate pass-through by foreign share in Mexico and Japan.** Weeks are grouped by the foreign share of the bills, in groups 10 percentage points wide, at the end of the previous month in Mexico and of the previous quarter in Japan. In each group the weekly change in the three-month bill yield is regressed on the weekly changes in the domestic benchmark and the foreign funding rate, and each dot is the coefficient on the foreign funding rate. The domestic benchmark is the 91-day TIIE (the interbank equilibrium rate of Banco de México) in Mexico and the three-month yen overnight-index-swap rate in Japan. Bars are 95% Newey–West intervals (4 lags), and the numbers above the horizontal axis count the weeks in each group. The data come from Banco de México, the Bank of Japan, and LSEG.