

# The Riksbank's bond purchases: who sold bonds to the Riksbank?

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Like many central banks, the Riksbank has purchased government bonds and private sector securities to make monetary policy more expansionary and as a complement to traditional interest-rate policy. Who has sold bonds to the Riksbank and what does this tell us about the transmission of bond purchases? In this article I use Financial Account data and new microdata on Swedish securities holders to assess which sectors sold bonds to the Riksbank.

Over the period 2015 to 2021, I find that foreign investors have accounted for a large share of sales of government and private sector bonds to the Riksbank. As a group, foreign investors show a greater propensity than domestic investors to adjust their portfolios of Swedish government bonds in conjunction with the Riksbank's purchases and with changes in bond supply. Although foreign investors have been active sellers of the bonds the Riksbank has purchased, they have rebalanced their portfolios of Swedish assets toward assets with more risk. These findings highlight the important role of foreign investors in the transmission of bond purchases in a small open economy.

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## 1 Introduction

In the years following the global financial crisis, many central banks purchased bonds on a large scale as a complement to traditional interest-rate policy when policy rates were at or near their effective lower bound. Bond purchases were also a key feature of the monetary-policy response to the financial and economic disruptions due to the covid-19 pandemic. Purchases alleviated strained market functioning and ensured that financial conditions remained accommodative and supportive of the recovery.

The literature on the effects of bond purchases has focused on the effects on interest rates. Both in Sweden and abroad, central-bank bond purchases have exerted downward pressure on bond yields. But how this effect has arisen is less well understood. Many channels have been proposed. Bond purchases are thought to lower bond term premia by inducing portfolio rebalancing and removing duration risk,

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lower liquidity premia by improving market functioning when markets are distressed, and lower expectations of future policy rates (Bhattarai and Neely 2022).<sup>1</sup>

This paper aims to shed light on portfolio rebalancing in Sweden. Which types of investors have sold bonds to the Riksbank and how have they rebalanced their asset portfolios? What are the implications for the transmission of bond purchases?

I analyse data from the Swedish Financial Accounts and new microdata on Swedish Securities Holdings to assess which sectors have ultimately sold bonds to the Riksbank. While participation in the central bank's purchase operations is limited to the central bank's counterparties, these counterparties can sell bonds either from their own inventory or on behalf of investors who do not participate directly in the operations.<sup>2</sup> With Financial Accounts and Securities Holdings data, it is possible to see beyond who participates in the purchase operations to map out how sectoral bond holdings have evolved during the Riksbank's bond-purchase programs.

I find that foreign and domestic investors sold Swedish government bonds to the Riksbank in about equal measure during the bond purchase program 2015 to 2017. However after controlling for the historical relationship with the supply of government bonds, the Riksbank's holdings and other financial factors, foreign investors show a greater propensity than domestic investors to adjust their holdings of government bonds in response to the Riksbank's purchases and to changes in the supply of government bonds. Experience of the pandemic purchases echoes this finding, with foreign investors the primary seller of the types of the bonds that the Riksbank purchased, including government, municipal and mortgage covered bonds.

Although foreign investors sold government bonds to the Riksbank during and following the 2015 – 2017 purchase program, they more than offset their sales of government bonds with purchases of other Swedish bonds. Overall, foreign investors rebalanced their portfolio of Swedish bonds toward higher risk bonds including bank-, covered- and corporate bonds. This does not mean that each individual investor necessarily rebalanced its portfolio in this way, rather the foreign sector as a whole. During the pandemic, foreign investors reduced their holdings of Swedish bonds in total. However, considering their gross portfolio of Swedish assets including deposits, bonds, loans and equity, foreign investors have since 2015 increased their financing of the Swedish non-financial corporate sector through bonds, loans and equity ownership.

These findings highlight the role of foreign investors in understanding the transmission of bond purchases in a small open economy. This is in contrast to the much of the theory and empirics on central-bank bond purchases which has been developed with larger economies in mind.

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<sup>1</sup> Further channels have been proposed: an uncertainty channel by which asset purchases reduce uncertainty about the outlook for economic recovery and the path of the policy rate; a bank lending channel by which increased central-bank reserves and deposits at banks may encourage lending by alleviating financial constraints and encouraging rebalancing of credit portfolios; and an exchange-rate channel.

<sup>2</sup> Birging and Hansson (2021) describe the Riksbank's purchase operations in practice.

## 2 Bond purchases affect interest rates and volumes

### 2.1 Central-bank bond purchases have lowered interest rates

The impact of large-scale central-bank bond purchases on interest rates is well documented, especially for the United States, United Kingdom and euro area (see for example Gagnon 2016 and Andrade et al. 2016 for metastudies). Broadly speaking, central-bank bond purchases have exerted downward pressure on the interest rates of those bonds that are purchased, including public- and private-sector bonds. Yields on bonds that are not eligible for purchase have also tended to decline but there is less consensus as to whether bond spreads have been compressed.

The experience of Australia, Canada and Sweden indicate that central-bank bond purchases in small open economies are also associated with declines in the yields. However the empirical evidence is mixed. De Rezende (2017) finds sizeable announcement effects of Swedish government bond purchases between 2015 and 2017 and attributes the effects to lower term premia and lower policy-rate expectations. In contrast, Diez de los Rios and Shamloo (2017) find that Swedish bond purchases did not affect domestic term premia and that the observed declines in bond yields were mainly due to purchases signalling lower future policy rates and declines in global term premia. Similarly, Arora et al. (2021) find that the effect of the Bank of Canada's pandemic bond purchase program was relatively weak for long-term yields and the Reserve Bank of Australia's assessment is that effects of bond purchases were smaller than indicated by international studies (Reserve Bank of Australia 2022).

Exchange rates tend to depreciate in conjunction with the announcement of bond-purchase programs, both for large economies such as the United States and euro area (Haldane et al. 2016 and Dedola et al. 2021) and in small, open economies (Melander 2021, Gustafsson 2021 and Reserve Bank of Australia 2022). Indeed, the exchange rate channel may be of special significance for small open economies.

### 2.2 Preferred-habitat investors are thought to play a role

Of the proposed mechanisms by which bond purchases have effect, the portfolio rebalancing channel posits that by purchasing bonds and reducing the supply available on the market – the “free float” – the central bank induces investors to rebalance their portfolios. To the extent that some investors have strong preferences to hold just the type of bond purchased by the central bank – so-called *preferred-habitat investors* – these investors will bid up the price and down the yield such that term premia on that bond, and its close substitutes, decline. Vayanos and Vila (2021) present a preferred-habitat model of the term structure that illustrates this mechanism. This term premia effect is likely to ripple on to other related asset types as investors are displaced and prices adjust.

Generally speaking, central-bank bond purchases can affect term premia when there are frictions or imperfections that limit investors' ability or willingness to rebalance their portfolios. More specifically, the effect on term premia depends can depend on

the prevalence and preferences of preferred-habitat investors, the availability and substitutability of other assets and the extent to which arbitrageurs can realign prices between asset classes. Investors may have preferred habitats for certain maturities, for certain risk-classes of bonds or for the assets of certain regions or countries.<sup>3</sup>

While some investors may have strong preferences for a certain market segment, or are required to hold certain assets to comply with regulations and liability-matching, other investors may switch more readily to other asset classes, moderating the effects on term premia. Indeed, for the portfolio-balance mechanism to exert an effect on term premia at all, arbitrageurs must be unable or unwilling to completely arbitrage between asset classes. At which price investors are willing to rebalance their portfolios depends on the supply of available substitutes. For example, an investor whose preferred habitat is government bonds might require little compensation in the form of lower term premia to rebalance into municipal bonds. But if municipal bonds are in short supply, the compensation demanded will be greater.

The theories of preferred habitat and portfolio rebalancing stretch far back but there is relatively little empirical research on preferred-habitat behaviour. Giese et al. (2021) document the existence of preferred-habitat investors in different maturity segments of the UK gilts market and find that preferred-habitat investors such as life insurers and pension funds are less price elastic than other investor types. There is more literature on home bias in investment which can be viewed as a kind of preferred habitat behaviour. For example, Koijen et al. (2017) find evidence of home bias in euro area investors.

### 2.3 International aspects of portfolio rebalancing

In much the same way that imperfect substitutability of assets of different maturities or risk-profile is required for portfolio-rebalancing effects on term premia to arise, some degree of imperfect substitution between domestic and foreign bonds is necessary for domestic purchase programs to lower domestic term premia.

Kabaca (2016) presents a small open-economy DSGE model in which domestic and foreign bonds are traded internationally. In the model, the effectiveness of central-bank bond purchases on the term premium in the small open economy depends on the degree of substitutability between domestic and foreign bonds. The model implies that bond purchases in small open economies are less effective at reducing long-term bond premia yields when home and foreign assets are highly substitutable.<sup>4</sup>

In more concrete terms, consider the perspective of a foreign investor whose preferred investment habitat is Swedish government bonds. If this investor believes that Norwegian government bonds for example have similar attributes, interest-rate,

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<sup>3</sup> Preferred habitats may differ because of regulations, transaction costs, specialised expertise and liquidity preferences among other things (Bernanke 2020).

<sup>4</sup> Imperfect substitution across assets is captured in the model with portfolio adjustment costs. In an estimated version of the model based on data for the United States and Canada, asset purchases are half as effective at stimulating total aggregate demand in a small open economy relative to a large economy because of the high substitutability between home and foreign bonds. Moreover, the depreciation of the exchange rate, a key channel in small open economies relative to large economies, is limited.

credit and exchange-rate risk to Swedish government bonds, then the two assets might be good substitutes. In response to lower Swedish yields because of asset purchases in Sweden, this investor might rebalance their portfolio toward Norwegian government bonds rather than to Swedish municipal or mortgage covered bonds.

The model by Kabaca (2016) is echoed in findings for the ECB's government bond purchases. Foreign investors and to a lesser extent banks have been the primary sellers of euro-area government bonds (ECB 2017). Kojien et al. (2017) find that the foreign sector displays more elastic demand for euro-area bonds than do domestic investors, potentially dampening the impact of bond purchases on government bond yields. Moreover, non-residents as a whole tend not to reinvest in the euro area after selling government bonds, reducing the effect of government bond purchases on other euro area assets.

In contrast, the foreign sector has played less of a role in the United States. Carpenter et al. (2015) find that during the Federal Reserve's large-scale purchases of Treasury securities, the primary sellers were the U.S household sector (which they point out is the sector that includes hedge funds) as well as U.S. broker-dealers and insurance companies. These investors were found to rebalance their portfolios toward riskier assets. A similar rebalancing toward corporate bonds is found among institutional investors that sold gilts to the Bank of England (Joyce et al. 2017).

The portfolio-rebalancing channel of asset purchases does not exist in isolation. Bond purchases signal lower future policy rates in some situations (Kaminska and Mumtaz 2022 for the United Kingdom and De Rezende 2017 for Sweden). Experience from the global financial crisis and in the early months of the covid-19 pandemic also indicates that bond purchases are particularly effective at restoring market function and lowering liquidity premia at times of market distress. Researchers differ in their assessment of the relative importance of these channels but all have likely been at work to some extent (Bailey et al. 2020).

## 3 The Riksbank's bond purchases and data on bond holdings

### 3.1 Government bond purchases 2015 to 2017

The Riksbank's large-scale purchases of government bonds began in February 2015 as a complementary monetary-policy measure at a time when the policy rate had been cut to -0,1 per cent and further rate cuts would be into untested territory.<sup>5</sup> Purchases started at a rapid pace and tapered somewhat in 2017 and were announced and implemented as a sequence of programs of a given amount over a given time frame. Net purchases ceased at the end of 2017 with purchases and reinvestments thereafter aimed at maintaining the size of the portfolio roughly stable (see Figure 1 and Melander 2021 for a detailed description of the Riksbank's bond purchase

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<sup>5</sup> Prior to 2015, the Riksbank made small purchases of government bonds as a preparatory measure to develop systems and operational knowledge in the event that purchases would need to be scaled up.

decisions from 2015 to 2020). The Riksbank initially purchased nominal government bonds issued by the Swedish National Debt Office (SNDO, *Riksgälden*) but in April 2016 broadened eligible securities to include inflation-linked government bonds.

### 3.2 Pandemic bond purchases 2020 to 2021

In light of the financial and economic disruption caused by the covid-19 pandemic, bond purchases were intensified and broadened in the spring of 2020. As well as renewed purchases of government bonds, the Riksbank announced purchases of covered bonds, municipal bonds and corporate bonds as well as government bills and commercial paper (see Figure 1 and Gustafsson and van Brömsen 2021 for a chronological description of monetary-policy measures during 2020).<sup>6</sup> Only paper issued in Swedish krona were eligible for purchase.

Entering 2020, the Riksbank already owned more than 40 per cent of outstanding Swedish government bonds issued in Swedish krona. Against this background, additional purchases of government bonds during 2020 and 2021 were modest.<sup>7</sup> Bond purchases were instead weighted heavily toward covered bonds and to some extent municipal bonds. Two thirds of the Riksbank's purchases were concentrated in covered bonds and just under twenty per cent in municipal bonds.

The sizeable purchases of covered bonds seen in Figure 1 reflect the large size of that market. By the end of 2021, the Riksbank's covered and municipal bond holdings amounted to 20 per cent of their respective outstanding stock. Purchases of corporate bonds were by contrast modest, amounting to approximately 1.5 per cent of the outstanding stock of SEK-denominated non-financial corporate bonds.

### 3.3 Data on bond holdings by sector

The data come from three sources – the Financial Accounts and Balance of Payments both of which have a relatively long data history and the Swedish Securities Holding statistics starting in 2019. Each data source reports bond holdings by sector and investor type although there are key differences in coverage and methodology.

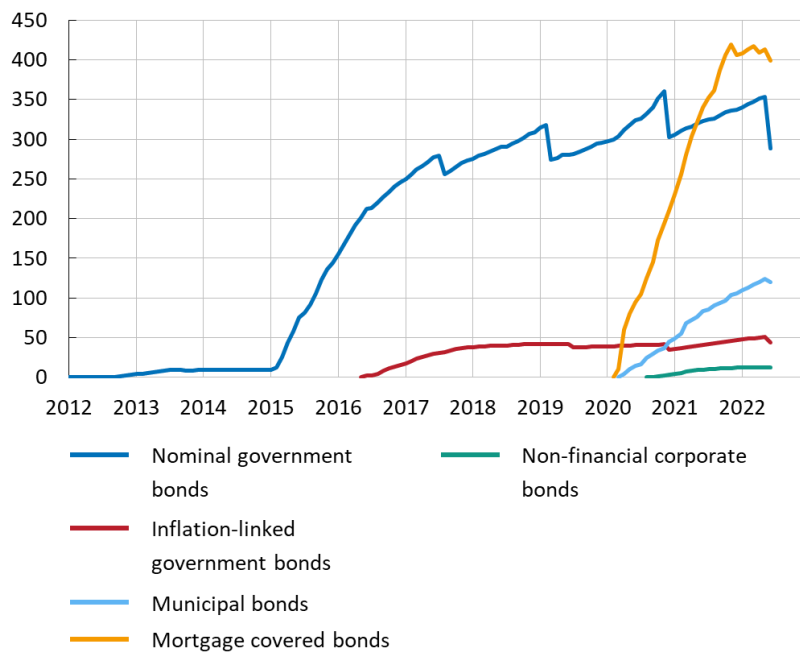
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<sup>6</sup> Municipal bonds include bonds issued by individual municipalities as well as by *Kommuninvest* on behalf of member municipalities.

<sup>7</sup> However, the SNDO increased issuance of short-term government bills and the Riksbank included Treasury bills in its purchase program.

**Figure 1. The Riksbank's holdings of Swedish bonds**

Nominal value, SEK billion



Source: Sveriges Riksbank.

- The International Investment Position (IIP), a component of the Balance of Payments, reports the foreign sector's holdings of debt securities issued in Sweden, by issuance sector and currency (Swedish krona and foreign currency). The statistics report the net of long and short investment positions of the foreign sector but do not provide a break down of holdings for domestic subsectors as in the Financial Accounts. The IIP data are available from 2006.
- The Financial Accounts (*Finansräkenskaperna*) published by Statistics Sweden reports transactions and holdings of financial assets and liabilities by detailed domestic sectors and by financial instrument including debt securities. Data on end-of-quarter holdings are market valued whereas transactions are changes in holdings net of valuation and reclassification effects. Quarterly data are available from 1996. Bonds issued in Swedish krona are not separately identified from those issued in foreign currencies and until 2019 only long positions in debt securities were reported; thereafter the net of long and short positions.
- The Swedish Securities Holding statistics (*databas för värdepappersinnehav, VINN*) consists of microdata on the ownership of interest-bearing securities on a security-by-security and investor-by-investor basis.<sup>8</sup> The statistics are collected by Statistics Sweden on behalf of the Riksbank. Data on debt securities are available from the first quarter of 2019 and so cover the Covid-

<sup>8</sup> The household sector is identified only in aggregate. VINN also includes data on listed shares and investment fund shares.

19 pandemic purchases but not earlier episodes. The data include long, short and net holdings of domestic investors and the net position of the foreign sector.

All sources are reported on a quarterly basis in Swedish kronor at the end of the period. None are seasonally adjusted. I complement these data sources with data from the Swedish National Debt Office on the outstanding amounts of nominal and inflation-linked government bonds and public bonds in foreign currency measured in both nominal value and market value.

The sectoral definitions of investor types in VINN align with those used in the Financial Accounts. An advantage with VINN is its more granular breakdown of securities by issuer and attribute. This allows separate identification of securities issued in Swedish kronor from those issued in foreign currency and as well as of covered bonds and bonds issued by municipalities and regions. This makes it possible to pinpoint sectoral holdings of the types of bonds that the Riksbank purchased during the pandemic.

The low frequency of the data is well suited to an analysis of how investors' holdings of securities have changed during the Riksbank's bond-purchase programs. While interest-rate changes largely occur upon announcement of a bond-purchase program, the transactions involved in rebalancing portfolios take time to implement.

There are some limitations with the data. A small share of Swedish investment funds are registered abroad and changes in their bond holdings are attributed to the foreign sector.<sup>9</sup> To the extent that some financial institutions that have participated in the Riksbank's reverse auctions (such as Nordea and Danske Bank) register their own inventory of bonds abroad rather than with their Swedish branch, sales from their own inventory will be attributed to the foreign sector. However, when they sell bonds on behalf of domestic Swedish customers, the change in bond holdings is attributed correctly to the domestic sector and likewise for foreign customers to the foreign sector. For these reasons, the analysis should be interpreted according to where investors are registered. However, the discrepancies introduced by this categorisation are small relative to the trends observed in the data.

The different methodologies of the Financial Accounts and Balance of Payments also pose a challenge to the analysis. In the Financial Accounts, the value of securities held by the foreign sector is calculated as the balance of outstanding debt securities not held by the domestic sector. In the Balance of Payments data for the foreign sector have historically been collected by surveys of issuers and from securities depositories.

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<sup>9</sup> *Fondbolagens Förening* publishes data on its members' funds registered in Sweden and abroad. Since 2018, the Financial Accounts cover more than 95 per cent of the value of funds reported by *Fondbolagens Förening*. From 2007 to 2017 the share is a little lower with 80 to 90 per cent coverage.



## Bonds are issued in Swedish krona and foreign currency

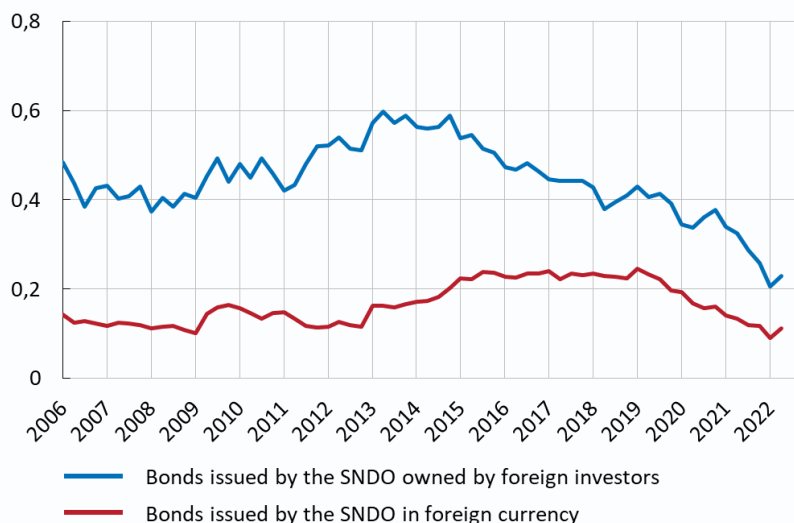
The Riksbank bought government debt denominated solely in Swedish krona but the SNDO also issues public bonds in foreign currency. These bonds are held almost exclusively by foreign investors and allows the SNDO to interact with a wider international investor base.<sup>10</sup> In the event of a sudden need to issue government debt, an existing broad investor base is an advantage.

The share of bonds issued by the SNDO in foreign currency has varied over time, reaching a peak between 2015 to early 2019 (see Figure 2). During this time, the SNDO issued foreign currency bonds on the Riksbank's behalf.

The share of all government and public bonds held by the foreign sector co-varies somewhat with the share of bonds that are issued in foreign currency. However the foreign sector's share of bond holdings fell by 20 percentage points from 2015 to 2019 and did not coincide with a decline in the share of bond issued in foreign currency.

**Figure 2. Bonds issued in foreign currency and held by foreign investors**

Share of outstanding government and public bonds issued by the SNDO



Source: SNDO and Statistics Sweden.

The share of municipal, covered and corporate bonds issued in foreign currency is somewhat higher – 20 per cent of covered bonds, 30 per cent of municipal bonds and over 50 per cent of non-financial corporate bonds have been issued in foreign currency on average since 2019.<sup>11</sup>

<sup>10</sup> The value of foreign-currency issued public bonds reported by the SNDO corresponds very closely with non-residents' holdings of foreign-currency bonds issued by the Swedish government as reported in the IIP.

<sup>11</sup> Based on data in VINN.

However, since 2019 and 2021 respectively, the Financial Accounts and Balance of Payments data on securities holdings are based on the data in VINN leading to better alignment between the IIP data and Financial Accounts. The Financial Accounts also underwent a methodological change starting 2019 to include short positions in debt securities which presents as a break in the data series for sectors' securities holdings.

Regarding repo transactions -- which are a common form of financial transaction between bond holders and money-market participants -- when an investor temporarily sells a bond in a repo transaction, the bond remains on the investor's balance sheet, in line with standard accounting practices. In other words, repo transactions are not registered as sales from the point of view of bond holdings. When an investor, often a bank, sells a security without first owning the bond this generates a short (negative) position. Short positions are incorporated in the IIP data and VINN and in the Financial Accounts after 2019.<sup>12</sup>

## 4 From whom has the Riksbank purchased?

In this section I illustrate how sectoral bond holdings have changed during periods in which the Riksbank has purchased bonds. For 2015 to 2017 the focus is upon holdings of government bonds whereas for the pandemic period I assess holdings of all the types of bonds that the Riksbank purchased. I complement the descriptive statistics with an econometric analysis of the response of different sectors' government bond holdings to the Riksbank's bond purchases and to other variables.

Figure 3 shows the holdings by sector of Swedish government bonds issued in all currencies reported by the Financial Accounts.<sup>13</sup> I categorise domestic investors into three subsectors whose holdings sum to the holdings of the domestic sector excluding the Riksbank -- insurance companies and pension funds;<sup>14</sup> the financial sector including banks, mortgage institutions and investment funds; and the non-financial sector which includes non-financial firms, households and the public sector.<sup>15</sup> The break in the data series in 2019 Q1 is evident, with sharply less holdings attributed to domestic financial sector as short positions were incorporated and a mirror-image increase in holdings attributed to the foreign sector. Even with this methodological change, the pronounced decline in the foreign sector's holdings since 2015 is visible.

The Financial Accounts do not report debt securities issued in Swedish krona separately from debt securities issued in foreign currency (see fact box on page 87).

<sup>12</sup> Prior to 2019, because the Financial Accounts does not incorporate short positions of domestic investors, it potentially overstates the holdings of domestic investors and understates the holdings of foreign investors relative to what is reported in the IIP.

<sup>13</sup> The Financial Accounts report the market value of assets and thus the numbers shown in Figure 3 are slightly higher than the nominal value of holdings reported by the Riksbank and shown in Figure 1.

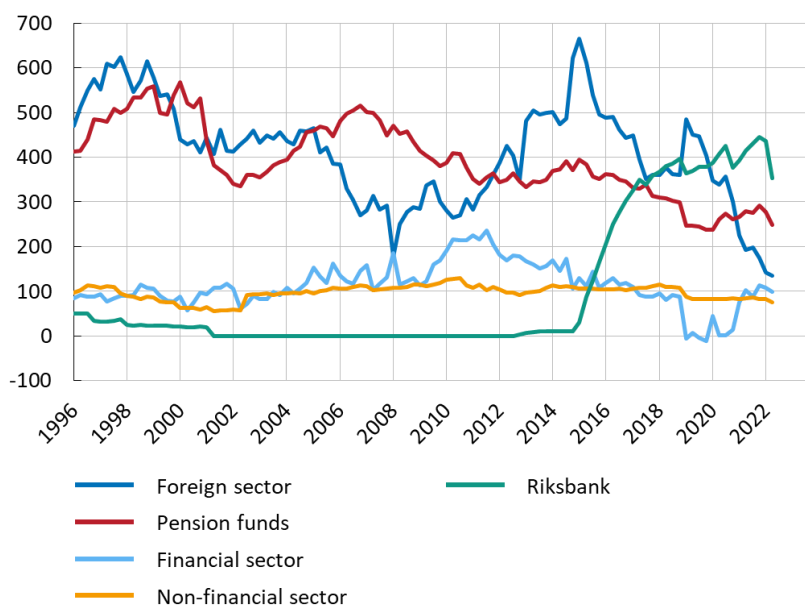
<sup>14</sup> This category includes Sweden's public pension funds (*allmänna pensionsfonder* AP-funds 1, 2, 3, 4 and 6) and *Pensionsmyndigheten*.

<sup>15</sup> This category includes non-profit institutions serving households. The public sector includes public authorities, public companies, municipalities and regions and funds and foundations that are controlled and mainly financed by the state. Within the non-financial sector, an increase in central government holdings of government bonds was offset by a decline in households' holdings when the SNDO ceased issuing *premieobligationer* in 2016.

The Riksbank has only purchased government bonds issued in Swedish krona. To get closer to answering the question of who sold these bonds, Figure 4 shows the share of government bonds issued in Swedish krona held by the Riksbank, the foreign sector and the domestic sector excluding the Riksbank respectively based on the IIP data and the SNDO's issuance statistics. The figure indicates that the ownership share of foreign and domestic investors declined in tandem as the Riksbank increased its ownership share during 2015 and 2017 but that the foreign ownership share has declined steeply since 2021.

**Figure 3. Holdings of government and public bonds issued by the SNDO by sector as reported in the Financial Accounts**

SEK billion



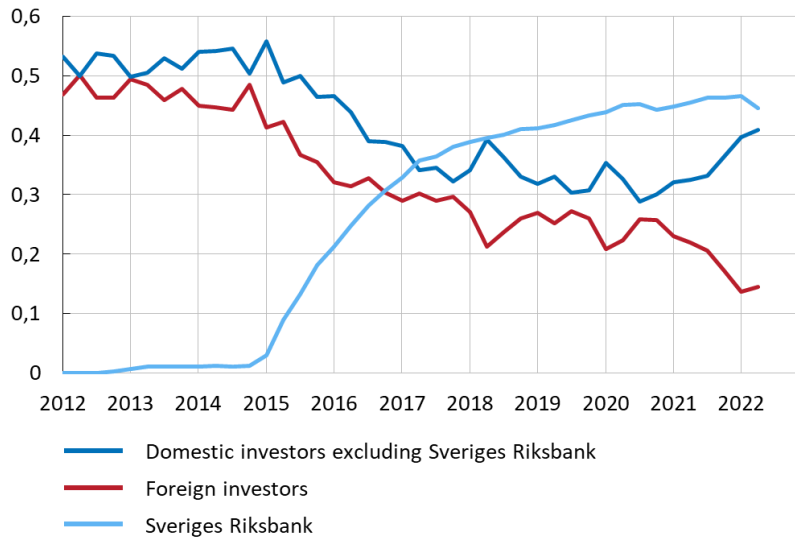
Note: The data include holdings of government bonds issued in Swedish krona and public bonds in foreign currency by the SNDO. There is a break in 2019 Q1 when the securities statistics in the Financial Accounts were harmonised with VINN and permitted short positions.

Source: Statistics Sweden.

#### 4.1 Riksbank Swedish government bond purchases 2015 to 2017

Of the Riksbank's net purchases of government bonds for roughly 300 billion between 2015 to 2017 (nearly 350 billion in market value terms), the foreign and domestic sector each accounted for roughly half of the sales (see Figure 5). Net issuance was modest. The Riksbank's ownership share rose to just under 40 per cent of the outstanding stock of government bonds while the respective shares of the foreign and domestic sectors each fell by about 20 percentage points over this period (see Figure 4).

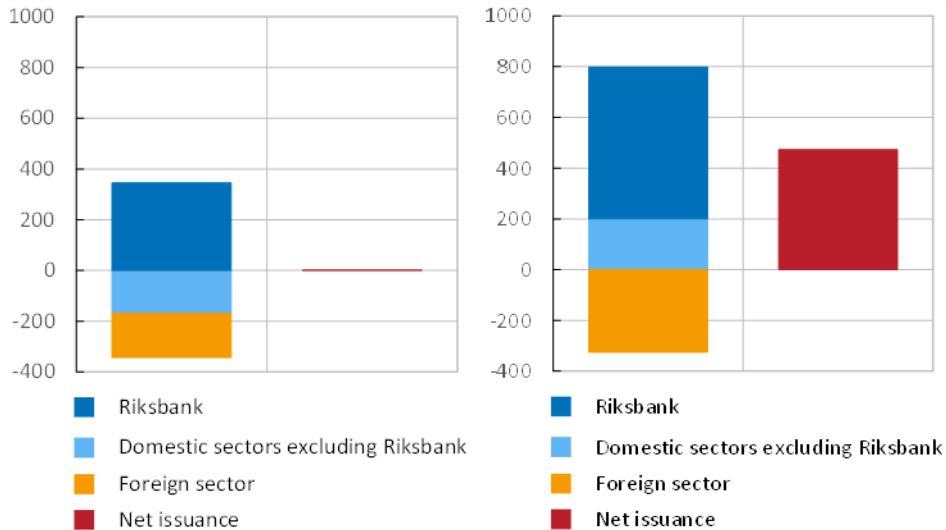
**Figure 4. Holdings of government bonds issued by the SNDO by sector**  
Share of outstanding government bonds issued by the SNDO



Note. The holdings of the domestic sector excluding the Riksbank are calculated as the market value of outstanding government bonds reported by the SNDO minus foreign investors' holdings of government bonds as reported in the IIP.

Source: Statistics Sweden and the SNDO.

**Figure 5. Change in government bond holdings by sector during the Riksbank bond-purchase programs**  
SEK billion



Note. The left panel shows changes in sectoral holdings and net issuance of Swedish government bonds between 2014 Q4 and 2017 Q4 based on IIP data and the SNDO's data on outstanding debt. The right panel shows changes in sectoral holdings and net issuance between 2019 Q4 and 2021 Q4 of government-, municipal-, mortgage covered- and non-financial corporate bonds issued in Swedish krona reported in VINN.

Source: Statistics Sweden and Sveriges Riksbank.

During the initial year of purchases, 2015, the foreign sector shed government bonds rapidly and at a faster than the domestic sector before slowing in 2016 and 2017. Ownership shares varied somewhat during 2018 and 2019 but seen to the end of 2019, which includes the period of reinvestment of the portfolio, the two sectors sold a roughly similar value of bonds to the Riksbank. This is despite the ownership share of foreign investors being on average 10 percentage points lower than the domestic share.

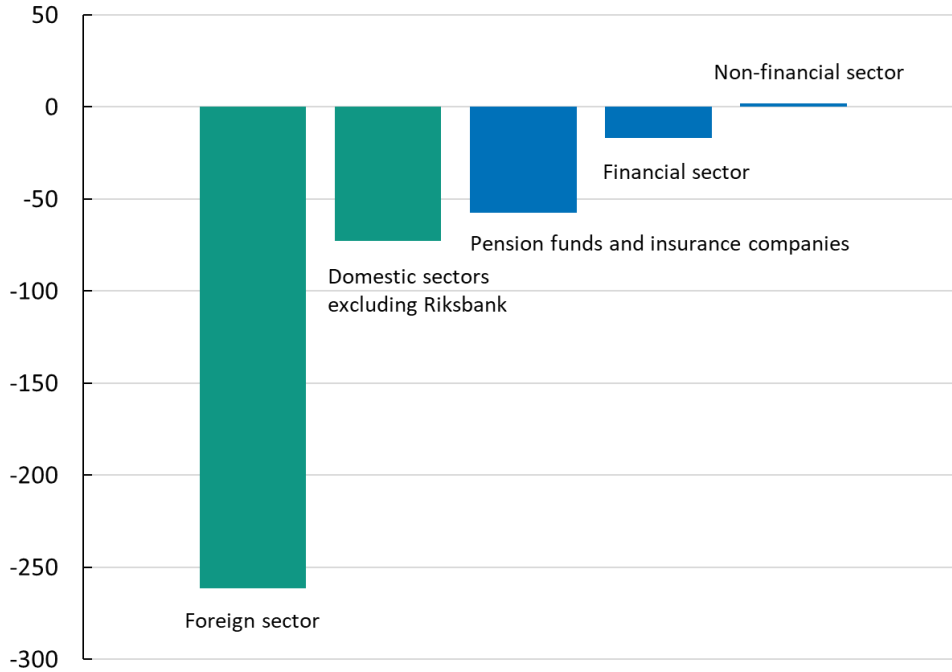
The Financial Accounts attribute three quarters of sales of government bonds to the Riksbank between 2015 and 2017 to foreign investors.<sup>16</sup> Indeed, the foreign sector is reported to have sold 40 per cent of its holdings as of 2014 Q4. Among domestic investors, insurance companies and pension funds were the primary sellers of government bonds (see Figure 6). Even though the absolute value of government bonds sold by the financial sector was modest, the financial sector sold 15 per cent of its initial 2014 Q4 holdings, a similar propensity to the insurance and pension sector. Recall, however, that the Financial Accounts prior to 2019 report only long positions. Domestic sectors' short positions were likely increasing during this period – in particular banks' – so the amounts shown in Figure 6 likely underestimate the sales of domestic investors and overestimate the sales of foreign investors.

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<sup>16</sup> The foreign sector's holdings of public bonds issued in foreign currency increased somewhat during 2015 to 2017, by about 30 billion according to the IIP data. Thus the decline in the foreign sector's holdings of bonds issued by the SNDO reported in the Financial Accounts reflects a decline in holdings specifically of government bonds issued in Swedish krona.

**Figure 6. Change in holdings of Swedish government and public bonds issued by the SNDO by sector**

SEK billion, change from 2014 Q4 to 2017 Q4



Note: The blue bars show changes in the holdings of domestic pension funds and insurance companies and the domestic financial and non-financial sectors and sum to the green bar which shows the change in holdings of the Swedish domestic sector excluding the Riksbank. The data are from the Financial Accounts.

Source: Statistics Sweden.

## 4.2 Pandemic bond purchases 2020 to 2021

During the covid-19 pandemic, foreign investors continued to be the dominant net sellers of the bonds that the Riksbank purchased (see Figure 5). The Riksbank's bond holdings increased by approximately 600 billion between 2020 and 2021.<sup>17</sup> Domestic investors also increased their holdings by about 200 billion. In part these increases absorbed new issuance, in part the foreign sector sold approximately 300 billion.

Foreign investors continued to sell government bonds, extending the decline in the foreign sector's ownership share sharply from 2021 as seen in Figure 4.<sup>18</sup> Foreign investors also on net sold municipal and covered bonds (Figure 7) with more than half of the Riksbank's purchases of covered bonds sold by foreign investors. Moreover, foreign investors sold a much larger share of their holdings than did the domestic

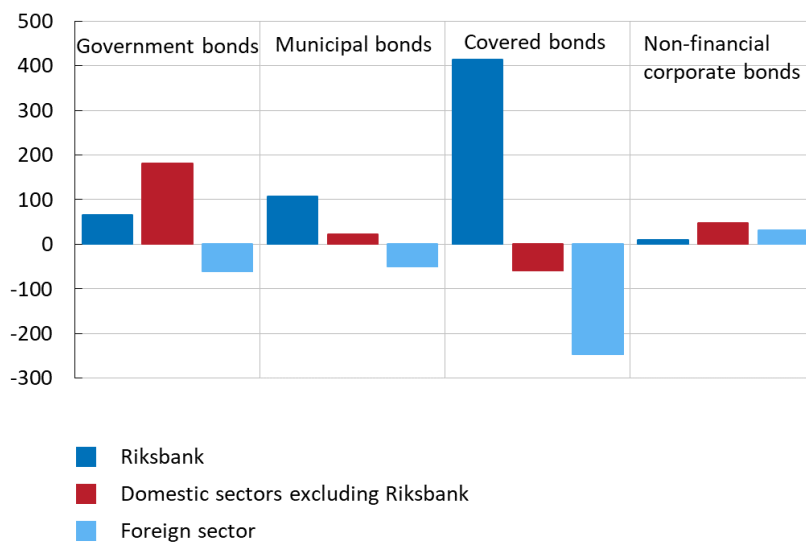
<sup>17</sup> The Riksbank purchased bonds, bill and certificate for a nominal value of 700 billion from March 2020 to the end of 2021. The change in the bond holdings shown in Figure 5 is only 600 million. The difference owes to maturing bonds and that the bill and certificate programs were also included in purchases for 700 billion.

<sup>18</sup> Foreign investors have anecdotally been more active in supplying government bonds to domestic investors in short-term repo transactions as bonds have become scarcer and interest rates on repo transactions have fallen. As explained above, because bonds sold in repo transactions continue to be recorded on the balance sheet of the original owner of the bond, the decline in foreign ownership is not attributable to this possible increase in repo activity.

sector. The foreign sector sold 40 per cent of its 2019 Q4 holdings of Swedish government and municipal bonds (issued in Swedish krona) and 50 per cent of its holdings of covered bonds issued in Swedish krona. In contrast, domestic investors increased their holdings of government and municipal bonds and sold just 4 per cent of their initial holdings covered bonds. Net issuance of non-financial corporate bonds increased during the pandemic and all sectors increased their holdings. The increase in the foreign sector's holdings of non-financial corporate is modest but indicates a small shift toward a riskier asset class in Sweden.

**Figure 7. Change in holdings of bonds by sector and by issuer type**

SEK billion, change from 2019 Q4 to 2021 Q4



Note. The figure shows the change in holdings of bonds issued in Swedish krona as reported in VINN. Municipal bonds include bonds issued by Kommuninvest, municipalities and regions.

Source: Statistics Sweden and Sveriges Riksbank.

### 4.3 Econometric analysis of government bond sales

In this section I investigate the relationship between the Riksbank's purchases of government bonds, bond supply and the propensities of sectors to sell bonds.

I follow Carpenter et al. (2015) and estimate a regressions in which the dependent variable is the change in the government bond holdings of a given sector and the key independent variable is the change in the Riksbank's net bond purchases. I also control for changes in the outstanding stock of government bonds, other financial variables and include an autoregressive term. The benchmark estimation takes the following form:

$$d(holding_i)_t = \alpha + \beta_1 d(holding_i)_{t-1} + \beta_2 d(holding_{RB})_t + \beta_3 d(outstanding)_t + \varepsilon_t, \quad (1)$$

where  $i$  is an index for the sector that indicates the foreign sector, the domestic sector as a whole excluding the Riksbank, and the three domestic subsectors

described earlier. The regressors  $d(holding_{RB})$  and  $d(outstanding)$  are the quarterly change in the Riksbank's holdings of Swedish government bonds and the change in outstanding bonds issued by the SNDO. The regressions are estimated on quarterly changes on data in the Financial Accounts from 1996 Q1 to 2022 Q2 because of its long data history and on data from the IIP from 2006 Q1 to 2022 Q2.

### Figure 8. Propensity to sell government bonds in response to the Riksbank's purchases

Coefficient estimates of  $\beta_2$  and long-run coefficient from equation (1)



Note: . The figure show the point estimate of  $\beta_2$  in blue, the 95 per cent confidence interval as a grey line and the long-run coefficient in orange. Regressions estimated with quarterly data from the Financial Accounts from 1996 Q3 to 2022 Q2.

For estimations with the Financial Accounts data, a dummy variable  $Dummy_{2019\ Q1,t} = 1$  in 2019 Q1 accounts for the methodological change in that quarter that causes a one-off jump in the differenced data. The main coefficient estimates are shown in Tables 1 and 2 in the Appendix.

#### 4.3.1 Foreign investors adjust their bond holdings by more than domestic investors

Figure 8 presents the estimates of coefficient  $\beta_2$ , which measures the degree to which sector  $i$ 's holdings of government bonds adjust in conjunction with the Riksbank's purchases of government bonds that quarter. The figure also shows the implied long-run coefficient from taking into account the distributed lag structure of the equation.<sup>19</sup> We can make several observations from the coefficient estimates.

First, the sign of the coefficients is intuitive – each sector reduces its holdings of government bonds as the Riksbank increases its holdings. The foreign sector sells

<sup>19</sup> The auto-regressive nature of equation (1) means that the long-run effect of a regressor is measured as its coefficient scaled by one minus the coefficient on the lagged dependent variable,  $\beta_j/(1 - \beta_1)$ .



government bonds to a greater extent than domestic sectors. For each 100 billion that the Riksbank increases its holdings of government bonds, the foreign sector is estimated to ultimately sell 69 billion while the domestic sector sells SEK 25 billion.<sup>20</sup> Among the domestic subsectors, insurance companies and pension funds are the primary sellers, selling 17 billion for each 100 billion that the Riksbank purchases. Estimates are smaller and less precise for the financial and non-financial sectors indicating that investors in these sectors are relatively inelastic to the Riksbank's purchases.

Second, the foreign sector also absorbs more of the variation in the stock of than the domestic sector. For each 100 billion increase in the outstanding stock of bonds, the foreign sector absorbs 54 billion and the domestic sector absorbs 39 billion. Among the domestic subsectors, Swedish insurance companies and pension funds account for most of this response and adjust their holdings by 28 billion, the financial sector by 9 billion and the non-financial sector by 4 billion.

Third, the point estimates in Table 1 indicate that foreign investors reduce their holdings of government bonds more in response to the Riksbank purchases than to changes in the supply of government bonds. The reverse is true of the domestic sector. However, one cannot reject the null hypothesis that the coefficient on the Riksbank's purchases is in fact equal to that on the outstanding stock. In other words, investors respond to changes to the free float whether it is due to Riksbank purchases or a change in the outstanding supply of SNDO debt.<sup>21</sup>

#### 4.3.2 Results are robust to financial controls and other data sources

As shown in the box on page 87 between 10 and 25 per cent of bonds issued by the SNDO over this sample have been issued in foreign currency and the foreign sector almost exclusively holds these bonds. The Financial Accounts lump together government bonds issued in Swedish krona and public bonds issued in foreign currency so the dependent variable in equation (1) contains both components. Given that my focus is on how sectors have rebalanced their holdings of the government bonds issued in Swedish krona, I use issuance data from the SNDO to separate for government bonds issued in Swedish krona from public bonds issued in foreign currency and include these as separate regressors. This shortens the sample slightly as the necessary data is available from 2002 Q1. The results are shown in panel 2 of Table 1. As expected, the foreign sector's long-run coefficient on foreign currency bonds is close to 1 and including this variable moderates the estimated response of the foreign sector to changes in the supply of Swedish krona issued government bonds.

A further extension is to control for financial variables which might influence the extent of portfolio rebalancing. To capture international conditions, I include the average of the two-year bond spread between Sweden, the US and Germany and the average USDSEK and EURSEK exchange rate. I also include a measure of option-based

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<sup>20</sup> The coefficient point estimates do not add up exactly to 1 but the standard errors around the coefficients permit this interpretation.

<sup>21</sup> Free float denotes the stock of bonds available for trading in the marketplace.

volatility, the VIX, to control for periods of heightened financial volatility. For domestic control variables I include the slope of the Swedish government yield curve (10 year to 3 month), a proxy for BBB corporate bond spreads (I use euro area 5 year BBB bond spreads) and the Riksbank's pandemic purchases of municipal, covered and corporate bonds. Coefficient estimates are shown in the third panel of Table 1.

Among the financial variables which are included, I highlight the coefficient on the VIX. For the foreign sector, the coefficient is negative, indicating that in periods of financial volatility, foreign investors sell Swedish government bonds. For a 10 point increase in the VIX, the foreign investors reduce their holdings of Swedish government bonds by 13 billion SEK while domestic investors increase their holdings by approximately the same amount. For context, the VIX rose by 20 points during the height of the pandemic in the spring of 2020. The sign of the coefficients is consistent with capital outflows by foreign investors during times of financial turbulence.

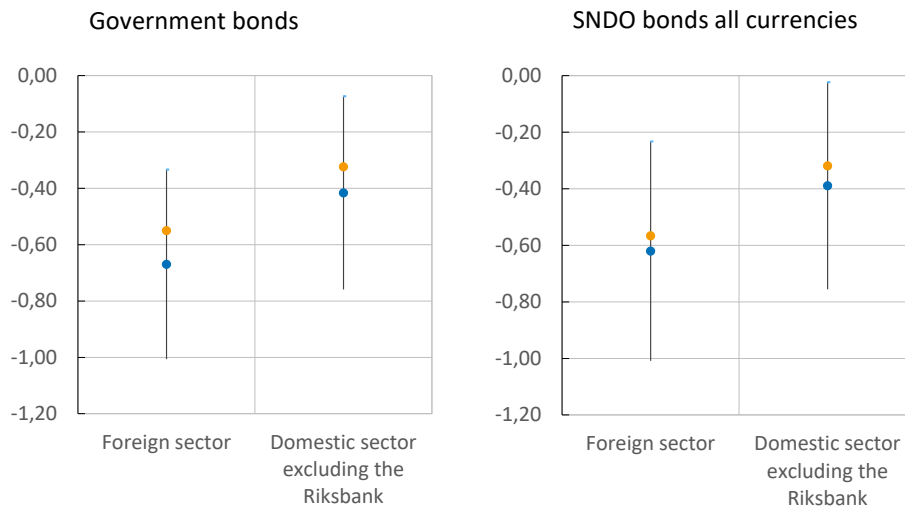
The key results are robust to these different specifications. In all specifications, the foreign sector shows a greater propensity than the domestic sector to reduce its holdings in response to the Riksbank's purchases. In two of three specifications it also adjusts its holdings to the outstanding stock by more than the domestic sector. Insurance companies and pension funds are the dominant seller among the domestic investors. The results are also very similar when estimated on the transaction data in the Financial Accounts net of market valuation effects.

I also conduct the same regression as in equation (1) on a shorter sample of government bond holdings using IIP data and issuance data from the SNDO to isolate holdings of government bonds (that is, bonds issued by the SNDO in Swedish krona). Figure 9 illustrates the coefficient estimates and implied long-run coefficients on the Riksbank's government bond purchases and Table 2 reports the coefficient estimates.

Foreign investors display a more elastic response to the Riksbank's purchases than do domestic investors, confirming the results from the longer sample of Financial Accounts data. The coefficients are statistically significantly different from zero, however, the difference between the coefficients for the two sectors is less pronounced and their confidence intervals overlap. This may reflect the shorter time period for the estimation but may also reflect the fact that the IIP captures the net of short and long positions.

Other factors than those in the regressions surely also play a role in determining a sector's government bond holdings. For example, the liabilities of pension funds and insurance companies, regulations affecting incentives for banks to hold bond inventories, and the risk mandates of investment funds to name just a few. However, with scant information about foreign-sector investors, it is difficult to incorporate these factors.

Figure 9. Coefficient estimates of  $\beta_2$  and long-run coefficient from equation (1)



Note. The figures show the point estimate of  $\beta_2$  in blue, a 95 per cent confidence interval as a grey line, and the long-run coefficient in orange. Regressions are estimated with data from the IIP and SNDO. The left panel shows the coefficient estimates in Panel A of Table 2. The right panel shows the coefficient estimates in Panel B of Table 2.

## 5 How has the foreign sector rebalanced its portfolio of Swedish financial assets?

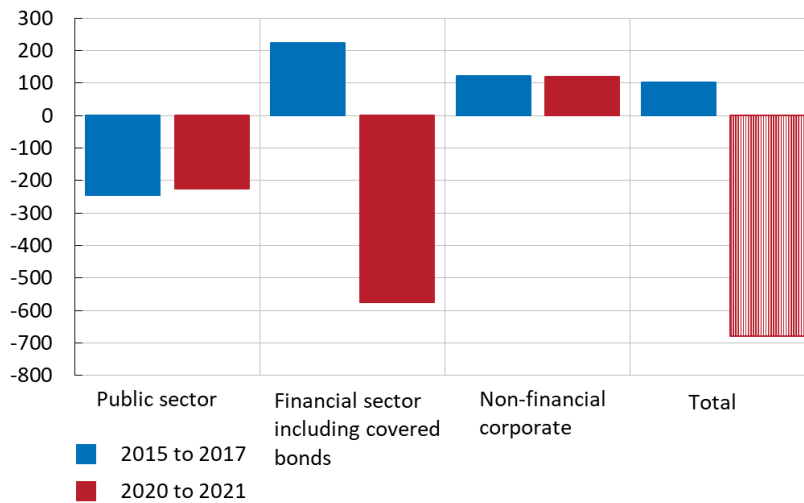
So far our focus has been on who has sold bonds to the Riksbank. In light of the pronounced role of the foreign sector, how has the foreign sector rebalanced its portfolio in light of its bond sales? Investors displaced from government bonds can rebalance their portfolios along the risk spectrum of Swedish assets or reallocate to alternative investments abroad.

Looking first at the foreign sector's portfolio of Swedish bonds issued in both Swedish krona and foreign currency, Figure 10 illustrates this portfolio grouped into three broad classes – public sector bonds, financial sector bonds including covered bonds, and non-financial corporate bonds. The blue bars are observations for 2015 to 2017, the orange bars for the pandemic episode. The shaded bars to the right show the change in the total bond portfolio.

During 2015 to 2017, sales of public sector bonds (in this case exclusively government bonds) were more than offset by investments in bank, covered and corporate bonds. In other words, foreign investors rebalanced their portfolios toward slightly riskier Swedish bonds. The 2020-2021 episode is somewhat different. Sales of public sector bonds were comparable to the earlier episode, as was reallocation into corporate bonds. However, heavy sales of covered bonds were not fully reinvested in other types of Swedish bonds and as a consequence the foreign sector's total portfolio of Swedish bonds declined.

**Figure 10. How has the foreign sector rebalanced its portfolio of Swedish bonds?**

SEK billion



Notes. Swedish bonds issued in all currencies from the Financial Accounts. Changes are calculated as follows: 2015 to 2017 is calculated as the change between 2014 Q4 and 2017 Q4; 2020 to 2021 as the change from 2019 Q4 to 2021 Q4. The public sector includes central government and municipalities. Financial sector bonds are bonds issued by financial companies including banks, institutions that issue mortgage covered bonds and other financial companies. Corporate bonds are those issued by non-financial firms. For 2020 to 2021, bonds issued by *Kommuninvest* are included in the Public Sector category, not in the Financial Sector.

Source: Statistics Sweden

Seen from a bigger perspective, the foreign sector's gross financial assets in Sweden increased during 2020 and 2021, largely due to investments in non-financial corporate loans and equity. Indeed since the beginning of 2015, the foreign sector has notably reweighted its portfolio of Swedish assets towards bonds, loans and especially equity in non-financial firms. Whether this development is specifically related to portfolio rebalancing in light of the Riksbank's bond purchase programs or reflects a general international search for yield in a low-interest rate environment we can only speculate about. These descriptive statistics need to be complemented with a systematic econometric analysis to draw firm conclusions.

## 6 Conclusions and further research

A recurring theme throughout this analysis is that foreign investors have actively sold the bonds that the Riksbank has purchased. Taken as a whole, foreign investors' government bond holdings appear more elastic with respect to the supply of bonds and to the Riksbank's purchases than domestic investors. There are several possible reasons for this.

Foreign investors in Swedish bond markets may, on average, have weaker preferred-habitat behaviour than domestic investors. While I have treated the foreign sector as

one entity, the foreign sector in truth consists of a disparate collection of investors. Investors include pension funds, insurance companies and sovereign wealth funds who are typically thought of as less flexible investors due to liability-matching requirements and mandates that dictate acceptable risk-taking and diversification. But the foreign sector also includes banks who maintain bond inventories for their own and customer trading, and investment and hedge funds who face fewer regulatory constraints and enjoy more scope to seek returns and arbitrage opportunities.

According to indicative data compiled by the IMF on international investment portfolios, about a quarter of the Swedish debt securities held by the foreign sector are held by insurance and pension funds.<sup>22</sup> By comparison, nearly one half of Swedish debt securities held by the Swedish domestic sector are held by insurance companies and pension funds.<sup>23</sup> This difference in composition may lead to different behaviour in the aggregate.

Another possible reason is that from the perspective of an international investor, bonds issued in other countries may be close substitutes for Swedish bonds. Swedish bonds share many of the attributes of bonds of close neighbouring countries in terms of credit rating, return and market liquidity. That a foreign investor is investing in Swedish securities indicates that it has the operational ability and risk mandate to invest in international markets, lowering the threshold to rebalance from one country to another.

Home bias may also drive the tendency of Swedish investors to be relatively inelastic bond holders. Koijen et al. (2017) document home bias in holdings of government bonds across euro area countries and investor sectors. Similarly, risk-averse foreign investors may withdraw from Swedish assets and reduce exposure to the Swedish krona exchange rate during periods of heightened financial risk and uncertainty.

What are the implications of the differences in investor behaviour? According to the theoretical model put forward by Kabaca (2016), interest rate and exchange rate responses to domestic bond purchases are attenuated when investors readily substitute domestic bonds for foreign bonds. But seen from the other direction, this suggests that the less elastic behaviour of the domestic sector may have played an important role for the decline in Swedish interest rates in conjunction with bond purchases. Moreover, for Sweden there is some evidence that the foreign sector has rebalanced its portfolio toward riskier Swedish assets, in particular those of the non-financial sector, which is arguably the intended and desirable expansionary flow-on effect of bond purchases.

There are several avenues for further research. The time-series analysis in this paper could be augmented with methods such as local projection analysis to estimate

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<sup>22</sup> Data sourced from the Coordinated Portfolio Investment Survey conducted by the IMF, data observation December 2021. Data on investor type is available for only eight countries but together these account for 60 per cent of the foreign sector's holdings of securities emitted by Swedish entities.

<sup>23</sup> Data from VINN, December 2021. This in part reflects the large scale of the collective pension savings system in Sweden (Nilsson et al. 2014).

impulse response functions of sectoral bond holdings. Another promising avenue of research is to fully exploit the micro data in the VINN dataset to explore portfolio rebalancing at the investor level. While the time series dimension of the dataset is short, the cross-sectional richness allows panel estimation of the portfolio rebalancing response to the pandemic bond purchases.

Lastly, the implications for the exchange rate of the foreign sector's role in the transmission of bond purchases is unclear. Theoretically, their presence may attenuate the exchange-rate response because of the high elasticity with which they sell domestic assets. But the capital outflows may bring about more exchange rate depreciation than would occur otherwise. Ultimately the question is an empirical one and the literature on capital flows and exchange rates could be a fruitful starting point to explore the role of the foreign sector's sales of bonds for the exchange rate.

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## APPENDIX – Econometric analysis of government bond holdings by sector and the Riksbank's bond purchases

**Table 1. Coefficient estimates of equation (1) with data from the Financial Accounts**

Coefficient estimates, standard errors and long-run coefficients

	Foreign sector	Domestic sectors excluding Riksbank	Pension funds and insurance companies	Financial sector	Non-financial sector
<b>Panel A: Equation 1, 1996 Q3 to 2022 Q2</b>					
Riksbank purchases, $\beta_2$	-0,76***	-0,26**	-0,15**	-0,09	-0,01
$\beta_2/(1 - \beta_1)$	-0,69	-0,25	-0,17	-0,07	-0,01
Outstanding stock, $\beta_3$	0,60***	0,42***	0,25***	0,11***	0,04***
$\beta_3/(1 - \beta_1)$	0,54	0,39	0,28	0,09	0,04
<b>Panel B: Equation 1 controlling for public bonds issued in foreign currency, 2002 Q2 to 2022 Q2</b>					
Riksbank purchases, $\beta_2$	-0,65***	-0,35***	-0,13***	-0,15	-0,05
$\beta_2/(1 - \beta_1)$	-0,62	-0,31	-0,13	-0,13	-0,04
Outstanding stock, $\beta_3$	0,48***	0,53***	0,25***	0,19***	0,06*
$\beta_3/(1 - \beta_1)$	0,45	0,46	0,25	0,16	0,06
Foreign currency bonds, $\beta_4$	1,21***	-0,25	-0,13	-0,08	-0,04
$\beta_4/(1 - \beta_1)$	1,15	-0,22	-0,12	-0,07	-0,03
<b>Panel C: Equation 1 controlling for public bonds issued in foreign currency and financial variables, 2002 Q2 to 2022 Q2</b>					
Riksbank purchases, $\beta_2$	-0,66***	-0,32**	-0,15***	-0,10	-0,02
$\beta_2/(1 - \beta_1)$	-0,59	-0,27	-0,15	-0,08	-0,02
Outstanding stock, $\beta_3$	0,52***	0,47***	0,25***	0,14	0,05*
$\beta_3/(1 - \beta_1)$	0,47	0,39	0,24	0,11	0,05
Foreign currency bonds, $\beta_4$	1,11***	-0,16	-0,10	-0,01	-0,03
$\beta_4/(1 - \beta_1)$	0,98	-0,14	-0,10	-0,01	-0,03
d(VIX)	-1,36***	1,29***	0,15	1,00**	0,20
$\beta_{VIX}/(1 - \beta_1)$	-1,21	1,08	0,14	0,76	0,19

Note. The dependent variable is the quarterly change in sector  $i$ 's holdings of Swedish government bonds (all currencies) expressed in SEK billion. The stars indicate the significance of the estimate coefficient where \* indicates significance at the 10 per cent level, \*\* at the 5 per cent level and \*\*\* at the 1 per cent level. The table also reports long-run coefficients, which are the regression coefficient estimates scaled by 1 minus the coefficient on the lagged dependent variable.

**Table 2. Coefficient estimates with data from the IIP and SNDO**

Coefficient estimates, standard errors and long-run coefficients

	Foreign sector	Domestic sector excluding Riksbank
<b>Panel A: Equation (1) estimated on holdings of government bonds, 2006 Q3 to 2022 Q2</b>		
Riksbank purchases, $\beta_2$	-0,67***	-0,42**
$\beta_2/(1 - \beta_1)$	-0,55	-0,32
Outstanding stock, $\beta_3$	0,57***	0,46***
$\beta_3/(1 - \beta_1)$	0,47	0,36
<b>Panel B: Equation (1) estimated on holdings of government and public bonds controlling for public bonds issued in foreign currency, 2006 Q1 to 2022 Q2</b>		
Riksbank purchases, $\beta_2$	-0,62***	-0,39**
$\beta_2/(1 - \beta_1)$	-0,57	-0,32
Outstanding stock, $\beta_3$	0,53***	0,49***
$\beta_3/(1 - \beta_1)$	0,49	0,40
Foreign currency bonds, $\beta_4$	0,86***	0,08
$\beta_4/(1 - \beta_1)$	0,78	0,06

Note. The dependent variable is the quarterly change in sector  $i$ 's holdings of Swedish government bonds (all currencies) expressed in SEK billion. The stars indicate the significance of the estimate coefficient where \* indicates significance at the 10 per cent level, \*\* at the 5 per cent level and \*\*\* at the 1 per cent level. The table also reports long-run coefficients, which are the regression coefficient estimates scaled by 1 minus the coefficient on the lagged dependent variable.