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Bank credit, asset prices and financial stability: Evidence from French banks

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Bank credit, asset prices and financial stability: Evidence from French banks [1]

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Abstract

This paper analyses the effect of asset prices on credit growth in France and tries to disentangle credit demand and supply factors, both for the whole 1993-2010 period and during periods of financial instability. Using bank-level panel data at a quarterly frequency, stock price growth is shown to have a significant effect on lending growth over the whole period, but without credit supply factors being singled out. By contrast, housing price growth has a significant effect during periods of financial instability only, even after controlling for credit demand effects. These results show that credit demand factors do play a large role but also provide evidence of tighter credit constraints on households in financial instability periods.

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Contents

Abstract……………………………………………………………………………… 1

I. Introduction……………………………………………………………………………… 3

II. Asset prices and bank balance sheets: related literature……………………………... 5

III. The dataset…………………………………………………………………………... 8
A. Description of the data……………………………………………………….. 8
B. Descriptive statistics………………………………………………………… 10

IV. Model and results……………………………………………………………………… 13
A. Model presentation…………………………………………………………... 14
B. Addressing the endogeneity issue…………………………………………… 16
C. Building a financial instability index………………………………………… 17
D. Baseline specification………………...……………………………………... 18
E. Focus on listed banks………………………………………………………… 22
F. Credit breakdown…………………………………………………………….. 24
Corporate loans……………………………………………………..……… 24
Loans to households……………………………………………………….. 25
Loans for purposes other than house purchase…………………………….. 27

Conclusion……………………………………………………………………………..... 30

References……………………………………………………………………………….. 31

Appendix………………………………………………………………….................... 34

Tables
Table 1. Correlation coefficients between the main variables…………………………... 10
Table 2. Granger causality tests………………………………………………………… 17
Table 3. Financial Instability Index-Principal Component Analysis-Loading factors…….. 18
Table 4. Determinants of total loan growth……………….……………………………….. 21
Table 5. Determinants of total loan growth of listed banks………………..………………. 24
Table 6. Determinants of corporate loan growth…………….……………………………….. 25
Table 7. Determinants of household loan growth………………..………………………… 26
Table 8. Determinants of non-mortgage loan growth……………..……………………….. 27
Table 10. Determinants of non-mortgage loan growth without NPL ratio…………..……... 31
Table A1. Descriptive statistics of model variables……………………………………….. 34
Table A2. Correlation coefficients between the variables………………………………… 35
Tables A3-A5. Determinants of stock price growth- Whole period/Financial Instability periods/Tranquil periods…………………………………………………………………… 36
Tables A6-A8. Determinants of housing price growth- Whole period/Financial Instability periods/Tranquil periods…………………………………………………………………… 38

Figures
Figure 1. Distribution of individual banks' size to the average size ratio………………… 9
Figure 2. France-Cyclical developments in credit and asset prices………………………... 11
Figure 3. Descriptive statistics of main model variables…………………………………... 12

I. INTRODUCTION

The financial crisis that started in 2007 shed new light on the real economic effects of asset prices. Indeed, the financial crisis had its roots in the United States' housing market developments. Creditors lent massively to low-income borrowers during the upturn on the expectation that rising housing prices would allow them to recover the full amount of their loans. Upon the downturn in the housing market cycle, borrowers went bust and the crisis propagated to other asset markets and other countries through bank loans' securitization and the so-called mortgage- and asset-backed securities dissemination.

The relationship between changes in asset prices and credit growth has been previously studied in the literature. Allen and Gale's model (2000) showed that financial crises are the consequences of credit-fuelled asset price bubbles through the use of debt contracts with limited liability. Borio and Lowe (2002) found empirically that the combination of sharp increases in asset prices and high credit growth constitutes a very good leading indicator of subsequent episodes of financial instability.

These findings had implications for the conduct of economic policy. First, they revived the debate on whether monetary policy should target asset price changes alongside with goods and services price inflation. Second, they gave rise to international policy discussions on the design of macroprudential policy, with the negotiations of a countercyclical regulation of capital within the Basel 3 framework or the greater use of loan-to-value ratios in the conclusion of credit contracts. Third, they triggered a controversy about the use of marked-to-market accounting for banks, given its procyclical effects on banks' balance sheets and credit growth.

The importance attached by governments to the smooth functioning of the credit channel in crisis times was illustrated by the large state interventions during the 2008/2009 financial crisis aimed at rescuing the banking systems and accompanied by conditionality in terms of the maintenance of credit growth.

This paper investigates the relationship between asset price changes, developments in the leverage of financial institutions, and credit growth. Its objective is to assess whether factors determining credit growth change with financial stability regimes. Its contribution is threefold. First, it develops an empirical model of credit growth estimation combining quarterly bank-specific panel data, economic and financial variables. The quarterly frequency is an important contribution of the paper as it is more appropriate for measuring the impact of highly volatile financial stability conditions on bank lending whereas most banking studies use annual data. Using annual data would reduce the significance of the relationship between asset price changes and credit growth with bank panel data. Second, the paper focuses on French banks. To our knowledge, this is the first paper analyzing credit growth in the French banking system using panel data at a quarterly frequency. This is relevant to the macroprudential literature because bank lending is by far the prevailing form of external finance in this country and thus has a large effect on the real economy. At the same time mortgage credit conditions are reportedly strict and less dependent on collateral valuation than in the US. This creates an interesting environment to assess the relationship between asset price growth and credit growth in a bank-based economy. Third, this paper constructs a financial stability indicator which makes it possible to estimate credit growth under different financial stability regimes and to distinguish periods in which demand or financial factors prevail.

The paper is organized as follows. Section II provides an overview of the related literature on asset prices and bank balance sheets. Section III describes the data and discusses some stylized facts resulting from simple descriptive statistics. Section IV presents the econometric model and discusses its results. Finally, section V concludes and discusses some policy implications.

II. ASSET PRICES AND BANK BALANCE SHEETS: RELATED LITERATURE

The literature has highlighted several channels through which asset prices impact the financial cycle and the real economy. Two broad categories of models have been developed. The first one is referred to as the financial accelerator model. According to this theory, temporary shocks on corporate wealth have magnified and long-lasting effects on the economy (Bernanke, Gertler and Gilchrist, 1999). This strand of literature focuses on the borrowers' balance-sheet—which applies to both firms and households— and tries to explain the channels of transmission of shocks from the financial sphere to the real economy based on the value of collateral. The borrowers' balance sheet channel stems from the inability of lenders: (i) to assess accurately borrowers' creditworthiness, (ii) to monitor fully their investments, and (iii) to enforce their repayment of debt. This brings about the requirement of collateral in the loan contract, which means that a borrower's access to credit depends on its net equity value. These imperfections entail credit constraints for the borrowers and a self-sustained amplifying effect on prices. The main assumption is that credit-constrained firms or households use (real estate or financial) assets as collateral to finance their investment projects as they cannot pledge their discounted future income stream. As the asset price increases, so do the value of the collateral and the borrowers' creditworthiness. Credit expansion then fuels the demand for assets and pushes asset prices up, creating an upward spiral, and conversely.

More broadly, financial accelerator models have been developed in a set-up in which firms as well as financial intermediaries are capital-constrained. In Holmström and Tirole's model (1997), borrowers' collateral plays a key role and two types of credit are available to them: bank loans and non-intermediated credit that requires greater collateral. A redistribution of wealth across firms and intermediaries impacts on investment, monitoring and interest rates. Furthermore, all forms of capital tightening (a credit crunch, a collateral squeeze or a savings fall) are shown to affect poorly capitalised firms the most severely because a firm's net worth determines its debt capacity due to moral hazard. A decrease in a firm's pledgeable capital has a more than proportional effect on its investment, through the role of the financial multiplier. Reduced credit restrains expenditure and results in lower aggregate demand.

Moreover, these imperfections entail an external finance premium which is the difference in cost between external and internal funds (Bernanke and Gertler (1989); Carlstrom and Fuerst

(1997)). This wedge is negatively correlated with borrowers' creditworthiness and thus with their net worth. The external finance premium arises from the need for the lender to align more closely the risk-taking incentives of the borrowers with his own through involving borrowers' net worth in the financing of a project. Consequently, the higher the borrower's net worth, the lower the premium he faces. The existence of the external finance premium then transmits financial shocks to the real economy since fluctuations in asset prices affect borrowers' net worth.

Credit constraints have been shown to interact with overall economic activity due to credit market imperfections and the dual role of assets in the economy. In Kiyotaki and Moore's model (1997), lenders cannot force borrowers to repay their debts unless the latter are secured. Therefore, durable assets in the economy are used as collateral for borrowing. The interactions between credit constraints and asset prices used as collateral create a powerful transmission mechanism whereby temporary shocks may entail large, persistent and amplified fluctuations of output and asset prices, according to an oscillation mechanism. These interactions bring about credit cycles which are propagated to business cycles via the following effect: an increase in the value of collateral raises firms' net worth, which allows them to borrow more. However, the rise in the debt lowers available funds and the investment in durable assets. These credit cycles are considered as equilibrium phenomena, which make the existence of a credit equilibrium bubble possible. In the same spirit, in Allen and Gale's model (2000), the presence of agency relationships in the banking sector causes bubbles which result from the use of debt contracts including limited liability. Investors borrow from banks and invest their funds in risky assets because they can avoid losses in low payoff states by defaulting on the loan. The bubble is followed by a collapse which entails widespread default. This leads banks to cut their lending.

Empirically, the extent of credit constraints has been measured through the sensibility of corporate investment to changes in asset prices. Chaney, Sraer and Thesmar (2008) attempt to measure the intensity of the collateral channel and the effects of credit constraints on US firms, by estimating the impact of real estate prices on corporate investment. A higher sensitivity of investment to collateral value is interpreted as reflecting a higher probability for a firm to be credit constrained, as an increase in the value of collateral acts as an easing of the constraint. The authors estimate that an increase in the collateral value of US firms by one dollar is associated with an increase in the investment of land-holding firms by 6 cents.

Another category of models endogenizes banks' capital structure and lending capacities. Chen (2001) adds a banking sector and bank capital into Kiyotaki and Moore's model, building on the assumption of the dual role of durable assets as productive input and as collateral for loans. His model sheds light on the interaction between asset prices and credit constraints which magnifies the propagation mechanism of a negative productivity shock. Within this framework, a higher bank capital-to-asset ratio for lending and a stricter collateral requirement for borrowing squeeze bank loans and investment at the same time. Therefore, his model is able to account for the concomitance between banking crises and depression in asset markets. In the same vein, Angeloni and Faia (2010) develop a standard DSGE model building on Diamond and Rajan (2000). They show that an asset price boom, as well as a positive productivity shock, increases bank leverage and risk. The simulations of their model lead them to advocate the combination of an anti-cyclical capital regulation (as in Basel III) and a response of monetary policy to asset prices or bank leverage.

Several empirical papers found large effects of asset price changes on bank lending. Frommel and Schmidt (2006) highlight strong co-movements between these two variables during unstable periods for several euro area countries (Belgium, Finland, France, Germany, Netherlands, Portugal), by applying a Markov switching error correction model, with a positive relationship being found during stable periods for Germany and Ireland only. They interpret their results as evidence of constraints in bank lending. While our paper shares some similarities with the previous one, its methodology differs to the extent that it uses panel data instead of time series and identifies the different financial stability regimes using a financial stability indicator based on actual data and not by estimating a Markov regime switching model. We consider the construction of a financial stability indicator to be more meaningful as it helps identifying the different regimes with more concrete observations. Adrian and Shin (2010a) show a positive relationship between asset price changes, developments in the leverage of large US investment banks and adjustments to the size of their balance sheets which are continuously marked to market. In times of economic growth and sharp rise in asset prices, the increase in banks' net worth and the targeting of a specific level of leverage lead those banks to purchase more assets, which amplifies the price increase and strengthens balance sheets even more. The reverse mechanism occurs in downturns. From this perspective, interplays between changes in leverage and changes in asset prices are procyclical, mutually reinforcing and amplify the financial cycle.

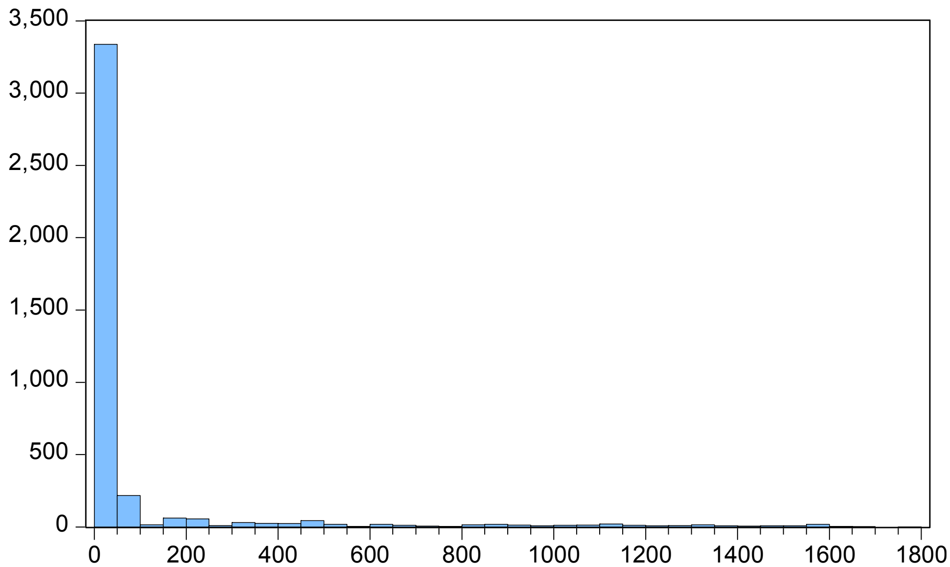
More broadly, literature has shed new light on the functioning of the bank lending channel since the start of the current financial crisis and stressed the role of new bank-specific characteristics in relation to market developments. In addition to the standard indicators used in this literature, namely size, capitalization, and liquidity (Angeloni et al., 2003), new factors, such as changes in bank's business models, a greater dependence on market funding and on non-interest source of income, have modified the monetary transmission channel in Europe and in the US, with banks exposed to higher funding liquidity risks restricting more their loan supply during crisis times (Gambacorta and Marques-Ibanez, 2011). At the same time, the structural change represented by larger securitization activity has made banks' lending supply more insulated from the effects of monetary policy changes before the crisis but more exposed to shocks in a situation of financial distress (Altunbas et al, 2009). Finally, the risk taking channel of monetary policy transmission highlights the effects of the maintenance of low interest rates over an extended period on banks' willingness to take on more risk through their impact on asset and collateral valuation and volatility, incomes and cash flows. This channel may strengthen the traditional financial accelerator as it brings about amplification mechanisms resulting from financial frictions in the credit market (Adrian and Shin, 2010b). All these studies support the Basel Committee's move to include funding liquidity risks into the international banking regulatory framework and/or call central banks to better monitor monetary policy impact on the attitude of banks towards risk.

III. The dataset

A. Description of the data

In our empirical analysis we use quarterly bank balance sheet data taken from banks' published reports and statements or extracted from Bankscope in case of missing data. We start with an unbalanced panel covering 73 French banks over the period 1993-2010, ten of which are listed on the stock market including the largest ones. We rely on solo (unconsolidated) data, which means that a group's different legal entities show up individually in the database. The 73 French credit institutions composing our dataset can be split into three categories according to their legal status: (i) 34 commercial banks; (ii) 30 mutual banks, savings banks and credit cooperatives; (iii) 9 financial and investment firms. A look at the distribution and descriptive statistics of each bank's size to the average size ratio (as measured by the balance sheet's size) shows that the vast majority of the French banks is made up of very small banks (Figure 1 and Table A1 in the Appendix). Therefore, even though banks' balance sheet data capture transactions with bank customers as a whole and not only those with resident customers, the small size of the majority of French banks suggests that they mainly have a domestic activity. However, at the group level, the banking system is concentrated as the six largest French groups account for 90 percent of the domestic loan outstanding. Finally, the gap between the median ratio (13 percent) and the average (100 percent) shows that the size of very large banks distorts the average value upwards. The very high standard deviation further testifies to the heterogeneity of the panel.

Figure 1: Distribution of individual banks' size to the average size ratio



Note: x-axis: value of the size ratio in percent; y-axis: number of observations

Particular attention is paid to the treatment of bank mergers, which may otherwise distort loan growth. To that end, we use annual reports from supervisory authorities listing the mergers that occurred over the course of the year. For mergers for which we have balance sheet data on the absorbed entities, we build a fictitious bank the year preceding the merger by summing up the outstanding loan of the merging parties. This allows us to compute a loan growth net of the effect of the merger for the year of this event. In the other cases, we interpolate the loan growth between the year preceding and the year following the merger. We carry out a further cleaning on our dataset in order to remove outlier values by eliminating data points corresponding to extreme credit growth that we define as values lower than the first percentile and higher than the last percentile of the initial dataset. We end up with 341 bank observations.

Financial data such as the stock exchange price index and interbank rates are taken from Bloomberg. Economic series such as real GDP and inflation are extracted from Haver Analytics. Real estate prices are taken from the BIS property price database. [2] The lending rate series related to the different categories of loans (total loans, corporate, household, mortgage, non-mortgage loans) are taken from the Banque de France database. Finally, the main refinancing rate is taken from the Banque de France for the 1993-1998 period and from the European Central Bank databases for the 1999-2010 period.

B. Descriptive statistics

Table 1 presents the correlation coefficients between the main variables of our model. An initial look at the data indicates that the correlation between credit growth on the one hand, real GDP and stock price growth on the other hand, is significant, but the correlation between credit growth and real estate price growth is low and insignificant. Moreover, real GDP growth appears to be extremely correlated with the stock price growth, with a correlation coefficient of 0.64 indicating a strong synchronization between the real and the financial cycles. In contrast, real estate price growth is less correlated with real GDP growth and very little correlated with stock price growth which signals a specificity of price developments in this market. Finally the negative and significant correlation between the NPL ratio and the real estate price growth (-0.06) means that when real estate prices decline, the NPL ratio increases. This correlation may reflect a wealth effect or the functioning of a collateral channel, whereas the same negative correlation cannot be observed between the NPL ratio and the stock price growth.

Table 1: Correlation coefficients between the main variables used in the model

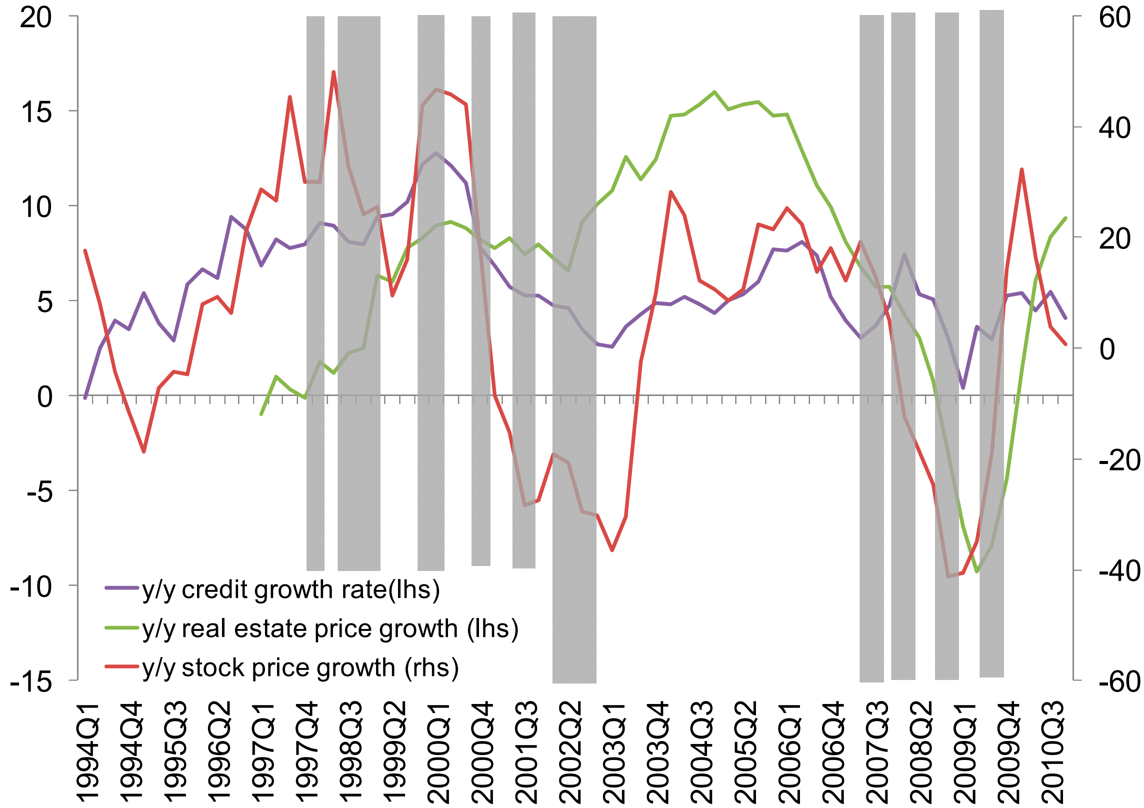
	Credit growth	Stock price growth	Real estate price growth	Real GDP growth	NPL ratio
Credit growth	1.00	0.13***	0.02	0.11***	-0.17***
Stock price growth		1.00	0.03*	0.64***	0
Real estate price growth			1.00	0.32***	-0.06***
Real GDP growth				1.00	0.02
NPL ratio					1.00

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %.

[2] Series on residential property prices, existing dwellings, per dwelling, q-all nsa (Q:FR:0:1:1:1:0:0)

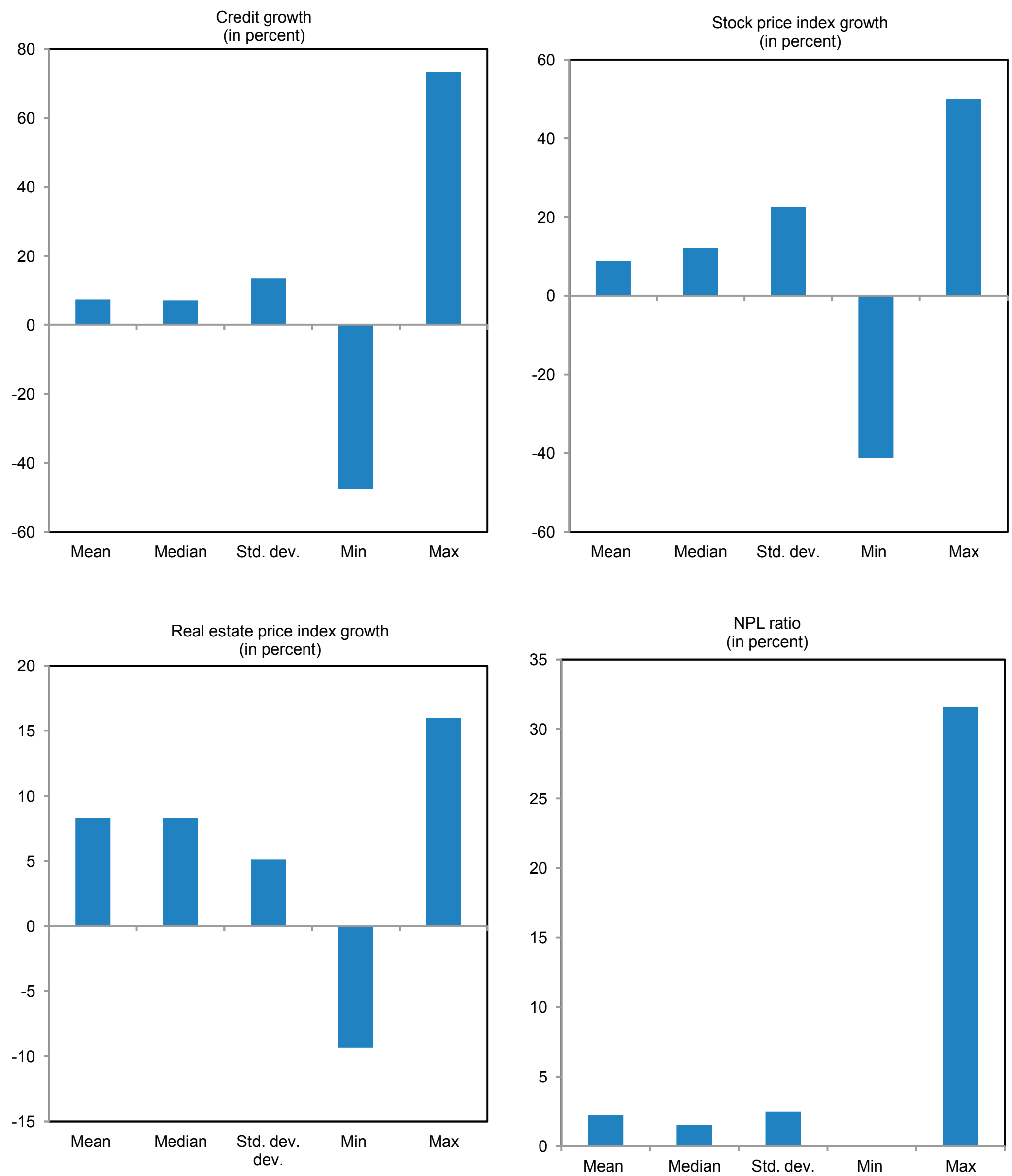
Graphically the correlation between asset price and credit growth seems to change across periods. Figure 2 illustrates the developments in credit and asset price growth in France over the period 1994-2010. In periods of financial instability, the relationship is less obvious since asset prices tend to sharply decline while the developments in credit growth are less clear cut.

Figure 2: France - Cyclical developments in credit and asset prices



Note: Shaded areas correspond to financial instability periods (period in which the financial instability index is above the 85th percentile of the distribution).

Figure 3. Descriptive statistics of main variables



The stock price index corresponds to the weighted average share price of the 40 companies with the largest capitalizations on the French stock exchange composing the CAC 40 index. Typically this index encompasses a very large range of economic sectors, as shown by its composition at the end of 2010 (financials: 15 percent, oil and gas: 15 percent, industrials: 15.8 percent, consumer goods and services: 25.3 percent, health care: 11.9 percent, basic materials: 6.8 percent, utilities: 5.6 percent, telecommunications: 3.4 percent, technology: 1.8 percent). Even though the companies composing the index have an international activity, the index can be deemed as representative of French companies' financial health and profitability given the wide range of sectors encompassed and the fact that the listed companies' core activities are carried out in France. Nevertheless, it should be acknowledged that the index is tilted towards large French corporations and that the latter have access to both domestic and international credit as well as retained earnings, making them less credit constrained. In contrast, small and medium size enterprises (SMEs) which are more dependent on bank credit are not listed.

Finally, the French credit market is quite specific and differs from the US credit market on several points. First, the mortgage credit activity as a whole is carried out by the banking system as there does not exist any government-sponsored enterprises such as Fannie Mae and Freddie Mac in France. Then, in contrast to the US, credit decisions are not made on the basis of the collateral valuation but on the banks' assessment of the borrowers' income streams and capacity to service the debt. Therefore, the income to debt service ratio plays a much larger role than loan to value ratios. Consequently, housing price fluctuations should be expected to transmit to credit growth to a lesser extent than in the US. Still, some sensitivity of credit growth to financial asset or housing price growth is to be expected as the bank may require a firm's equity capital or a household's real estate to be posted as collateral for a loan in case the borrower fails to repay its loans, for example after a firm's failure or an individual's layoff. Blazy and Weill (2006) reckon that 75 percent of credit lines granted by banks to French firms in financial distress are associated with at least one type of collateral, with SMEs accounting for a majority of the firms composing their sample.

IV. MODEL AND RESULTS

We estimate a model of credit growth including credit demand factors, supply factors and financial variables, using panel data. The assumption that we want to test is that lending supply factors and financial variables such as asset price changes are prevalent determinants of credit growth in periods of financial instability, whereas credit demand factors dominate in more normal times. With a view to getting rid of seasonality problems, we use year-on-year growth rates at a quarterly frequency.

A. Model presentation

The model is expressed as follows:

$$\Delta L_{it} = \beta_0 + \sum_{m=1}^{M} \beta_m X_{m,i,t} + \varepsilon_{i,t} , \tag{1}$$

where ΔL_{it} is bank *i*'s year-on-year lending growth in percent at quarter t; β_0 is the intercept; β_m , m=1,…M, denote the M coefficients common to all banks on the explanatory variables, $X_{m,i,t}$; $\varepsilon_{i,t}$, the residuals of the equation assumed to be independent and identically distributed.

Our credit demand variables are aimed at capturing borrowers' income changes and financing costs. They are as follows:

- The real GDP growth, $G\breve{D}P_t$, in percent, expected to have a positive impact on bank lending as more buoyant economic activity positively affects borrowers' income and profits, in line with Kashyap and Stein (2000);
- The inflation rate, $Infl_t$, in percent, taken as another proxy for credit demand shocks and for which we expect a positive sign;
- The change in lending rates charged on borrowers, in percentage points, Δi_t , on which we expect a negative sign because higher financing costs reduce the demand for loans.

Our credit supply variables are aimed at capturing bank's ability to lend based on solvency and funding availability. They are as follows:

- The change in bank *i*'s leverage defined as the asset-to-equity ratio, ΔLev_{it} , in percentage points, as a proxy for the bank's solvency and long-term capital target. A rise in this variable's value means that the bank is more leveraged. We expect a negative sign as a higher leverage ratio indicates that the bank's solvency diminishes and the capital constraint becomes more binding, which leaves the bank with less scope to extend new loans;
- The change in non-bank customer deposits, ΔD_{it} , in percentage points, as a measure of external funding availability for the bank. We expect a positive sign because an increase in deposits broadens the base to finance lending;

- The size of the bank, $Size_{it}$, measured by the ratio of a bank's total assets to the average total assets of all banks in percent, taken at each period. This ratio is meant to avoid spurious correlation stemming from a time trend in banks' assets. We expect a negative sign, as small banks may have more room to extend credits and expand their balance sheet size than the large ones;
- The non performing loan ratio, NPL_{it}, defined as the non performing loans to total loans ratio, taken as a proxy for the internal measure of risk. The expected sign is negative as an increase in the loan portfolio riskiness may weigh on banks' ability to resume lending;
- Dummy variables for the entities belonging to each of the six largest French banking groups, as the banks within the same group may behave similarly, especially during a crisis, and with large loans having to be approved by the headquarter;
- The change in the main interest rate of the central bank, Δr_t , in percentage points, for which we expect a negative sign since this variable captures banks' funding costs.

We add two financial variables capturing asset price growth, namely the percent change in the level of the stock exchange price index, $\Delta Stocks_t$, and the percent change in the level of the real estate price index, $\Delta \mathrm{Re}\, al_t$. These variables can have an impact on bank lending via the supply as well as the demand side. We expect a positive sign through three effects. On the borrower's side, a rise in asset prices produces a positive wealth effect if the borrower owns an asset portfolio, which can boost credit demand. Moreover, in the case of loans for house purchase, increases in housing prices raise the amount of loans needed to finance the purchase of a given quantity of assets. On the lenders' side, the rise in asset prices eases the collateral constraint imposed by banks on borrowers and may make banks more willing to extend new loans. Third, it strengthens banks' balance sheets if marked-to-market assets account for a significant part of the asset portfolio. Therefore, this lowers the bank's cost of funding due to the confidence effect on investors and raises the bank's ability to extend loans.

Finally, as we expect a possible autocorrelation of credit growth, we add the lagged dependent variable, ΔL_{it-1}.

B. Addressing the endogeneity issue

The possible endogeneity of asset price change is raised by the credit-fuelled asset price bubble theory developed by Allen and Gale (2000). Failing to take this issue into account may distort the results of the credit growth regression. In order to explore the direction of causality between our three variables of interest, namely credit, stock price, and housing price growth, we first carry out Granger causality tests based of the estimation of a VAR model including these three variables. The Akaike and Schwarz criteria indicate the same optimal number of lags *K*=4.

Therefore, the VAR model is expressed as the following system of three equations:

$$(2)\begin{cases}\Delta L_{it} = \sum_{k=1}^{4} \alpha_{1k} \Delta Stocks_{t} + \sum_{k=1}^{4} \lambda_{1k} \Delta \mathrm{Re}\,al_{t} + \sum_{k=1}^{4} \delta_{1ik} \Delta L_{it-k} + \mu_{1i} + u_{1it} \\ \Delta Stocks_{t} = \sum_{k=1}^{4} \alpha_{2k} \Delta Stocks_{t} + \sum_{k=1}^{4} \lambda_{2k} \Delta \mathrm{Re}\,al_{t} + \sum_{k=1}^{4} \delta_{2ik} \Delta L_{it-k} + \mu_{2} + u_{2t} \\ \Delta \mathrm{Re}\,al_{t} = \sum_{k=1}^{4} \alpha_{3k} \Delta Stocks_{t} + \sum_{k=1}^{4} \lambda_{3k} \Delta \mathrm{Re}\,al_{t} + \sum_{k=1}^{4} \delta_{3ik} \Delta L_{it-k} + \mu_{3} + u_{2t}\end{cases}$$

where $\mu_{1,2,3}$ and $u_{1,2,3}$ are the constants and the residuals of each equation, respectively.

Standard Granger causality tests are based on time-series estimations. Variable x_t is said to "cause" variable y_t if the lagged values of x_t improve the forecast of y_t. Therefore these tests should be understood as being about statistical instead of economic causality. The null hypothesis *H0* is that of no causality: $H0: \alpha = 0$, where $\alpha = (\alpha_1, \cdots, \alpha_4)$ is the vector of the lagged coefficients.

The stationarity of our different variables has been checked using various unit root tests. The results of the Granger causality tests are presented in Table 2. They should be taken with caution and for illustrative purposes only as they do not establish causality with certainty given that an unobserved third variable, such as financial imbalances or exuberance, that would affect the two endogenous variables might drive the results. They show bidirectional causality between the stock price growth and the credit growth, and between stock price and real estate price changes. This finding points to mutually reinforcing effects or suggests the existence of a common factor. By contrast, the causality between credit growth and real estate price change runs from the former variable to the latter, suggesting that real estate prices are not a significant factor of credit growth over the whole period but that credit growth fuels real estate price changes.

Table 2: Granger causality tests

Null Hypothesis:	Obs.	F-Statistic	Prob.
ΔL_{it} does not Granger Cause $\Delta Stocks_t$	3528	2.68**	0.03
$\Delta Stocks_t$ does not Granger Cause ΔL_{it}		4.57***	0.00
ΔL_{it} does not Granger Cause $\Delta Real_t$	2712	5.66***	0.00
$\Delta Real_t$ does not Granger Cause ΔL_{it}		0.81	0.52
$\Delta Stocks_t$ does not Granger Cause $\Delta Real_t$	2720	177.27***	0.00
$\Delta Real_t$ does not Granger Cause $\Delta Stocks_t$		140.68***	0.00

C. Building a financial instability index

As we want to determine whether credit growth and the extent of credit constraints change during periods of financial instability compared to the whole and tranquil periods, we construct a financial stability index which is made up of four components: the volatility of the stock price index (CAC 40) measured by its standard deviation over the quarter, the volatility of the stock price index of the banks included in the CAC 40 index[3] as a measure of the specific stability of the banking system; the spread between the 10-year French government bond yield and the 10-year German government bond yield; and the spread between the 3-month interbank rate (Euribor since the creation of the euro) and the overnight indexed swap (the Euribor-OIS spread) as an indicator of default risk in the interbank market. Therefore, the index is constructed in such a way as an increase in the index value indicates higher financial instability. We expect a higher sensitivity of lending growth to changes in asset prices during financial instability periods due to a more binding collateral constraint.

In order to eliminate the redundancy between the variables composing our financial stability index resulting from their possible correlation, we carry out a principal component analysis. After checking that only the first component should be retained using several criteria[4], we

[3] The bank stock price index is built as the sum of the stock price of the banks composing the index weighted by their market capitalization.

[4] Eigenvalue-one criterion, scree test, proportion of value and interpretability criterion.

compute the eigenvector with the loading factors given by the first component. The respective loading factors for our four variables are presented in Table 3.

Table 3: Financial Instability Index-
Principal Component Analysis - Loading factors

Stock market volatility	0.46
Bank stock price index volatility	0.55
Government bond yield spread	0.55
Libor-OIS spread	0.43

We then define financial instability periods as periods during which the financial stability index value is above the 85th percentile of the distribution The choice of this threshold results from a trade-off between the fact that financial instability episodes are low probability events and the need to have enough data points. The 85th percentile value is equal to 111 and the index peaked at 199 in 2001Q3.

D. Baseline specification

Given the multiple directions of causality between our three main variables and the presence of endogeneity, we chose to estimate a simultaneous system of three equations in which the endogenous regressors are dependent variables from other equations in the system. [5] We estimate the system on panel data by using a three-stage least square estimator with fixed effects to account for unobserved bank-specific characteristics. To correct for heteroskedasticity, we use analytical weights, which are inversely proportional to the variances.

Therefore, our simultaneous set of equations is expressed as follows (expected signs in brackets):

[5] As a robustness check, we re-estimate the model using a Generalized Method of Moments (GMM)- Estimated Generalized Least Square (EGLS) with cross-section fixed effects, cross-section weights and White period for the coefficient covariance method. Our results were unchanged, in particular as regards the signs of the main variables' coefficients.

$$
(3)\left\{
\begin{array}{l}
\Delta L_{it} = \underset{}{\beta_0} + \underset{(+)}{\beta_1 \Delta Stocks_t} + \underset{(+)}{\beta_2 \Delta \mathrm{Re}\, al_t} + \underset{(+)}{\beta_3 \Delta L_{it-1}} + \underset{(+)}{\beta_4 G\breve{D}P_t} + \underset{(+)}{\beta_5 Infl_t} + \underset{(-)}{\beta_6 \Delta i_t} + \underset{(-)}{\beta_7 \Delta Lev_{it-1}} \\
\quad + \underset{(+)}{\beta_8 \Delta D_{it}} + \underset{(-)}{\beta_9 Size_{it-1}} + \underset{(-)}{\beta_{10} NPL_{it-1}} + \underset{(-)}{\beta_{11} \Delta r_t} + \beta_{12} Group1 + \beta_{13} Group2 \\
\quad + \beta_{14} Group3 + \beta_{15} Group4 + \beta_{16} Group5 + \beta_{17} Group6 + \varepsilon_{it} \\
\Delta Stocks_t = \delta_0 + \underset{(+)}{\delta_1 \Delta \mathrm{Re}\, al_t} + \underset{(+)}{\delta_2 \Delta L_{it}} + \underset{(+)}{\delta_3 G\breve{D}P_t} + \underset{(-)}{\delta_4 \Delta r_t} + \mu_t \\
\Delta \mathrm{Re}\, al_t = \gamma_0 + \underset{(+)}{\gamma_1 \Delta Stocks_t} + \underset{(+)}{\gamma_2 \Delta L_{it}} + \underset{(+)}{\gamma_3 G\breve{D}P_t} + \underset{(-)}{\gamma_4 \Delta r_t} + \rho_t
\end{array}
\right.
$$

where β_k, δ_k and γ_k are parameters to estimate, β_0, δ_0 and γ_0 being intercepts and ε_{it}, μ_t and ρ_t residuals.

The three main endogenous variables, namely credit, stock price, and real estate price growth, are instrumented by their first lags. Our bank-specific variables ΔLev_{it-1}, $Size_{it-1}$ and NPL_{it-1}, are lagged by one period as they are considered to be potentially endogenous. Finally, the deposit growth ΔD_{it} is not considered to be endogenous as the loans granted by a bank are not translated into deposits at the same bank necessarily.

In equation (3), our variables of interest are $\Delta Stocks_t$ and $\Delta \mathrm{Re}\, al_t$, the other variables stand for control. Results are presented in Table 4. [6] Over the whole period, seven variables have a significant coefficient, including three at the 1 percent level (column 1). The coefficient on one of our main variables of interest – $\Delta Stocks_t$ - has the expected sign and is very significant, which confirms that increases in stock prices are correlated with accelerated credit growth, possibly through the collateral channel or due to banks' stronger balance sheets. By contrast, the coefficient on the real estate price growth variable $\Delta \mathrm{Re}\, al_t$ is not significant, which indicates that over the whole period changes in real estate prices, in contrast to changes in stock prices, do not have any effect on bank lending. The coefficient on the lagged dependent variable is very high and significant, suggesting a high autoregressive behavior of credit

[6] In an alternative specification of the model, we introduced the Libor-OIS spread among the explanatory variables to control for the funding conditions of the banking system. However, the coefficient of this variable was found to be insignificant and its introduction did not change the other results.

growth and high adjustment costs of credit stock. The significant and positive sign of the deposit growth shows that funding availability is a determinant factor of lending growth and seems to matter more than changes in the leverage ratio given the insignificant coefficient of the latter. The (weakly) significant and negative coefficient on the NPL ratio confirms that the quality of the loan portfolio plays a role in credit growth.

Strikingly, the non-significance of the coefficients on two of our three credit demand factors, in particular real GDP growth, and the unexpected positive sign of the lending rate change suggest that credit demand factors would not have played a large role in France over the period. This may result from the aggregate character of our credit demand variables whereas it could be argued that demand for loans depends on firm characteristics.[7] The weakly significant and unexpected positive sign of the lending rate change indicates either that the change in lending rate is endogenous, as a sharp rise in credit growth might push lending rates up, or that a supply regime prevailed over the period whereby an increase in the lending rate encourages banks to increase their lending supply, thus supporting effective credit growth. In that case, the change in lending rate would rather be a credit supply factor. Remaining supply variables, namely the leverage ratio change, the size ratio, the change in the refinancing rate, and the dummies for groups' entities, are not significant, except for one group at the 10 percent level.

Moreover, as regards the stock price and housing price growth estimations, we do not find any significant effect of the lending growth on each of these variables, which suggests that our specification is robust to the endogeneity issue (Tables A3 and A6 in the Appendix).

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[7] A way of improving our credit demand factors would be to use the geographic location of the bank's headquarters, and therefore market fixed effects or demand proxies at the geographic unit level, using real estate price indices at the regional level provided by the BIS. However, given data limitations and the low number of banks' headquarters located in provincial France, this regression would only be possible for Paris' region. This regression provides the same results as the baseline specification.

Table 4: Determinants of total loan growth

Explanatory variables	Exp. sign	(1) Whole period	(2) Financial Instability	(3) Tranquil
$\Delta Stocks_t$	+	0.08***	0.75**	0.07**
		(2.58)	(2.11)	(2.16)
$\Delta Real_t$	+	0.11	2.7***	0.07
		(0.81)	(2.78)	(0.47)
ΔL_{it-1}	+	0.73***	0.41***	0.8***
		(18.4)	(4.2)	(18.75)
$G\breve{D}P_t$	+	-0.75	-9.14**	-1.01
		(-1.04)	(-2.28)	(-1.19)
$Infl_t$	+	-0.59	2.29	-0.58
		(-0.82)	(0.31)	(-0.77)
Δi_t	-	2.7*	-29.02*	2.61*
		(1.76)	(-1.79)	(1.6)
ΔLev_{it-1}	-	-0.04	0.56***	-0.21**
		(-0.42)	(3.3)	(-1.87)
ΔD_{it}	+	0.06***	0.13*	0.06**
		(2.55)	(1.86)	(2.28)
$Size_{it-1}$ *100	-	-0.1	0.37	-0.15
		(-0.77)	(1.37)	(-1.03)
NPL_{it-1}	-	-1.28*	-0.15	-1.45*
		(-1.66)	(-0.09)	(-1.72)
Δr_t	-	-1.02	10.14	-1.06
		(-1.24)	(1.76)	(-1.27)
Group 1		0.02	-3.99	1.54
		(0.01)	(-1.56)	(0.9)
Group 2		0.37	-1.07	1.19
		(0.22)	(-0.39)	(0.62)
Group 3		-1.75	-1.19	-0.85
		(-1.3)	(-0.46)	(-0.57)
Group 4		-0.21	2.45	0.08
		(-0.16)	(0.92)	(0.06)
Group 5		-1.19	0.56	-0.99
		(-0.72)	(0.13)	(-0.56)
Group 6		-2.69*	2.54	-2.66
		(-1.7)	(0.87)	(-1.52)
c	+	5.85**	5.73*	6.33*
		(2.02)	(1.85)	(1.83)
R2		0.71	0.77	0.75
Number of obs.		261	47	214

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %; t-statistics in brackets.

We then reestimate equation (3) during financial instability and tranquil periods separately. Results are presented in columns 2-3 of Table 4 and Tables A4-A7 in the Appendix. Strikingly, the housing price change variable has a significant and positive impact during financial instability periods in contrast to the whole period and tranquil times. This may reflect banks' and borrowers' higher risk aversion in such periods and a greater sensitivity of lending supply and demand to real estate prices. Likewise, the coefficient of the stock price growth has a higher value which may be due to differences in the means and the standard deviations of the variables across periods. Moreover, lending growth appears much less autoregressive in financial instability periods compared to other periods, as shown by the lower value and the lower significance of the lagged loan growth coefficient. This suggests a higher volatility of loan growth in such periods. The change in lending rates shows up with a (weakly) significant and negative coefficient in financial instability periods, highlighting the role of credit demand in such periods.

Interestingly, the leverage ratio growth has a significant effect in both financial instability and tranquil periods but with a change of sign, suggesting a non-linear relationship. Whereas it has a negative effect on lending growth in tranquil periods, as expected since a rise in the ratio entails a decline in a bank's solvency, its effect is positive in financial instability periods. This may be due to banks' higher risk aversion which leads them to deleverage on their assets and to reduce lending growth even when solvency margins are restored. Likewise, the puzzling negative and significant coefficient on GDP growth in such periods may be explained by the lag between the turning points in the financial and the business cycles or by the banks' will to restore their profitability and solvency. This may weigh on their credit supply despite a pick up in the business cycle.

Finally, as the groups' dummies have insignificant coefficients in every period, we decided to take them out from the other specifications of the model.

E. Focus on listed banks

As robustness checks, we carry out several alternative estimations. First, we check whether listed banks are more sensitive than the others on changes in asset prices. To that end, we add the following two variables in our specification:

- a dummy variable for listed banks, $List_{it}$, on which the expected sign is a priori ambiguous. On the one hand, the lending supply growth of listed banks may be higher than other banks due to their broader access to funding and debt markets. On the other hand, due to their larger size and increased market discipline, they might be more constrained in increasing their loan supply;
- an interaction term between the dummy $List_{it}$ and the growth in the stock price index, $List_{it} * \Delta Stocks_t$, on which we expect a positive sign: listed firms are expected to be more sensitive to changes in asset prices due to the effect of investors' requirements in

terms of return on equity on the volume of the asset portfolio and its composition. Therefore, listed banks should extend even more loans in period of asset price increases if we assume that the required return on equity is then more easily met and banks are less constrained in their investment decisions, in particular for investments in risky loans.

Results are presented in Table 5. We do not find compelling evidence of a greater sensitivity of the lending supply of listed French banks to changes in asset prices compared to the lending supply of other banks over the whole period (column 1). First, the coefficient on the interaction term $List_{it} * \Delta Stocks_t$ is admittedly positive and significant but is not significantly different at the 5 percent level from the coefficient on the asset price growth variable alone in the previous specification, according to a Wald test. Moreover, in this specification, the asset price growth variable turns insignificant, as is the dummy variable for listed banks, which suggests that their lending behavior is not different from the other banks. [8] Interestingly, in financial instability periods, the stock price growth variable coefficient remains significant while the interaction term is not (column 2).

[8] Alternatively we checked whether the banks' business models have an impact on the lending growth sensitivity to asset prices by introducing a dummy variable equal to 1 for banks whose trading book assets to total assets ratio exceeds 25 percent at a given point in time and an interaction term between this dummy and the stock price growth variable. As previously, the interaction term has a positive and significant coefficient but is not statistically different from the coefficient on the asset price growth variable alone in the first specification, while the business model dummy's coefficient is not found to be significant.

Table 5: Determinants of total loan growth of listed banks

Explanatory variables	Exp. sign	(1) Whole period	(2) Financial Instability	(3) Tranquil
$\Delta Stocks_t$	+	0.04	0.62***	0.03
		(1.22)	(2.66)	(0.85)
$\Delta Real_t$	+	0.1	2.66***	0.08
		(0.75)	(2.68)	(0.53)
ΔL_{it-1}	+	0.74***	0.43***	0.81***
		(19.18)	(4.9)	(19.49)
$G\breve{D}P_t$	+	-0.88	-8.8**	-1.1
		(-1.22)	(-2.22)	(-1.31)
$Infl_t$	+	-0.52	-0.51	-0.53
		(-0.72)	(-0.73)	(-0.7)
Δi_t	-	2.29*	-27.64*	2.68*
		(1.76)	(-1.86)	(1.64)
ΔLev_{it-1}	-	-0.06	0.52***	-0.25**
		(-0.58)	(2.8)	(-2.29)
ΔD_{it}	+	0.07***	0.13**	0.06**
		(2.62)	(2.04)	(2.16)
$Size_{it-1}$ *100	-	0.01	-0.05	0.03
		(0.14)	(-0.29)	(0.37)
NPL_{it-1}	-	-0.35	-0.96	-0.43
		(-0.63)	(-0.9)	(-0.72)
Δr_t	-	-0.91	9.87	-0.84
		(-1.12)	(1.53)	(-1.03)
$List_{it}$	?	-0.27	0.51	-0.34
		(-0.29)	(0.28)	(-0.35)
$List_{it} * \Delta Stocks_t$	+	0.07***	0.09	0.07***
		(2.45)	(1.58)	(2.36)
c	+	3.58	5.58	4.08
		(1.53)	(1.01)	(1.44)
R2		0.71	0.75	0.74
Number of obs.		261	47	214

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %; t-statistics in brackets.

F. Credit breakdown

Next, we disaggregate bank loans between different types of loans: corporate loans, household loans, and loans for purposes other than house purchase in order to better disentangle credit demand and supply factors.

Corporate loans

As in Chen (2001), we assume that firms' net worth serves as collateral for corporate loans. Therefore, a high sensitivity of corporate loans to asset value can be interpreted as evidence of firms being credit constrained as an increase in the assets' value raises the firms' pledgeable net worth. Results on corporate loans are presented in Table 6. The main difference with the results of the total loan growth estimation concerns the insignificant coefficient of the stock price growth variable. Moreover, the higher significance of the coefficient on the non-performing ratio over the whole period compared to the total loan estimation may signal tighter credit constraints on corporations, especially SMEs, as banks may restrain their loans to this segment more sharply when the overall quality of their loan portfolio deteriorates.

Table 6: Determinants of corporate loan growth

Explanatory variables	Exp. sign	(1) Whole period	(2) Financial Instability	(3) Tranquil
$\Delta Stocks_t$	+	0.01	0.39	0.02
		(0.2)	(1.51)	(0.4)
$\Delta Real_t$	+	0.14	2.64**	0.07
		(0.73)	(2.21)	(0.32)
ΔL_{it-1}	+	0.65***	0.68***	0.65***
		(15.47)	(6.49)	(14.36)
$G\breve{D}P_t$	+	1.34	-0.33	0.58
		(1.2)	(-0.08)	(0.44)
$Infl_t$	+	0.17	0.25	0.31
		(0.16)	(0.3)	(0.27)
Δi_t	-	4.6**	9.71	3.54
		(2.21)	(0.7)	(1.6)
ΔLev_{it-1}	-	-0.1	0.72***	-0.29*
		(-0.66)	(2.52)	(-1.79)
ΔD_{it}	+	0.11***	0.19*	0.09**
		(2.75)	(1.71)	(2.11)
$Size_{it-1}$ *100	-	-0.02	-0.1	0.03
		(-0.2)	(-0.5)	(0.28)
NPL_{it-1}	-	-1.6**	-1.86	-1.54
		(-1.82)	(-1.15)	(-1.53)
Δr_t	-	-2.1	-11.32	-1.24
		(-1.52)	(-1.36)	(-0.87)
c	+	-0.85	-16.09**	0.87
		(-0.24)	(-1.95)	(0.2)
R2		0.63	0.73	0.63
Number of obs.		254	47	207

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %; t-statistics in brackets.

Loans to households

We now assume that households use their real estate assets or their financial asset portfolio as collateral for their loans. Given French banks' already mentioned practice of basing credit decisions on income stream and capacity to service debt rather than collateral valuation, we do not expect a large effect of real estate price changes. Results are presented in Table 7. The autoregressive coefficient is even higher at 0.79 than previously, which points to higher adjustment costs in the stock of loans to households. The coefficient of the housing price growth variable remains insignificant over the whole and tranquil periods. Finally, the unexpected positive but weakly significant coefficient of the non-performing ratio may stem from a loan compositional effect whereby banks increase their loans to households when the overall quality of their portfolio declines as increasing the loan outstanding makes the non performing loan ratio decline mechanically in the first place and because household loans may be considered as less risky than corporate loans. Indeed, their quality is arguably less dependent on the business cycle due to the social safety net.

Three main differences arise during financial instability periods: the significant but negative coefficients on the stock price and real estate price growth variables and the significant and positive sign of the real growth variable. As regards the first two variables, the result might be explained by the inertia of credit growth whose reaction to the turning points in the stock price and real estate cycles may be delayed in financial instability periods. In contrast, the expected result on real growth, contrasting with the other specifications, suggests that household credit demand plays a large role in such periods.

Table 7: Determinants of household loan growth

Explanatory variables	Exp. sign	(1) Whole period	(2) Financial Instability	(3) Tranquil
$\Delta Stocks_t$	+	0.05	-0.66**	0.06
		(1.06)	(-2.02)	(1.2)
$\Delta Real_t$	+	-0.19	-7.68**	0.02
		(-0.82)	(-1.93)	(0.07)
ΔL_{it-1}	+	0.79***	0.51***	0.84***
		(27.62)	(4.4)	(31.41)
$G\breve{D}P_t$	+	-0.04	10.4**	0.11
		(-0.03)	(2.16)	(0.09)
$Infl_t$	+	0.29	0.5	-0.4
		(0.2)	(0.18)	(-0.24)
Δi_t	-	0.5	0.1	2.78
		(0.17)	(0.7)	(0.94)
ΔLev_{it-1}	-	0.01	0.44	-0.07
		(0.1)	(0.92)	(-0.53)
ΔD_{it}	+	0.02	-0.18	0.02
		(0.52)	(-0.89)	(0.57)
$Size_{it-1}$ *100	-	0.01	-0.31	0.04
		(0.12)	(-1.01)	(0.51)
NPL_{it-1}	-	1.26*	0.51	0.9
		(1.62)	(0.21)	(1.22)
Δr_t	-	-0.95	4.75	-1.51
		(-0.69)	(1.33)	(-0.94)
c	+	2.02	43.27**	0.53
		(0.53)	(1.99)	(0.13)
R2		0.78	0.53	0.84
Number of obs.		242	41	201

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %; t-statistics in brackets.

Loans for purposes other than house purchase

Finally, in order to identify pure credit supply factors, we estimate the growth in loans for non house purchase purposes. This methodology enables us to eliminate the effect of a housing price rise on credit demand as such a rise could have an impact on lending growth through a pure credit demand effect, causing an increase in the amount of loans needed to finance the acquisition of a given real estate. The coefficient of the housing price change is found to be insignificant over the whole period of observation (Table 8, column 1), suggesting that credit supply factors are not dominant, while the stock price growth variable remains significant at the 5 percent level. By contrast, the coefficient of the housing price change turns significant at the 10 percent level during financial instability periods (columns 2), showing a higher sensitivity of lending supply to housing price changes in such periods.

Table 8: Determinants of non-mortgage loan growth

Explanatory variables	Exp. sign	(1) Whole period	(2) Financial Instability	(3) Tranquil
$\Delta Stocks_t$	+	0.08**	0.47*	0.06
		(2.04)	(1.78)	(1.5)
$\Delta Real_t$	+	0.06	1.84*	0.09
		(0.35)	(1.65)	(0.48)
ΔL_{it-1}	+	0.74***	0.35***	0.82***
		(19.78)	(3.67)	(20.86)
$G\breve{D}P_t$	+	-0.79	-4.84	-0.94
		(-0.91)	(-1.08)	(-0.94)
$Infl_t$	+	-0.75	-0.53	-0.78
		(-0.87)	(-0.85)	(-0.88)
Δi_t	-	3.43**	-13.46	3.76**
		(2.07)	(-0.92)	(2.14)
ΔLev_{it-1}	-	-0.17	0.5**	-0.38***
		(-1.5)	(2.14)	(-3.1)
ΔD_{it}	+	0.1***	0.14*	0.09***
		(3.17)	(1.65)	(2.94)
$Size_{it-1}$ *100	-	0.13*	0.07	0.16**
		(1.78)	(0.5)	(2.02)
NPL_{it-1}	-	-0.43	-1.83	-0.38
		(-0.68)	(-1.41)	(-0.55)
Δr_t	-	-1.06	5.73	-1.1
		(-1.06)	(0.75)	(-1.09)
c	+	2.48	1.74	2.31
		(0.88)	(0.25)	(0.69)
R2		0.71	0.64	0.75
Number of obs.		258	46	212

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %; t-statistics in brackets.

Most strikingly, the coefficient of the housing price change is even more significant and positive in the non-mortgage loan growth estimation when the non performing loan ratio is dropped, whereas it is not significant in the same specification during tranquil periods (Table 9). The removal of the non performing loan ratio may be justified by the negative correlation between the non performing loan ratio and the housing price growth which can create redundancy between the two variables. In financial instability periods, a fall in house prices may cause a rise in the NPL ratio which in turns depresses lending growth. In such periods a one-point decline in real estate price growth entails a 2.83 percentage point decline in non-mortgage lending growth. This finding provides evidence of tighter credit constraints in financial instability periods with loan volumes being more sensitive to changes in housing prices through supply effects, either through the collateral constraint or banks' balance sheet deterioration. It can be reconciled with the reportedly lower role of loan to value ratios in French banks' credit decisions by the fact that declining real estate prices might affect banks' balance sheets, if they are real estate owners, or by the fact that banks may ask for collateral in the form of real estate even for a non house purchase loan. That collateral will be seized if the borrower fails to repay its loans, for example after losing his job. In that case a decline in collateral value may discourage the bank to extend new loans.

Overall, the results of our econometric estimations suggest that credit demand factors are important but are not the only factors of the credit drop in financial instability periods. Therefore, they cannot entirely explain why banks fell short of the French government objective to maintain credit growth in the midst of the 2009/2010 crisis. In France, the government injected 63.5 billion euros into the capital of all French financial institutions and of specific institutions in the form of preferred shares, and granted guarantees on the banks' debt worth 360 billion euros. The conditions for this support included the maintenance of a smooth flow of credit to the economy in a range of 3-4 percent in annual average and a cap on remunerations. If these interventions allowed the avoidance of a major bank's failure, with the exception of one case, the banks fell short of the credit growth objective as the credit to the private sector fell by 0.1 percent in 2009 but picked up by 4.7 percent in 2010.

Table 9: Determinants of non-mortgage loan growth without NPL ratio

Explanatory variables	Exp. sign	(1) Whole period	(2) Financial Instability	(3) Tranquil
$\Delta\ Stocks_t$	+	0.05*	0.34	0.05
		(1.65)	(1.35)	(1.34)
$\Delta\ \mathrm{Re}\ al_t$	+	0.16	2.83**	0.14
		(1.38)	(2.28)	(1.14)
ΔL_{it-1}	+	0.78***	0.53***	0.84***
		(22.02)	(6.68)	(22.02)
$G\breve{D}P_t$	+	-0.78	-6.8	-1.04
		(-0.96)	(-1.48)	(-1.08)
$Infl_t$	+	-0.96	-9.3**	-0.72
		(-1.12)	(-2.01)	(-0.78)
Δi_t	-	3.67**	-16.16	3.76**
		(2.35)	(-1.1)	(2.26)
ΔLev_{it-1}	-	-0.13	0.52**	-0.31***
		(-1.12)	(2.26)	(-2.47)
ΔD_{it}	+	0.09***	0.13	0.09***
		(3)	(1.58)	(2.68)
$Size_{it-1}$ *100	-	0.08	0.04	0.1
		(1.11)	(0.26)	(1.24)
Δr_t	-	-0.96	8.78	-0.95
		(-0.95)	(1.09)	(-0.92)
c	+	1.48	10.35	1.7
		(0.63)	(1.07)	(0.65)
R2		0.7	0.67	0.73
Number of obs.		286	52	234

Note: *** significant at the threshold of 1 %, ** 5%, * 10 %; t-statistics in brackets.

In a nutshell, stock price changes seem to have a significant and positive effect on lending growth over the whole period of observation, in contrast to the findings of Frommel and Schmidt (2006), with mixed evidence of their effects in financial instability periods but neither of these results enables us to single out credit supply factors. By contrast, real estate price changes are not found to have any significant effect on lending growth in tranquil periods but do have one in financial instability periods. The diverging results compared to Frommel and Schmidt (2006) who found a higher influence of share prices in the unstable regime in France may be explained by the different methodologies, the different definition of the unstable regime, and the econometric estimator. The authors define the share price variable as the deviation of the national index from its long term trend, and they define the unstable regime as a regime in which the error correction term estimated by a Markov switching error correction model is negative as the credit volume adjusts towards its long term value.

V. Conclusion

This paper analyses the effect of asset prices on credit growth in France and tries to disentangle credit demand and supply factors, both for the whole 1993-2010 period and during periods of financial instability. Using bank-level panel data at a quarterly frequency, stock price growth is shown to have a significant effect on lending growth on the whole period while housing price growth has a significant effect during periods of financial instability only, after controlling for credit demand effects. We interpret these results as evidence of tighter credit constraints on households in financial instability periods.

In our opinion, these results make a case for monetary policy to take into account developments in asset prices due to their effect on the monetary policy transmission mechanism through the credit channel. Blurred relationships in periods of financial instability suggest the need for monetary authorities to monitor a large range of indicators in such periods. Moreover, our findings support the implementation of a macroprudential policy which would try to regulate the interactions between asset price growth, bank-level prudential indicators, and aggregate risk-taking level, and should include a large range of asset prices into the list of indicators monitored.

Future ways of research lie in better disentangling demand and supply side factors of credit growth. This may be achieved by using the results of bank lending surveys carried out by central banks, ideally at individual banks' level to allow their use in panels. These surveys provide useful information on changes in lending standards based on banks' answers and thus on developments in the supply side of credit. Moreover, incorporating off-balance sheet items into the dataset would provide a more comprehensive picture of the changes in banks' exposures and commitments across the cycle.

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APPENDIX

Table A1: Descriptive statistics of the variables used in the model

Number of banks	73
Number of observations	341
Credit growth, in percent	
Mean	7.4
Median	7.1
Std.	13.5
Min	-47.5
Max	73.2
Deposit growth, in percent	
Mean	6.5
Median	5.1
Std.	12.1
Min	-25.3
Max	50.1
Change in leverage, in pps	
Mean	0.1
Median	0.2
Std.	3
Min	-18.3
Max	16.9
Size ratio, in percent	
Mean	100
Median	12.6
Std.	272.3
Min	0.1
Max	1762
NPL ratio, in percent	
Mean	2.2
Median	1.5
Std.	2.5
Min	0
Max	31.6
Change in base rate, in pps	
Mean	-0.3
Median	-0.3
Std.	1.1
Min	-3.3
Max	1.9

Number of banks	73
Number of observations	341
Change in lending rate, in pps	
Mean	-0.2
Median	0
Std.	0.6
Min	-2.1
Max	0.1
Real GDP growth, in percent	
Mean	1.9
Median	2.1
Std.	1.3
Min	-3.2
Max	4.3
Inflation rate, in percent	
Mean	1.7
Median	1.8
Std.	0.6
Min	-0.5
Max	3.7
Stock price growth, in percent	
Mean	8.8
Median	12.2
Std.	22.6
Min	-41.3
Max	49.9
Real estate price growth, in percent	
Mean	8.3
Median	8.3
Std.	5.1
Min	-9.3
Max	16

Table A2: Correlation matrix

	ΔL	ΔD	ΔLev	Size	NPL	GDP	Infl	Δr	Δi	Stock	Real
ΔL	1.00										
ΔD	0.08	1.00									
ΔLev	0.12	0.11	1.00								
Size	-0.02	-0.10	0.10	1.00							
NPL	-0.17	0.29	0.05	-0.15	1.00						
GDP	0.11	0.03	0.10	0.00	0.02	1.00					
Infl	-0.02	0.05	-0.14	0.00	-0.08	-0.21	1.00				
Δr	0.11	0.03	0.10	0.00	-0.06	0.57	0.05	1.00			
Δi	0.05	0.05	0.17	0.00	-0.05	0.47	-0.01	0.82	1.00		
Stock	0.13	0.02	0.06	0.00	0.00	0.64	-0.24	0.36	0.02	1.00	
Real	0.02	0.11	-0.10	0.00	-0.06	0.32	0.63	0.28	0.15	0.03	1.00

Table A3: Determinants of stock price growth – Whole period

Explanatory variables	Exp. sign	(1) Total loans	(2) Total loans Listed banks	(3) Corporate loans	(4) Household loans	(5) Non-mortgage loans	(6) Non-mortgage loans without NPLs
$\Delta \mathrm{Re}\, al_t$	+	2.13***	2.13***	2.13***	2.61***	2.19***	0.48***
		(11.88)	(11.88)	(11.65)	(12.26)	(12.06)	(2.77)
ΔL_{it}	+	0.04	0.04	0.05	-0.05	0.04	-0.04
		(0.5)	(0.5)	(0.87)	(-1.08)	(0.62)	(-0.5)
$G\breve{D}P_t$	+	17.44***	17.44***	17.58***	14.77***	17.61***	20.06***
		(17.93)	(17.93)	(17.91)	(11.93)	(17.97)	(18.43)
Δr_t	-	1.29	1.29	1.09	3.71	1.03	-1.16
		(1.29)	(1.29)	(1.09)	(3.09)	(1.05)	(-1.01)
c		-52.33***	-52.33***	-52.76***	-52.11***	-53.31***	-38.06***
		(-18.13)	(-18.13)	(-18.14)	(-17.65)	(-18.35)	(-11.50
R2		0.72	0.72	0.72	0.72	0.72	0.65
Number of obs.		261	261	254	242	258	286

Table A4: Determinants of stock price growth – Financial instability periods

Explanatory variables	Exp. sign	(1) Total loans	(2) Total loans Listed banks	(3) Corporate loans	(4) Household loans	(5) Non-mortgage loans	(6) Non-mortgage loans without NPL
$\Delta \mathrm{Re}\, al_t$	+	-1.16	-1.16	-1.12	-20.12***	-1.12	-0.87
		(-1.34)	(-1.34)	(-1.33)	(-12.16)	(-1.32)	(-1.36)
ΔL_{it}	+	-0.13	-0.13	-0.16	0.04	-0.2	-0.15
		(-0.61)	(-0.61)	(-1.11)	(0.6)	(-1.13)	(-1)
$G\breve{D}P_t$	+	22.8***	22.8***	23.2***	30.96***	23.05***	22.8***
		(12.3)	(12.3)	(12.49)	(20.11)	(12.45)	(13.02)
Δr_t	-	1.92	1.92	1.88	-4.79***	1.79	1.62
		(0.84)	(0.84)	(0.9)	(-3.11)	(0.81)	(0.79)
c		-39.89***	-39.89***	-40.72***	80.14***	-40.69***	-42.34***
		(-5.09)	(-5.09)	(-5.24)	(7.21)	(-5.21)	(-6.2)
R2		0.85	0.85	0.85	0.92	0.85	0.87
Number of obs.		47	47	47	41	46	52

Table A5: Determinants of stock price growth – Tranquil periods

Explanatory variables	Exp. sign	(1) Total loans	(2) Total loans Listed banks	(3) Corporate loans	(4) Household loans	(5) Non-mortgage loans	(6) Non-mortgage loans without NPL
$\Delta \mathrm{Re}\, al_t$	+	2.33***	2.33***	2.36***	2.67***	2.43***	0.28
		(11.76)	(11.76)	(11.66)	(10.26)	(12.1)	(1.57)
ΔL_{it}	+	0.11	0.11	0.1*	-0.04	0.11*	0.01
		(1.4)	(1.4)	(1.73)	(-0.89)	(1.7)	(0.15)
$G\breve{D}P_t$	+	14.5***	14.5***	14.67***	11.43***	14.59***	18.53***
		(13.82)	(13.82)	(13.81)	(7.57)	(13.8)	(15.3)
Δr_t	-	2.38**	2.38**	2.15**	5.86***	2.22**	-2
		(2.27)	(2.27)	(2.02)	(3.86)	(2.14)	(-1.65)
c		-49.04***	-49.04***	-49.75***	-46.4***	-50.13**	-31.05***
		(-15.87)	(-15.87)	(-15.82)	(-14.48)	(-16.07)	(-8.6)
R2		0.69	0.69	0.7	0.69	0.7	0.73
Number of obs.		214	214	207	201	212	234

Table A6: Determinants of housing price growth – Whole period

Explanatory variables	Exp. sign	(1) Total loans	(2) Total loans Listed banks	(3) Corporate loans	(4) Household loans	(5) Non-mortgage loans	(6) Non-mortgage loans without NPLs
$\Delta Stocks_t$	+	0.15***	0.15***	0.14***	0.17***	0.15***	0.01
		(7.44)	(7.44)	(7.17)	(10.34)	(7.66)	(0.4)
ΔL_{it}	+	0	0	-0.03	0	-0.05**	-0.04
		(-0.05)	(-0.05)	(-1.46)	(0.02)	(-2.24)	(-1.56)
$G\breve{D}P_t$	+	-2.44***	-2.44***	-2.35***	-1.18***	-2.5***	-1.6***
		(-5.27)	(-5.27)	(-5.04)	(-2.84)	(-5.47)	(-2.79)
Δr_t	-	-1.57***	-1.57***	-1.43***	-3.25***	-1.36***	0.57
		(-4.83)	(-4.83)	(-4.39)	(-10.89)	(-4.27)	(1.5)
c		14.62***	14.62***	14.6***	12.53***	14.97***	13.18***
		(15.95)	(15.95)	(16.26)	(15.83)	(17.03)	(11.96)
R2		0.13	0.13	0.13	0.35	0.15	0.07
Number of obs.		261	261	254	242	258	286

Table A7: Determinants of housing price growth – Financial instability periods

Explanatory variables	Exp. sign	(1) Total loans	(2) Total loans Listed banks	(3) Corporate loans	(4) Household loans	(5) Non-mortgage loans	(6) Non-mortgage loans without NPL
$\Delta Stocks_t$	+	-0.2***	-0.2***	-0.19***	-0.3**	-0.2***	-0.16***
		(-11.87)	(-11.87)	(-11.78)	(-2.22)	(-12.09)	(-13.56)
ΔL_{it}	+	-0.03	-0.03	-0.01	-0.01	-0.03*	-0.02
		(-1.18)	(-1.18)	(-0.88)	(-0.71)	(-1.81)	(-1.44)
$G\breve{D}P_t$	+	2.17***	2.17***	2.18***	0.75***	2.21***	1.88***
		(7.52)	(7.52)	(7.38)	(3.4)	(7.64)	(7.08)
Δr_t	-	1.26***	1.26***	1.16***	-0.71***	1.26***	0.89***
		(4.34)	(4.34)	(4.35)	(-2.97)	(4.57)	(3.77)
c		2.88***	2.88***	2.75***	5.62***	2.78***	3.36***
		(4.87)	(4.87)	(4.72)	(12.04)	(4.77)	(6.26)
R2		0.7	0.7	0.7	0.55	0.71	0.82
Number of obs.		47	47	47	41	46	52

Table A8: Determinants of housing price growth – Tranquil periods

Explanatory variables	Exp. sign	(1) Total loans	(2) Total loans Listed banks	(3) Corporate loans	(4) Household loans	(5) Non-mortgage loans	(6) Non-mortgage loans without NPL
$\Delta Stocks_{t}$	+	0.15***	0.15***	0.15***	0.13***	0.15***	0.03
		(8.04)	(8.04)	(7.85)	(8.23)	(8.4)	(1.18)
ΔL_{it}	+	-0.02	-0.02	-0.03**	0	-0.05**	-0.04
		(-0.73)	(-0.73)	(-2.07)	(0.15)	(-2.51)	(-1.54)
$G\breve{D}P_t$	+	-2.29***	-2.29***	-2.23***	0.01	-2.37***	-1.89***
		(-4.79)	(-4.79)	(-4.63)	(0.02)	(-5.05)	(-2.8)
Δr_t	-	-1.99***	-1.99***	-1.85***	-3.86***	-1.83***	0.26
		(-6.43)	(-6.43)	(-5.9)	(-13.37)	(-6.06)	(0.62)
c		15.22***	15.22***	15.2***	11.22***	15.47***	14.37***
		(16.38)	(16.38)	(16.62)	(13.39)	(17.44)	(11.22)
R2		0.23	0.23	0.23	0.49	0.25	0.06
Number of obs.		214	214	207	201	212	234