

The Interaction Between Domestic Monetary Policy and Macroprudential Policy in Israel*

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Abstract

We examine the impact of domestic macroprudential (MaP) policy measures targeted at the banking sector, alongside the impact of domestic monetary policy on housing, consumer, and business bank credit dynamics, using individual bank panel data for the period 2004–19. We find that domestic MaP measures targeting housing sector credit reduced the growth rate of housing credit and contributed to business credit growth. Other general MaP measures reduced growth of credit to the business sector. Monetary policy was generally found to be effective, with a significant negative impact on bank credit before the Global Financial Crisis. The interaction between monetary policy and MaP highlights the role of monetary policy after 2008, and the effect of accommodative monetary policy on consumer and business credit fostered by housing MaP measures. We found that the impact of foreign monetary policy on credit growth is negative, as is the impact of domestic monetary policy, suggesting its capacity to function as a leading indicator for domestic monetary policy.

Keywords: financial stability, policy evaluation, banking sector, credit markets, regulation, global financial crisis.

JEL Classification: E51, E52, E58, G01, G21, G28.

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1 Introduction

This paper analyzes the effects of domestic monetary policy and macroprudential (MaP) policy on domestic bank credit. We analyze policies undertaken in Israel between 2004 and 2019, while referring to the potential effects of global monetary policy. Home prices have more than doubled since 2008, alongside a substantial increase in housing credit (mortgages). This development, which may pose a significant risk to the financial sector and particularly to the banking sector, triggered several macroprudential measures targeted at the banks. Therefore, we chose to analyze the effects of monetary policy on the housing, consumer (nonhousing) and business sector credit separately.

We find that domestic MaP measures affected credit markets differently. We show that the domestic MaP measures targeted at housing sector credit reduce the growth rate of housing credit. MaP measures targeted at reducing banks' credit concentration decreased credit growth to the business sector. Monetary policy was generally found to be effective, with a negative impact on housing and consumer credit, both before and after the global financial crisis (GFC). The interaction between monetary policy and MaP had an unclear effect on credit growth. In addition, we found that the impact of foreign monetary policy on housing and consumer credit growth is negative, similar to the impact of domestic policy, suggesting its ability to lead domestic monetary policy, while its effect on the growth of business sector credit is positive.

The use of MaP measures has expanded following the GFC. The theoretical literature based on DSGE models supports the view that MaP measures can dampen credit cycles. Kannan et al. (2012) demonstrated by using a DSGE model with a housing sector that monetary and macroeconomic policies can help stabilize the economy, given the shocks that hit the economy. When financial or housing demand shocks drive the credit and the housing boom, MaP measures can mitigate them and improve welfare. However, in contrast, the optimal response to a shock to productivity is to avoid MaP measures. Nevertheless, DSGE models offer limited empirical guidance on the influence of the interaction between MaP and monetary policy on credit cycles. We aim to assess these empirical linkages.

The interaction between monetary policy and MaP policy was found to be insignificant in the literature (IMF, 2013; Aiyer et al., 2014; Dell'Ariccia et al., 2012). De Marco and Wieladek (2016) found for the UK that tightening monetary policy and MaP measures reinforced each other, but only for small banks. Similarly, Forbes et al. (2017) found that monetary policy can amplify the impact of regulatory measures. In contrast, De Jonghe et al. (2020) found a trade-off between monetary policy and regulatory capital requirements in the case of Belgium—the effect of monetary expansion on credit supply is more limited as banks' capital requirements are higher. Cerruti et al. (2017) found that the effectiveness of MaP measures on credit growth is lower in advanced economies that tend to have alternative sources of non-bank credit and more open economies that tend to enable borrowers to obtain funds from across the border.

Gambacorta et al. (2020) examined the effect of domestic MaP measures on domestic credit through an empirical exercise similar to ours. Unlike our estimation, they used granular information on bank loans at the firm level from eight different

countries. They found that MaP measures have been successful in easing credit cycles and reducing banking sector risk. They also found that bank-specific characteristics influence the impact of MaP on credit. Finally, they find that MaP measures that reinforce monetary policy (i.e., in the same direction of influence) are relatively more effective.

Everett et al. (2021), which was part of the 2018 International Banking Research Network (IBRN) project contributed to the literature with Dutch and Irish data. They employ a similar methodology to the one we adopt, examining the effect of monetary policy and macroprudential policy, and the interaction between them, on domestic mortgage lending. In both countries, the banking sector is relatively concentrated, with the seven largest banks accounting for about 80 percent of all retail bank assets. As both Ireland and the Netherlands are small economies in the euro system, monetary policy shocks may be referred to as exogenous to these two countries. Like Israel, Ireland and the Netherlands have employed various macroprudential measures in the last decade against the background of rapid increases in home prices. Everett et al. (2021) complemented their analysis with the use of confidential bank-level data for domestic lending. They find that domestic monetary policy shocks reduced mortgage lending growth in both countries, while prudential regulations mitigated this effect only in Ireland but not in the Netherlands. They find only weak evidence for an international lending channel: no significant effect of foreign (US, UK) monetary policy shock, with or without interaction with the MaP measures, is found on mortgage lending for Ireland, while weak evidence that tightening monetary policy in the UK reduces mortgage lending is found for the Netherlands.

Another paper in the 2018 IBRN project studies the interaction between macroprudential policy and monetary policy in Norway and Sweden (Cao et al., 2021) and finds evidence that aggregate macroprudential policy depresses aggregate lending, although different types of MaP steps do not lead to significantly different effects. Bussière et al. (2021) summarize the main findings of seven papers of the 2018 IBRN project. Most of these papers relate mainly to macroprudential policies targeted at capital flows and the possible spillovers from monetary policies in core economies to recipient economies. The findings show that macroprudential policies in recipient countries can partly offset monetary policy spillover effects in the core (large) economies. Bussière et al. (2021) also remarked that the impact differs considerably across macroprudential policy instruments, suggesting the importance of granular analysis.

The remainder of the paper is organized as follows. Section 2 briefly presents the economic background and the Israeli environment. Section 3 describes the data used in Section 4 for the estimations and results. Section 5 concludes. The Appendix presents additional results.

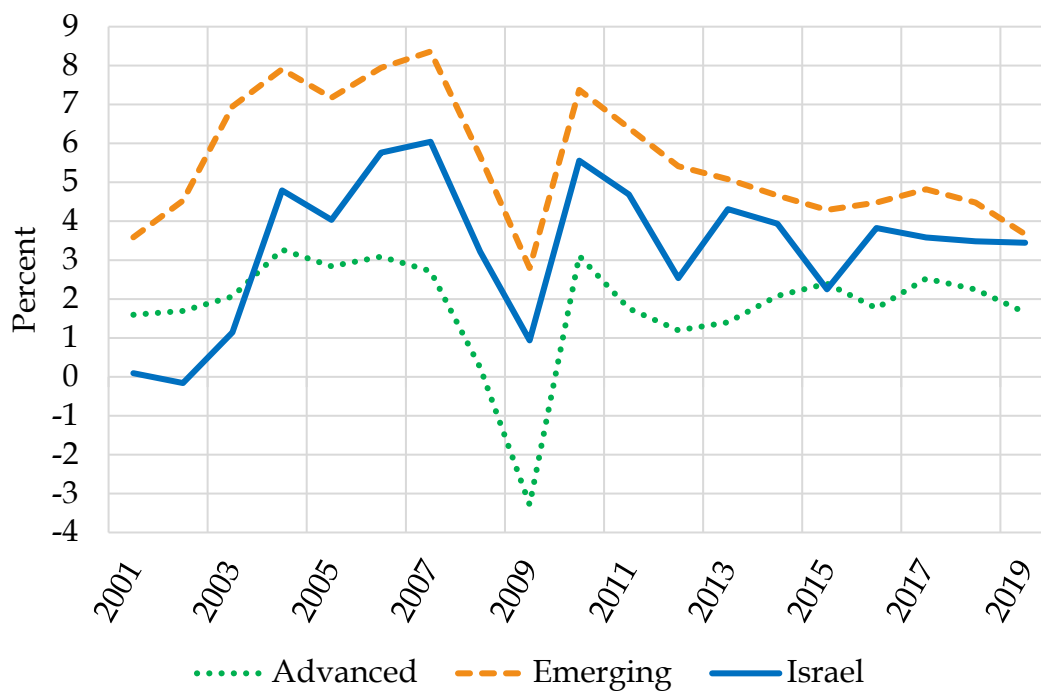
2 Economic Background

2.1 Macroeconomic Background

Since the beginning of the new millennium, and in particular after 2003, the Israeli economy has enjoyed a relatively stable macroeconomic environment, characterized

by high growth rates and price stability. The economy was hit during these years by two major crises. The first, at the end of 2001, was due to the dot.com global crisis coupled with geopolitical hostilities. The second was the GFC, which the Israeli economy weathered quite well, experiencing only a short period of slowdown at the end of 2008 and the beginning of 2009 before returning to growth rates close to its potential in the second half of 2009 (Figure 1).

Figure 1: Annual GDP Growth in Israel and Advanced and Emerging Economies



Notes: Annual GDP growth in percentage points. Sources: Bloomberg and Central Bureau of Statistics.

Compared with the adverse effect of the crisis on advanced economies overall, Israel suffered relatively mildly, more akin to the experience of developing economies. In particular, the crisis had a limited and moderate effect on Israel’s financial system, and the financial institutions remained stable. The factors contributing to the relatively mild effect of the GFC on Israel include a conservative financial system and in particular, a conservative and closely supervised banking system, a balanced housing market, and a successful economic – both fiscal and monetary – policy.

In the last decade, the Israeli economy has been growing at an average rate of about 3 percent¹, enjoying a record-low unemployment rate with a tight labor market. Growth has been driven by a steady increase in private consumption at annual rates of about 3—5 percent, with exports catching up in the last two years, primarily high-tech services and, to a much lesser extent, goods exports. As a small open economy, Israel’s real activity is substantially influenced by the global economy, and its exports in particular are affected by the development of global trade.

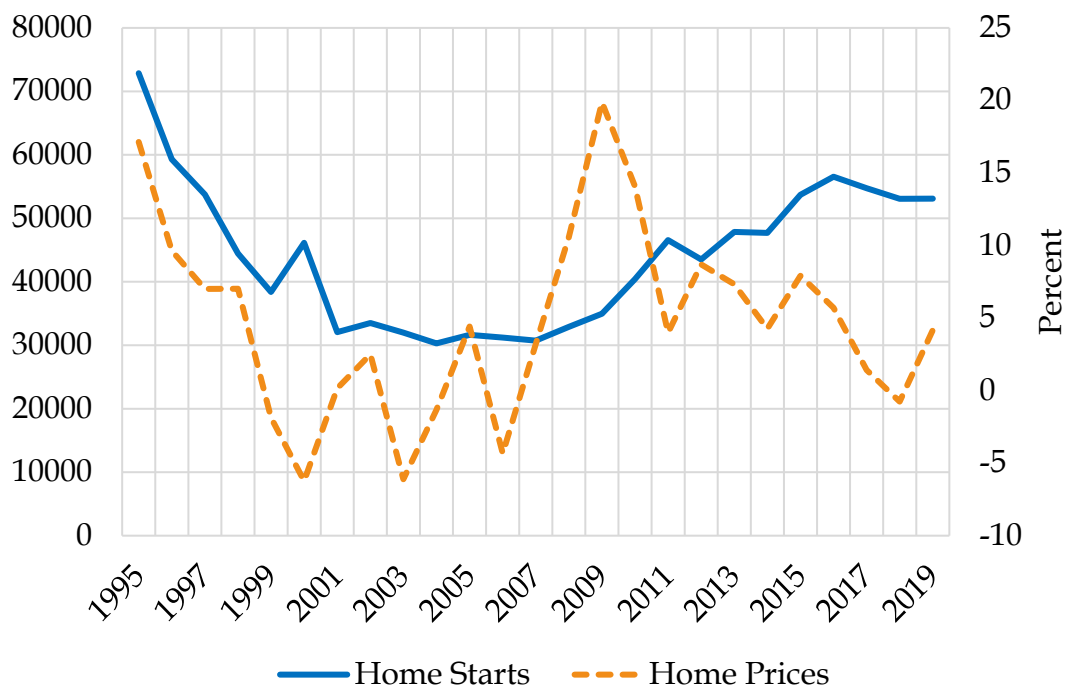
¹ Israel's annual population growth is about 1.7 percent.

Since the beginning of the 2000s, Israel has enjoyed low inflation rates. Inflation is at a low single-digit rate, similar to many other advanced economies, within the framework of an inflation targeting regime. Since 2003, the target range has been set between 1 and 3 percent, and actual inflation fluctuates around this target range. In recent years, inflation has been lower than the target, and monetary policy is generally characterized as accommodative (see details in Section 2.4). Forces affecting the domestic inflation rate are a tight labor market with a substantial increase in nominal wages, and, at the same time, structural changes led by increased competition and greater exposure to e-commerce. Domestic inflation is also affected by global inflation trends and the exchange rate, which exhibited prolonged appreciation in the last decade.

2.2 Housing Sector

Israel enjoyed a vast influx of immigrants during the 1990s, increasing its population by a magnitude of 20 percent (1 million people) within five years. The housing market—the private sector, accompanied by government intervention—reacted, and housing starts surged at the beginning of the 1990s, and prices increased by a double-digit rate. The cycle ended in the beginning of the 2000s with buildings activity and home prices declining by about 12 percent from peak to trough in mid-2007. Between 2007 and 2018, home prices rose steadily, with the price level having more than doubled within a decade.

Figure 2: House Starts and Annual Rate of Change in Home Prices



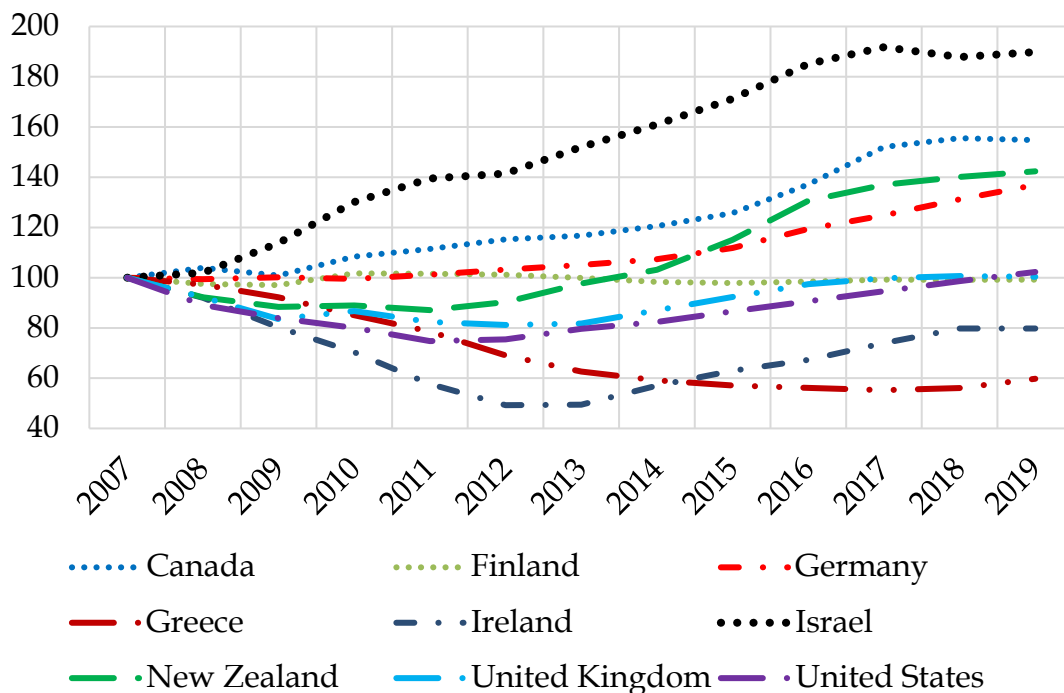
Notes: The left axis relates to house starts units and the right axis relates to home prices, which are expressed in annual percentage changes. Source: Central Bureau of Statistics.

On the supply side, since the beginning of the previous decade, building starts have been at lower levels than the level derived from the growth in the number of households. This level reflected an adjustment of the surplus supply created in the economy after the wave of immigration noted above wound down, but starting in the middle of the last decade, it created a shortage in the supply of homes relative to demographic needs.

The housing supply side in Israel is generally inelastic. The planning process in Israel is very long: from the time a decision to build is made, through obtaining all the necessary approvals and permits, until the completion of construction, the process takes about 13 years, on average. This slow supply response results in large price effects in response to positive demand shocks.

A significant government program that was launched in recent years, which essentially subsidizes new apartments for buyers who meet specific characteristics (first-time young buyers), has had a significant impact on the market. This is because it removes both supply and demand from the free market, while in contrast, it may encourage households that did not plan to purchase a home to enter the market. This large-scale program makes it very difficult to analyze the market and assess excess demand or supply and the expected future price development. Even before that, taxation had been changed to reduce investor demand.

Figure 3: Home Prices in Israel and Various Countries



Notes: The home price index is 100 in 2007. Source: OECD

In the last few years, signs of a slowdown in the market have emerged, with both a decline in housing starts and transactions, and moderated and even declining prices, for several quarters. The annual price increase in 2019 was about 3.5 percent (Figure 2).

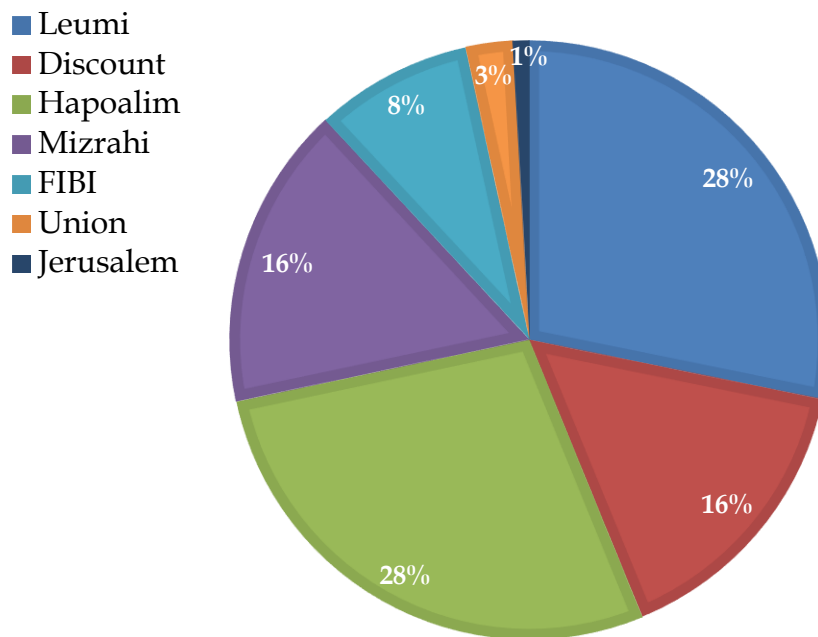
As noted above, since 2008, home prices in Israel increased by about 130 percent. This rate of increase in home prices is exceptional compared to other countries (Figure 3). Looking at a different starting point partially reduces Israel’s deviations from other countries, but comparing the price-to-rent ratio with the past strongly warns regarding the high level of housing prices in Israel.

2.3 Banking Sector

The Israeli banking sector is relatively concentrated and consists of a small number of banks. Seven banking groups control most of the domestic banking system, representing 99.6 percent of the banking sector, with two dominant banking groups (Bank Leumi and Bank Hapoalim).

In our analysis, we focus on the credit portfolio of these seven major banks.² The concentrated structure of the Israeli banking sector may be attributed to the small size of the Israeli economy, together with the existence of economies of scale and scope³ (Figure 4).

Figure 4: The Israeli Banking System in 2019



Notes: Total assets of NIS 1,663,764,100 in December 2019. Source: Bank of Israel, Banking Supervision Department.

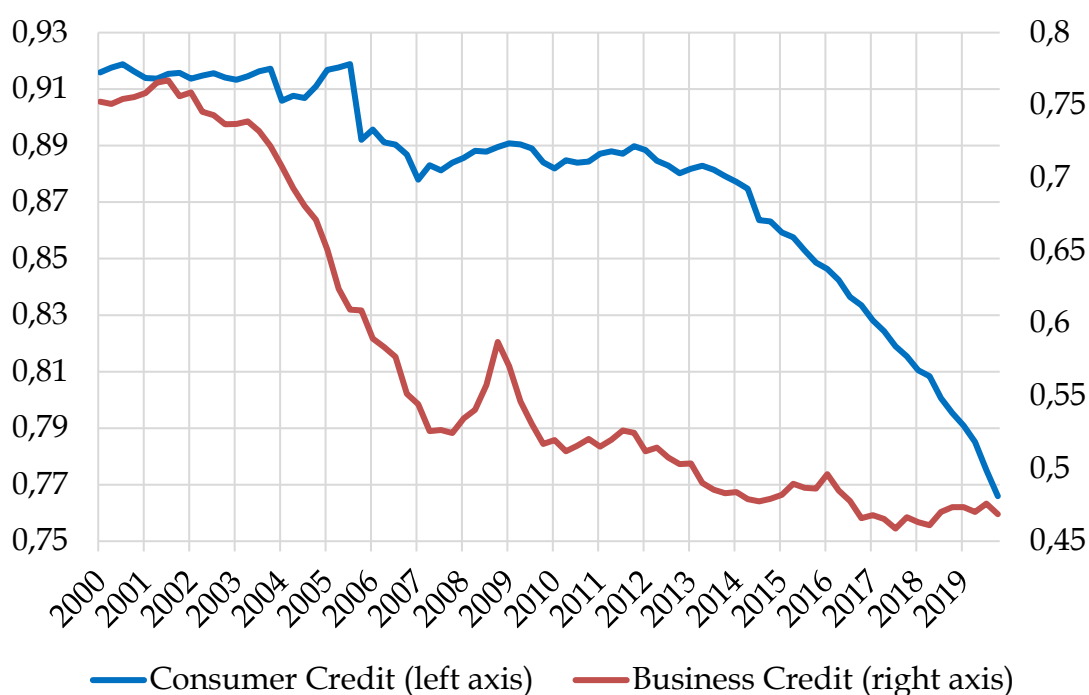
² Leumi, Hapoalim, Discount, Mizrahi-Tefahot, First International, Union Bank and Bank of Jerusalem.

³ Summary report of the team to examine banking competitiveness, April 18, 2013. This report identified several characteristics of the Israeli banking system, namely: the system is typified by acute concentration that hampers its competitiveness; Israeli banks are not particularly profitable by international standards; and their operational efficiency is rather low relative to banks in other advanced economy countries, due in part to high wage costs relative to their scale of activity.

The banks in Israel exhibited substantial resilience to the developments of the GFC in the global financial system. This is against the background of conservative management and very close supervision (i.e., the undeveloped securitization market, the banks cannot trade equities).

In the past, not only the banking system suffered from a high level of concentration, but the entire credit market did as well. Yet the last two decades have seen changes due to the government reducing its primary borrower role in the economy. This change shifted private capital from investments in government bonds to private sector investments, thus easing big companies' access to credit from the capital markets, creating a movement toward non-bank credit. In addition, the amount of loans given by institutional investors has grown, thanks to changes in the pension plans array in Israel. These contribute as well to the reduction of the share of banks in business and consumer credit (Figure 5).

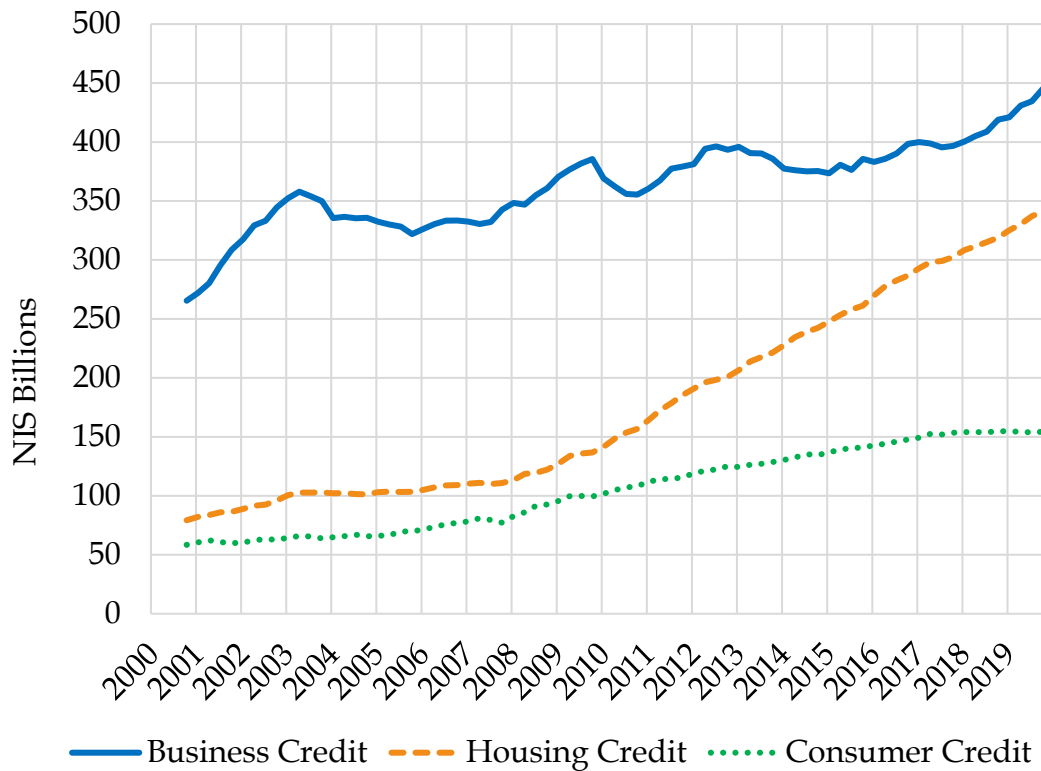
Figure 5: Banks' Share of Consumer and Business Credit



Notes: Percentage of consumer and business credit issued by private banks in Israel. Source: Bank of Israel, Banking Supervision Department.

The domestic credit portfolio among the seven big banks, which includes business (non-financial) credit and credit to households, has been growing since 2001. The largest component is the household sector, which includes ever-rising levels of housing loans. In the fourth quarter of 2019, the portfolio's total amount of credit stood at NIS 970 billion, representing approximately 69 percent of Israel's annual GDP (Figure 6a).

Figure 6a: Credit Balance, 7 Major Banks

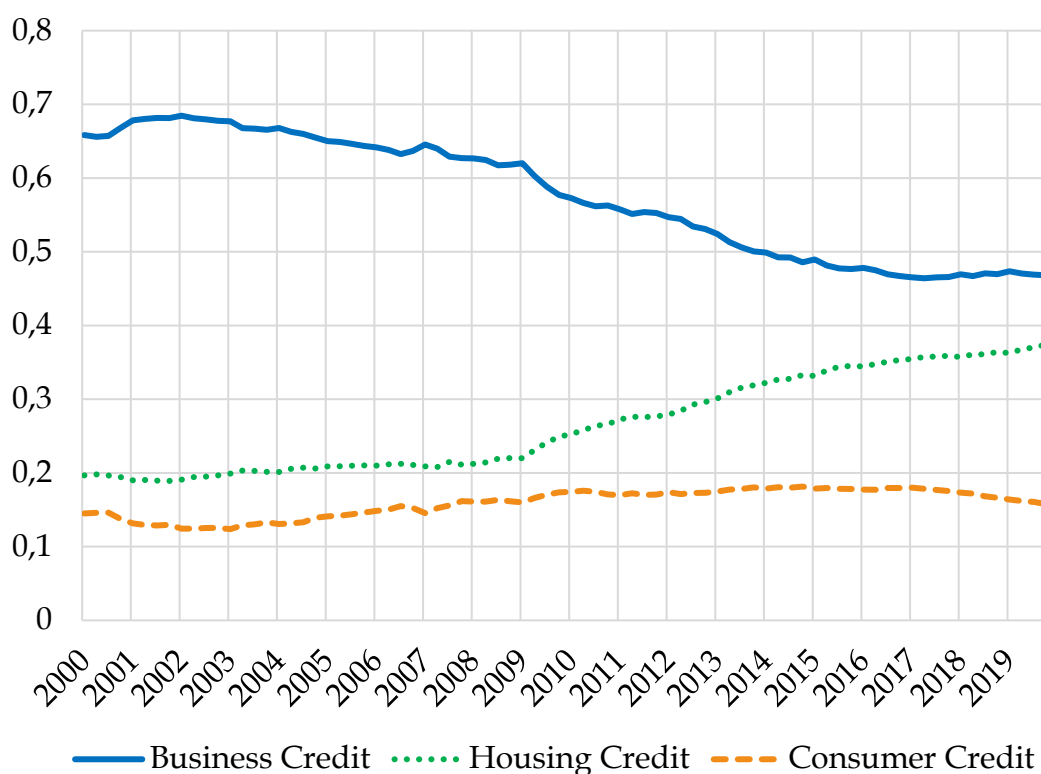


Notes: Credit balance of the seven major banks in Israel in NIS billion. Source: Bank of Israel, Banking Supervision Department.

Relative to the GDP, the share of housing credit has grown, against the background of increasing housing prices. Consumer credit has remained relatively stable relative to GDP, and credit to large businesses has declined (Figures 6b and 6c).

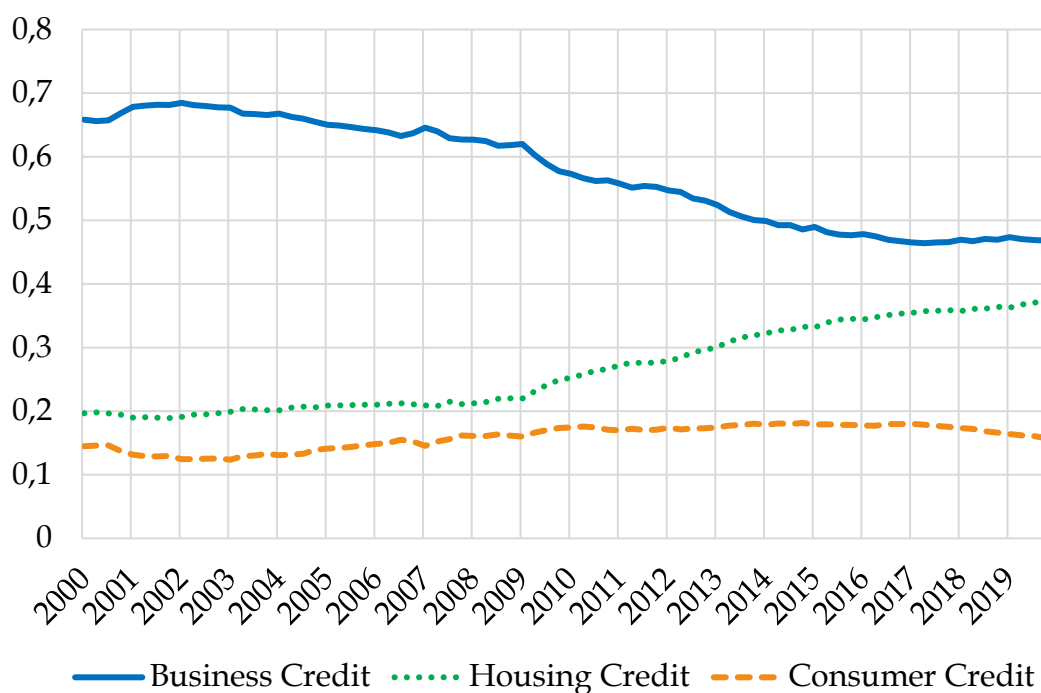
On the side of business credit, the reduction in credit can be linked to factors such as (1) requiring banks to reach capital targets set by regulators by decreasing the share of big business credit out of total credit; (2) setting limits that should minimize the concentration among borrowers; (3) increasing access to institutional and market lending.

Figure 6b: Credit to GDP Ratio, 7 Major Banks



Notes: Percentage of business, housing, and consumer credit to real GDP in Israel. Source: Bank of Israel, Banking Supervision Department.

Figure 6c: Distribution of Balance Sheet Credit, 7 Major Banks

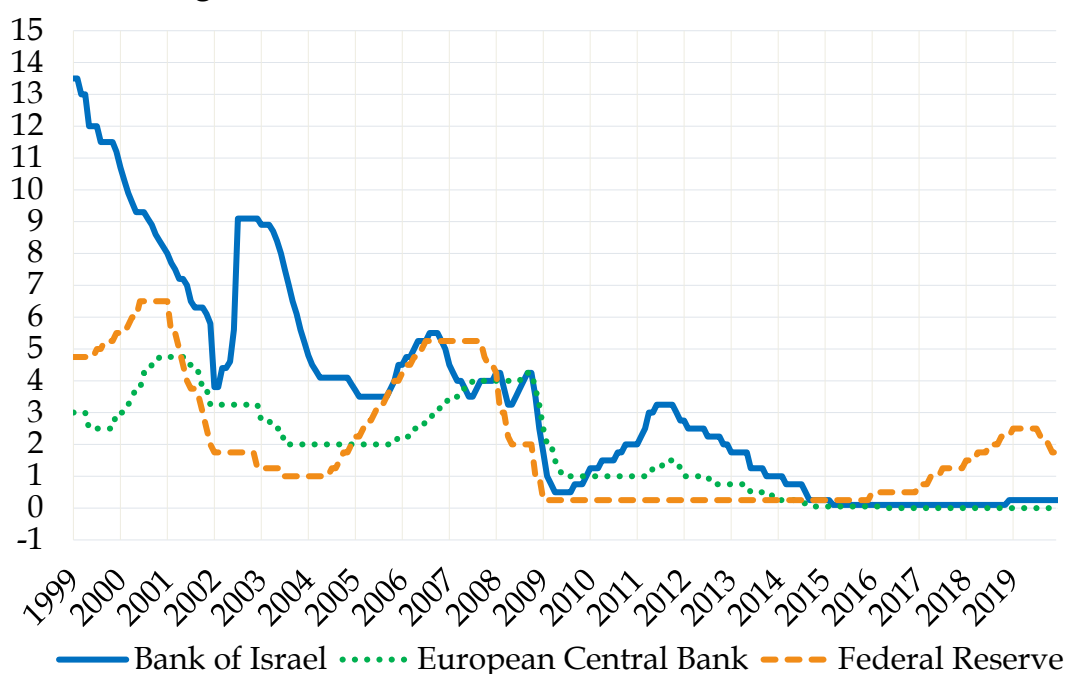


Notes: Percentage of business, housing, and consumer credit to total bank balance-sheet credit in Israel. Source: Bank of Israel, Banking Supervision Department.

2.4 Monetary Policy

Since the mid-1990s, monetary policy in Israel has been conducted within the framework of an inflation target regime within a 1–3 percent band, and more specifically as a “flexible inflation target” allowing for temporary deviations from the target range. A flexible target allows the consideration of the deviation of GDP growth from its potential and financial stability considerations when setting the monetary policy, as long as the inflation rate is expected to converge to the target within the next two years. The exchange rate may be characterized as “managed float”, as the Bank of Israel has been intervening in the foreign exchange market since March 2008 – first with pre-announced daily amounts and since August 2009 in a discretionary manner, according to market conditions⁴ (Caspi et al., 2018). Against the background of a relatively stable exchange rate, the Bank of Israel did not intervene in the market during 2018 (apart from intervention according to the gas program).

Figure 7: Bank of Israel, Fed, and ECB Interest Rates



Notes: Nominal interest rates. Sources: Bloomberg and the Bank of Israel.

Since the GFC, domestic monetary policy has been very accommodative. The Bank of Israel did not set negative interest rates or implement QE as an additional instrument, but did use, as noted above, intervention in the foreign exchange market as an additional tool and forward guidance to better communicate the future monetary policy path. The interest rate remained the principal monetary policy instrument, set at 0.1 percent since 2015, and increased to 0.25 percent in November 2018 (Figure 7). Looking farther into the past, the decline in the Bank of Israel’s

⁴ In addition, the Bank of Israel purchased a pre-announced amount annually as part of a program intended to offset the effects of natural gas production on the exchange rate. This program ceased in the beginning of 2019.

nominal interest rate reflected both the adaptation to a lower inflation environment as well as a decline in real interest rates, from about 6 percent in the beginning of the 2000s to about 2 percent in the first decade of the millennium, and to around zero in recent years, in line with the very accommodative global monetary policy.

2.5 Regulation and Macroprudential Steps

The debt to GDP ratio in Israel is low relative to other countries. Total debt to GDP is about 180 percent, with households' debt to GDP (housing and consumption) particularly low at around 40 percent in 2019, with no significant change since 2000. Total business sector debt (excluding financial institutions) was about 70 percent of GDP, with bank credit constituting about half of this credit. Public debt to GDP in 2019 was around 60 percent.

In the last decade, the risk stemming from the housing market was the main threat to Israel's financial stability. Of particular note were the banks' large exposure to the housing market, including exposure to housing credit that has grown considerably over the past decade, and credit exposure to the real estate and construction sector, which together account for 47 percent of total bank credit.

The Bank of Israel began to implement MaP measures at a relatively early stage of the financial cycle, about two years after the current housing prices cycle started in 2008.

The MaP measures can be divided into two major groups: steps aimed at the housing market and other steps. Within the housing sector, we divide the measure into those limiting borrowers, such as LTV limits, and those setting limitations on the banks, such as differential risk weights. Other steps not aimed at the housing market are classified as capital and liquidity requirement measures, i.e., measures referring to Big Borrowers, such as limitations on credit concentration. In the following sections, we refer to the specific types of MaP measures.⁵

A summary of all macroprudential measures taken by the Bank of Israel is presented in Table 1.

2.5.1 Mortgage Market Measures

For MaP in the housing sector, we refer to two different types of measures. The first, LTV, is aimed at influencing the quality of mortgages and borrowers' risk, and thus on the level of risk to the banks from the mortgage market; and other measures, which are aimed at strengthening the banks' resilience to a crisis, such as increased provisions and additional capital requirements and raise costs to banks.

In the first stage (2009–10), the MaP measures included some bank warnings and limitations. Later on, there were additional capital requirements for risky loans and provisions and restrictions on the characteristics of the loans that can be offered by the banks.

In 2010, a MaP measure was introduced—a requirement for a supplementary capital allowance regarding housing loans. The Risk-Weighted Assets (RWA) capital

⁵ The partition of the MaP measures follows the IBRN guidelines, and is set in the IBRN MaP measures international dataset.

allocation criteria is 100 percent for loans with an LTV greater than 60 percent when the variable-rate credit component comprises more than 25 percent, and the level of the loan is over NIS 800,000.

In 2011–14, several MaP measures were adopted to strengthen banks' and households' stability. Although influencing housing prices was not a declared goal of the Bank of Israel, moderated home prices would have been a welcomed outcome. Despite the measures taken in recent years, housing prices continued to rise.

In 2011, a requirement stating that only up to one-third of the total loan can bear interest at a variable rate that is adjusted at a frequency of up to 5 years was established. This measure was introduced to cope with the great demand for loans bearing a variable rate against the background of low interest rates, which led to new loans with variable interest rates reaching 80 percent of total new loans at that time.

Due to the continued rise in housing prices and mortgage volumes, additional measures were implemented that limited the mortgage loans' exposure. In October 2012, the LTV ratio was limited to 70 percent, except for first-time homebuyers (75 percent) and investors, including nonresidents (50 percent).

In 2013, three new measures were introduced: 1. The PTI ratio was limited to 50 percent of income. Housing loans, where the monthly repayment is over 40 percent of income, are weighted at 100 percent of RWA to calculate the capital adequacy ratio; 2. The portion of the loan at variable-rate interest was limited to two-thirds of the total loan, for all loan periods; 3. The loan period was limited to 30 years (inclusive). In September 2014, an additional capital allowance requirement was introduced, amounting to 1 percent of outstanding housing loans, to address vulnerabilities and boost the banks' loss absorption capacity. Until 2017, housing prices continued to rise despite the measures taken. The housing market remained very active, mortgage interest rates continued to decrease, and the volume of mortgage lending rose, as did the volume of housing market transactions.

Baudot-Trajtenberg et al. (2017) examine the effect of the MaP action implemented in October 2010—restrictions on the level of LTV on home prices and borrowers. The study used microdata on mortgage loans before and after the move. The step was effective, the banks were obliged to allocate more capital, and mortgage interest rates increased. Baudot-Trajtenberg et al. (2017) found that the impact on housing prices was limited, and this was also because only 15 percent of the mortgage takers were affected by this move. The step incentivized the more risky borrowers, with an LTV of over 60 percent, to reduce leverage. In response to these restrictions, borrowers bought less expensive homes, farther from the center of the country, and in poorer neighborhoods.

In addition to the MaP measures that were implemented by the Bank of Israel, other factors, no less important, affected the supply side: measures by the government to increase the supply of land and to increase the number of housing starts, and on the demand side, such as government fiscal measures (taxation).

2.5.2 Other Tools

Another type of MaP measures, based on capital tools, aims to increase the banking system's stability and reduce systemic risks. Since 2013, the Bank of Israel has implemented a capital requirement for risk-weighted capital assets and asset quality.

Table 1: Macroprudential measures

	Stability measures	Decision date	Application date	Influence Date	Type
1	The directive regarding limitations on the indebtedness of a borrower and a group of borrowers was amended.	20/08/2003	31/03/2004	20/08/2003	CON
2	A 100% capital surcharge on groups of borrowers who buy properties collectively.	25/03/2010	01/04/2010	25/03/2010	HSE
3	Banking corporations shall make a supplemental provision at the rate of at least 0.75 percent on account of outstanding housing loans that were issued on or after July 1, 2010, and in which the existing ratio in each case between the debt (prorated to the bank's share in the mortgage) and the value of the mortgaged property on the date of loan execution exceeds 60 percent.	11/07/2010	Q3 2010	Q3 2010	HSE
4	RWs increased on housing loans with LTVs above 60%, a floating component of more than 25% and mortgage value greater than NIS 800,000. A minimum risk weight of 100% is applied to these mortgages (banks could lower to 75%). This is a change from the previous 35-75% range.	28/10/2010	26/10/2010	26/10/2010	HSE
5	The core capital ratio target shall be set at a rate no lower than 7.5 percent.	30/06/2010	31/12/2010	30/06/2010	GEN
6	Limiting LTV ratio in housing loans: up to 75% for first-home buyers, up to 50% for investors, up to 70% for those upgrading their homes.	01/11/2012	01/11/2012	01/11/2012	HSE
7	RWs on some housing loans are increased, depending on their LTV. Loans with LTVs between 45-60% have a higher RW of 50% and those with LTVs between 60-75% are weighted at 75%	21/03/2013	01/01/2013	01/01/2013	HSE
8	A bank will not issue a housing loan with a DSI of more than 50%.	29/08/2013	01/09/2013	01/09/2013	HSE
9	Risk weight of 100% imposed on mortgages with Debt Service to Income (DSI) between 40-50%	29/08/2013	01/09/2013	01/09/2013	HSE
10	The maximum variable rate portion of a mortgage loan cannot exceed 2/3, and the maximum portion of a variable rate, which can change within 5 years since the date of approval cannot exceed 1/3.	29/08/2013	01/09/2013	01/09/2013	HSE
11	A loan shall not be approved or granted if the term to final repayment exceeds 30 years	29/08/2013	01/09/2013	01/09/2013	HSE

12	<p>A. Banking corporations should increase their Common Equity Tier I Capital target by a rate that represents 1 percent of their outstanding housing loans.</p> <p>B. Banking corporations may reduce the risk-weight attributed to variable interest leveraged loans from 100% to 75%.</p> <p>As the first decision was more influential than the second, ultimately the decisions were declared to be a stringency.</p>	28/09/2014	01/01/2015	28/09/2014	HSE
13	(Basel III - Small & Large Banks) Tier 1 Capital target	28/03/2012	01/01/2015	28/03/2012	GEN
14	(Basel III - Small & Large Banks) Total Capital Target	28/03/2012	01/01/2015	28/03/2012	GEN
15	Limitations on borrowers'/groups of borrowers' indebtedness: (1) The indebtedness of a borrower other than a bank to a banking corporation shall not exceed 15% of the banking corporation's capital; (2) The indebtedness of a group of borrowers to a banking corporation shall not exceed 25% of the banking corporation's capital; (3) The indebtedness of a banking group of borrowers to a banking corporation shall not exceed 15% of the banking corporation's; (4) The indebtedness of a controlled group of borrowers to a banking corporation shall not exceed 50% of the banking corporation's capital; (5) Total indebtedness of all "borrowers," "groups of borrowers," and "banking groups of borrowers," whose net indebtedness to the banking corporation exceeds 10% of the banking corporation's capital, shall not exceed 120% of the banking corporation's capital.	09/06/2015	01/01/2016	09/06/2015	CON
16	Basel III - Large Banks	28/03/2012	01/01/2017	01/01/2015	GEN

Notes: Housing combines two IBRN categories: Real Estate Credit (REC) and LTV limits. CON stands for concentration limits; HSE stands for housing macroprudential regulation; GEN stands for general capital requirements.

Our analysis distinguishes between MaP measures targeting big borrowers and other MaP measures, as they may affect the banks' portfolios differently. As a result of the big borrowers' dominance in the business sector, MaP limits the banks' capital exposures to big borrowers, thus changing the banking sector supply for credit distribution by increasing the small-medium business and household shares.

As part of the Basel III framework, the Bank of Israel implemented a minimum Liquidity Coverage Ratio of 100 percent. Liquidity requirements limit the credit supply so that banking corporations have to increase the liquidity assets in their balance sheets. Moreover, an additional leverage ratio surcharge also contributes to controlling the banking system's leverage. It may influence the banks' capital and, as a result, credit supply. In our analysis, we refer to liquidity and capital tools together as banking stability tools.

3 The Data

3.1 Bank Credit

The bank credit data are taken from the domestic bank reports to the Bank of Israel (Banking Supervision Department) on a quarterly basis, in accordance with the supervision directive 831.

The data include credit to the public,⁶ deposits in the bank and other debts, excluding bonds and securities, which were borrowed or purchased under repurchase agreements. The credit data is disaggregated to commercial credit, which we refer to as business credit,⁷ credit for housing loans, and other credit for households, and is also divided into different economic sectors, domestic and abroad.

Other than the credit data, the source for the rest of the banking institutions' data is the publicly available quarterly published reports of the banks, describing the level of liquid assets, liabilities to assets, and deposits to assets. We include cash, bank deposits, and securities in the liquid assets category other than those encumbered to the lenders.

Our panel includes the seven largest banks in the domestic bank sector, which account for 99 percent of the bank sector (See Section 2.3).

3.2 Capital Adequacy

Capital adequacy measures the amount of capital, allowing a private bank to face unexpected losses, which can be incurred by the bank due to a realization of risks to which the bank is exposed. The supervision policy is brought forward in two ways, both through a minimum capital requirement and by ensuring the quality of the capital. Besides applying the various Basel rules in Israel, the Banking Supervision Department at the Bank of Israel establishes its further requirements.

Since 2010, the Banking Supervision Department's requirement deals separately with two sets of capital: one is "Total capital", including Tier one, Tier two, and Tier three capital; the other one is Tier one capital or core capital, on its own – a distinction that preceded the final recommendation of Basel III.

⁶ During the first quarter of 2011, changes were made in the instructions of the Banking Supervision Department. This created new series regarding the banking system's credit. In order to deal with this discontinuity of the series, we placed a dummy variable to express the reporting change.

⁷ Including agriculture, industry, electricity, water, construction and real estate, commerce, transportation, information and telecommunication, and other business credit, leaving out credit for finance.

In our empirical exercise, we used the gap between the ratio of actual capital to risk components of the banks, and the most recent requirement of the Banking Supervision Department, even if it had yet to be imposed. For example, in March 2012 the Banking Supervision Department published minimum core capital goals, which the banks had to reach by the beginning of 2015. In the paper, the gap for the years 2012–15 was calculated as the difference between the actual ratio for each period, and the target ratio for 2015. This, out of an understanding that the banks' policy will change during these years to reach the target.

The source of the capital adequacy data is the financial statements published by the banks each quarter, yet the requirement regarding "Tier one" capital has been declared only in 2010. Therefore, before 2010, the gap between the ratio of actual capital to risk components of the banks, and the most recent requirement of the Banking Supervision Department refers to the "total capital" data that were available since the 1990s.

3.3 Monetary Policy Surprises

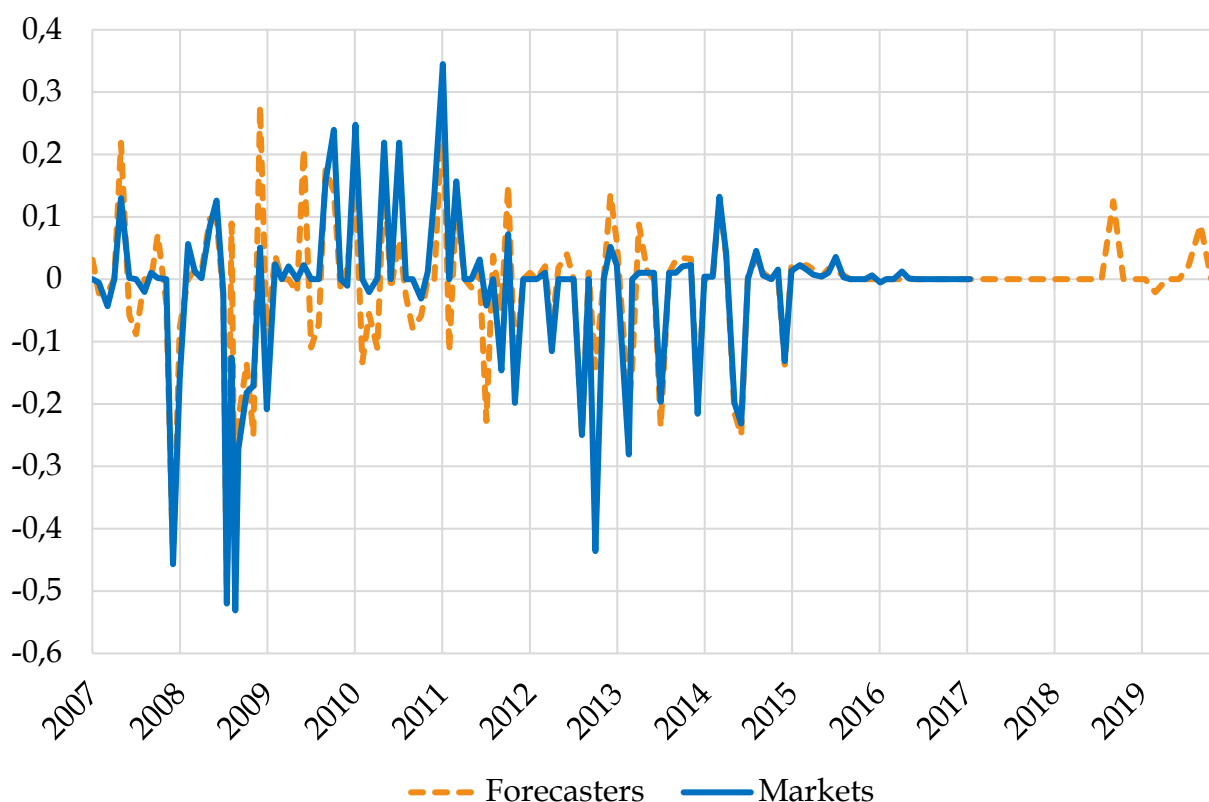
Monetary policy surprises can be extracted from several sources. Based on the financial markets' expectations, the most common one was examined by Gürkaynak et al. (2005) for the US. Kutai (2020) suggests an alternative methodology for Israel by relaxing the assumption of constant coefficients, and estimates the effect of forward guidance separately for each shock and term to maturity. Although the methodology in Kutai (2020) is in line with the literature (Gürkaynak et al., 2005; Cesa-Bianchi et al., 2020; Andrade and Ferroni, 2020), the period it can cover, starting from 2007, is too short for our estimations. Consequently, we use the expert forecasts for the interest rate decisions extracted from Bloomberg, beginning from 2003.

The monetary policy surprises we use in our estimations are the difference between the interest rate set by the Monetary Committee of the Bank of Israel and the average of all the available forecasts made by the professional forecasters available before the interest rate decision. As shown in Figure 8, expert forecasts are close to market forecasts.

Following the GFC, we can observe several periods of monetary surprises, captured by both methodologies. Between 2012 and 2014, some monetary policy decisions surprised both market and expert forecasts.

Figure 8 shows that the two measures have a similar pattern, with a few exceptions, leading to a correlation coefficient of around 0.84. Our domestic data about monetary policy surprises extracted from expert forecasts span a more extended period than market-based data. Thus, the correlation justifies our use of monetary policy surprises based on expert forecasts in our estimations.

Figure 8: Market-Based and Average of Expert-Based Monetary Policy Surprises⁸



Sources: Bloomberg and Kutai (2020).

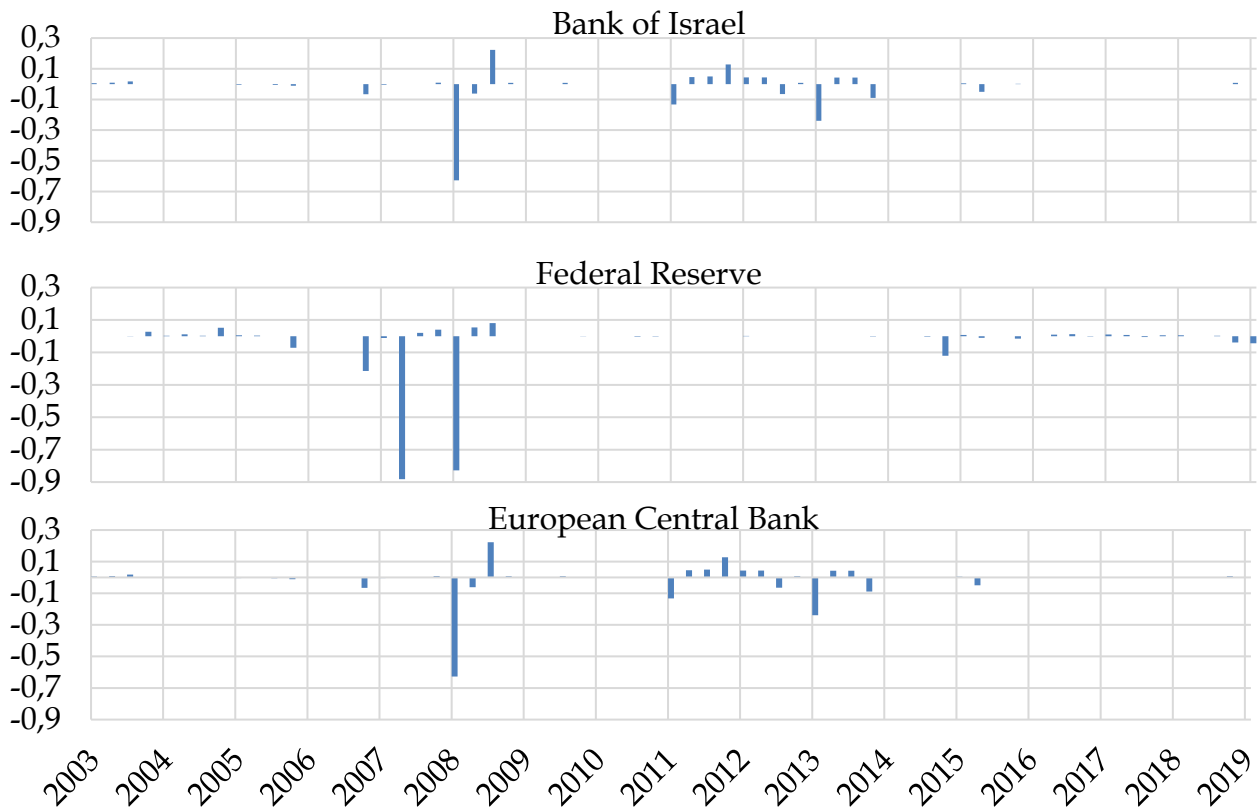
We assume the surprise's effect remains constant during the entire period until the next interest rate decision. We aggregate the decision-frequency surprises to quarterly data by summing surprises collected for each decision during the corresponding quarter. Until April 2017, interest rate decisions were taken by the Bank of Israel 12 times a year, usually toward the end of the month. Since April 2017, the Committee decides on the interest rate eight times a year. As shown in Figure 8, surprises were almost absent since mid-2015, against the background of a stable interest rate of 0.1 percent since that time.

We include in our estimation monetary surprises in the US, and in an alternative specification, we also add the eurozone's surprises. As noted before, the Israeli banking system is entirely local, with practically no foreign-owned banks' activity. Moreover, the share of loans denominated in foreign currency is relatively small, especially in the consumer and mortgage segments. Still, as the ability to substitute local currency credit with credit denominated in (or linked to) foreign currency exists, we opt to test the importance of this factor on the bank credit growth rate.

We use monetary surprises to the US and the eurozone economies derived via the same methodology we use for Israel (Figure 9). As seen in the figure, the magnitude of the ECB's policy surprises is much smaller than for the US. The correlation between these measured surprises is about 0.5 between any two measures.

⁸ The Israeli data for market surprises is only available from 2007 to 2017 (Kutai, 2020).

Figure 9: Monetary Policy Surprises, US, Eurozone, and Israel



Source: Bloomberg.

3.4 Prudential Measures

We refer in our estimation to the list of macroprudential measures summarized in Table 1. We classified the MaP measures into three groups: MaP measures regarding the housing market, generally relating to the composition of the mortgage and the LTV; measures related to the concentration of credit (big borrowers, industry concentration); and other general measures.

We include in the estimation of each of the types of credit – housing, consumer and business, the three types of MaP measures.⁹ We expect measures that refer to the sector estimated to impair the growth rate of the estimated credit, while MaP measures that refer to other types of credit, which are substitutes for the banks as suppliers, or for the borrowers as demanders of credit, to have a positive effect on the growth rate of the credit studied.

Each of these MaP categories is assigned the value of 1 in periods in which at least one prudential step in the category became effective. We include the indicator variable for housing MaP measures as the accumulation of steps since 2004 as we assume that the implemented steps continue to affect the market as long as they are in place. General MaP measures were included in the estimation accumulated over eight quarter lags relative to

⁹ We do not include in our estimation additional steps that are categorized as relating to the foreign exchange market (implemented in the first quarter of 2011) and steps relating to interbank exposure limits (December 2011). See Table 1.

the date they became effective, and concentration-related steps—with an accumulated four-quarter lags.¹⁰ This allows different time spans for the MaP step to affect the market.

Table 2: Macroprudential measures by category and imposed quarter

	Concentration	General	Housing
Sep-03	1		
Mar-10			1
Jun-10		1	
Sep-10			1
Dec-10			1
Jun-12		1	
Dec-12			1
Mar-13			1
Sep-13			1
Sep-14			1
Mar-15		1*	
Jun-15	1		

Notes: *Big banks only.

Table 2 reveals two main facts. The first is that most of the MaP measures have been implemented in recent years, after the GFC. The other fact that characterizes the Israeli policy is that the use of housing MaP measures was intense relative to other measures, in view of rapid increases in home prices during these years (Figures 3 and 4).

3.5 Other Macroeconomic Variables

In order to take into account the effect of the business cycle in general and indicators for the activity in the housing market, we added control variables such as the unemployment rates, change in real wages, business sector GDP growth, and the change in home prices. A detailed description of the macroeconomic variables in each specification is presented below, in Section 4.

3.6 Sample Period

The estimation is carried out as a weighted cross-section panel estimation, assuming cross-section weights, correcting cross-section heteroscedasticity, and contemporaneous correlation. The estimation is performed for seven banks over 63 periods (2004:Q4–2019:Q4)—a total of 441 observations. The dependent variable is the log difference of the real quarterly level of credit.

Due to its substantial influence on the market, we distinguish, for the monetary policy surprises and the constant, between the period before and after the GFC starting from the third quarter of 2008.

¹⁰ For the business credit sector estimation, the four lags accumulated are lagged four quarters, rather than one as in the other sectors.

4 Estimation and Results

As described in Section 2, the banking sector in Israel is characterized by a small number of domestic banks for which lending activity is concentrated on the domestic market, and its sources are domestic as well. That is, the lending activity abroad of the domestic banks and the activities of foreign banks in the domestic market is marginal. Naturally, those properties lead us to focus on estimates of the influence of the domestic monetary policy and domestic macroprudential measures, and the interaction between them, on the domestic banks' lending. Because Israel is a small open economy, we complement the specification with monetary policy surprises from the US¹¹, as described in Section 3.2, in order to allow the interest rate differential between domestic and foreign financing to affect the growth of domestic credit.

Within the total domestic banks' lending activity, housing credit (mortgages) rose sharply since 2007–08, in parallel with the acceleration in the housing transactions, accompanied by a rapid increase of the home prices index. Our first objective is to assess the domestic transmission of MaP policies—in their interaction with monetary policy—to the *mortgage market*.

Nonhousing consumer credit is the second component of bank credit that we examine. This credit is not backed by the borrower's housing, is usually used for consumption, but may also serve—by the banks as suppliers, and households as demanders—as a substitute for mortgages. We estimate a separate equation for the growth of *consumer credit*.

The third main component of the domestic banks' total lending activity is the lending activity to the *business sector* (excluding the financial sector). Throughout the sample period, it constitutes around 50 percent, on average, of the total credit of the business sector and of the total banks' lending. Our objective is to assess the domestic transmission of prudential policies when interacting with monetary policy and lending activity to the business sector.

We allow a change in banks' behavior and their response to the policy implemented after the GFC. Such a change occurred in the relationship between monetary policy and credit growth due to the GFC.

In addition, our estimation controls for macroeconomic conditions that affect the demand for credit and bank-specific time-varying characteristics that affect the supply side, such as:

$$\Delta Y_{b,t} = f(\text{MaP}_t, \text{MonPol}_t, \text{MaP} \times \text{MonPol}_t, \text{Foreign MonPol}_t, \text{Macro}_t, \text{BankChar}_{b,t})$$

where $b=1, \dots, 7$, $t=2004\text{Q4}-2018\text{Q3}$, $\Delta Y_{b,t}$ is the log change of domestic bank credit, for housing, consumer, or business credit, according to the specific case, by bank b at quarter t . The macroeconomic and bank-specific control variables vary by type of credit. We will elaborate on the specific variables in the sections describing the estimation results.

We include each of the three macroprudential dummies—relating to housing, concentration or general measures accumulated over different lengths of periods. While we found that the effect of housing MaP measures is best exhibited when considering the possible effect of all measures in the past on this market, we found that the general measures and concentration measures affect credit dynamics when taking into account the

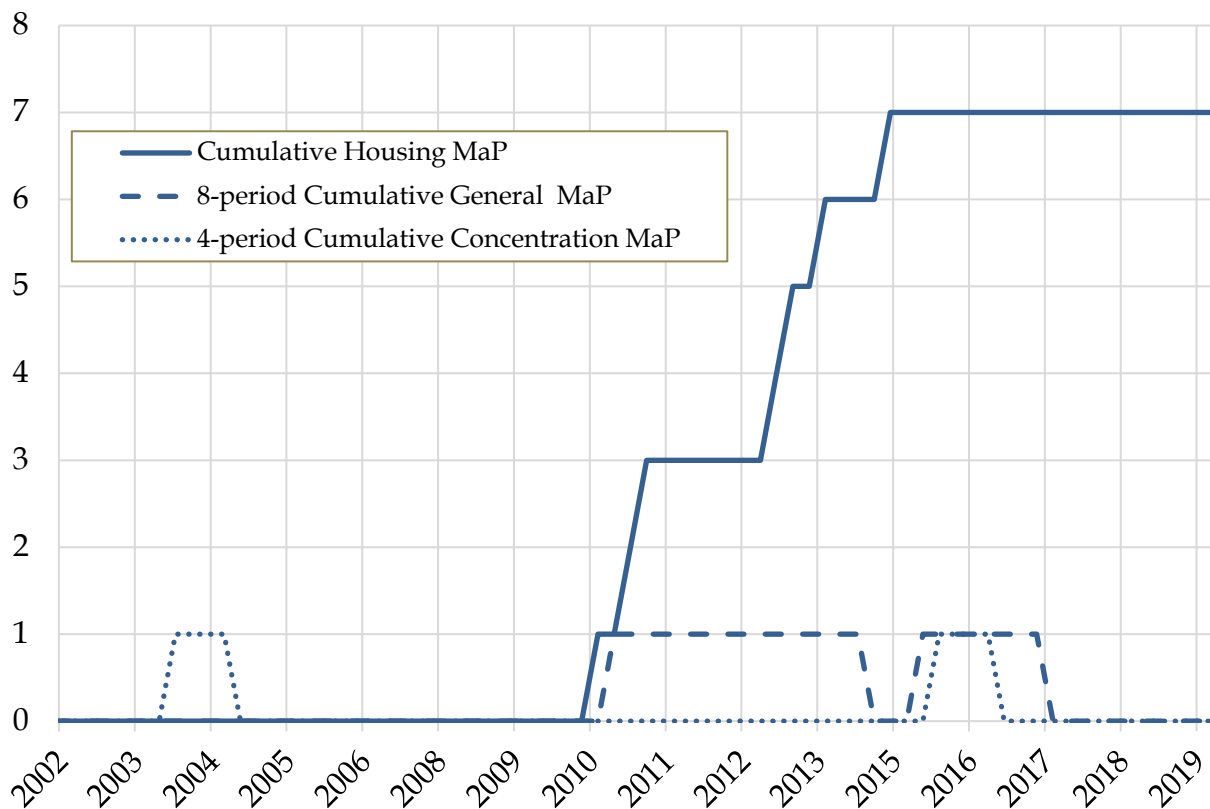
¹¹ In an alternative specification, we also include monetary policy surprises from the eurozone. The qualitative results remain unchanged (See Appendix).

accumulation of the measures over a shorter period (Figure 10). The interaction between MaP measures and monetary policy is specified as the product of the MaP measures as described above and the monetary policy surprise lagged one period or two periods. Foreign monetary policy is included with 1 and 2 lags.

In the preferred specifications, shown in the tables, we include the effect of policy shocks in the US, as most of the foreign currency credit is denominated in dollar terms. We present an alternative specification adding the euro area monetary policy surprises in the Appendix. Our qualitative results remain robust to this alternative specification.

For each of the credit types, we present four specifications. Column 1 of each of the tables includes the basic specification. Column 3 presents the specification including global monetary policy surprises, and columns 2 and 4 add to these specifications the interaction terms between MaP and monetary policy.

Figure 10: Cumulative MaP Measures



Notes: MaP dummy variables used in the estimations. Source: Bank of Israel, Research Department.

Standard errors $\epsilon_{b,t}$ are cross-section weighted and allow for conditional correlation between the contemporaneous residuals for cross-sections i and j , but restrict residuals in different periods to be uncorrelated. The estimation results are presented in Tables 3 to 5.

4.1 Housing Credit Estimation Results

Domestic policy variables: We find that (surprises to) monetary policy, had a significant negative effect on the growth rate of housing credit, which turned insignificant in the period after the financial crisis, marked by the third quarter of 2008 (Table 3). We find that MaP

measures relating to the housing market succeeded in reducing the growth rate of housing credit for all specifications. We show that general MaP measures also had a negative effect, although significant only in the specifications excluding the interaction term. MaP measures relating to the concentration of the banks' activity were found to have a positive effect, as expected, albeit significant only in the full specification, which includes global monetary policy and the interaction between domestic monetary policy and MaP measures (column 4). This positive effect is reasonable due to a substitution effect with business credit, which tends to increase mortgage lending as a substitute for business lending, in particular to large borrowers.

We also find that the interaction between housing MaP measures and monetary policy does not affect housing credit development, interacting monetary policy with general and concentration-oriented MaP measures do show a positive and generally significant effect.

A positive coefficient indicates that, for example, the accommodative effect of a negative surprise to monetary policy (interest rate was reduced by more than expected) on housing credit is offset by these MaP measures, which are not aimed directly at the housing market. Or, putting it the other way around, the tightening effect of the MaP measures was offset by the accommodative monetary policy.

Foreign monetary policy: We estimate a negative effect of US monetary policy surprises on housing credit before the GFC, and an insignificant positive effect thereafter. If foreign currency credit and local currency housing credit were substitutes, we would expect to see a negative coefficient; the positive effect may indicate that US surprises are an indication for the expected domestic monetary policy and therefore tend to slow the growth rate of mortgages.

Macroeconomic variables: Aggregate demand for housing credit depends on the volume of activity in the housing market. We find that an increase in home price increases the demand for housing credit. This is both because higher prices indicate excess demand in the market, but also because, for a given number of transactions, the real volume will be larger, inducing higher demand for mortgages.

In addition, a better macroeconomic situation, with higher activity and employment, supports the ability of households to apply for and receive mortgages. We find a negative effect of the lagged rate of change in the unemployment rate (ages 25-64) and a positive effect of the lagged change in wages on the rate of increase of housing credit.

Bank characteristics variables: We also control for bank characteristics that may affect the bank's tendency to offer credit. The bank's capital relative to the supervisory requirements (lagged two periods) has a significant positive effect on housing credit growth. A positive gap, meaning the bank has excess capital relative to requirements, positively affects its willingness to offer housing credit.

Table 3: Housing credit, sample 2004:Q2 – 2019:Q4, 7 banks

		4	2	3	4
		Basic – excl. interactions and global policy	Including interactions	Including global policy	Including interactions and global monetary policy
MaP	Cumulative MaP_housing(-1), since 2004	-0.001**	-0.002**	-0.002***	-0.002***
	MaP_general(-1) to (-8)	-0.004*	-0.003	-0.06**	-0.004
	MaP_concentration(-1) to (-4)	0.002	0.01	0.01	0.01**
Monetary Policy	Monetary policy(-1) until the GFC	-1.92*	-2.26**	-1.43	-2.17
	Monetary policy(-2) until the GFC	-4.59***	-4.57***	-2.76**	-2.86**
	Aggregated before 2008	-6.51***	-6.83***	-4.18**	-5.02***
	Monetary policy(-1) after the GFC	0.83	0.88	-0.31	-2.71
	Monetary policy(-2) after the GFC	0.76	0.56	0.28	-0.16
	Aggregated after 2008	1.59**	1.44	-0.03	-2.87
Interactions	Cumulative MaP_housing(-1) × Mon. policy(-1)		-0.16		0.28
	Cumulative MaP_housing(-1) × Mon. policy(-2)		-0.26		-0.19
	Aggregated MaP_housing × Mon. policy		-0.42		0.09
	MaP_general(-1) to (-8) × Mon. policy(-1)		1.16		2.61
	MaP_general(-1) to (-8) × Mon. policy(-2)		2.84		2.94
	Aggregated MaP_general × Mon. policy		4.00		5.56*
	MaP_concentr.(-1) to (-4) × Mon. policy(-1)		4.02		3.84
	MaP_concentr.(-1) to (-4) × Mon. policy(-2)		3.09		2.92
	Aggregated MaP_concentr. × Mon. policy		7.11*		6.76
Foreign	U.S. monetary policy(-1) until the GFC			-1.81	-1.20
	U.S. monetary policy(-2) until the GFC			-2.96**	-2.89**
	U.S. Aggregated before 2008			-4.76***	-0.48**
	U.S. monetary policy(-1) after the GFC			2.00	5.67
	U.S. monetary policy(-2) after the GFC			0.65	1.85
	U.S. Aggregated after 2008			2.65	7.51
Banks^	Excess Tier(-1)	0.39***	0.40***	0.57***	0.57***
Macro	D(real wage(-2))	0.12*	0.14**	0.18**	0.19**
	D(unemployed 25-64(-5))	-0.78***	-0.62**	-0.74***	-0.59*
	D(log(house_prices(-1)))	0.08***	0.07**	0.06**	0.06*
	Seasonal Dummies	Yes	Yes	Yes	Yes
	Data Break Dummies	Yes	Yes	Yes	Yes
	C	0.001	0.001	-0.004	-0.003
	CRISIS2008	0.01**	0.01**	0.02***	0.02***
	Observations	441	441	441	441
	Adjusted R²	0.17	0.17	0.18	0.18

Notes: *p-value < 10%, **p-value<5%, ***p-value<1%. ^ The estimation included in addition the change in liabilities to assets, the change in bank's real assets, the change in the share of deposits in assets, the change in liquid assets, and the change in excess reserves to assets, with varying lags. All were insignificant.

4.2 Consumer (nonhousing) Credit Estimation Results

Domestic policy variables: While housing credit (relative to GDP) increased considerably in the last 15 years, the share of consumer credit in GDP remained relatively stable (see Figure 6b). Generally, we find it difficult to relate consumer credit changes to policy or macroeconomic developments. The share of variance explained by these economic variables

is relatively small (Adjusted R^2 is only about 5 percent). We do not find any significant effects of the MaP measures of any kind - aimed at the housing market, general measures or measures relating to concentration issues, and consumer credit evolution. Monetary policy had a significant negative effect on consumer credit development before 2008, but this diminished later (Table 4).

MaP measures aimed at housing credit may have a positive or negative effect on consumer credit. Making housing credit more expensive or more limited is expected to increase the substitute credit—both from the demand-side and the supply side. However, in contrast, housing (mortgage) credit and consumer credit may be complements, and limiting mortgages will also tend to reduce demand for consumer credit. Looking at the interaction between monetary policy and MaP measures, we find a significant negative effect of the interaction between monetary policy surprises and housing MaP. Coupling a surprising interest rate hike with accumulated housing market MaP measures intensifies the magnitude of monetary surprises. So, in the event of a negative surprise to interest rates (accommodative policy), adding housing MaP measures increases the positive effect on consumer credit more. Because MaP measures in the housing market were initiated only after 2008, monetary policy did affect the dynamics of consumer credit, although monetary policy surprises on their own were not found to have a significant effect in our specification after 2008. Interaction of monetary policy surprises with concentration-related MaP measures is found to positively impact some specifications, which means that the effect of accommodative monetary policy on consumer credit is offset by the concentration MaP measures set at that time. This is even though one could have expected these measures aimed at credit to large businesses to increase banks' supply of consumer credit.

Foreign monetary policy: We find that until 2008 a positive surprise to the global rate tended to decrease the growth rate of consumer credit. After 2008, the effect is insignificant. As in housing credit, it may be that changes or surprises in the interest rates abroad are an indication for the expected local monetary policy and therefore have a negative effect on the growth rate of consumer credit.

Macroeconomic variables: We find it difficult to describe the development of consumer credit with macroeconomic variables. We do find that an increase in wages does tend to increase (demand for) consumer credit.

Bank characteristics variables: We find that the ratio of liabilities to assets in the bank's balance sheet has, as expected, a negative effect on the (supply of) consumer credit. Other bank attributes are not found to be significant.

Our ability to describe consumer credit dynamics is weak in all specifications, with an R^2 of about 5 percent.

Table 4: Consumer credit, sample 2004:Q2 - 2019:Q4, 7 banks

		1	2	3	4
		Basic - excl. interactions and global policy	Including interactions	Including global policy	Including interactions and global monetary policy
MaP	Cumulative MaP_housing(-1), since 2004	-0.001	-0.002	-0.002	-0.003
	MaP_general(-1) to (-8)	0.003	0.01	0.000	0.005
	MaP_concentration(-1) to (-4)	-0.003	0.01	0.002	0.01
Monetary Policy	Monetary policy(-1) until the GFC	-0.52	-1.55	8.12*	7.02
	Monetary policy(-2) until the GFC	-12.38***	-12.77***	-16.87***	-17.78***
	Aggregated before 2008	-12.91**	-14.32**	-8.75**	-10.76**
	Monetary policy(-1) after the GFC	-0.07	-0.74	-0.42	-1.75
	Monetary policy(-2) after the GFC	0.54	3.16	-3.13	8.17
	Aggregated after 2008	0.47	2.42	-3.55	6.42
Interactions	Cumulative MaP_housing(-1) × Mon. policy(-1)		-0.92		-1.06
	Cumulative MaP_housing(-1) × Mon. policy(-2)		-2.39**		-2.97*
	Aggregated MaP_housing × Mon. policy		-3.31**		-4.03*
	MaP_general(-1) to (-8) × Mon. policy(-1)		6.19		9.83
	MaP_general(-1) to (-8) × Mon. policy(-2)		7.17		4.50
	Aggregated MaP_general × Mon. policy		13.36		14.33
	MaP_concentr.(-1) to (-4) × Mon. policy(-1)		7.98		0.45
	MaP_concentr.(-1) to (-4) × Mon. policy(-2)		19.08		18.88
	Aggregated MaP_concentr. × Mon. policy		27.06*		19.33
Foreign	U.S. monetary policy(-1) until the GFC			-11.80***	-11.05**
	U.S. monetary policy(-2) until the GFC			5.66	6.61
	U.S. Aggregated before 2008			-5.44	-5.19
	U.S. monetary policy(-1) after the GFC			-1.46	2.07
	U.S. monetary policy(-2) after the GFC			7.50	-8.41
	U.S. Aggregated after 2008			6.04	-6.34
Banks^	Excess Tier(-1)	-0.15	0.05	-0.008	0.05
	D(Liabilities(-1)/Assets(-1))	-3.96**	-4.29**	-4.42**	-4.515**
Macro	D(real wage(-1))	0.66***	0.63**	0.10***	0.88***
	D(unemployed 25-64(-2))	-0.93	-0.31	-1.85	-1.11
	Seasonal Dummies	Yes	Yes	Yes	Yes
	Data Break Dummies	Yes	Yes	Yes	Yes
	C	0.03**	0.03*	0.02	0.02
	CRISIS2008	-0.01	-0.003	0.01	0.004
	Observations	441	441	441	441
	Adjusted R²	0.04	0.04	0.05	0.05

Notes: *p-value < 10%, **p-value<5%, ***p-value<1%. ^ The estimation included in addition the change in a bank's real assets, the change in the share of deposits in assets, the change in liquid assets, and the change in excess reserves to assets, with varying lags. All were insignificant.

4.3 Business Credit Estimation Results

Domestic policy variables: Although the share of bank credit in total business credit has decreased in the last decade from about 75 percent to 50 percent (Figure 6b), business credit is still an important segment of the banking sector's credit, with a share of about 40 percent of total bank credit. We find that general MaP measures had a significant negative effect on the growth rate of business credit, in most specifications, as may be expected. However, in contrast, MaP measures aimed at the housing credit tend to increase (supply) of the business sector, as those are substitutes on the asset side of the bank's balance sheet. We do not find evidence for any effect of the concentration MaP measures, which were put into place only once during the sample, in the second quarter of 2015.

Similar to our results for housing and consumer credit, monetary policy had a negative effect before the GFC, but its influence diminishes and unexpectedly has some positive effect after the GFC, contrary to our basic intuition.

We find evidence (in some of the specifications) for a significant negative effect of the interaction between monetary policy and the housing MaP measures. Accommodative monetary policy interacted with measures aimed at the housing market tends to increase business credit, meaning that substitution effects, on the supply-side drove banks to increase the supply of business credit more when the policy became more accommodative and was accompanied by demand-reducing MaP measures in the housing market. Yet at the same time, accompanying accommodative monetary policy with general MaP measures, relevant for all credit offered by the bank, will tend, according to our estimation, to have a weaker expanding effect on business credit than would have been expected otherwise.

This result is somewhat surprising, as business credit is a substitute for housing credit, at least on the bank's supply side. Again, as seen in the case of consumer credit, it may be that any MaP measures taken by the central bank emphasize and strengthen the signal extracted from surprises to monetary policy. Interaction of monetary policy surprises with the other two classes of MaP, were found to be insignificant (or marginally significant) in most specifications).

Foreign monetary policy: Foreign monetary policy has a negative effect on the growth rate of domestic business credit after 2008. The negative sign suggests that the signaling effect of a surprise in foreign interest rates is stronger than the possible substitution effect with foreign credit.

Macroeconomic variables: We control for real activity using the average business sector GDP growth rate in the previous two quarters, and find a positive and significant effect of activity on business credit. We also find that a lower unemployment rate (lagged two quarters) tends to increase (the demand for) business credit, as is expected.

Bank characteristics variables: The bank's capital relative to the supervisory requirements (lagged four periods) has a significant positive effect on business credit growth. Other bank characteristics were not found to be significant.

Table 5: Business credit, sample 2004:Q2 – 2019:Q4, 7 banks

		1	2	3	4
		Basic – excl. interactions and global policy	Including interactions	Including global policy	Including interactions and global monetary policy
MaP	Cumulative MaP_housing(-1), since 2004	0.001**	0.001**	0.001***	0.001**
	MaP_general(-1) to (-8)	-0.008***	-0.005*	-0.006**	-0.005
	MaP_concentration(-4) to (-7)	-0.004	-0.006	-0.005	-0.005
Monetary Policy	Monetary policy(-1) until the GFC	0.12	-0.44	1.30	0.50
	Monetary policy(-2) until the GFC	-2.76**	-2.17*	-3.73***	-2.95*
	Aggregated before 2008	-2.64*	-2.61	-2.43	-2.45
	Monetary policy(-1) after the GFC	1.26**	0.21	2.92***	2.11
	Monetary policy(-2) after the GFC	3.31***	3.83***	3.43***	7.30***
	Aggregated after 2008	4.57***	4.04***	6.35***	9.40***
Interactions	Cumulative MaP_housing(-1) × Mon. policy(-1)		0.28		-0.01
	Cumulative MaP_housing(-1) × Mon. policy(-2)		-0.515*		-1.03**
	Aggregated MaP_housing × Mon. policy		-0.24		-1.03
	MaP_general(-1) to (-8) × Mon. policy(-1)		2.92		2.27
	MaP_general(-1) to (-8) × Mon. policy(-2)		3.51*		2.30
	Aggregated MaP_general × Mon. policy		-0.59*		4.57
	MaP_concentr.(-4) to (-7) × Mon. policy(-1)		1.84		1.03
	MaP_concentr.(-4) to (-7) × Mon. policy(-2)		-2.65		-1.12
	Aggregated MaP_concentr. × Mon. policy		-0.81		-0.09
Foreign	U.S. monetary policy(-1) until the GFC			-1.98	-1.39
	U.S. monetary policy(-2) until the GFC			1.55	0.96
	U.S. Aggregated before 2008			-0.44	-0.42
	U.S. monetary policy(-1) after the GFC			-4.37**	-2.68
	U.S. monetary policy(-2) after the GFC			-0.55	-6.16
	U.S. Aggregated after 2008			-4.92	-8.84
Banks^	Excess Tier(-5)	0.396***	0.28*	0.31*	0.35**
	D(Liabilities(-1)/ Assets(-1))	-0.73	-1.08*	-0.89	-1.05*
Macro	D(BusinessGDP(-2))	0.22***	0.20***	0.20***	0.21**
	D(unemployed 25-64(-2))	-1.56***	-1.75***	-1.76***	-1.59***
	Seasonal Dummies	Yes	Yes	Yes	Yes
	Data Break Dummies	Yes	Yes	Yes	Yes
	C	-0.03***	-0.02***	-0.02***	-0.02***
	CRISIS2008	0.02***	0.01***	0.01**	0.01***
	Observations	441	441	441	441
	Adjusted R²	0.30	0.30	0.30	0.30

Notes: *p-value < 10%, **p-value<5%, ***p-value<1%. ^ The estimation included in addition the change in bank's real assets, the change in the share of deposits in assets, the change in liquid assets, and the change in excess reserves to assets, with varying lags. All were insignificant.

5 Concluding Remarks

In our paper, we analyze policy's effect on bank credit. We present the results of an analysis of the effect of both domestic monetary policy and macroprudential policy undertaken in Israel during the period 2004–19 on domestic credit, and also refer to possible effects of global monetary policy. We estimate the effect of monetary policy, macroprudential measures and the interaction between them on housing credit, consumer credit, and credit to the business sector.

We find that macroprudential policy affected the development of banking credit. Our results show that MaP measures targeted at housing sector credit did reduce the growth rate of housing credit while increasing business credit growth. General MaP measures worked to reduce the growth rate of business credit. We could not find a clear effect of the single step targeted at the lending concentration on any credit components.

Monetary policy was found to have a clear and significant effect on credit growth rates, but this effect did not persist, at least according to our estimation, after the GFC. We find some evidence for the effect of monetary policy when it interacts with MaP measures taken after 2008. As the share of foreign currency credit is very small, the effect of monetary policy in the US is in the same direction as that of the domestic monetary policy, indicating it to be a signal for possible future local policy rather than a substitute.

We find that the interaction between monetary policy and macroprudential policy is important. MaP measures targeted at the housing market, when interacted with monetary policy, tended to intensify the accommodative effect of an (unanticipated) reduction in the interest rate on consumer and business credit. The interaction of general MaP measures with monetary policy offset the accommodative effect of reducing rates on consumer and business credit.

We also find that macroeconomic conditions, i.e., output growth and employment growth, are associated with credit growth rates and bank-specific characteristics, particularly the bank's capital relative to the supervisory requirements, affect the supply of credit.

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Appendix – Estimation Including ECB Monetary Policy Surprises

Table 3a: Housing Credit, Sample 2004:Q2 – 2019:Q4, 7 Banks, incl. ECB monetary policy

		1	2	3	4
		Basic – excl. interactions and global policy	Including interactions	Including global policy	Including interactions and global monetary policy
MaP	Cumulative MaP_housing(-1), since 2004	-0.001**	-0.002**	-0.002**	-0.002***
	MaP_general(-1) to (-8)	-0.004*	-0.003	-0.004*	-0.003
	MaP_concentration(-1) to (-4)	0.002	0.01	0.005	0.009**
Monetary Policy	Monetary policy(-1) until the GFC	-1.92*	-2.26**	-0.88	-0.92
	Monetary policy(-2) until the GFC	-4.59***	-4.57***	-3.23**	-3.70***
	Aggregated before 2008	-6.51***	-6.83***	-3.23**	-3.20**
	Monetary policy(-1) after the GFC	0.83	0.88	-0.25	-3.36
	Monetary policy(-2) after the GFC	0.76	0.56	0.37	0.80
	Aggregated after 2008	1.59*	1.44	0.13	-2.56
Interactions	Cumulative MaP_housing(-1) × Mon. policy(-1)		-0.16		0.35
	Cumulative MaP_housing(-1) × Mon. policy(-2)		-0.26		-0.30
	Aggregated MaP_housing × Mon. policy		-0.42		0.05
	MaP_general(-1) to (-8) × Mon. policy(-1)		1.16		3.45*
	MaP_general(-1) to (-8) × Mon. policy(-2)		2.84		2.50
	Aggregated MaP_general × Mon. policy		4		5.95*
	MaP_concentr.(-1) to (-4) × Mon. policy(-1)		4.02		2.53
	MaP_concentr.(-1) to (-4) × Mon. policy(-2)		3.09		5.07*
Aggregated MaP_concentr. × Mon. policy		7.11*		7.60*	
Foreign	U.S. monetary policy(-1) until the GFC			-2.51*	-2.48*
	U.S. monetary policy(-2) until the GFC			-2.38*	-2.02
	U.S. Aggregated before 2008			-4.89***	-4.50**
	U.S. monetary policy(-1) after the GFC			-0.43	5.11
	U.S. monetary policy(-2) after the GFC			0.59	0.77
	U.S. Aggregated after 2008			0.16	5.88
	ECB monetary policy(-1) until the GFC			24.89**	32.45**
	ECB monetary policy(-2) until the GFC			-15.08	-15.26
	ECB Aggregated before 2008			9.81	17.18
	ECB monetary policy(-1) after the GFC			2.93	2.16
	ECB monetary policy(-2) after the GFC			-1.05	-1.00
ECB Aggregated after 2008			1.88	1.17	
Banks^	Excess Tier(-1)	0.39***	0.40***	0.59***	0.61***
Macro	D(real wage(-2))	0.12*	0.14**	0.18**	0.16*
	D(unemployed 25-64(-5))	-0.78***	-0.62**	-0.66**	-0.58*
	D(log(house_prices(-1)))	0.08***	0.07**	0.06**	0.06*
	Seasonal Dummies	Yes	Yes	Yes	Yes
	Data Break Dummies	Yes	Yes	Yes	Yes
	C	0.001	0.001	-0.003	-0.001
	CRISIS2008	0.01**	0.015**	0.02***	0.02***
	Observations	441	441	441	441
	Adjusted R²	0.17	0.17	0.19	0.19

Notes: *p-value < 10%, **p-value<5%, ***p-value<1%. ^ The estimation included in addition the change in liabilities to assets, the change in the bank's real assets, the change in the share of deposits in assets, the change in liquid assets and the change in excess reserves to assets, with varying lags. All were insignificant.

Table 4a: Consumer Credit, Sample 2004:Q2 – 2019:Q4, 7 Banks, incl. ECB monetary policy

		1	2	3	4
		Basic – excl. interactions and global policy	Including interactions	Including global policy	Including interactions and global monetary policy
MaP	Cumulative MaP_housing(-1), since 2004	-0.001	-0.002	-0.003	-0.003
	MaP_general(-1) to (-8)	0.003	0.005	0.001	0.006
	MaP_concentration(-1) to (-4)	-0.003	0.01	0.002	0.01
Monetary Policy	Monetary policy(-1) until the GFC	-0.52	-1.55	7.30	6.90
	Monetary policy(-2) until the GFC	-12.38***	-12.77***	-20.04***	-20.81***
	Aggregated before 2008	-12.91**	-14.32***	-12.74**	-13.91**
	Monetary policy(-1) after the GFC	-0.07	-0.74	1.46	0.65
	Monetary policy(-2) after the GFC	0.54	3.16	-1.35	14.52
	Aggregated after 2008	0.47	2.42	0.11	15.17
Interactions	Cumulative MaP_housing(-1) × Mon. policy(-1)		-0.92		-0.87
	Cumulative MaP_housing(-1) × Mon. policy(-2)		-2.39**		-3.67**
	Aggregated MaP_housing × Mon. policy		-3.31**		-4.54**
	MaP_general(-1) to (-8) × Mon. policy(-1)		6.19		7.55
	MaP_general(-1) to (-8) × Mon. policy(-2)		7.17		2.10
	Aggregated MaP_general × Mon. policy		13.36		9.65
	MaP_concentr.(-1) to (-4) × Mon. policy(-1)		7.98		0.30
	MaP_concentr.(-1) to (-4) × Mon. policy(-2)		19.08		21.84*
	Aggregated MaP_concentr. × Mon. policy		27.08*		22.14
Foreign	U.S. monetary policy(-1) until the GFC			-10.64**	-10.98**
	U.S. monetary policy(-2) until the GFC			9.43**	10.06**
	U.S. Aggregated before 2008			-1.21	-0.92
	U.S. monetary policy(-1) after the GFC			2.45	4.95
	U.S. monetary policy(-2) after the GFC			13.88	-9.42
	U.S. Aggregated after 2008			16.33	-4.47
	ECB monetary policy(-1) until the GFC			9.70	54.76
	ECB monetary policy(-2) until the GFC			-114.18**	-117.15**
	ECB Aggregated before 2008			-104.47	-62.39
	ECB monetary policy(-1) after the GFC			-7.45	-6.77
	ECB monetary policy(-2) after the GFC			-9.84	-9.58
ECB Aggregated after 2008			-17.29	-16.34	
Banks^	Excess Tier(-1)	-0.15	0.05	-0.38	-0.26
	D(Liabilities(-1)/ Assets(-1))	-3.96**	-4.29**	-5.26***	-5.16***
Macro	D(real wage(-1))	0.66***	0.63**	1.13***	1.003***
	D(unemployed 25-64(-2))	-0.93	-0.31	-1.03	0.36
	Seasonal Dummies	Yes	Yes	Yes	Yes
	Data Break Dummies	Yes	Yes	Yes	Yes
	C	0.03**	0.03*	0.020	0.03*
	CRISIS2008	-0.01	-0.003	0.01	0.000
	Observations	441	441	441	441
	Adjusted R²	0.04	0.04	0.06	0.06

Notes: *p-value < 10%, **p-value<5%, ***p-value<1%. ^ The estimation included in addition the change in liabilities to assets, the change in bank's real assets, the change in the share of deposits in assets, the change in liquid assets, and the change in excess reserves to assets, with varying lags. All were insignificant.

Table 5a: Consumer Credit, Sample 2004:Q2 – 2019:Q4, 7 Banks, incl. ECB monetary policy

		1	2	3	4
		Basic – excl. interactions and global policy	Including interactions	Including global policy	Including interactions and global monetary policy
MaP	Cumulative MaP_housing(-1), since 2004	0.001**	0.001**	0.001**	0.001**
	MaP_general(-1) to (-8)	-0.008***	-0.005*	-0.006**	-0.004
	MaP_concentration(-5) to (-8)	-0.004	-0.006	-0.004	-0.004
Monetary Policy	Monetary policy(-1) until the GFC	0.12	-0.44	0.46	-0.82
	Monetary policy(-2) until the GFC	-2.76**	-2.16*	-3.94***	-2.66
	Aggregated before 2008	-2.64	-2.61	-3.49	-3.49
	Monetary policy(-1) after the GFC	1.26**	0.21	2.95***	2.43
	Monetary policy(-2) after the GFC	3.31***	3.83***	3.42***	6.94**
	Aggregated after 2008	4.57***	4.04***	6.37***	9.38***
Interactions	Cumulative MaP_housing(-1) × Mon. policy(-1)		0.28		0.021
	Cumulative MaP_housing(-1) × Mon. policy(-2)		-0.515*		-1.03**
	Aggregated MaP_housing × Mon. policy		-0.24		-1.01
	MaP_general(-1) to (-8) × Mon. policy(-1)		2.92		1.77
	MaP_general(-1) to (-8) × Mon. policy(-2)		3.51*		2.96
	Aggregated MaP_general × Mon. policy		6.43*		4.73
	MaP_concentr.(-5) to (-8) × Mon. policy(-1)		1.84		0.90
	MaP_concentr.(-5) to (-8) × Mon. policy(-2)		-2.65		-2.87
	Aggregated MaP_concentr. × Mon. policy		-0.81		-1.97
Foreign	U.S. monetary policy(-1) until the GFC			-1.41	-0.48
	U.S. monetary policy(-2) until the GFC			1.73	0.80
	U.S. Aggregated before 2008			0.32	0.32
	U.S. monetary policy(-1) after the GFC			-2.37	-0.54
	U.S. monetary policy(-2) after the GFC			0.06	-5.53
	U.S. Aggregated after 2008			-2.31	-6.07
	ECB monetary policy(-1) until the GFC			-21.09	-23.46
	ECB monetary policy(-2) until the GFC			-13.19	-16.57
	ECB Aggregated before 2008			-34.28*	-40.03**
	ECB monetary policy(-1) after the GFC			-2.77	-3.72
	ECB monetary policy(-2) after the GFC			0.05	0.83
	ECB Aggregated after 2008			-2.72	-2.89
Banks^	Excess Tier(-5)	0.40***	0.28*	0.33**	0.38**
	D(Liabilities(-1)/ Assets(-1))	-0.73	-1.08*	-1.03*	-1.25**
Macro	D(BusinessGDP(-2))	0.22***	0.20***	0.17*	0.17*
	D(unemployed 25-64(-2))	-1.55***	-1.75***	-1.80***	-1.61***
	Seasonal Dummies	Yes	Yes	Yes	Yes
	Data Break Dummies	Yes	Yes	Yes	Yes
	C	-0.03***	-0.02***	-0.02***	-0.02***
	CRISIS2008	0.02***	0.01***	0.01***	0.02***
	Observations	441	441	441	441
	Adjusted R²	0.30	0.30	0.30	0.30

Notes: *p-value < 10%, **p-value<5%, ***p-value<1%. ^ The estimation included in addition the change in liabilities to assets, the change in bank's real asset, the change in the share of deposits in assets, the change in liquid assets, and the change in excess reserves to assets, with varying lags. All were insignificant.