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Abstract

Which structural macroeconomic shocks have typified rising house prices? What ultimate factors have compromised financial stability and risk? These questions are answered for the Venezuelan economy by estimating a FAVAR model with macroeconomic, banking and asset price variables. We find that real house prices only respond to demand shocks occurring at aggregate or sectorial level. Most significant house price growths also take place with greater financial exposure to mortgages and real domestic currency depreciations, two factors that potentially magnify rising house prices. Monetary expansions from fiscal origin also increase house prices. In terms of banks' performance, we find that credit is directed toward firms for expansionary supply shocks, but toward household spending, on goods or housing, for expansionary demand shocks. In all these cases, banking leverage increases, but mainly when shocks have a significant effect on output. Rising risk and financial instability stem from the combination of growing interest rates and domestic currency appreciation, two events that provide incentives for banks to re-arrange portfolio allocation at the cost of a higher volatility of returns. Increasing risk seems to be strongly conditioned by abrupt reductions in banks' liabilities.

JEL Classification: E44, E32, R31.

Key Words: macroeconomic shocks, housing market, financial stability, banking assets, portfolio allocation

* The views expressed in this paper are the exclusive responsibility of the authors and do not reflect the views of Directors of the Venezuelan Central Bank or Cemla.

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I. Introduction

An aspect of great relevance for policy-makers is whether credit and asset price booms can endanger the stability of the financial system and the entire economy. Empirical research, based on different countries' experiences, has helped to identifying some of the conditions that anticipate financial crises. An emerging consensus is that high levels of banking credit and leverage increase the probability of observing financial crises (Schularick and Taylor, 2012 and Gourinchas and Obstfeld, 2012).

On the other hand, the emergence in the US of a house prices bubble prior to the 2008 financial crisis has led to ask about the causal relationship between credit, house prices and financial crises. As Goodhart and Hofmann (2007) state, there are several theoretical channels that can give account of the clear endogeneity (or bi-directional causality) existing between banking credit and house prices. However, because banking credit can have a direct theoretical link with monetary policy decisions, the question that naturally arises is whether monetary policy explains house price bubbles. In this sense, Eickmeier and Hofmann (2013) claim that US monetary policy shocks have a highly significant and persistent effect on house prices. This result is extended for several advanced countries by Bordo and Landon-Lane (2013). Therefore, according to these works, monetary policy has a prominent role for explaining house price booms, and potentially, financial instability.

In a more general work for the US economy, Buch, Eickmeier and Prieto (2014, a) investigate how different macroeconomic shocks are transmitted to banks in terms of affecting their (backward and forward looking) risk. These same authors, in Buch, Eickmeier and Prieto (2014, b), provide further empirical evidence regarding the bank risk taking channel of expansionary monetary policy, and the dissimilar responses observed across different types of banks.

In all these stories, although several macroeconomic conditions might affect credit, house prices, and financial stability, the monetary policy aspect of the macroeconomic performance appears to be predominant for explaining how, during normal times, risks factors build up for financial intermediaries and the rest of economic agents. Other macroeconomic shocks that might also be relevant to explain excessive asset price growth and financial instability tend to be overlooked.

In a similar fashion, developing macro-prudential policies lean towards the use of tools to control excessive credit growth and leverage based on the assumption that credit and leverage surges tend to be negative phenomena for all time and places. However, the implementation of these policies still faces the difficulty of determining under which circumstances credit and leverage booms can indeed be negative. When we take a deeper and closer look at the interplay between leverage, risk and credit for particular countries, we may found – as we think it is the case for Venezuela – that the underlying dynamics may well depend on the nature of shocks affecting the economy, which may differ according to a variety of intuitional and policy settings. We consider that country studies such as this can help to disentangle the appropriate tools for mitigating banking risk.

In this context, the objective of this paper is to empirically determine which macroeconomic conditions typify rising house prices and credit, and what ultimate factors compromise financial stability and risk. We do so by studying the impact of five major macroeconomic structural shocks (aggregate and sectorial) on house prices, portfolio allocation, stability, and performance indicators of the Venezuelan banking system. Since this paper is about normal times, we presume that the relevant shocks in the economy have a macroeconomic origin, and correspondingly we focus on the impact such shocks on the allocation of financial resources[1]. We also take into consideration the potential endogeneity among financial variables: banking portfolio decisions can respond to asset prices, but portfolio decisions can also affect asset prices. For this reason, we implement an econometric approach that allows acknowledging endogeneity among a considerable number of variables, both macroeconomic and financial.

The selection of structural shocks intends to fit a broad classification of shocks hitting economies, but also to capture the particular characteristics of the Venezuelan economy. Besides an aggregate supply shock, we define four demand shocks, divided into aggregate and sectorial, to stress the fact that some shocks are borne in the aggregate goods market, while other shocks originate in specific sectors of the economy[2]. Two aggregate real demand shocks are differentiated according to their impact on the relative price of consumption or the relative price

[1] Oppositely, works of Fornari and Stracca (2012), Eickmeier and Ng (2011), Hirstov *et al*. (2012) and Bagliano and Morana (2012) among others, have studied the global transmission of credit restrictions or financial shocks to the economic performance of countries.

[2] This classification is also equivalent to separating shocks according to the type of information used in their identification process.

of tradables[3]. Most of the literature acknowledges the existence of one real (fiscal) shock as opposed to a nominal (monetary) shock. We define two real shocks because we presume that changes in the relative consumption price might bring about important differences in the response of real production. On the other hand, we identify two structural sectorial shocks that emerge from the monetary and external sector respectively, and are more related to the particular institutional arrangement of the Venezuelan economy: a monetary and a durable surge shock. The monetary shock follows the identification in Chirinos and Pagliacci (2014) that proposes looking at money creation variables and deposit interest rates as key defining features of the shock[4]. The durable surge shock relates to the idea that, in an economy with exchange rate controls, that is, a dual exchange rate market with capital mobility restrictions, expectations of devaluation can precipitate an increase in the consumption and the price of durables goods. For this shock, a rising exchange rate premium (between the official and the non-official market rates) and a significant allocation of financial resources toward mortgages are crucial to characterize distress of the exchange rate system.

There are already a couple of empirical works for the Venezuelan case that are directly related to this paper. For the housing market, Carvallo, Chirinos and Pagliacci (2012) claim that, due to changes in external conditions, a larger supply of loans to households has implied a greater banks' exposure to housing loans and an increase in house prices. However, is it not clear whether other conditions not directly related to the external sector might also trigger movements in house price and banks' exposure. On the other hand, in Chirinos and Pagliacci (2014), oil and monetary shocks, although similar from the macroeconomic point of view, induce differentiated banks' portfolio allocations, and therefore, involve different types of risks. In particular, oil shocks have attached a strong liquidity effect that increases banks' liabilities, and rises banks' financing to firms and the government. For the monetary shock, households seem to receive a greater share of banks' loans.

At a methodological level, we use sign restrictions to identify the above five structural shocks in the context of a FAVAR model. The model specification combines observable general macroeconomic variables (real activity growth, inflation and the relative price of consumption) with unobservable factors that capture the common co-movements among micro-banking data

[3] We use the price of goods in terms of services at the consumer level as a proxy for the relative price of tradables.
[4] In this case, the monetary shock does not address unanticipated changes in monetary policy actions but it refers to unanticipated changes in the primary money creation process driven by the fiscal authorities.

and other specific macroeconomic variables. The choice of this structure responds to both, the acknowledgement of the different endogeneity relationships already mentioned, and the application of a distinctive treatment for aggregate and sectorial shocks. In particular, using a block diagonal structure for the sign restriction identification, analogously as in Mumtaz and Surico (2009), we let shocks stemming from the goods market to have an immediate impact on all variables summarized trough the factors, but we compel sectorial shocks not to have an instant effect on the goods market. This is justifiable from the perspective that we are estimating endogenous relationships in normal times and not during crises, when, for instance, sectorial financial shocks might end up affecting the goods market immediately. In terms of the econometric setup and identification technique, our work is close to that Buch, Eickmeier and Prieto (2014, a). Nonetheless, it differs in two technical details regarding the implementation: the diagonal structure for the sign restriction identification and the estimation of factors[5].

At the individual bank level, we gather a total of 140 variables corresponding to 11 financial institutions that represent about 60% of the Venezuelan banking assets. This data mostly includes general performance indicators, exposures to different assets, two measures of financial stability, the median value of each variable and some aggregated banking indicators such as interest rates and the growth rate of assets. There are also nine sectorial macroeconomic variables that characterize the money creation process related to fiscal and foreign currency actions, the external sector, the housing market, bond yields and banks' exposure to foreign debt. The analysis carried out along the paper is mostly based on the impulse responses of (aggregate and sectorial) macroeconomic variables and banking aggregated indicators to structural shocks. The heterogeneity of responses across banks will not be addressed in this paper.

Regarding results, we develop a simple framework that allows us to systematically compare responses of relevant variables across shocks, in order to contrast our empirical evidence with other works in the literature. We find that real house prices basically respond to (aggregate and sectorial) demand shocks, but not to aggregate supply shocks. Most significant booms in real house prices occur simultaneously with increases in banks' exposure to mortgages and real domestic currency depreciations. Monetary expansions from fiscal origin also cause increasing house prices. In terms of banking performance, we find that credit is directed toward firms for expansionary supply shocks, but toward household spending for expansionary demand shocks. In

[5] A more detailed discussion on these two issues is presented in the next section.

all these cases, banking leverage increases, but mainly when shocks have a significant positive effect on output.

Overall, risk appears to be related to a combination of macroeconomic and money market related factors. While expansionary supply shocks alleviate banking risk, contractionary sectorial shocks and expansionary aggregate real demand shocks increase it. For all these shocks, rising risk is associated to a real domestic currency appreciation and rising interest rates, which probably induce changes in the portfolio allocation of banks and increase the volatility of their returns. Also, in all these cases, a reduction of fiscal money creation and/or an increase of foreign currency liquidations take place, decreasing the net primary money creation in the economy.

Our general interpretation is that credit growth or high banking leverage may precede financial distress because asset growth is probably a necessary, but not a sufficient condition for distress. The circumstances that indeed might increase the chances of a banking crisis are more probably related to the unexpected reduction of banking funds used to build up assets. Therefore, policy prescriptions in the direction of mitigating banks' instability should evaluate the institutional or functional modifications that would stabilize banks' funds.

The rest of the paper is organized as follows. Section II explains the methodological strategy to identify structural shocks in the FAVAR. It also provides empirical and theoretical insights for the identification of shocks with reference to macroeconomic and institutional characteristics of the Venezuelan economy. Section III interprets identified aggregate shocks in terms of the overall performance of the economy. Section IV presents and analyzes results from the perspective of house prices and macroeconomic conditions, whereas section V does it by looking at financial performance, allocation decisions, and stability. Section VI summarizes the main messages of the paper. In order to focus on the identification of shocks and interpretation of results along the main body of the paper, the structure of the FAVAR and the technical details of the estimation are covered in appendix 1. However, it is advisable to check this appendix at this point, if the reader is not familiar either with the FAVAR or sign restriction literature.

II. Identification of structural shocks and results

This paper identifies five structural shocks, which can be classified into three general aggregate shocks and two specific sectorial shocks. Next, we will show the identification of shocks implemented, first for aggregate and then for sectorial shocks, and argue the reasons for the identifying assumptions.

Aggregate shocks intend to disentangle all the fluctuations in the aggregate goods market, which are characterized by the behavior of real activity, general prices and the adjustments that operate in relative consumption prices. By definition, an expansionary aggregate supply shock propitiates an increase real activity and a reduction in inflation. On the contrary, expansionary aggregate demand shocks mostly increase prices, but may or may not have positive real effects. This division of shocks, simply in supply or demand shocks, constitutes a mean to summarize the impact of multiple shocks that might affect the economy. Similarly as argued by Blanchard and Quah (1989), identified aggregate supply and demand shocks can be interpreted as the net effect of many other shocks having a simultaneous impact on the goods market. This is opposed to the notion of identifying monetary policy, fiscal policy or productivity shocks, whose characterization already points out at the origin of macroeconomic fluctuations. In our case, the characterization of shocks intend to organize and rationalize all what is happening in the rest of the economy, say in the asset markets or the banking sector.

Besides this broad classification, we assume there are two types of real aggregate demand shocks that affect consumption patterns and relative prices: those increasing the consumption and relative price of goods (as a proxy for tradables), and those increasing the consumption and relative price of services (as a proxy for non-tradables). Since demand shocks might or might not have an immediate impact on real activity, the definition of these demand shocks uses exclusively general and relative price information. The summary of the restrictions imposed in the definition of shocks is presented in table 1.

Table 1. - Restrictions imposed for identification of aggregate macroeconomic shocks

	Expansionary Aggregate Supply	Expansionary Demand in Tradables	Expansionary Demand of Non Tradables
Y	+		
P	-	+	+
RCP		+	-

Variables: Growth of real activity (Y), Inflation, measured as the growth of general consumer price index (P), Growth of relative consumption price: PT/PNT (RCP).

In the literature, Canova (2005) and others (such as Clarida and Gali 1994) typically identify one real demand shock instead of two. The presumption behind this more detailed taxonomy is that, in an oil abundant economy with the additional complication of exchange rate controls, consumption patterns and allocation of productive inputs can occur in a non standard fashion[6]. For example, given the exchange rate arrangement with dual markets, incentives to increase imports can induce a greater consumption of tradable goods and specialization in the commercialization of those goods. Therefore, after oil resources are directed into the domestic economy expanding aggregate demand, a greater consumption of tradables may have diverse real, banking or sectorial effects than a greater consumption of services. Therefore, we use the behavior of relative consumption prices to disentangle two potentially different real demand shocks[7].

As opposed to aggregate shocks, sectorial shocks refer to structural shocks that have its origin in more specific markets and do not necessarily have a defined effect on the aggregate goods market. Given the particular characteristics of the Venezuelan economy, we define a monetary and a durable surge shock. The summary of restrictions imposed on sectorial structural shocks is shown in table 2. Restrictions for all shocks are applied for six consecutive periods in order to characterize persistent enough structural shocks.

The monetary shock, opposed to what is usually addressed in the literature, does not refer to a monetary policy shock, but to the way money is usually introduced in the economy. In Venezuela, a monetary expansion takes place when the public sector (the central government and the oil state company) spends external resources into the domestic economy and expands the quantity of deposits channeled by the financial system. Therefore, we characterize this shock according to the movements on the variables that define it, that is, the fiscal money creation and deposit interest rate variables, as proposed in Chirinos and Pagliacci (2014). As any monetary shock, a positive value represents an expansionary aggregate demand shock. Nonetheless, we do not impose any restriction on the expected response in the aggregate goods market in order to ponder the magnitude and timing of its impact. We presume that the single price that instantaneously responds to this shock is the nominal exchange rate in the non-official market,

[6] In the framework of the Dutch disease, an increase in oil resources generates a growth of aggregate demand, a temporary positive effect on real activity, and a reduction in the relative price of tradables.

[7] Since in Venezuela price controls have mainly affected the behaviour of the price of services, the construction of the relative index of consumption prices uses de information of non-controlled services for the metropolitan area.

which is measured in units of domestic currency per dollar. Since the official exchange rate is fixed for most of the period, movements in the non-official market are measured in terms of the exchange rate premium between the official and non-official market.

The second sectorial shock is referred as a durable surge and it addresses the fact that in an economy with an exchange rate control that fixes the official exchange rate, there are devaluation expectations that continuously emerge. Since these expectations are not directly observable, we need to define a set of conditions that indirectly portray the system distress. We do so by borrowing a variation of Calvo (1986) argument that expectations of collapse of a fixed exchange system precipitates the consumption of durable goods. In this case, we presume that part of this consumption behavior is summarized by rising house prices. Finally, we complete this scenario assuming an increasing banking credit to the housing market and a larger exposure to mortgages by banks. In the overall, this shock can also be interpreted a surge in house prices that has its origin in external and banking conditions. The summary of restrictions imposed on sectorial structural shocks is available in table 2. Restrictions for all shocks are applied for six consecutive periods in order to characterize persistent enough structural shocks.

Table 2.- Restrictions imposed for identification of sectorial macroeconomic shocks

	Monetary shock	**Durable surge shock**
FM	+	
TID	-	
ERGAP	+	+
RHP		+
GMGL		+
SMGL		+

Variables: fiscal money creation (FM); Implicit interest rate of liabilities (TID); Exchange rate premium (ERGAP); Growth of real house prices (RHP); Growth of aggregate mortgages (GMGL); Share of mortgages to total loans (SMGL).

As already mentioned, the sign restriction identification compels the behavior of the restricted variables in their responses to structural shocks. In this paper, since we deal with a FAVAR, the implementation of the identification might not seem straightforward. A first element to consider is that, differently from Eickmeier and Hoffman (2013) and Buch *et al.* (2014, a), who also identify structural shocks with sign restrictions in a FAVAR, we do not clean factor estimates from their contemporaneous relationship with observable variables. This is so, because we do not attempt to interpret factor estimates nor have we imposed the recursive identification strategy followed by Bernanke, Boivin and Eliasz (2005). It is also the case, that it is precisely the

contemporaneous relationship between observable variables and factors what we want to preserve in order to analyze the impact of macroeconomic shocks on the rest of variables.

A second element regarding the implementation of the sign restriction identification carried out in this paper is that specific or sectorial shocks cannot affect observable variables contemporaneously. In other words, shocks defined at the aggregate level could be pervasive in their effect on all variables, but when a shock is originated in specific markets or sectors, they cannot transmit right away (within the month) to the aggregate goods market. This notion is achieved by using a block diagonal structure in the rotation matrix that differentiates orthogonal from structural shocks, as is similarly done in Mumtaz and Surico (2009). In particular, aggregate shocks are identified only with the information coming from the three observable variables that characterize the goods market. On the contrary, identification of sectorial shocks uses all the information contained in the factors and consequently, it potentially exploits the entire common movements among the rest of variables. These two technical issues regarding sign restriction identification implementation are explained in appendix 1 in further detail.

Results from impulse responses of variables to the above structural shocks are summarized in table 3. Impulse responses for the group of selected variables are available in appendix 2. List of variables in the FAVAR are in appendix 3.

Table 3: Qualitative Summary of Impulse Responses to Different Shocks

Block / Shock	Expansionary Supply Shock	Expansionary Tradable Demand Shock	Expansionary Non Tradable Demand Shock	Expansionary Monetary Shock	Expansionary Durable Surge
Restrictions Identification	*Increase in economic activity and reduction in general prices*	*Increase in general prices and increase in relative consumption price*	*Increase in general prices and decrease in relative consumption price*	*Fiscal money creation and increase in foreign exchange rate premium*	*Increase in foreign exchange premium and house prices with greater mortgage growth and exposure*
Macro variables	• Lasting increase in aggregate activity and price reduction • Real domestic currency depreciation • Reduction in foreign exchange premium • Import surge • Fiscal money creation and raise in FX currency liquidation (but positive net effect) • Lower domestic interest rates • Growth in aggregate loans and securities • Lower yield for foreign bonds	• Increase in aggregate activity • Real domestic currency appreciation • Increase in foreign exchange premium • Import surge • Fiscal money contraction and raise in FX currency liquidation (negative net effect) • Higher domestic interest rates • Growth in aggregate loans and contraction in securities • Higher yield for foreign bonds	• No effect on aggregate activity • Real domestic currency appreciation • Reduction in foreign exchange premium • Raise in FX currency liquidation (negative net effect) • Higher domestic interest rates • Contraction in securities	• Transitory increase in activity and late price acceleration • Increase in the relative price of tradable goods • Real domestic currency depreciation • Increase in foreign exchange premium • Late increase in imports • Fiscal money creation and reduction in FX currency liquidation (positive net effect) • Lower domestic interest rates • Small growth in securities • Lower yield for foreign bonds	• No effect on aggregate activity or general prices • Increase in the relative price of tradable goods • Real domestic currency depreciation after 5 months • Lasting increase in foreign exchange premium • Small import reduction • Reduction in FX currency liquidation (positive net effect) • Small loan contraction

Banks' Portfolio Allocation	• Reallocation towards securities away from loans • Decrease in foreign bond share • Loan reallocation toward firms, away from consumers and mortgages	• Reallocation toward loans away from securities • Decrease in foreign bond share • Loan reallocation toward consumers, away from firms and mortgages	• Reallocation toward loans away from securities • Loan reallocation toward consumers, away from mortgages	• No reallocation between loans and securities • Loan reallocation toward consumers and mortgages, away from firms	• No reallocation between loans and securities • Increase in foreign bond share • Loan reallocation towards consumers and mortgages, away from firms
Banks' Performance	• Increase in operating cost and interest margin • Decreased liquidity after 12 months • Increase in leverage after a year • Reduction in ROA volatility	• Decrease in operating costs and increase in margin • Increased liquidity • Transitory increase in leverage • Increase in ROA volatility and probability of insolvency	• Increase in operating costs • Immediate decreased liquidity that reverts after 12 months • Reduction in leverage after a year • Increase in ROA volatility and probability of insolvency	• Decrease in operating cost and margin • Immediate increase in leverage • Decrease in ROA volatility and probability of insolvency	• Decrease in operating cost and margin • Increase in leverage • Immediate decrease in ROA volatility and probability of insolvency (after 6 months)
Housing Market	• Growth in mortgages and reduction in interest rates (supply increase) • No significant effect on prices and increase in number of transactions	• Contraction in mortgages and increase in interest rates (supply reduction) • Significant reduction in prices but increase in number of transactions	• Contraction in mortgages and increase in interest rates (supply reduction) • Increase in prices after 12-month	• Growth in mortgages and reduction in interest rates (supply increase) • Transitory increase in prices and late increase in number of transactions	• Growth in mortgages and reduction in interest rates (supply increase) • Increase in prices during a year

III. Interpretation and comparisons of structural shocks

The objective of this section is to get a qualitative overview of what is the overall economy performance for structural shocks, without discussing its effects on asset markets or the particular performance of banking indicators. These issues will be addressed in the following two sections.

In the case of the aggregate supply shock, from the works of Bárcenas, Chirinos y Pagliacci (2013) and Chirinos and Pagliacci (2014), we know that it mostly refers to the occurrence of an oil boom in the context of an administrated policy of imports and exchange rate controls. That is, the combination of increased imports with a greater availability of oil resources has behaved as an expansionary aggregate supply shock, whose identification has been very robust to different models estimated for the 2004-2011 period. The novelty that the oil shock has consistently behaved as a supply shock (with increase in real activity and a reduction in inflation) rather than as a demand shock, has to do with the fact that imports have become a significant source of cheap intermediate inputs and consumption goods. In this scenario, notwithstanding its strong positive liquidity effect with diminishing interest rates, the nominal exchange rate in the non-official market diminishes, but real domestic currency depreciation takes place[8].

In the case of the two real aggregate demand shocks identified, possible explanations regarding the factors that trigger them, and their sequencing in time, are more difficult to identify. Since both shocks are framed during expansions of the aggregate demand, and more precisely during expansions of aggregate consumption, the underlying causes of these shocks should be looked for in the factors that drive household consumption and/or saving decisions. These triggering factors might refer to all fiscal, monetary or exchange rate actions not summarized by the set of available variables in the FAVAR[9].

[8] The measure of real exchange rate constructed is simply proxy of a bilateral purchasing power with respect to USA, where the variations of the nominal exchange rate (Dom/$) in the non-official market is compared to the wedge of inflation rates between USA and Venezuela. In this case, real domestic currency depreciation is driven by the reduction in domestic inflation.

[9] In the Venezuelan case, it is likely that changes arising either in the administration of the exchange control regime and/or in the management of financial public assets and liabilities are particularly relevant. For instance, given the capital mobility restrictions associated to the control, in several opportunities the government allowed families to buy, with domestic currency, foreign denominated debt, which could be sold in international markets for foreign currency. This would refer to a case in which families reduce current consumption to increase savings in foreign currency, out of a policy action created in the context of the exchange rate control.

The comparison between these two expansionary real aggregate demand shocks shows that differences arise not only in the relative consumption price, but also in their effect on real activity, imports and the nominal exchange rate (exchange rate gap). In particular, it is interesting to note that only a positive shock to the consumption of goods, and not services, triggers a considerable increase in real output of non-tradable sectors. This presumably happens because the (non-tradable) sectors motorizing real activity are related to the commercialization of these (tradable) goods. In this case, opposed to the Dutch disease type of prediction, a temporary real growth caused by an excessive aggregate demand occurs with an increase (not a reduction) in the relative price of tradables. While the rising demand of tradable goods induces an increase of the nominal exchange rate (in the non-official market) and an increase of imports, the other shock produces opposite results. Similarities between these two real demand shocks lie in the monetary aspect, where both shocks induce increasing interest rates. Also, both shocks are associated to real domestic currency appreciations, indicating that prices are augmenting more than proportionally with respect to the non-official nominal exchange rate.

In terms of the two sectorial demand shocks, the main difference arises also in their effect on the aggregate goods market. While a positive monetary shock causes a temporary increase in real activity and a late response in inflation, a greater demand of durable goods does not have a statistical impact on either aggregate real activity or general prices[10]. Other differences are found in terms of interest rates and imports. While the monetary shock drives down all interest rates, including foreign bonds yields, the durable surge does not do so. Imports increase after a year for the monetary shock and shrink for the durable shock[11].

There are other differences among the identified structural shocks that are worthy of attention. For example, since the monetary shock is identified as an increase in fiscal money creation, which is ultimately related to the amount of oil resources that enter into the domestic economy, it could be asked whether this shock is adequately separated from the supply shock (also related to oil booms). To answer that, it is important to understand that the real effect of the oil boom is associated to the availability of cheaper intermediate and consumption goods, while its monetary aspect materializes when the government domestically spends the local currency counterpart of

[10] In the limit, looking at the median response of output and prices, the durable demand shock induces a response more similar to a contractionary supply shock than to an expansionary demand shock.

[11] Also, in terms of the foreign public bonds, a positive demand on durables increase the exposure of banks to these bonds, which can be related to the possible future slowdown in real activity. A comment on this regard will be made in the section addressing the behavior of foreign public debt yields.

such resources. These two events take place at different moments in time and reflect the particular monetary arrangement of the Venezuelan economy[12]. Also, although in both shocks the real domestic currency depreciates, in the supply shock this behavior is driven by the reduction of the inflation rate, while in the monetary shock occurs at the expense of huge nominal exchange rate escalation (in the non-official market).

On the other hand, the expansionary tradable demand shock shares also some features with the positive monetary shock: while both shocks increase real activity, inflation and the relative price of tradables, the real shock pushes interest rates upward while the monetary shock drives interest rates down. This is because these two shocks induce opposite effects on net money creation. Also the behavior of real exchange rate and imports differs.

Another valid comparison can be drawn between a positive durable demand shock and an expansionary demand of tradables, since most durable goods (except houses) are in fact tradables. As a matter of fact, in both cases the relative consumption price increases and the nominal (non-official) exchange rate increases, but in one case as a consequence of a greater demand of tradable goods, in the other case as the origin of the demand of durables (the expectations of devaluation or external distress). Therefore, while for the tradable shock this greater demand turns into a positive real effect (with more available imported goods), in the durable surge only relative prices adjust. The diverse origin of shocks also translates into a divergent pattern for the real exchange rate movements. At the level of the housing market, the behavior of prices is radically the opposite.

Finally, a word of caution for interpreting results. Since explanations of asset markets or banking performance indicators sometimes involve referring to the mirror images of identified shocks, the reader needs to be careful with the direction of shocks addressed in different parts of the text. For instance, in the case of contractionary real demand shocks we would be referring to the case of falling aggregate demand with a reallocation of consumption away from the corresponding sector.

[12] This refers to the fact that the oil company must sell an important part of oil resources to the Central Bank in exchange for domestic currency.

IV. Real house prices and macroeconomic conditions

Which macroeconomic conditions explain rising real house prices? Which are the macroeconomic shocks that mostly affect this price? What is the role played by housing credit? Are real domestic currency appreciations and higher leverage common conditions surrounding rising real house prices?

The previous questions can be addressed by the impulse responses already obtained, but focusing on the direction of structural shocks that move house prices in the same direction. In table 4, we summarize the direction of other variables' impulse responses, for the shocks that portray rising house prices. Partial associations between house prices and other variables emerge when directions of responses are mostly identical.

Table 4. Variables responses for shocks with rising real house prices

Shock	RHP	NHT	GMGL	TMGL	SMGL	LEV	RCP	RER	ERGAP	Y
↓ DT	+	-	+	-	+	-	-	+	-	-
↑ M	+	+	+	-	+	+	+	+	+	+
↑ DS	+	...	+	-	+	+	+	+	+	...
↑ DNT	+	...	-	+	-	-	-	-	-	...

Shocks: Demand of tradable goods (DT); Demand of non-tradable goods (DNT); Monetary (M); Durable surge (DS). Arrows indicate if the shock is expansionary (up) or contractionary (down).
Variables: Growth of real house prices (RHP); Number of house transactions (NHT); Growth of aggregate mortgages (GMGL); Interest rate of mortgages (TMGL); Share of mortgages to total loans (SMGL); Banking leverage (LEV); Growth of relative consumption price: PT/PNT (RCP); Growth of real exchange rate (RER); Exchange rate premium (ERGAP); Growth of real activity (Y).

The first general assessment is that the number of transactions in this market (NHT), and therefore, the sales of houses, seems to be positively related with movements in real activity[13]. Secondly, house prices basically change with expansionary or contractionary demand shocks, but not with aggregate supply shocks that potentially increase also the supply of houses.

Rising house prices mostly occur when demand of durables (↑DS), non-tradable (↑DNT) and in general, all goods and services (↑M) increase. This happens simultaneously as real activity does not contract (either stays the same or increases). Nonetheless, it is initially striking that when the demand of tradable goods is shrinking (↓DT), house prices boost, as it points out the information in table 4.

[13] The number of house transactions also increase during expansionary supply shocks, but without affecting their price.

Possible explanations of these different evidences are advanced next. When a contractionary tradable shock occurs (↓DT), aggregate demand is falling, but a redistribution of demand toward non-tradable goods is also operating. This justifies an increasing demand in the housing market. At a more specific level, house prices also rise because, while a temporary reduction in the availability of houses for sale operates (↓NHT), at bank level, funds are directed to the housing market. So, the increase in housing mortgages and a reduction in mortgage interest rates enable few acquisitions of houses at higher prices. Since real domestic currency depreciates during this shock, also there is a possible positive pass through to some housing segments.

For an expansionary monetary shock (↑M), in which the money creation is mainly driven by fiscal decisions, excess money supply in hands of families would boost the demand of mainly (tradable) goods, foreign denominated assets, and houses. Simultaneously, the allocation of financial funds, first toward consumption loans and second, toward mortgages, explains the possibility that families lift potential liquidity constraints and materialize their demand in rising house prices[14]. For the non-tradable shock (expansionary DNT), the greater demand of services does not translate into a positive boost in real activity, but potentially increases the demand for houses (also a non tradable). In this case, the reduction in the supply of mortgages and a reallocation toward consumption loans lag the increase house prices, which occurs almost after a year. In this last case, a real domestic currency appreciation occurs. This particular scenario is consistent with findings in Carvallo, Chirinos and Pagliacci (2012) where some situations of real domestic currency appreciation and no movements in real activity lead to rising house prices.

Another important shock that explains growing house prices is a surge in durable goods (↑DS). In this case, by construction, expectations devaluations and a greater allocation of financial funds to the housing market are the triggering factors for such demand. In particular, houses might represent a mean to avoid wealth losses, as nominal and real domestic currency depreciation takes place. This depreciation can also signal a possible pass through to some housing segments.

Now, from all these different macroeconomic situations, which are the variable associations that emerge? The first most remarkable result is that, for shocks explaining the largest variance of real house prices (all but expansionary DNT), the financial system is directing resources toward

[14] In terms of the positive correlation that emerges between a monetary easing and rising real house prices, this result is comparable to the ones referring in the literature to the role of monetary policy in promoting housing booms. However, it is distinctive from the perspective that fiscal actions, and not monetary policy actions, are the ones determining the monetary stance of the economy.

the housing market. Although we cannot state that this reallocation of funds is the ultimate cause for increasing house prices, it obviously is an important element in the transmission mechanism[15]. Less likely, growing house prices can also occur, in absence of larger mortgage exposure and leverage, as it is the case for a expansionary DNT. Therefore, reallocation of funds to the real estate market can be considered an amplifying factor for rising house prices.

Secondly, most cases when real house prices boost a simultaneous real domestic currency depreciation. Since by definition, structural shocks are the ultimate cause for both, rising real house prices and real exchange rate, we cannot establish a direct causality between these two variables. However, we can state that real domestic currency depreciation potentially intensifies rising real house prices as it signals higher nominal prices for most expensive housing segments.

Finally, real output growth does not seem to be a necessary condition for increasing house prices. On the contrary, in some analyzed cases, it is the reduction in real activity a characteristic accompanying rising real house prices. Aggregate supply shocks, which mostly affect output, do not have a statistical significant effect on house prices.

V. Financial system performance

V.1 Banks' portfolio allocation

Identified shocks imply differentiated movements in the allocation of resources between different asset classes. While the expansionary supply shock tends to increase the share of securities (mostly public debt bonds), the two real aggregate demand shocks, on the other hand, reduce the share of securities and increase the relative weight of loans. The other two sectorial shocks, the monetary and durable surge shocks, have no distributional effect at this level, but imply a reallocation of funds within types of loans. Independently of these patterns, expansionary shocks (except for expansionary DNT) increase banking leverage, especially when shocks have a positive impact on real activity.

Regarding allocation between loan classes, an expansionary supply shock tends to assign credit to firms, reducing the portfolio share of consumer and housing loans. Oppositely, all identified

[15] This result is also consistent with findings in Carvallo, Chirinos and Pagliacci (2012), in which shocks increasing the supply of mortgages are followed by a growth in real house prices.

demand shocks (including the durable surge shock) imply a movement away from loans to firms and toward asset classes related to household spending (on consumption goods or houses). To be noticed, similar loan allocation effects are established by Chirinos and Pagliacci (2014) where an expansionary oil shock (equivalent to a positive supply shock) favors credit to the corporate sector, whereas a monetary shock inclines banks towards consumer and housing-related lending. Our results extend those findings, by identifying more comprehensive shocks.

A general explanation for these loan allocation patterns could be that the financial system adjusts its supply of funds to the credit demand of agents motorizing, either production (in the supply shock) or houselhold spending (for the rest of shocks). Nonetheless, loan interest rate movements are not always upward, indicating that other factors (not related to credit demand behavior) might affect banks' decisions to allocate funds. For instance, for the aggregate supply shock, where loan interest rates tend to decline, lending to firms could be a combination of a greater availability of deposits and the selection of agents perceiving higher rents[16].

The previous trends in assets allocation are also likely to leave a mark upon the sources of latent risk. For example, an increasing allocation of funds to the public sector during expansionary supply shocks could increase banks' risk in scenarios of oil price reductions and government insolvency (Chirinos and Pagliacci 2014, Moreno and Pagliacci 2011). Less clear is the risk effect of portfolio reallocation between types of loans for demand shocks, but increasing the share of credit to households could materialize in increasing risk, if during economic contractions households end up with a worse performance than firms.

V.2 Banks' instability and risk

There are several forms to measure risk in the literature. Some authors use the ratio of non-performing loans, such as Buch *et. al* (2010), others refer to leverage or the share of consumer credit and mortgages to total assets such as Angeloni *et. al* (2010). Many others make use of market based metrics of probability of default in the line with Merton (1973) or recur to the computation of Z-scores. For the measurement of banks' risk, we rely on two measures widely used in the literature: Z-scores and the cross-sectional standard deviations of returns on assets (see Buch, Eickmeir and Prieto 2014, a). The Z-score measure is calculated using banking data

[16] In fact, since expansionary supply shocks are related to positive oils shocks with increasing imports at the official exchange rate, the government and firms are the ones receiving the greater share of the oil rent.

on capitalization, returns and its volatility[17]. Theoretically speaking, Z-scores are inversely related to the probability of insolvency, i.e. the probability that the equity base of the bank will be sufficiently eroded to render the bank insolvent. Therefore, lower values indicate- a greater probability of insolvency. The second measure, the cross-sectional standard deviations of returns on assets, tries to capture systemic volatility of returns and seem to closely anticipate periods of financial tension.

Table 5 shows the response of the two selected measures of risk and other related variables for shocks with increasing risk: higher volatility of cross-sectional rates of returns and an increase in the probabilities of insolvency (lower Z-scores).

Table 5: Variables responses for shocks with increasing risk

Shock	ROADEV	ZETA	LEV	RHP	TIL	GLOANS	SLOANS	RER	ERGAP	RCP
↑DT	+	-	+	-	+	+	+	-	+	+
↓AS	+	-	-	...	+	-	+	-	+	…
↓M	+	-	-	-	+	…	…	-	-	-
↓DS	+	-	-	-	…	+	…	-	-	-
↑DNT	+	-	-	+	+	…	+	-	-	-

Shocks: Aggregate supply (AS); Demand of tradable goods (DT); Demand of non-tradable goods (DNT); Monetary expansion (M); Durable surge (DS). Arrows indicate if the shock is expansionary (up) or contractionary (down).
Variables: Standard deviation of ROA (ROADEV); Z-score (ZETA); Banking leverage (LEV); Implicit interest rate of loans (TIL); Growth of aggregate banks' loans (GLOANS); Share of total loans to total assets (SLOANS); Growth of real exchange rate (RER); Exchange rate premium (ERGAP); Growth of relative consumption price (RCP).

For all types of shocks associated with increasing risk, the local currency is experiencing real appreciation. Also, both the yield on foreign currency denominated bonds and domestic interest rates are increasing.

There is also an extensive literature on the association between the level of interest rates and risk[18]. In adverse selection models such as Stiglitz and Weiss (1981), high loan interest rates are associated with increasing risk because the average pool quality of borrowers' projects lowers, although lenders' benefits rise. On the other hand, in recent contributions, Cociuba *et. al* (2012), and Malherbe (2012) develop DSGE models in which low interest rates increase risk in the

[17] Returns volatility is calculated as the standard deviation of ROA over a moving twelve month window.
[18] Some models of asymmetric information and interest rate are: Townsend (1979), Stiglitz and Weiss (1981), Diamong and Dybvig (1983), Diamond (1984), Bernanke and Gertler (1987), Milde and Riley (1988), Jaffe and Stiglitz (1990), Holmstrom and Tirole (1997).

context of deposit insurance and limited liability[19]. Likewise, if episodes of low real and nominal interest rates are prolonged, banks' managers have incentives to search for higher yields by taking more risk. When these low interest rates are the result of persistent monetary accommodations, it operates what is called the "risk-taking channel" of monetary policy (see Angeloni et. al 2010, Angeloni and Faia 2009).

Regarding the role of domestic currency appreciation as a triggering factor for financial instability, Kaminsky and Reinhart (1999), Gourinchas *et al.* (2001), and Gourinchas and Obstfeld (2012) have established substantial international evidence. Nonetheless, the underlying microfoundations of the effect domestic currency appreciation on risk have not been well established. Bruno and Shin (2013), in a model in which banks intermediate dollar denominated funds, stipulate that, by virtue of domestic currency appreciation, local borrower´s project values (in dollars) increase, so banks tend to augment leverage, facing higher potential future risks.

Although this extensive literature might provide general arguments to rationalize our empirical results, given the particular characteristics of the Venezuelan economy, some work needs to be done to provide a reasonable story. In the first place, domestic currency appreciation does not necessarily addresses a strong signal of external vulnerability, given that real exchange rate movements are measured in the non-official market, where the value of the domestic currency adjusts to supply and demand conditions. What we do observe, is that for all shocks, real domestic currency appreciation occurs simultaneously with a reduction of fiscal creation and/or an increase of foreign currency liquidations, both of which decrease net money creation and shape a general upward tendency for interest rates. This primary monetary tightening has induced, in some cases, a reduction of the nominal exchange rate (ERGAP), and in the rest of cases, a growth rate smaller than domestic inflation. This combination of rising interest rates and lowered real exchange rates provides incentives for the financial system to re-arrange their portfolio allocation. In most of these scenarios, the share of loans to assets tends to increase, and redistribution occurs liquidating public debt security positions while intermediating more funds to the private sector through loans. In this process, profits suddenly change in time and become

[19] In those moral hazard models, deposit insurance lowers bank´s marginal cost of funding bellow its social cost. Banks have incentives to take projects with socially negative NPV, as limited liability allows benefiting from risky projects going well while being partially shielded from risky projects going bad.

uneven for banks, reflecting increasing risk in terms of both, time volatility of banks' returns and cross section volatility of systemic returns[20].

At the light of previous results, a fundamental question arises: what is triggering the emergence of banking risk? One view in the literature, such as in Adrian and Boyarchenko (2012), is that increasing banking leverage is the ultimate cause of systemic risk, since during leverage build up banks tend to assume more risk in their investments and borrowers' profiles. Later, during situations of financial stress, as risk materializes, leverage tends to decrease as asset crunch unravels. Our results might support this view, since, for most shocks, higher risk is associated with a process of de-leveraging and falling house prices, while during times of relative financial stability, leverage and house prices tend to rise (table 5).

Nevertheless, it would seem that the role played by monetary conditions, which are mainly resumed by the primary money creation conditions, is fundamental for triggering risk. In our case, the circumstances that indeed might increase the chances of a crisis are more probably related to the unexpected reduction of banking funds used to build up assets, given a previous situation of growing leverage. That is, a potential sudden reduction of banks' funds constitutes the ultimate cause of increasing banking risk. Reallocation of assets also takes place because there probably are price mechanisms at work through exchange rate and interest rate adjustments. So, our interpretation is that credit growth or high banking leverage may precede financial distress because asset growth is probably a necessary, but not a sufficient condition for distress.

This theoretical stand has already been taken in the literature, for instance in Perotti and Suarez (2011), which argues that the root of banks' risk lies in the quality of funding: wholesale funding is cheaper but unstable. In our case, the instability of funds has its roots in the volatility of net primary money creation and in the institutional arrangement that allows that fiscal and exchange rate actions modify the quantity of primary money in the economy.

[20] Although not shown in the impulse responses, ROA does not show a defined pattern with respect to the behavior of Z-scores and might increase or decrease depending on the shock considered. However, risk adjusted returns decrease, indicating that Z-scores are mainly driven by the behavior of volatility of returns.

VI. Final summary

The objective of this paper is to determine which macroeconomic conditions typify rising asset prices and what ultimate factors compromise financial stability and risk. Methodologically, we have accomplished this objective by defining meaningful structural macroeconomic shocks that affect asset prices and banking performance indicators. Specific results emerge by addressing partial variable associations that come out across shocks. This allows interpreting results in comparison with the related academic literature.

Of the two assets analyzed, we find that real house prices basically respond to expansionary or contractionary aggregate and sectorial demand shocks. For shocks explaining the largest variance of real house prices, the financial system directs resources toward mortgages. Although we cannot state that this reallocation of funds is the ultimate cause for increasing house prices, it probably represents an amplifying factor for it. Secondly, since for most cases real house prices boost simultaneously with real domestic currency depreciations, we believe that a real depreciation also magnifies rising real house prices, as it signals higher nominal prices for most expensive housing segments. Finally, while a great deal of academic literature provide evidence on the positive effect of a loose monetary policy on house prices, our results show that a fiscal monetary expansion also causes increasing house prices.

Among the most significant results for banking performance, we find that for expansionary supply shocks the allocation of financial credit is directed toward firms, and for expansionary demand shocks, toward household spending on housing and/or goods and services. In all these cases, leverage increases, but mainly when these expansionary shocks have a significant positive effect on output. Rising risk and financial instability stem from the combination of rising interest rates and a lowered real exchange rate, two conditions that provide incentives for re-arranging portfolio allocation. Redistribution of funds occurs by liquidating public debt security positions and the intermediation of funds to firms or households through loans. However, we believe that the reduction of banking funds that operates during all these shocks is an important factor for increasing risk. Regarding to existing literature, risk is defined in different ways and comparisons are not straightforward.

In Venezuela, since the instability of funds has its roots in the volatility of net primary money creation, it seems necessary to adjust the institutional arrangement that regulates the quantity of primary money in the economy. Therefore, policy prescriptions in the direction of mitigating banks' instability should evaluate the institutional or functional modifications that would stabilize banks' funds.

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Appendix 1

Structure of the model

Consider the following system:

$$X_t = \Lambda F_t + \zeta_t \quad (1)$$

$$\mathrm{B}^{-1} Z_t = \Gamma_1 Z_{t-1} + ... + \Gamma_q Z_{t-q} + u_t \quad (2)$$

The first equation refers to a factor model, in which sectorial macroeconomic and banking variables *X* are function of a set of non-observable factors *F*, through the factor loadings Λ. By construction *X* has time dimension *T* and *N* variables, being *N*>*T*. For this investigation *N*=149 (140 banking variables plus 9 sectorial variables) and *T*=96 (monthly observations from January 2004 through December 2011).

The second equation represents a structural VAR where *Z* includes observable macroeconomic variables *Y* and factors *F*, such that $Z = \begin{bmatrix} Y \\ F \end{bmatrix}$ with observable variables stacked first. Structural shocks are represented by *u* and have a diagonal covariance matrix. B and Γ are structural VAR parameters. This second equation can also be written as a reduced VAR, such that:

$$Z_t = \mathrm{A} Z_{t-1} + e_t \quad (3)$$

where *A* is the companion matrix form that translates any VAR(q) into a VAR(1). Reduced form residuals *e* have covariance matrix Σ.

Equation (1) and (3) constitute the FAVAR model. Since *N*>*T*, factors can be estimated through principal component analysis, and can be considered as observable for estimating equation (3). Equation (3) is estimated by OLS as any VAR. This implies that the estimation of the FAVAR is carried out in two stages and that uncertainty of factors is considered negligible, as in Bernanke, Boivin and Eliasz (BBE, 2005). The order of VAR is selected looking at Schwarz and Hannan-Quinn criteria, which suggest the use of 1 lag. Stability conditions of the VAR are also satisfied.

The number of factors included in the VAR is determined qualitatively: including the minimum number of factors that produce stable impulse responses, but avoiding an excessive volatility as the number of factor increases. Tests, such as the ones proposed by Bai and Ng (2002), were also applied, providing a range between 5 and 8 factors as the optimal number of factors. We finally chose the first 5 principal components of *X* as the relevant factors to be included in the estimation of equation (3). This makes *Z* a vector of 8 variables.

Sign restriction identification

This type of identification starts by finding a set of orthogonal errors in the estimated VAR according to (3). Through any orthogonalization process, that is, any matrix decomposition that satisfies $\hat{\Sigma} = \hat{V}\,\hat{V}'$, orthogonal errors can be retrieved with the expression $\varepsilon_t = \hat{V}^{-1} e_t$. In particular, we obtain $\hat{V}$ from the Cholesky decomposition of $\hat{\Sigma}$. Because structural shocks are strictly identified by their expected effect on economic variables, orthogonal shocks may not necessarily qualify as such. Therefore, the way sign restriction identification works is by combining orthogonal shocks in such a way that the resulting structural (also orthogonal) shocks have the properties imposed by the researcher. Operationally, if we assume that structural shocks

are related to orthogonal shocks through a matrix Q, such that $\varepsilon_t = Q\, u_t$ then, we can write structural impulse responses from the VAR as $I\hat{R}Z(h) = \hat{\mathrm{A}}^{h-1}\,\hat{V}\,Q$ for the h^{th} horizon. However, Q must be a rotation matrix, which by definition satisfies $Q'Q = \mathrm{I}$, so that we can always write $\hat{\Sigma} = \hat{V}\,Q\,Q'\,\hat{V}' = \hat{V}\,\hat{V}'$. That is, the properties of the estimated covariance matrix are preserved. According to Rubio, Waggoner and Zha (2010), Q can be obtained from applying the QR decomposition to a uniform random matrix. For a FAVAR, since factors cannot be interpreted, impulse responses on final variables are given by $IRY(h)$ and $IRX(h) = \Lambda\, IRF(h)$, where $IRY(h)$ and $IRF(h)$ come from the partition of $I\hat{R}Z(h) = \begin{bmatrix} IRY(h) \\ IRF(h) \end{bmatrix}$ and Λ are the eigenvectors associated to the selected factors. Therefore, sign restriction identification consists on finding several (enough) rotation matrices Qs that satisfy the restrictions imposed on impulse responses of final variables[21]. Notice that this procedure avoids imposing null restrictions on B, as it is the case when using Cholesky decomposition as a structural identification scheme. In other words, $\hat{V}\,Q$ does not generally exhibits zero restrictions, as it does $\hat{V}$.

Since we want to identify aggregate and sectorial structural shocks, we impose differences on the way these shocks are defined and their impact on the rest of the economy. For instance, aggregate shocks are strictly identified with the information coming from the aggregate goods market. Specific or sectorial shocks, on the contrary, have its origin in more specific markets and do not necessarily have a defined effect on the aggregate goods market. In terms of their relationship with the rest of the economy, aggregate structural shocks have an immediate impact on all variables, but sectorial shocks do not have an instant effect on the goods market. These two sets of assumptions are imposed by assuming a block diagonal form to matrix Q, such that $\begin{bmatrix} Q_1 & 0 \\ 0 & Q_2 \end{bmatrix}$. Notice that the non-zero blocks of Q, say Q_1 and Q_2 , also satisfy $Q_1'Q_1 = \mathrm{I}$ and $Q_2'Q_2 = \mathrm{I}$, and Q can still be defined as a rotation matrix.. Since the goods market is characterized by three observable variables in the FAVAR, for our model, Q_1 is a 3x3 matrix and Q_2 is a 5x5 matrix. The use of this block diagonal structure for Q is a generalization of the procedure used in Mumtaz and Surico (2009), which define Q as $\begin{bmatrix} Q_1 & 0 \\ 0 & I \end{bmatrix}$, i.e. the combination of a rotation matrix with an identity matrix, in order to distinguish international from domestic shocks, in a FAVAR for UK augmented with international factors.

Compared to a recursive identification scheme, the identification achieved with a block diagonal structure of Q has a couple of advantages. First, although the impact matrix $\hat{V}\,Q$ has a block of zeros, these zero restrictions are located only its upper-right hand side corner and are fewer in number than those appearing in a recursive identification scheme. Second, the greatest gain to the use of this block diagonal structure is that different types of shocks combine information from diverse groups of variables, differentiating the set of information that characterize each type. This makes impact of shocks more powerful and still allows defining shocks in terms of co-movements of several (not one) variables.

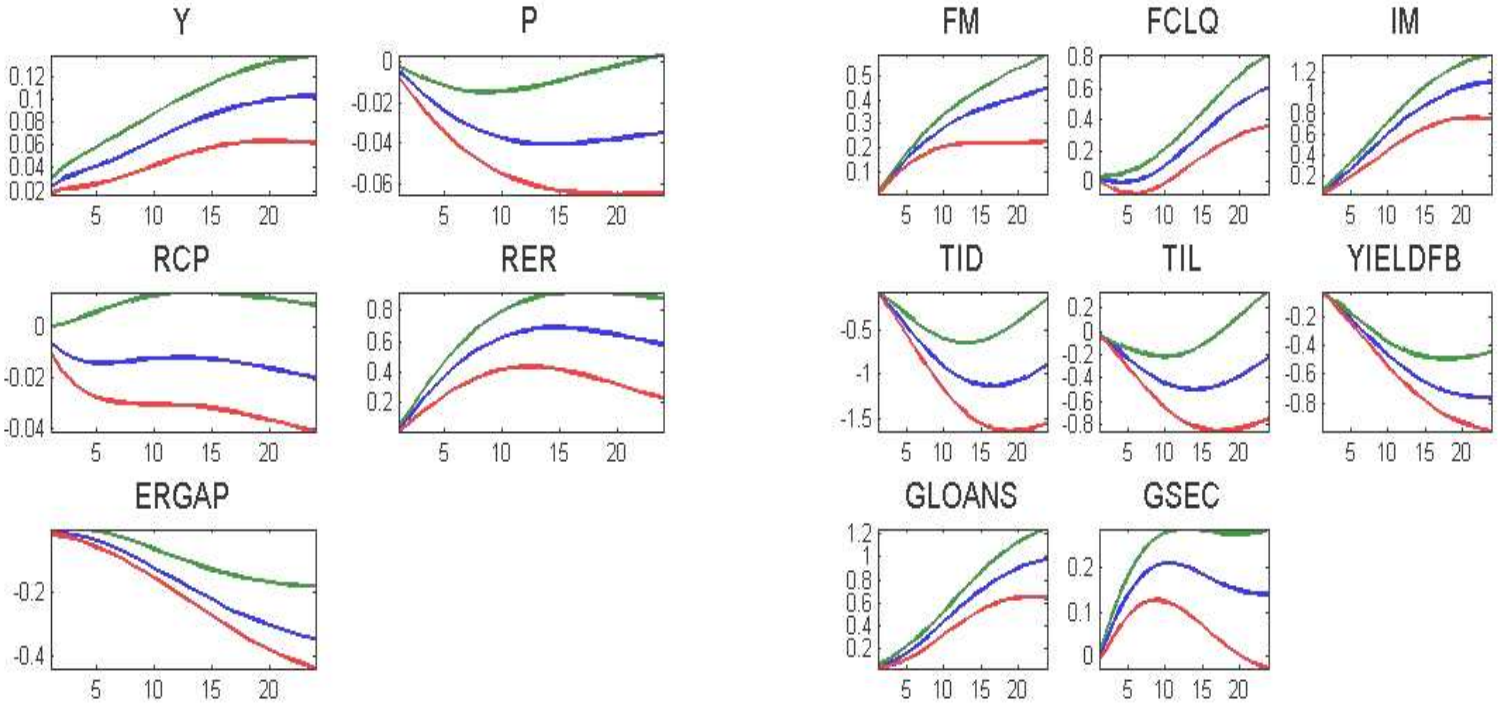
[21] For each potential draw of Q that generates impulse responses, identification entails to keeps only those draws that satisfy restrictions imposed, but for *all identified* shocks simultaneously. This is so in order to preserve orthogonality among structural shocks.

Given the importance of the work of BBE (2005) in the FAVAR literature, it is important to comment on the differences that arise in terms of the general identification strategy used in this paper. BBE (2005) apply a recursive identification scheme by two means: using the Cholesky decomposition on a VAR where factors are ordered first than the observable interest rate variable, and ensuring that the recursive identification scheme is empirically satisfied. This last condition entails removing the contemporaneous effect of interest rate on factors, which is done by regressing estimated factors against "slow moving factors" and the interest rate[22]. They also dedicate some effort to explain which factors can be considered slow movement. All this is done because a shock to the interest rate must not affect factors contemporaneously. When using sign restrictions, identification is achieved by addressing the behavior of observed variables and factors are only instruments to summarize other variables' co-movements. Therefore, we do not clean factor estimates from their contemporaneous relationship with observable variables because we are not imposing a recursive identification scheme and it is precisely the contemporaneous relationships between observable variables and factors what we want to preserve in order to adequately ponder the impact of macroeconomic shocks. Although Eickmeier and Hoffman (2013) and Buch *et al.* (2014, a) also identify structural shocks with sign restrictions in a FAVAR closer in spirit to our model than to the BBE FAVAR, they do clean factors from observable variables. It is our belief that this procedure is not justified given the reasons already mentioned.

[22] Boivin, Giannoni and Mihov (2009) suggest instead an iterative procedure to eliminate the effect of the observable variable on factors.

Appendix 2

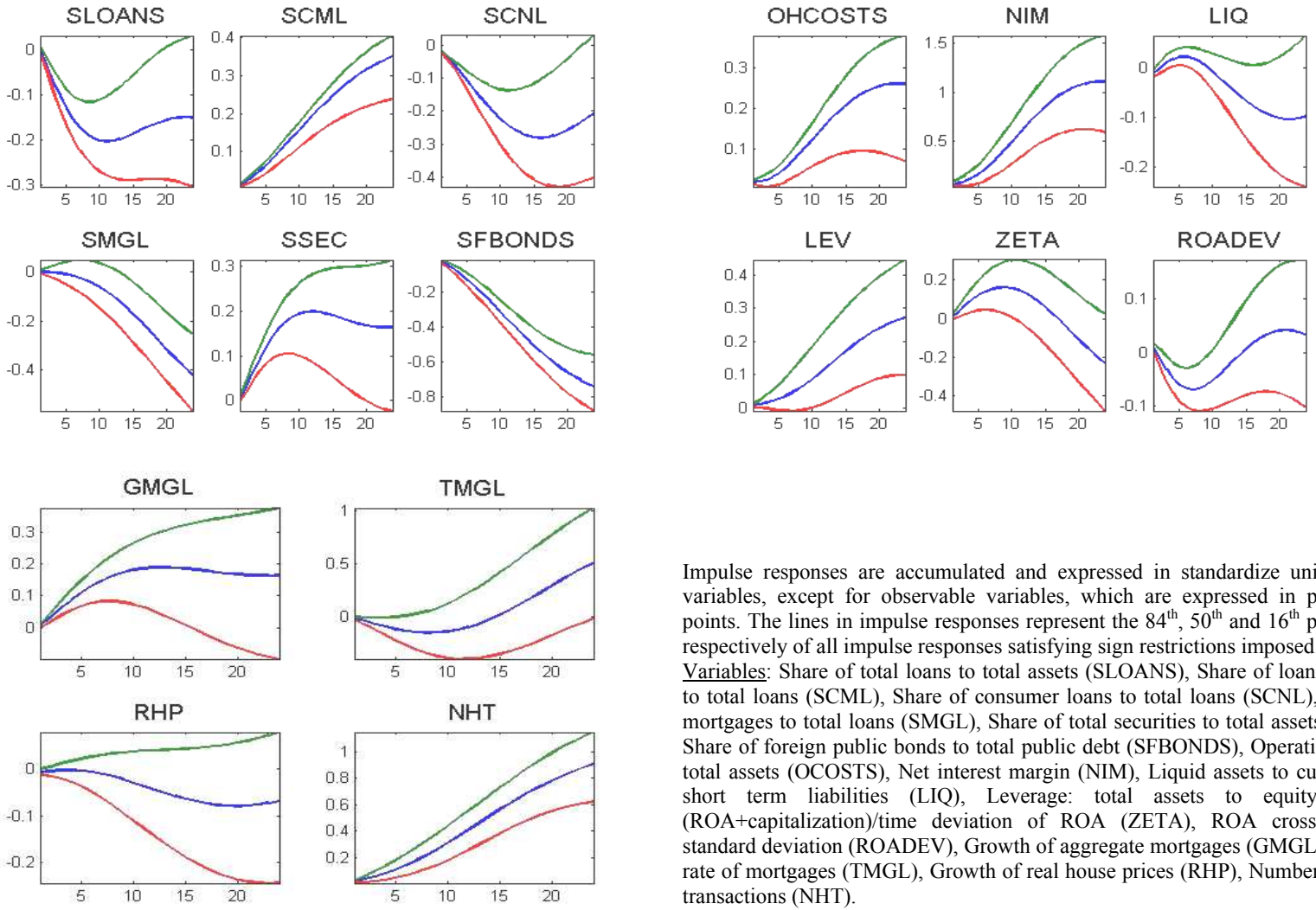
1.1. Expansionary aggregate supply shock: macroeconomic performance



Impulse responses are accumulated and expressed in standardize units for all variables, except for observable variables, which are expressed in percentage points. The lines in impulse responses represent the 84th, 50th and 16th percentiles respectively of all impulse responses satisfying sign restrictions imposed.

Variables: Growth of real activity indicator (Y), Growth of general consumer price index (P), Growth of relative consumption price: price of tradables/price of non-tradables (RCP), Growth of real exchange rate (RER), Exchange rate gap (ERGAP), Money creation of fiscal origin to money base (FM), Foreign currency liquidations to money base (FCLQ), Growth of foreign currency value of private imports (IM), Implicit interest rate of liabilities (TID), Implicit interest rate of loans (TIL), Yield of foreign public bonds (YIELDFB), Growth of aggregate banks' loans (GLOANS), Growth of aggregate banks' securities (GSEC).

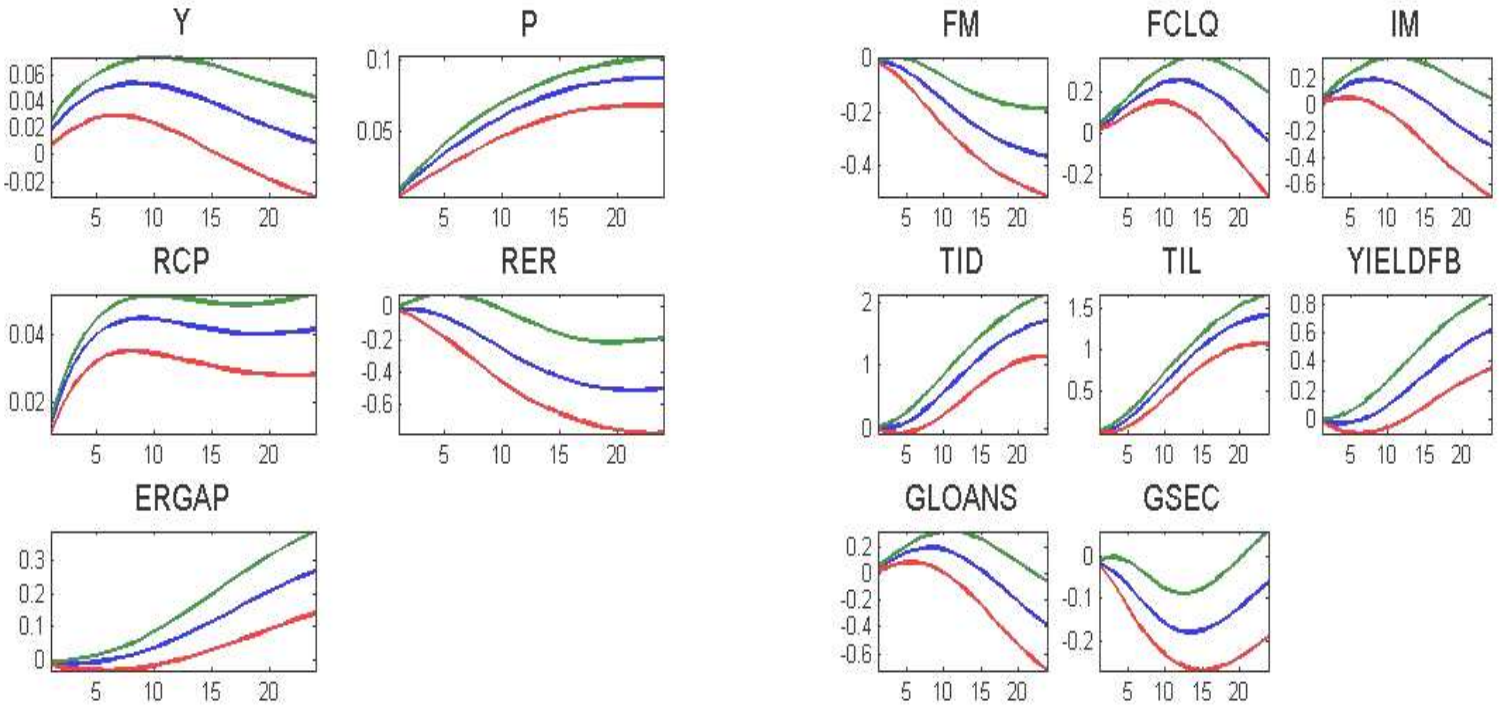
1.2. Expansionary aggregate supply shock: banks' performance and housing market



Impulse responses are accumulated and expressed in standardize units for all variables, except for observable variables, which are expressed in percentage points. The lines in impulse responses represent the 84th, 50th and 16th percentiles respectively of all impulse responses satisfying sign restrictions imposed.

Variables: Share of total loans to total assets (SLOANS), Share of loans to firms to total loans (SCML), Share of consumer loans to total loans (SCNL), Share of mortgages to total loans (SMGL), Share of total securities to total assets (SSEC), Share of foreign public bonds to total public debt (SFBONDS), Operating costs / total assets (OCOSTS), Net interest margin (NIM), Liquid assets to customer & short term liabilities (LIQ), Leverage: total assets to equity (LEV), (ROA+capitalization)/time deviation of ROA (ZETA), ROA cross-sectional standard deviation (ROADEV), Growth of aggregate mortgages (GMGL), Interest rate of mortgages (TMGL), Growth of real house prices (RHP), Number of house transactions (NHT).

2.1. Expansionary tradable demand shock: macroeconomic performance



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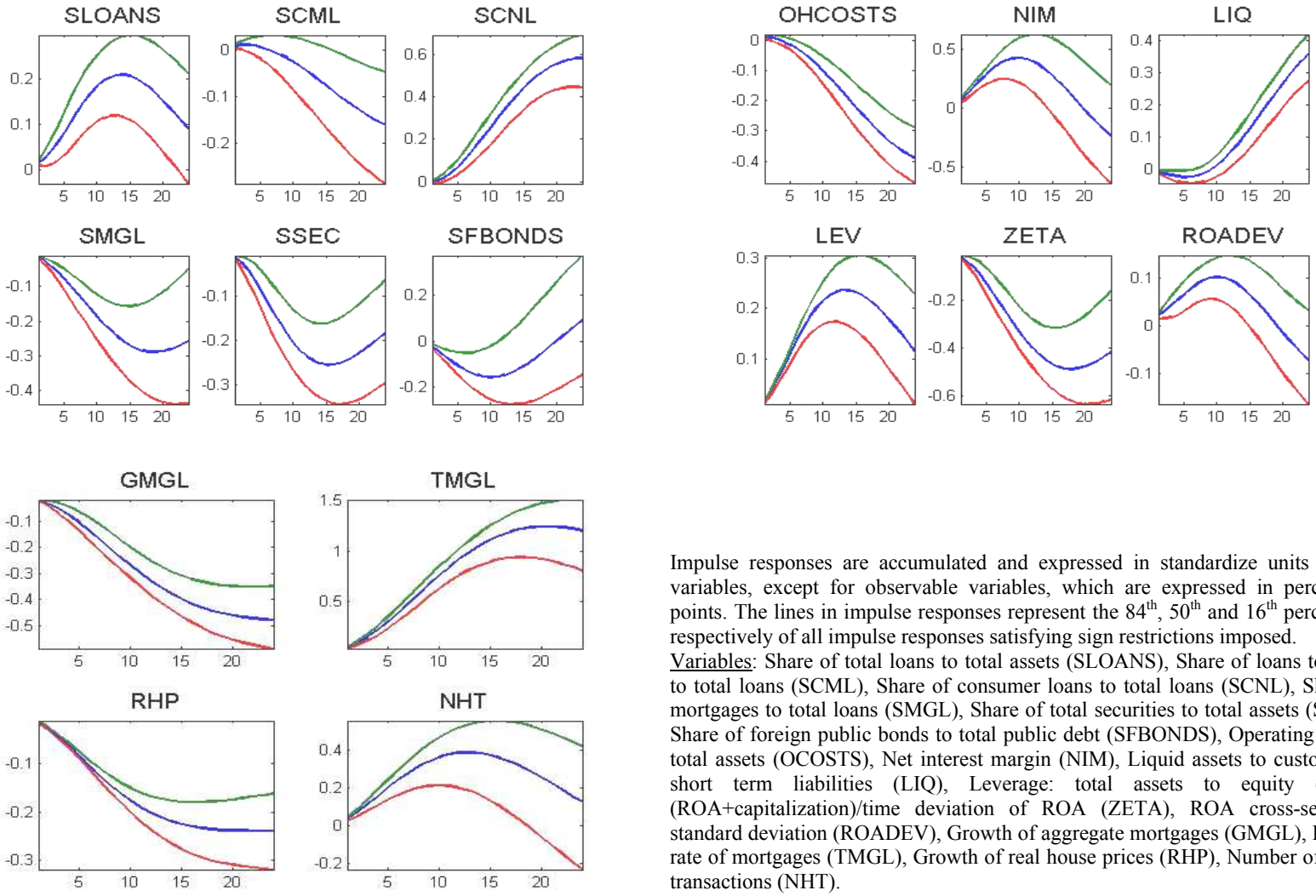
2.2. Expansionary tradable demand shock: banks' performance and housing market



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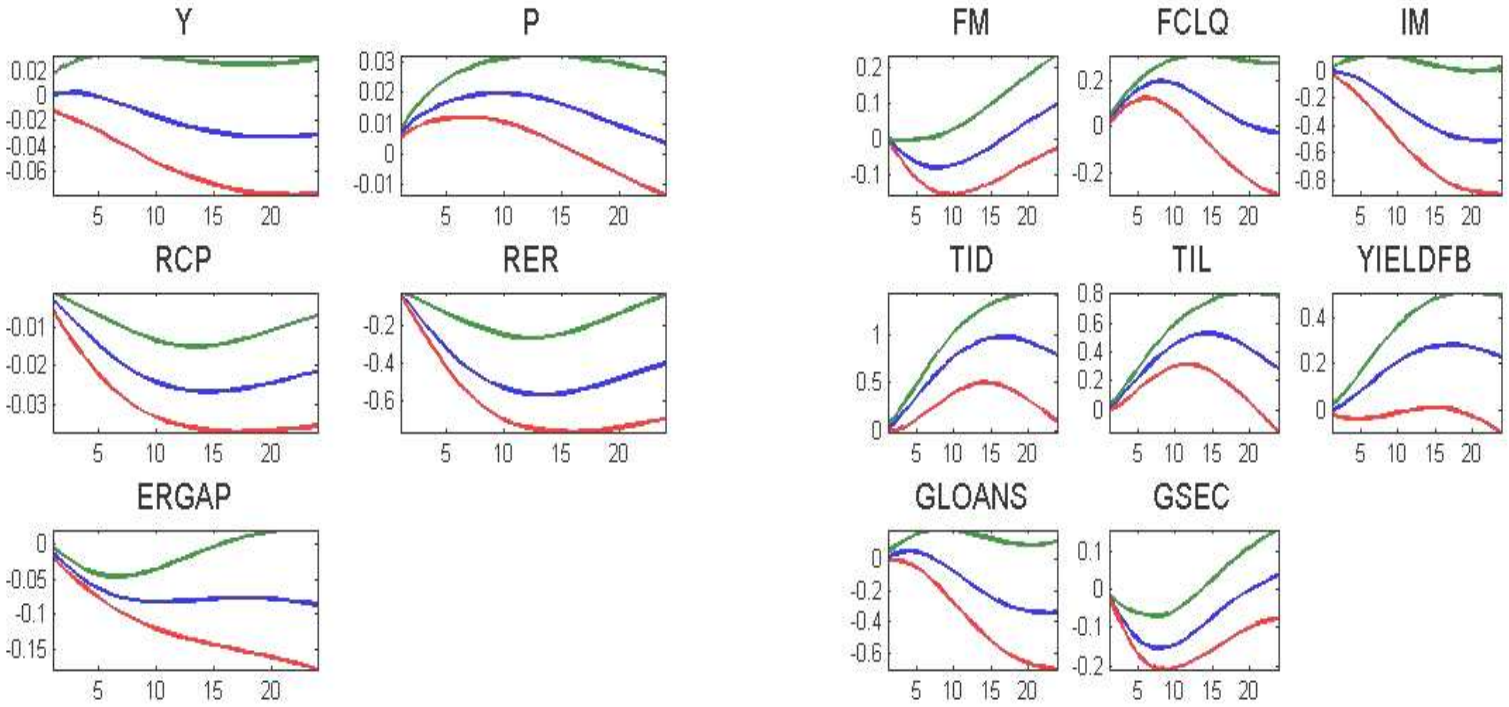
3.1. Expansionary non-tradable demand shock: macroeconomic performance



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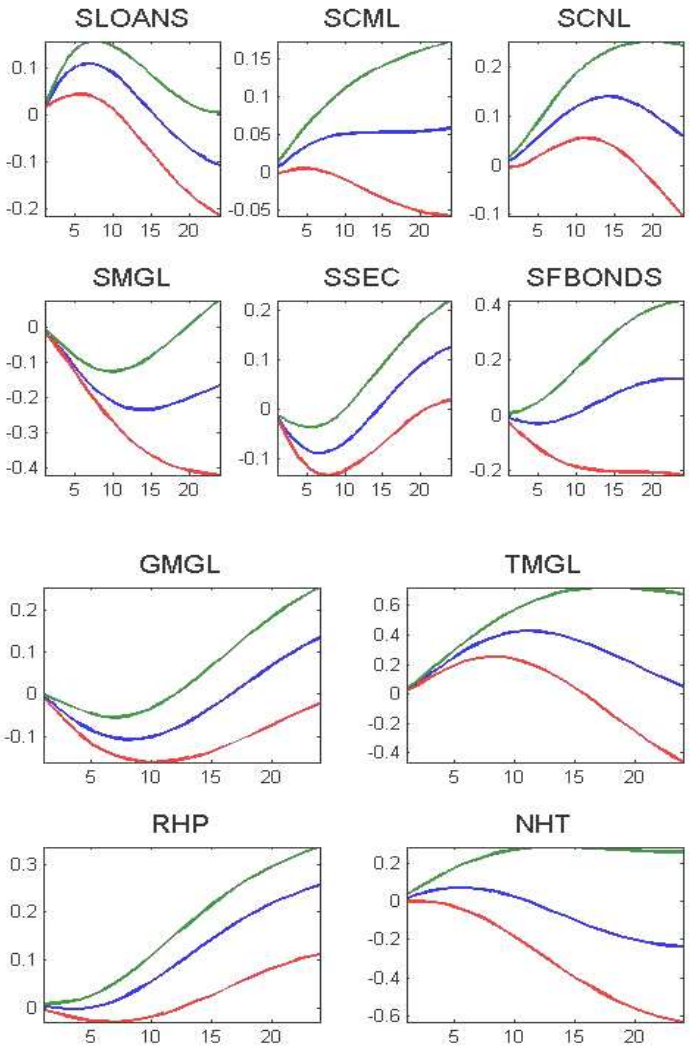
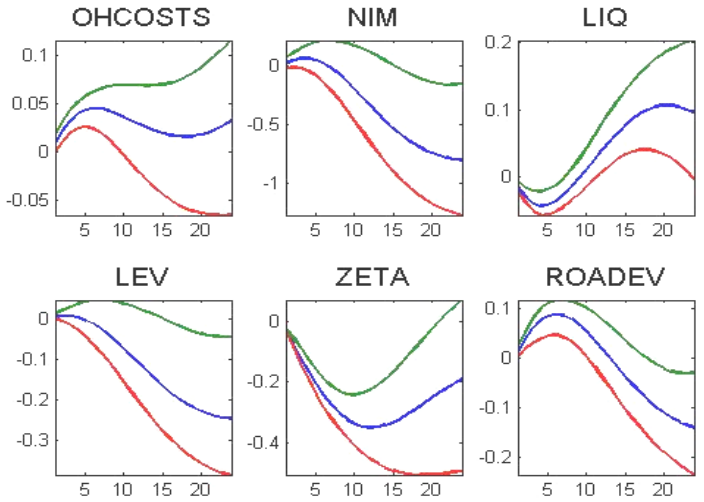
3.2. Expansionary non-tradable demand shock: banks' performance and housing market





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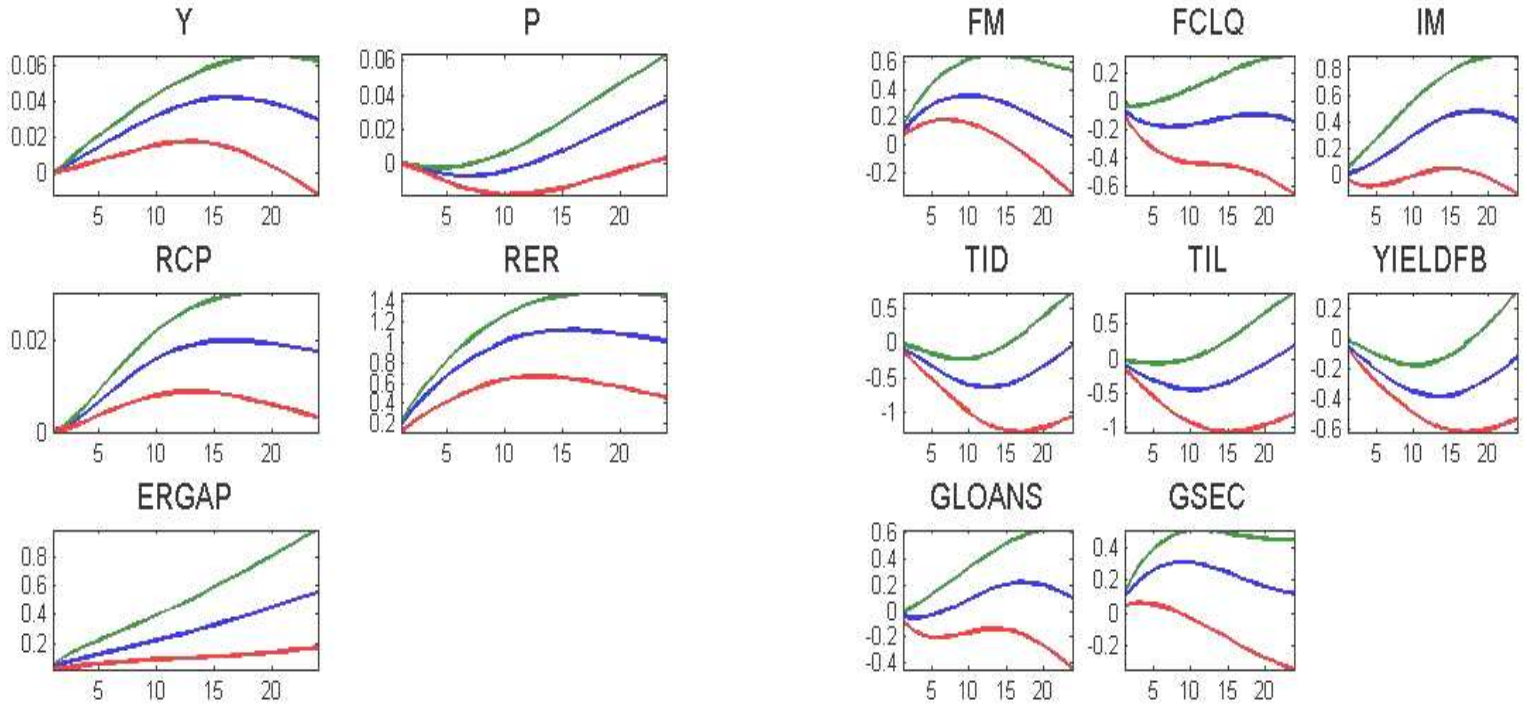
4.1. Expansionary monetary shock: macroeconomic performance



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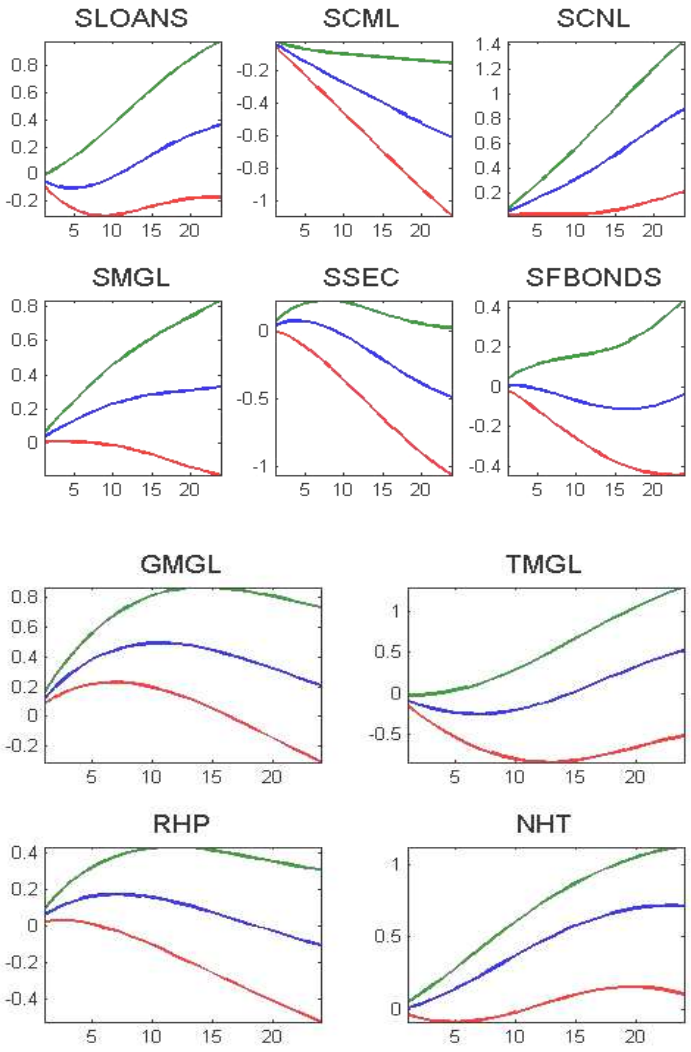
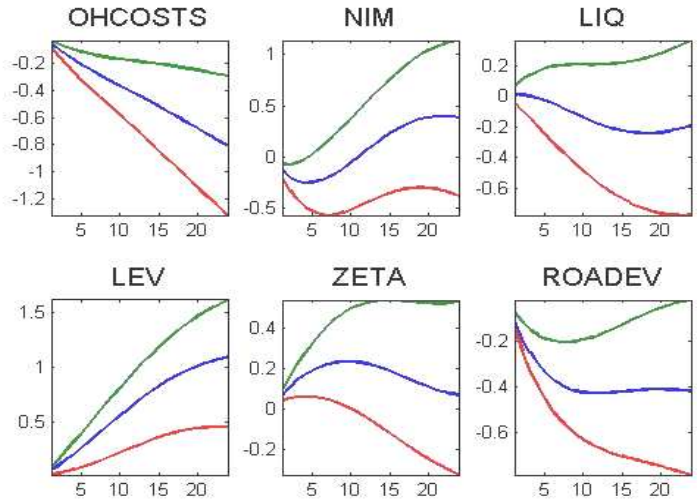
4.2. Expansionary monetary shock: banks' performance and housing market





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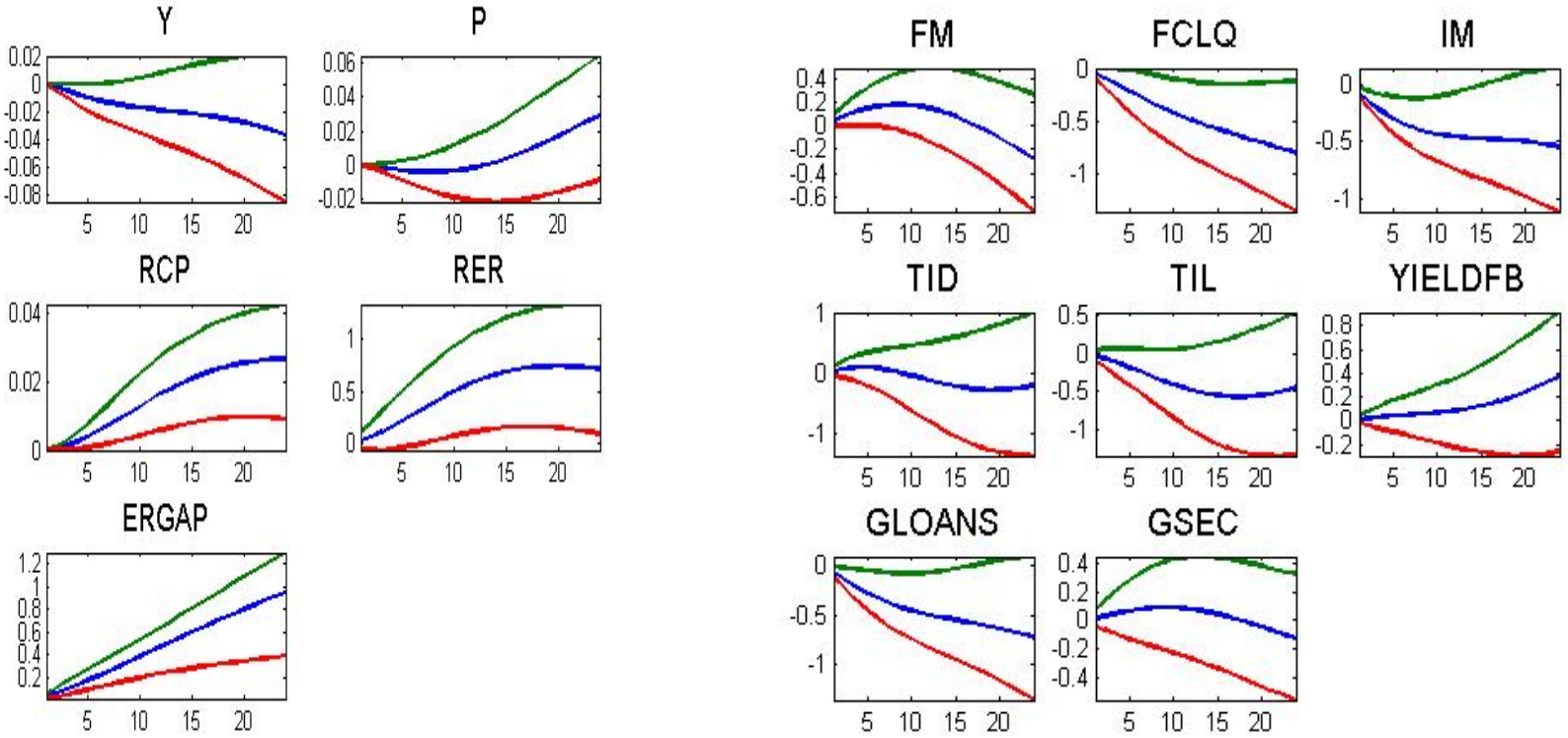
5.1. Durable surge shock: macroeconomic performance



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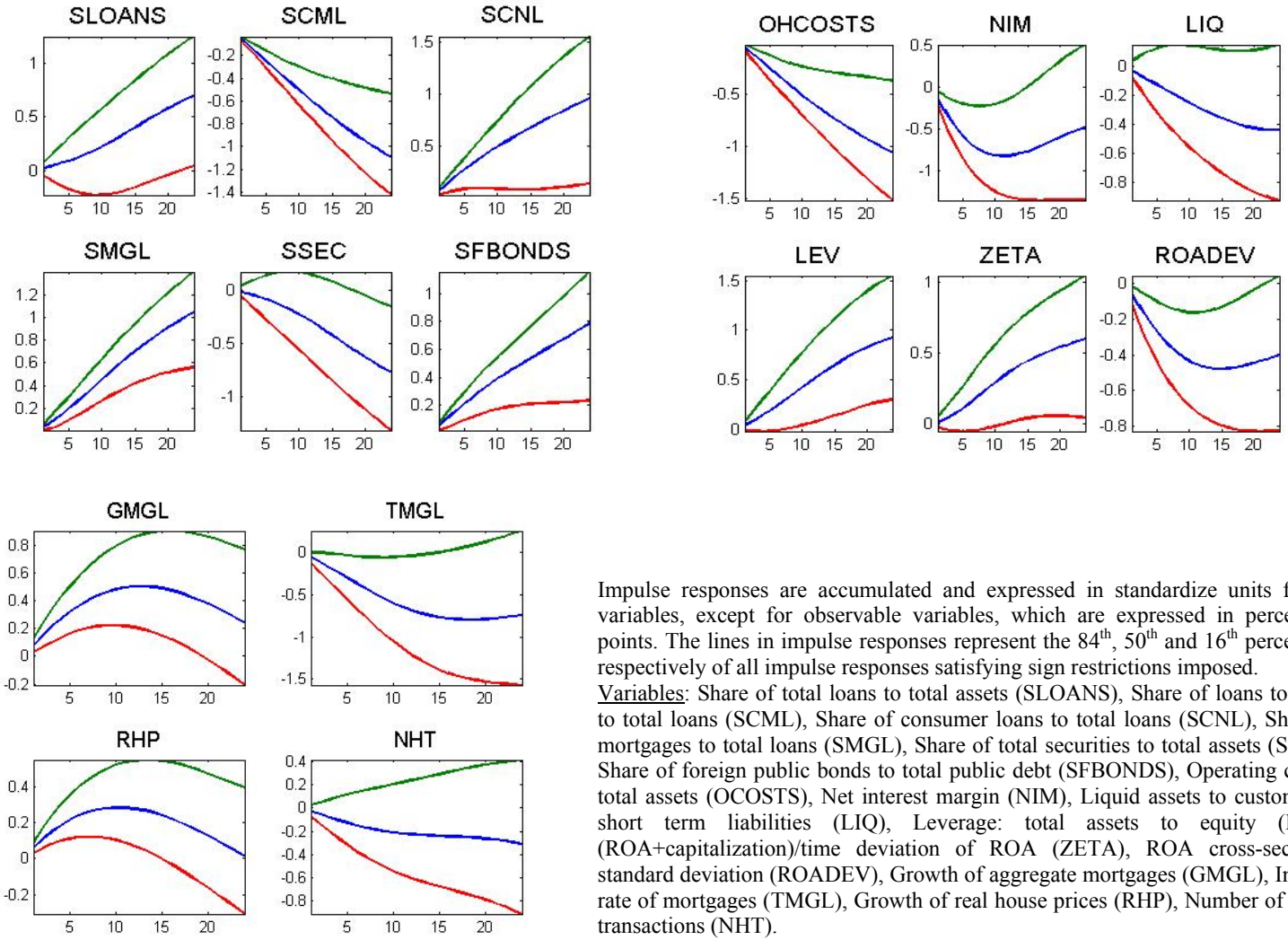
5.2. Durable surge shock: banks' performance and housing market



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Appendix 3: List of variables used in the FAVAR

Aggregate macroeconomic variables	Y	Growth of real activity indicator
	P	Growth of general consumer price index
	RCP	Growth of relative consumption price: price of tradables/price of non-tradables
Sectoral macroeconomic variables	FM	Money creation of fiscal origin to money base
	FCLQ	Foreign currency liquidations to money base
	IM	Growth of foreign currency value of private imports
	RER	Growth of real exchange rate
	ERGAP	Exchange rate gap
	RHP	Growth of real house prices
	NHT	Number of house transactions
	YIELDFB	Yield of foreign public bonds
	SFBONDS	Share of foreign public bonds to total public debt
Banking variables	NIM	Net interest margin
	CFUNDS	Cost of funds to total deposits
	OCOSTS	Operating costs to total assets
	LEV	Leverage: total assets to equity
	LIQ	Liquid assets to customer & short term liabilities
	ZETA	(ROA+capitalization)/time deviation of ROA
	ROADEV	ROA cross-sectional standard deviation
	TNL	Nominal interest rate of loans
	TIL	Implicit interest rate of loans
	TMGL	Interest rate of mortgages
	TND	Nominal interest rate of liabilities
	TID	Implicit interest rate of liabilities
	GLOANS	Growth of aggregate bank loans
	GSEC	Growth of aggregate bank securities
	GCML	Growth of aggregate loans to firms
	GCNL	Growth of aggregate consumer loans
	GMGL	Growth of aggregate mortgages
	SLOANS	Share of total loans to total assets
	SSEC	Share of total securities to total assets
	SCML	Share of loans to firms to total loans
	SCNL	Share of consumer loans to total loans
	SMGL	Share of mortgages to total loans