Quantifying the impact of the financial crisis on the real sphere for France and the United States

Christophe Blot, Sabine Le Bayon, Matthieu Lemoine, Sandrine Levasseur

Observatoire français des conjonctures économiques (OFCE), Center for Economic Research-Sciences Po

69 Quai d'Orsay 75 340 Paris cedex 07, France.

Abstract: *The current financial crisis has now led to a fall in real output and the downturn is yet expected to last for some time. The aim of our paper is to analyse and quantify the impact financial crisis on the French and the United States economies. We first present the shocks characterising at best financial crisis and explain how they come through the real economy. The remaining of the contribution is devoted to the empirical work based on a VAR model. Structural shocks are identified using the generalised approach of Pesaran and Shin (1998) which does not require ad hoc assumptions on how shocks come through the system contemporaneously. Most of impulse responses to shocks are found theoretically consistent and statistically significant. Finally, the historical decompositions show that past and current financial shocks contribute significantly to the declines in the economic activity in France and in the United States.*

Introduction

Nearly two years after the 9th august of 2007, the financial crisis is still unfolding. For a short time, it has been thought that damages might be soft. But those hopes vanished with the accumulation of bad statistics. The recession is now official for many industrialized and developing countries. In France, more than 217 000 new unemployed have been recorded between December 2007 and December 2008. The industrial production index plummeted. It was 16 % lower in March 2009 than a year before.

There are many examples in the economic and financial history where financial crises were followed by recessions. Bordo and alii (2001) even showed that those recessions were often deeper. There is consequently a special need for explaining why financial crashes lead to recessions and through which channels financial shocks come through real activity. That is what the paper copes with. The mechanisms of propagation are first introduced theoretically and are then used in VAR models where we identify financial shocks and look through the impulse response functions of the industrial production. Based on those models estimated for France and the United States, we calculate the historical decomposition of the industrial production and then assess the role of financial shocks in explaining the industrial cycle, with a specific focus on the recent events.

Many papers focused on the costs of banking and financial crises. In most cases, those costs have been evaluated *ex-post*[1]. As the financial crisis is still an ongoing process, it would be hazardous to give a final assessment of the total effects of the financial distress. The point is more to show that financial shocks have always significant negative impact on real activity and then to look at where we do stand now. We rule out pure statistical methods which consist in estimating the decline in output or in output growth relative to the pre-crisis trend[2]. Those approaches may be useful to compare financial crisis with common criteria but they suffer from serious measurement issues. It is first needed to precisely define the beginning and the length of the crisis. The costs also depend on whether they are estimated with output level or output growth. More crucial is the hypothesis about the time period - 3 or 5 years - used to estimate pre-crisis trend. It has then no economic meaning since it may be overestimated if there were clear signs of overheating. Finally, this method does not disentangle causality. Does the decline in growth come from the financial distress or from others shocks? Demirgüc-Kunt, Detragiache and Gupta (2000), Barrell, Davis and Pomerantz (2006) or Cerra and Saxena (2008) provide a precise dating of crises and create a dummy variable. The negative impact of banking, currency and twin crises is then tested in panel regressions. But even if control variables are included in the regressions, the issue of the nature of the shocks is not specifically addressed. The role of stock prices, of housing prices, of interest rates and credits is not stated whereas there is a need to clarify causalities that rely on the transmission channels of fully identified structural shocks.

The most thorough way would be to estimate structural equations in a full macroeconometric model. But the empirical literature hardly finds significant results on macro-equations. Theoretical channels such as financial frictions are now well known in the literature and have been successfully tested in panel regressions with micro data on firms and banks[3]. But at the aggregate level, tests relying on the bank lending channel or the broad credit channel often fail to fully confirm that financial factors play a prominent role in business cycles. Macro-

[1] See Hoogarth and Saporta (2001) for a literature survey and Reinhart and Rogoff (2008) for a short descriptive intuition on the costs of the biggest financial distresses.
[2] See the recent paper of Claessens, Kose and Terrones (2008).
[3] See Loupias and alii (2003) or Chatelain and alii (2003) for the euro area.

financial linkages are then hard to integrate in macroeconomic models and it is necessary to adopt *ad-hoc* hypothesis in order to get sizeable effects of shocks[4].

Another approach consists in estimating parsimonious VAR models. The analysis of financial crises then relies on a simple macroeconomic framework where structural shocks are identified with a simple set of hypothesis. The propagation of shocks is not completely revealed by using a reduced model but we may clearly highlight the causalities by estimating impulse response functions to fully identified shocks. The rest of the paper is organised as follows. We first review the different transmission channels of financial shocks. We then present the model, focusing on the choice of variables and on the identification scheme. Finally, impulse response functions and historical decomposition for the French and the US industrial production are described.

1. The transmission of financial shocks in a theoretical perspective

The current financial crisis, characterized by a sharp fall of stock markets, a slowdown (or a drop) of housing prices and the paralysis of interbank markets, induces various kinds of shocks affecting consumption and investment decisions and then, real output. In particular, non financial agents (*i.e.* households and firms) are facing a shock on their financing conditions, on their wealth as well as a shock of uncertainty (Spilimbergo et *al.*, 2008). While differing by their extent from one crisis to another one, these shocks have been recurrently observed during financial crisis. This section proposes a theoretical understanding on how these shocks come through the real economy, based on the existing literature. Yet, this literature has been mainly developed for analysing the transmission of monetary policy shocks. However, it can be easily extended to study more broadly the effects of financial shocks.

1.1. The interest rate channel (or capital cost channel)

The capital cost channel constitutes a key mechanism in the transmission of interest rate shocks (due to changes of liquidity on interbank market and/or changes of monetary policy) in the standard Keynesian textbook model. Assuming price and wage stickiness, a fall in the interest rate, by reducing the capital cost, induces a rise in investment spending, thereby leading to a rise in aggregate demand and, then, in output. A similar line of reasoning holds for

[4] See Barrell and *alii* (2006) for example who calibrate the impact of a banking crisis with the NIGEM macroeconomic model by imposing a 800 basis point change in the spreads between borrowing and lending rates in the first quarter after the shock.

investment decisions in housing or purchases of durable goods by households, with a fall in the interest rate accounting for a fall in the cost of borrowing.

For the interest channel operates, two key elements have to be considered (see Mishkin, 1995, 1996). On the one hand, decisions of households and firms are affected by the *real* interest rate – rather than the *nominal* one – meaning that some price stickiness in the economy is needed. On the other hand, decisions of households and firms are depending on *long term* interest rate – rather than *short term* one – meaning that changes in the short term rate (due, for instance, to monetary actions of the central bank) have to lead to corresponding changes in the (real) long term interest rate[5]. When a financial shock occurs, a direct shock on long term rates (*e.g.* a bond shock) or on short term rates (*e.g.* a shock on interbank market) rather than monetary policy actions *per se*, may alter the term structure of interest rates. The financial turmoil, by inducing a drying up of liquidity available for commercial banks, has resulted in a sharp increase of interbank market rates. How fast and to which extent this shock is transmitted to interest rates paid by firms and households is typically an empirical matter. Yet, the Lucas criticism may be particularly relevant in the actual "troubled" times[6].

While the theory suggests that this channel may play a key role, the incapacity of empirical studies to find a strong impact of interest rate changes on investment and consumption decisions has led to consider other channels for the transmission of monetary policy, in particular the credit channel and the "wealth" effect.

1.2. The « wealth » effect

The « wealth » effect finds its theoretical roots in the permanent income of Friedman. Households own wealth, made of labour revenues, financial assets (stocks, bonds etc.) as well as non financial ones (housing). This wealth allows households to determine the permanent income (by actualizing her current and future incomes) on which their consumption is based. One shock affecting adversely their wealth (*e.g.* a fall in stock market or in housing prices) will reduce the permanent income and then, their consumption. If the adverse shock is temporary (or perceived as temporary), the impact on consumption will be also temporary and not sizeable due to the actualisation on the *whole* current and future incomes. But, if the adverse

[5] If, as assumed by the term structure of interest rates, the long term rate consists in an average of expected future short term rates, a fall in the (real) short term rate leads to a fall in the (real) long term one which stimulates investment of firms and expenditure of households.

[6] For France, the delays of transmission from interbank market rates to debtors ones have been estimated to two or three months (depending on the type of credit) over the last decade (Coffinet, 2005). However, due to a deterioration of their balance sheet, banks may have few incentives to pass rapidly a lower interest rate set by the central bank on debtor rates. For the United States, see Mishkin (2009) on the transmission of lower Federal Reserve rates on households and firms rates in the context of the current crisis.

shock is perceived as permanent (*e.g.* the burst of bubbles on stock and housing markets), the reduction of permanent income will be sizeable, inducing a long-lasting fall of consumption.

To date, the empirical estimates of the wealth effects in explaining the (aggregate) consumption of households have been quite disappointing, except for the United States or the United Kingdom. Two main factors account for this finding. First, households in Continental Europe own a smaller share of their wealth in financial assets than American or British ones[7]. As a result, the consumption of households in Continental Europe displays a low reactivity to fluctuations on stock market. Second, Anglo-Saxon households can run into debt as far as the value of their housing goes up; conversely, this source of financing is drying up with a reversal in housing prices, then contributing to depress expenditures of households. In Continental Europe, and especially in France, as very few households are using mortgage loans, the "housing wealth" effect is almost ineffective (see ECB, 2009). For these two reasons, labour revenues accounts for the bulk of consumption in Continental Europe, contrasting with the United States and the United Kingdom in this respect[8]. The fall in housing prices (observed in the United States since 2007) and the burst of stock market since mid-2007 is expected to have a lower impact on the real economy in Continental Europe than in Anglo-Saxon countries.

1.3. The importance of (amplifying) financial effects

The current turmoil gives a central role to the financial sphere in the transmission of crisis towards the real economy. As shown by Bernanke and Blinder (1988) and by Bernanke and Gertler (1995, 1996), financial imperfections (due to informational asymmetries) contribute to the transmission – with an amplifying effect - of monetary, real and financial shocks.

Several mechanisms explain the phenomenon of financial amplification[9]. In models based on the financial accelerator, borrowers have to pay a premium for external financing which is specific to each debtor and depending on its financial situation[10]. The higher informational asymmetries, the more costly external financing; the higher net wealth, the less

[7] For instance, at the end of December 2006, financial assets (life insurance and pension funds included) accounted for 23 % of the French households wealth against respectively 56 % and 36.5 % for American and British ones (Aviat et *al.*, 2007).
[8] For estimates of wealth effects, see Houizot et *al.*(2000), Aviat et *al.*(2007), ECB (2009).
[9] See Clerc and Pfister (2002) or Bean et *al.* (2003) for a review of this literature.
[10] The premium is due to additional costs engaged by the creditor to screen and control outcomes obtained (and declared) by the borrower.

costly external financing is[11]. Thus, a monetary, real or financial shock, which either alters the revenues of non financial agents or reduces the value of collaterals, will result in a higher premium of external financing. Investment and consumption projects[12] of agents financially constrained will be then modified, amplifying in turn the initial shock. Moreover, as the premium of external financing depends on the net wealth of agents, banks may adjust their balance sheet, in favour of large firms and to the detriment of the small ones.

The current financial crisis, by inducing a tightening of financial conditions, a fall in financial and housing assets together with deteriorated growth perspectives, has a huge negative impact on the financial situation of firms and households. The financial accelerator then constitutes an important channel by which financial shocks come through the real sphere, as a result of lower investment and consumption far beyond "wealth" effects and higher capital cost.

In models based on the financial accelerator, banks have no specific role to play in financing economic activities. The literature on the bank lending channel goes further, assuming that banks can be forced to reduce their credit supply[13] if they are unable to find substitutes when a shock reduces their own financing[14].

Current concerns about a *credit crunch* (that is, a rationing in credit supply), as a result of a disrupting interbank market, are quite large. Surely, central banks have intervened on this market (in particular in October 2008) by huge injections of liquidity. However, to date, banks are facing problems of refinancing. Yet, the initial shock may be amplified by a slowdown in securitisation activities. Altunbas et *alii* (2007) have found that securitisation over the last decade have reduced the bank lending channel by giving an additional source of liquidity to banks and by allowing them to reduce regulatory capital requirements. Then, if opportunities of securitisation are suddenly reduced, banks will loose this additional source of financing and, the credit channel could be reactivated.

Other empirical works (*e.g.* Peek and Rosengren, 1995) have found that shocks on banking capital induce banks to reduce their credit supply in case of regulatory capital

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[11] More precisely, the net wealth reflects the capacity for the borrower – household or enterprise – to give some guarantees based on its financial assets and/or housing, net from its debts.

[12] The pioneered models are only analysing the effects on investment of firms. But the model can be easily extended to households' consumption by assuming that housing assets are used as collateral (see Goodhart and Hofmann, 2007 or Mishkin, 2007).

[13] See ECB (2008) for a review of this literature.

[14] In particular, banks of small size and/or facing to capitalisation and liquidity problems may have difficulties in finding "fresh" capital. The empirical literature finds that liquidity is crucial for European banks (Erhman et *alii*, 2003; Loupiac et *alii*, 2003). Ashcraft (2006) shows that, in the United States, the bank lending channel is lower when the banks are affiliated to a multibank holding company.

requirements, which reinforces the credit channel[15]. Following a shock lowering the quality of their assets, in order to satisfy their prudential ratios, banks have either to reduce their exposure to risk (by offering lower credit) or to increase their bank capital. However, in a context of informational asymmetries, raising capital is costly, especially in financially and economically "troubled" times. With the subprime crisis, both the subsequent large depreciations of banking assets, the illiquidity of structured and the burst of stock market, are expected to activate further the banking capital channel. Even if governments have helped in recapitalising banks, the risk of portfolio adjustment remains. In that case, lower expenditures of non financial agents would come from a reduction in the credit supply – rather than from a reduction in the credit demand.

1.4. Uncertainty

The current crisis, alongside its pure financial aspects, induces a higher uncertainty for economic agents. The growth and employment perspectives are not only bad-oriented but also more uncertain (OFCE, 2008). Firms and households have to decide how much to invest and consume in a riskier environment, which may result in a wait-and-see behaviour. In a context of higher uncertainty, households tend to save more for precaution purposes. For instance, empirical studies show that fluctuations in the unemployment rate – used as a *proxy* of uncertainty – have a (huge) negative impact on consumption[16]. For firms, the line of reasoning is based on the irreversibility of investment decisions, as some installation costs are no longer recoverable. The investment decision is then similar to exercise an option (Pyndick, 1988): as the decision is irreversible, the enterprise may delay its investment projects, waiting for better times. Thus, investment is realised only if gains are higher than installation costs together with the implicit price of the option which increases with volatility. The global uncertainty surrounding the actual macroeconomic situation could induce firms to delay (some of) their investment decisions, slowing down further demand and production[17].

2. Methodology: modelling financial shocks

The previous section provided details on the theoretical transmission of financial shocks to the real sphere. In particular, changes in asset prices – on stock and housing markets – come from a vector of repeated shocks, which occur in each financial crisis. The previous section also

[15] The channel we consider here is the "banking capital" channel (see Van den Heuvel, 2002).
[16] See Aviat et *alii* (2007) for a recent theoretical model.
[17] For recent developments on uncertainty, see Bloom (2009).

underlined the role of the banking system and of the uncertainty generated by a financial shock. Thus, a model of financial shocks should take into account all the shocks which play a role in the transmission and amplification of financial crisis. The VAR framework seems particularly relevant, as it allows to identify the generating process of shocks and to assess their macroeconomic impact. After a brief presentation of the variables included in the model and of the specification of the model, we particularly detail the estimation of impulse responses.

2.1. Variables

The VAR model includes 7 variables: a business variable (index of industrial production, IIP), a price variable (consumption price index, cpi), a variable for the refinancing cost of banks (the interbank rate with a 3-month maturity) and 4 variables which take into account the transmission channels of financial crisis (interbank spread, stock prices, their volatility and housing prices). The model is estimated for France and the United States with monthly data in the time period 1974:01-2009:02 (1975:01-2009:02 for the United States). The availability of the IIP determines the end date of the estimation sample[18]. In order to keep only their cyclical components, all variables are detrended with a Hodrick-Prescott filter. Unit root tests confirm that this step provides stationary time series[19].

This VAR model aims at capturing the standard interactions between real activity (measured by industrial production), prices (measured by consumer prices index) and the monetary policy (measured by the 3-month interbank rate). The 3-month interbank rate approximately reflects the monetary policy, as it is determined by 3-month anticipations of financial markets concerning the key policy rate[20]. Nevertheless, during a crisis, the interbank rate also reflects liquidity problems of banks[21]. Yet, 4 variables are introduced in the VAR to deal specifically with financial effects. These 4 variables are detailed in what follows.

First, the stock price is a proxy of the financial wealth of agents. A krach does not only affect the financial wealth of households, but makes difficult the financing of firms and deteriorates the balance sheet of financial institutions, whose assets are estimated by their market price. This penalizes investment projects.

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[18] Annex 1 details the treatment and the sources of the series.

[19] ADF tests (*Augmented Dickey-Fuller*) reject the unit root hypothesis with a threshold of 1 % for most variables (10% for others).

[20] For France, the key policy rate was set by the *Banque de France* until 1999 and by the European Central Bank after. Thus, since 1999, this rate depends on the general conditions in the euro area, and not specifically of those in France. However, the short-term economic situation of France is highly correlated with that of the euro area.

[21]For example, from September 16 (following the bankruptcy of Lehman Brothers) to October 10, 2008 (the date of the cut of the ECB key policy rate), the interbank rate increased by 50 base points because of drying-up liquidity.

Second, house prices approximate the housing wealth of households. This source of wealth accounts for 60% of the households' wealth and is more uniformly distributed than the finance wealth. Both supply and demand factors explain the recent downturn. The weakness of demand comes from the insolvency of some households and from the difficult refinancing related to the low earnings of banks. This lower demand requires an adjustment of the supply, which implies less housing starts, more dismissals in the housing sector and a feedback effect on the demand.

Third, tensions of the banking system are incorporated in the model *via* the interbank spread, *i.e.* the difference between the 3-month interbank rate and the key policy rate. A high spread reflects a difficult refinancing of banks in a crisis period. The volume of market transactions would be more relevant for measuring the drying-up of the interbank market, but this variable is not available with a monthly frequency over a long period. Hence, the interbank spread is a *proxy* of the quantitative problem faced by the banks during the crisis, while the interbank interest rate only measures the refinancing cost related to monetary policy. Such a specification takes into account the beginning of the transmission of the crisis. It does not allow to test directly the impact of the crisis on the financing conditions (price and volume) of non-financial agents, because long time series are not available for amounts and costs of loans to households and firms.

Figure 1 shows the evolution of interbank spreads since 1974 for France and the related events (expectation of change in the monetary policy during an exchange rate crisis, distrust between bank etc.) to spread shocks (defined as spreads higher than 1.65 times the standard deviation of the centered series)[22]. The current spread shock has been much smaller in France (and other members of the euro area) than in the United States (with a maximum of, respectively, 110 and 310 base points in October 2008)[23]. Besides, this spread vanished in France at the beginning of 2009 while it remains quite high in the United States. This recent spread shock might seem smaller than the shocks of the 1970's, of the end of the 1980's and of the beginning of the 1990's. However, since the end of the turmoil in the European exchange rate mechanism in 1996, this spread has known a strong decrease of its mean (from 52 base points in the period 1974-1995 to 27 base points in the period 1996-2008) and of its standard

[22] *"Perhaps the most striking indicator of the various stages in the current crisis is the spread between the three-month Euribor, an indicative rate for unsecured lending among banks, and the three-month euro overnight index average (Eonia) swap rate. A strong increase of the spread in summer 2007 and in September 2008 reflects the reluctance of banks to lend to each other, closely related to a general lack of transparency about the risks individual banks have been carrying on their books" (* Gertrude Tumpel-Gugerell, Member of the Executive Board of the ECB, Speech of 22 January 2009).

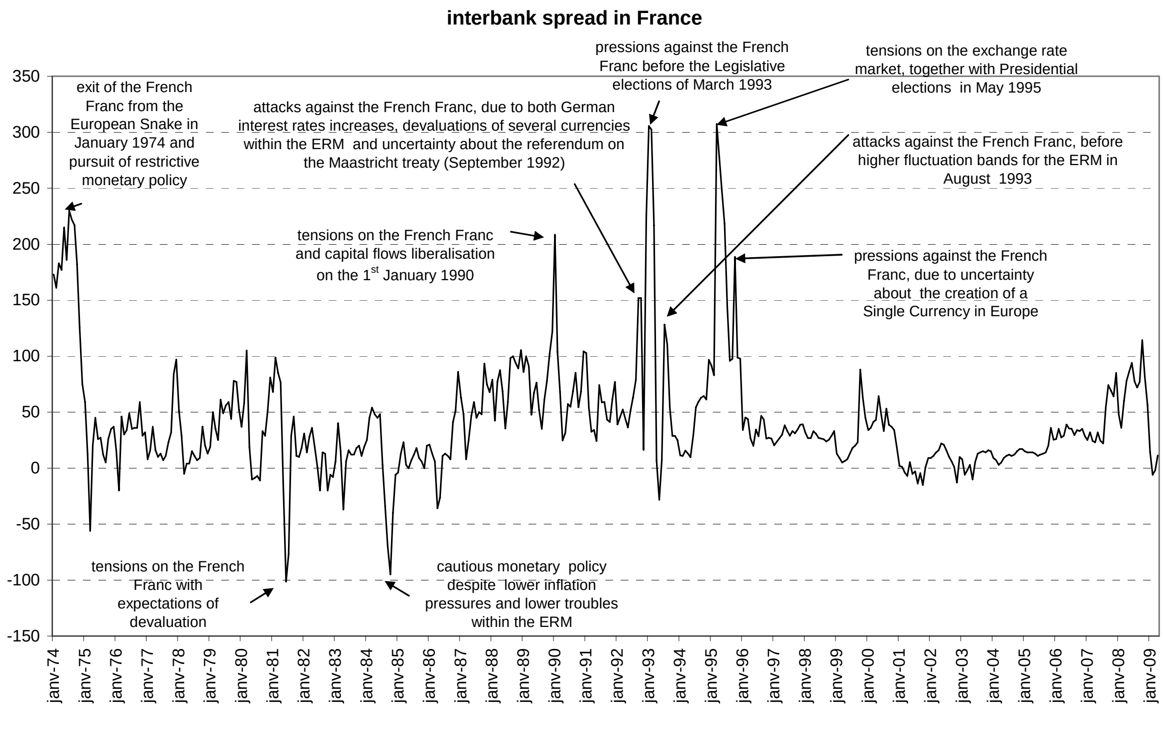
[23] For the United States, the graph of the interbank spread is located in annex 2.

deviation (from 63 points in the first period to 23 points in the second period). Thus, the recent increase of the spread is particularly strong and persistent with respect to the last decade.

Another indicator, the spread between the 3-month interbank rate and the interest rate of 3-month Treasury bills, would confirm the high tensions on the interbank market in the recent period. This spread is not disturbed by the expectations of the monetary policy, because they are taken into account by both series. Thus, this indicator does only reflect the drying-up of the interbank market. This indicator reached a historic level at the end of 2008[24].

Figure 1: interbank spread in France

Base points



Source: Banque de France, European Central Bank.

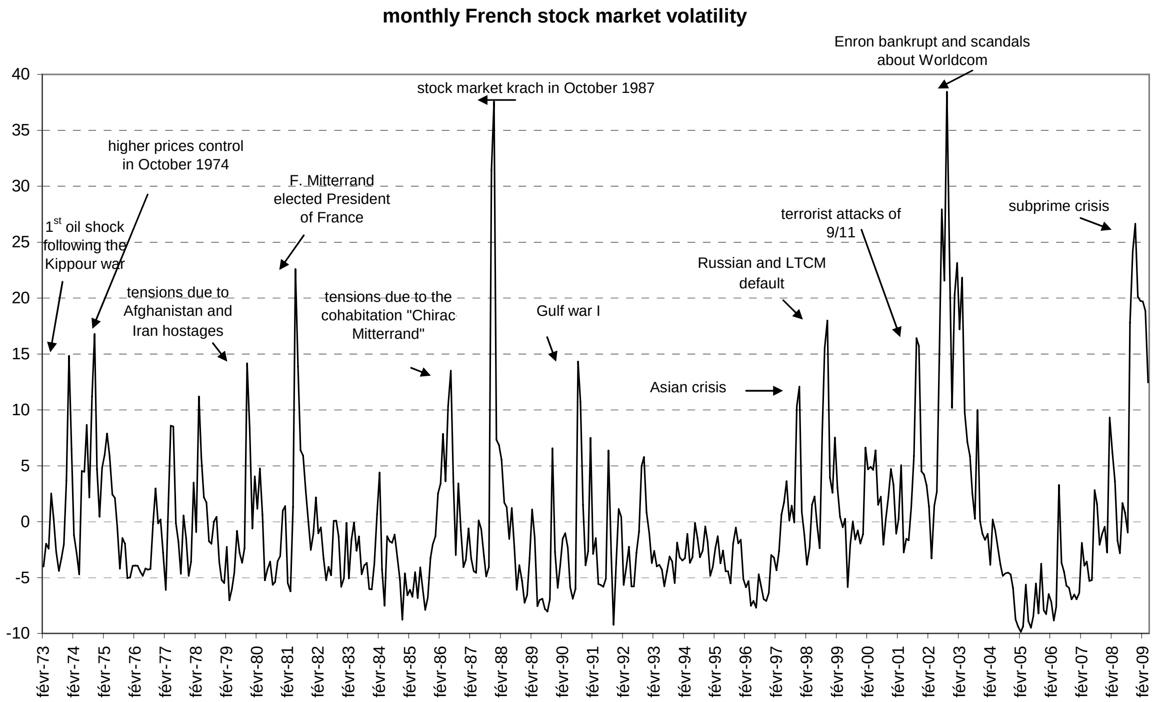
Fourth, the volatility of stock prices is included in the model, in order to proxy the uncertainty in the economy[25]. Usually, the evolution of the volatility is smooth with gradual increases or decreases. Volatility peaks come from booms, crashes or hiccoughs (when consecutive economic news trigger strong increases and decreases) of the stock market. Figure 2 shows the chronology of the stock volatility since 1973. It also lists the causes of important shocks, *i.e.* higher than 1.65 times the standard deviation of the centered series. For France,

[24] This time series is not included in the VAR model, because it is not available before 1986.
[25] For other proxies of the uncertainty (e.g. variability of profits), see Bloom (2009).

the peak of November 2008 is one of the 3 stronger peaks for 3 decades, with that of the stock market krach in 1987 and those of 2002-2003 related to the bursting of the internet bubble and the distrust against the balance sheets of firms after the Enron/Worldcom scandals. For the United States, the recent peak is the highest since 1973, closely followed by the peak of the 1987 crash (see annex 2).

Figure 2: Stock volatility in France

Standard deviation (in %)



Source: Datastream.

Note: the volatility is centered.

2.2. Specification of the VAR model

Consider the augmented vector autoregressive model, estimated by ordinary least squares:

$$x_t = c + \sum_{i=1}^{p} B_i x_{t-i} + e_t, \qquad t = 1974\text{m}1, \ldots, 2009\text{m}02 \tag{1}$$

where x_t is a (7×1) vector of endogenous variables, e_t is the (7×1) vector of canonical residuals with Σ the variance-covariance matrix. B_i are (7×7) coefficient matrices and p is the number of lags[26].

As structural shocks cannot be observed, they can only be deduced from estimated residuals. Various approaches are possible. Generally, some identifying constraints are imposed, where estimated residuals are expressed as linear combinations of structural shocks:

$$P\varepsilon_t = e_t$$

where ε_t is a (7×1) vector of structural shocks and P a combination matrix. Assuming also that structural innovations have a covariance equal to the unity matrix, we get:

$$PP' = \Sigma$$

The Choleski decomposition, usually used for estimating impulse responses[27], assumes that P is lower triangular.

The VMA (vector moving average) representation allows identifying the impact of innovations on each variable. This representation is written:

$$x_t = \mu + \sum_{i=0}^{\infty} A_i e_{t-i} = \mu + \sum_{i=0}^{\infty} A_i P \varepsilon_{t-i} \text{ ,}$$

where the unconditional expectation μ and matrices A_i are analytically determined by inverting the VAR representation. The impulse response, a (7×1) vector, contains responses of each variable at horizon h to a structural shock on the j^{th} variable at horizon 0:

$$\psi_j^c(h) = A_h P u_j, \quad h = 1, 2, ...,$$

with u_j the selection vector (7×1), whose j^{th} element is equal to 1 and other elements are equal to 0.

At each date t, the historical decomposition is defined as the impact of past and present structural shocks on the j^{th} variable to the vector x_t:

[26]We used the Schwartz BIC criteria. The two models were then estimated with two lags.

[27]All specifications of structural VAR models follow such a scheme and only differ by the choice of the identifying constraints.

$$x_{jt}^{c}=\sum_{i=0}^{\infty}A_iPU_j\varepsilon_{t-i},\quad j=1,...,k$$

with U_j the (7×7) selection matrix whose element (*j,j*) is equal to 1 and other elements are equal to 0.

The main drawback of the Choleski decomposition concerns its dependence of responses on the ordering of the variables in the VAR model. It is necessary to place variables in a precise ordering justified by the adjustment speed of each variable to contemporaneous shocks. These implicit assumptions are difficult to justify, when the model incorporates some financial variables. Indeed, interest rates and stock market variables are daily quoted and should quickly integrate all news. Thus, their reaction to shocks should be quasi-instantaneous and it is difficult to assume a specific ordering for such variables.

Hence, structural shocks were estimated following the generalized impulse response analysis proposed by Pesaran and Shin (1998). Unlike the Cholesky impulse response analysis, this approach is invariant to the ordering of the variables in the VAR. The response functions are given by:

$$\psi_j^g(h)=\frac{1}{\sqrt{\sigma_{jj}}}A_h\Sigma u_j,\quad h=1,2,... \tag{2}$$

where $\psi_j^g(h)$ measures the effect on the 7 variables of one standard error shock to the j^{th} residual at horizon *h*. Through Σ, this impulse response depends on σ_{jk}, the covariance between the residuals of the k^{th} and the j^{th} equations of the VAR model, and σ_{jj} , the residual standard deviation of the j^{th} equation. Impulse responses directly depend on the information of the covariance matrix. Similarly, we can easily compute the historical decomposition of any variable of the vector *x*. We then have:

$$x_{jt}^{g}=\frac{1}{\sqrt{\sigma_{jj}}}\sum_{i=0}^{\infty}A_i\Sigma U_je_{t-i}.$$

with U_j a selection matrix where the element (*j,j*) is equal to 1 and others are equal to 0.

3. A comparison of financial shocks in France and in the United States

3.1. Impulse responses to various shocks

We compute generalized impulses for our two models (France and the United States) to check the relevance of our macroeconomic framework and to assess the role of financial shocks in the cyclical dynamics.

We find that industrial production responses to shocks are theoretically consistent in France and in the United States[28]. In France, a shock on housing prices has a stronger and more persistent impact on industrial production (lasting 23 months) than a shock on the stock exchange, which is significant from the 4th to the 13th month (figure 3). Industrial production increases immediately after a positive real estate shock, with a peak one year later. Responses for the United States are very close, despite a lower and a less persistent impact of housing shocks on industrial production than in France (figure 4). A shock on housing prices is also less persistent than a shock on the stock exchange, but the impact of the latter on American industrial production reaches a higher peak. Thus, in both countries, we can expect that real estate crises will have a more negative impact on economic activity than stock exchange ones. That may explain why the current crisis has stronger effects than the 2001 crisis, as the real estate market remained dynamic in both France and the United States.

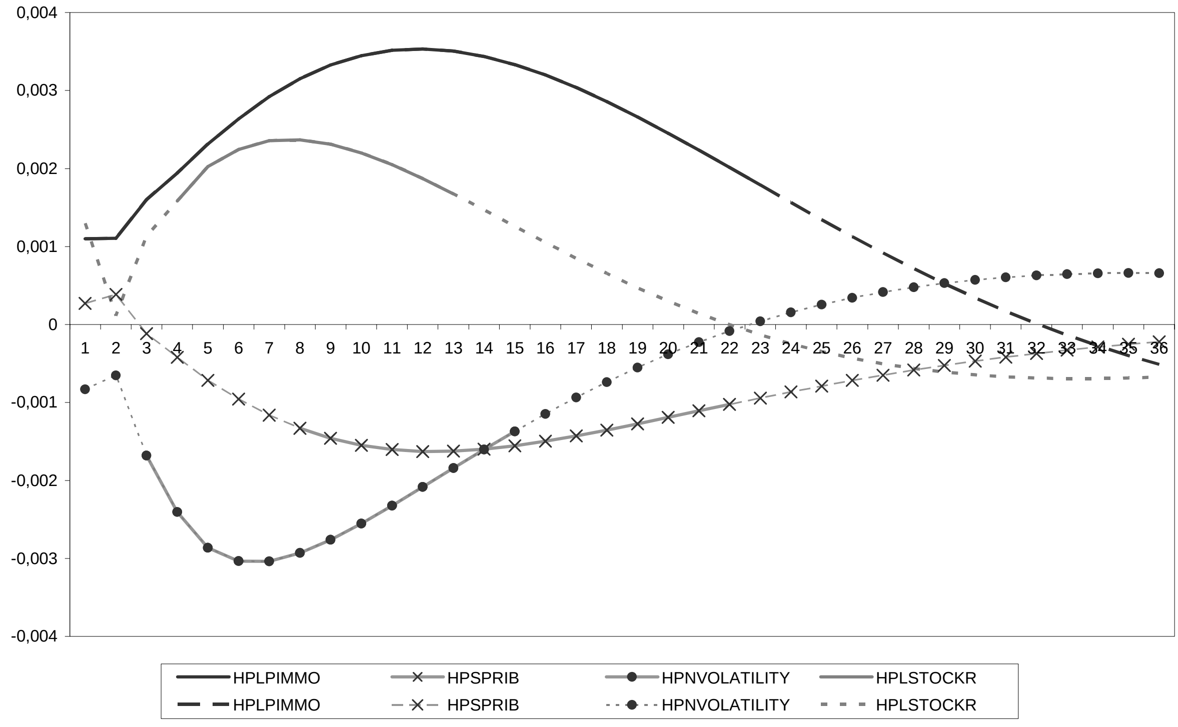
From our estimates of impulse responses, we can deduce that the current fall in housing prices induces a negative shock on wealth and increases the premium of external financing. Yet, compared to shocks on the stock exchange, those on real estate market have not only financial effects but also macroeconomic ones, through the construction sector. Unfortunately, our macroeconomic framework does not allow us to assess if wealth effects (through consumption) affects more the real economy than financial amplification effects – (through the decline in the value of collaterals).

Let's turn now on the two other variables used to measure financial shocks, namely the stock exchange volatility and the interbank spread. In France, both of them are significant while, in the United States, only the volatility shock induces a fall in the industrial production. According to our model, a higher uncertainty (*proxy* by volatility on stock exchange) is an important component of the fall in real activity: this shock is strong and persistent (lasting 12 months) with a similar impact in France and in the United States. Comparatively, the fall in industrial production is smaller after a shock on the interbank spread. Its decline becomes

[28]We also try to estimate a VAR with employment instead of industrial production but outcomes were less conclusive.

significant about 8 months after the shock occurs and, only in France. One can draw a parallel with the transmission of monetary policy in France, since a rise of the 3-month interbank rate has a significant negative impact on industrial production after 7 months. Therefore, we can conclude that the mechanisms of transmission of these shocks -monetary policy and financing cost of banks- are relatively close. Recently, the spread between the interbank rate and the main refinancing rate has increased, due to the banking crisis. But, as mentioned previously in this article, this variable may not well suited to capture the exact role of banks in the transmission and amplification of shocks. For example, Lown and Morgan (2006) suggest measuring the effects of loan supply by using data from the Loan Officer Opinion survey[29]. Unfortunately, we cannot use these quarterly data for France because they are only available since 2003.

Figure 3 : Response of the French industrial production to financial shocks



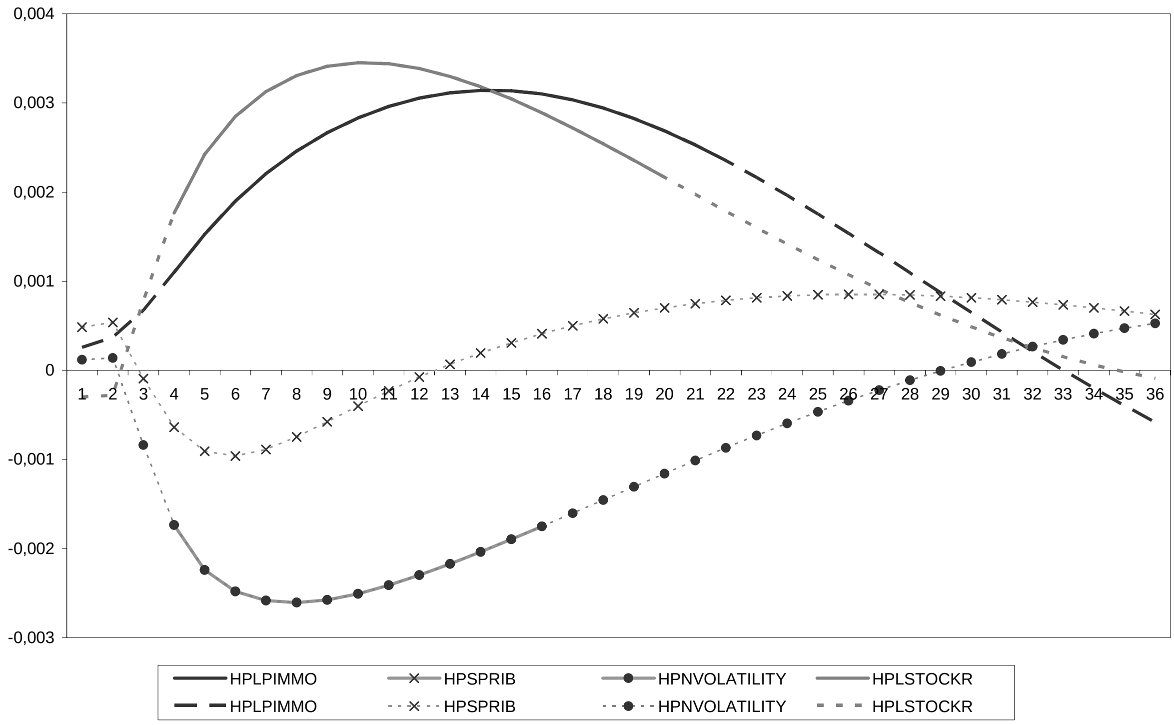
Note 1 : The responses of industrial production to the various shocks are represented by continuous lines when significant and by dotted lines otherwise. The confidence intervals were generated using Monte Carlo simulations with plus or minus 1.65 standard error, namely at the 10% level.

Note 2 : HP (…) for Hodrick-Prescott filter; L (...) for Log; SPRIB for interbank spread; PIMMO for housing prices; NVOLATILITY for stock volatility; STOCKR for stock exchange index.

[29] In this survey, banks have to say if they have recently "tightened", "remained unchanged" or "eased" their credit standards for approving loans.

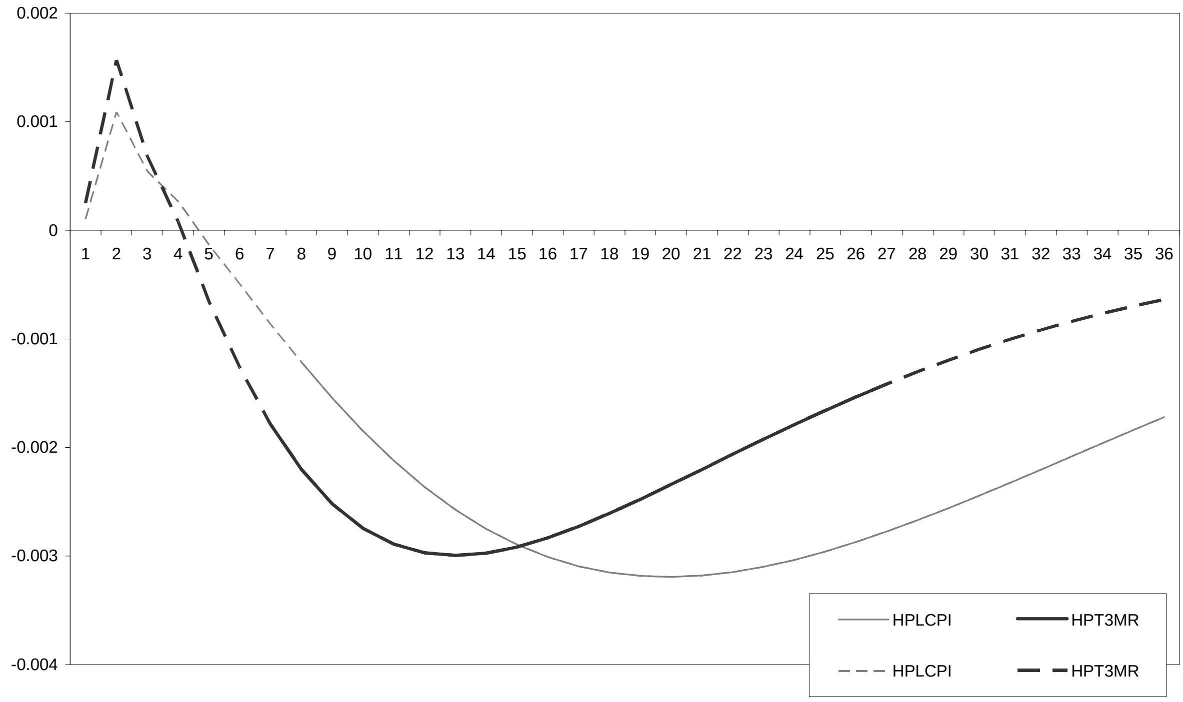
A shock on inflation -comparable to a supply shock- induces a fall in industrial production at the 10% level after 8 months in France and in the United States (figures 5 and 6). This effect is persistent, remaining significant until the 36th month. A shock on 3-month interbank rate is significant from the 7th to the 27th month in both countries, with a peak one year after the shock occurs. These results are consistent with the idea that there are some delays in the transmission of monetary policy and that a shock on monetary policy has persistent effects.

Figure 4: Response of the US industrial production to financial shocks



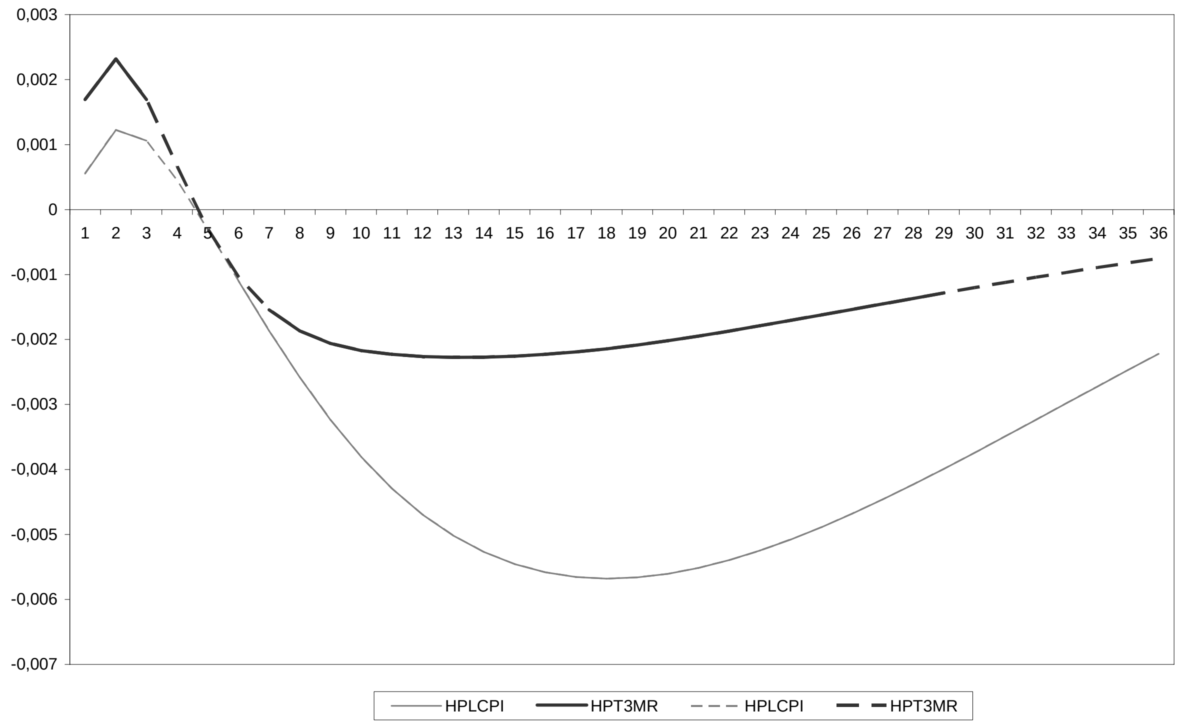
Note: same legend as in the previous figure.

Figure 5: Response of the French industrial production to other shocks



Note: HP (…) for Hodrick-Prescott filter; L (...) for Log; CPI for consumer prices index; T3MR for three-month interbank rate.

Figure 6: Response of the US industrial production to other shocks



Note: same legend as in the previous figure.

Apart from the industrial production, we can underline other outcomes[30]. First, in both countries we find a price puzzle[31]. After a restrictive monetary policy (*i.e.* a rise in the interest rate), prices tend to rise for about 10 months in France and 7 months in the United States. Then, they progressively return to their trend, meaning a late slowdown of inflation. Therefore, a monetary shock could be viewed as a reaction of the central bank to an anticipated rise of inflation, so that the increase in interest rate would not reduce inflation immediately, due to delays in the transmission of monetary policy.

We can now analyse the responses of short-term interest rates to check the reaction function of monetary authorities to various shocks. For France and the United States, interest rates increase immediately in response to a non anticipated rise of prices (see figures in appendix 3). Interest rates rise for 8 months before coming back to their trend. Then they fall after 21 months. This result is significant at the 10% level, but not at the 5% one. In both countries, interest rates increase after a shock on industrial production (about 2 months after the shock occurs in France and 3 months in the United States). Responses are no longer significant after 15 or 16 months. It is worth noting that the response of monetary authorities is stronger in the United States than in France (and in the euro area since 1999). Interest rates also rise after a housing shock. The rise is persistent, since it is significant from the 10th month to the 29th month after the shock occurs in France. It is more immediate and more persistent in the United States. Nevertheless, the monetary policy response to a stock exchange shock is not significant in the United States, whereas it is significant in France, with a rise of interest rates from the 8th month to the 18th month after a shock.

3.2. Historical impact of financial shocks on industrial production

Using historical decompositions of the industrial cycle, we measure the impact of the identified past and current shocks on industrial production.

On figure 7, the impact of financial shocks on the French cycle is the sum of 4 shocks (stock exchange, volatility, housing prices and interbank spread). In the past, this global impact was particularly negative three times (with a decrease of 5 to 7,5 % of the cyclical industrial production) : after the 1987 financial crisis, during the recession of 1993-1994 and after the

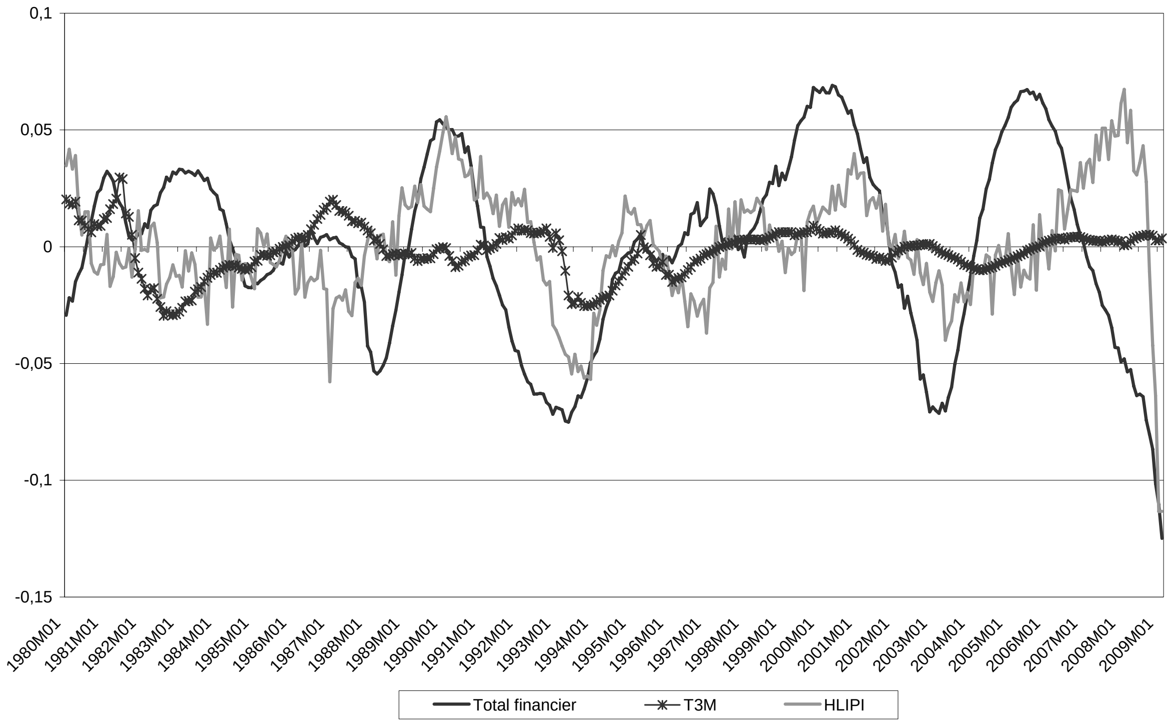
[30]The figures of impulse responses which are not represented in this article are available upon request to the authors.
[31]The introduction of oil prices –as an additional endogenous variable or as an exogenous one- does not help to solve the price puzzle in our model.

burst of the internet bubble in 2001. The impact of financial shocks following the subprime crisis is even more negative, reaching -12,5% in February 2009. On the contrary, the recession of the early eighties was mainly due to monetary policy shocks. Concerning housing shocks, they represent a major part of financial shocks since the early nineties. Thus, in February 2009, real estate shocks explain almost 80% of the industrial cycle, when financial shocks as a whole account for 110% of this cycle. The contribution of the three other financial shocks to the current crisis is much weaker, especially the stock exchange and of the interbank spread shocks. On average the volatility explains 20% of the fall in industrial production from October 2008 to February 2009. Alongside the wealth effect, the real estate shock has led to a decrease of housing starts, which may explain why we find such a huge contribution of this shock to the decline of industrial production. The shock to volatility -a proxy of the uncertainty that economic agents are facing- contributes to explain the amplification of the current crisis in France.

In the US, figure 7 emphasizes the importance of the burst of the internet bubble and the subprime crisis with regard to the previous financial crises. Concerning monetary policy shocks, they have a less pro-cyclical impact in the early nineties and become clearly counter-cyclical in 1995. In February 2009, the impact of financial shocks (estimated at -6,5%) explains 90% of the industrial cycle. Like in the French case, housing shocks account for a major part of financial shocks. Stock exchange, volatility and interbank spread shocks have little effects in comparison.

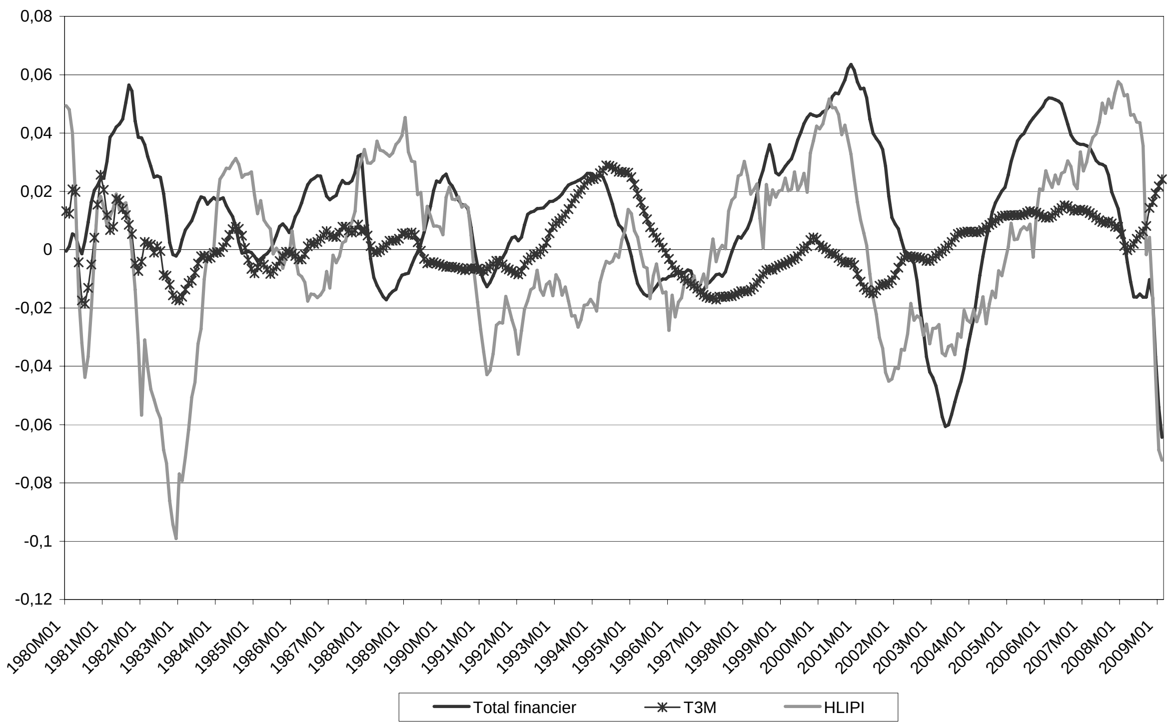
The strong prevalence of real estate shocks in the US is consistent with the fact that this sector has caused the subprime crisis. The weak role of other financial shocks is less intuitive. Nevertheless it should be noted that the choice of the number of lags in the US VAR has an influence on the relative importance of the various financial shocks, even if it does not affect the contribution of the financial shock as a whole.

Figure 7: Historical impact of several shocks on French industrial cycle



Note: The financial shock is the sum of the stock exchange, the housing prices, the volatility (in the stock market) and the interbank spread shocks. Monetary policy shocks represent shocks to the 3-month interbank rate.
Source: Datastream, calculations of authors.

Figure 8: historical impact of several shocks on the industrial cycle in the US



Note: same legend as in the previous figure. Sources: Datastream, calculations of authors.

Conclusion

This paper has attempted to assess the impact of financial shocks on the real activity in France and in the United States. We resorted to a structural VAR approach, where financial shocks were identified with housing and stock prices, interbank spread and stock market volatility. Impulse reaction functions of the HP filtered industrial production were estimated with the generalized method developed by Pesaran and Shinn (1998). All shocks have the expected effect that is significant in almost all cases. We found out that housing and stock price shocks led to a decline in the business cycle that is strong and generally long lasting. The analysis also suggests that uncertainty does matter since shocks to volatility are followed by a decline in industrial production. Finally, less significant results are obtained with the interbank spreads, which aimed to capture the banking sector difficulties and their potential impact on credit supply. Further research is needed to find a good proxy of the role played by banks in financial crisis. Lown and Morgan (2006) recently suggested that credit standards are significant in predicting future bank lending and real GDP. Bank lending surveys have indicated a net tightening of credit standards since the third quarter of 2007. It may then have played a role in the transmission of financial shocks. The paper confirms that financial crises are generally quickly followed by a downturn – after 1 to 6 months – with real activity reaching a trough between 8 and 15 months later.

The identification scheme for structural shocks has then been used to simulate the past dynamic of the industrial production in France and in the United States. Aggregated financial shocks have strongly contributed to business cycles, especially since the end of the nineties. It is therefore crucial to implement ad hoc macroeconomic policies that will stabilize the economy as soon as a country is hit by a financial shock. But more than this, a new set of financial regulations should be promoted in order to avoid future financial crises and limit their potential damages.

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Appendix 1: Data and sources for France and the US

As seen previously, the VAR model includes 7 variables: the index of industrial production, the consumption price index, the 3-month interbank rate, the interbank spread, the housing prices, the stock market prices and their volatility.

The index of industrial production is defined in volume and seasonally adjusted. The consumption price index is also seasonally adjusted. These two series are provided by INSEE in the French case. They are respectively provided by BEA (Bureau of economic analysis) and BLS (Bureau of labor statistics) for the US.

For France, the 3-month interbank rate is the 3-month Euribor since 1999 and was the 3-month PIBOR previously. For the US, the IMF provides the 3-month LIBOR. Data come from Datastream and DataInsight. Interest rates are expressed in real terms using the trend of inflation[32] (obtained with a Hodrick-Prescott filter), because of the high level of inflation during the seventies and the eighties.

The interbank spread is the difference between the 3-month interbank rate and the key policy rate.

The stock market index comes from Datastream. It concerns the quoted shares as a whole for France, and for the US. It is deflated using the trend of consumption price index (obtained with a Hodrick-Prescott filter).
The interbank rate, the interbank spread and the stock market index are monthly averages.

For France, the stock volatility is obtained from two series. Since January 2000, an index of volatility of the CAC 40 is available in the Datastream database. Before 2000, the volatility is calculated by using the Datastream function 061E (30-day volatility) and the stock market index. The two series of volatility have been pasted, after correcting differences of average and standard deviation between series. The volatility has been then normalized.
For the US, we have to use the same type of calculation, because the index of volatility of the S&P 100 provided by CBOE (Chicago board options exchange) is only available since 1986. For obtaining volatility before 1986, we have then applied the function 061E to the stock market index, and pasted it with the CBOE serie. The volatility has been normalized.

[32] We use the trend of inflation because of the prices volatility, mainly due to the evolutions of raw materials.

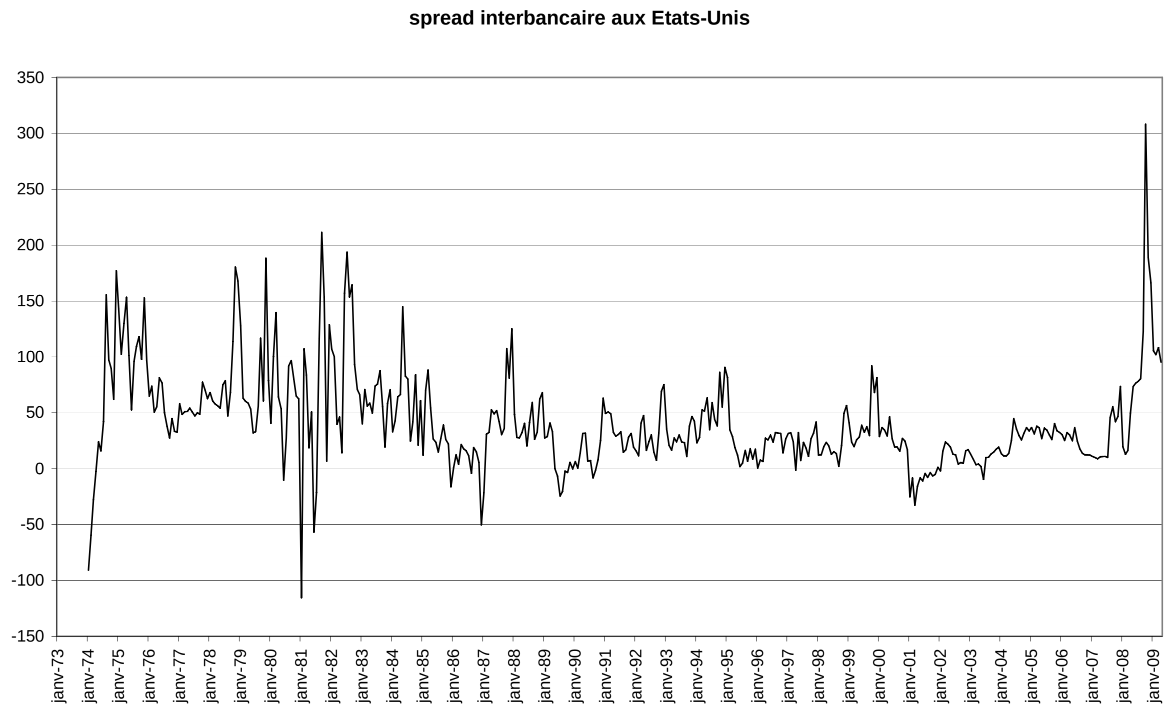
Housing prices stem from three data sources for France. Since the first quarter of 1996, INSEE provides seasonally adjusted data. Between 1978 and 1986, we have to use the deflator of housing wealth (INSEE). And before 1978, data are provided by Jacques Friggit (CGPC). After a careful monthly adjustment using AREMOS, all the three data series have been pasted to form a housing price index.
For the US, the calculations were similar. Since January 1987, the Case-Schiller index (which is seasonally adjusted) of Standard&Poors is available on a monthly basis. Between 1975 and 1987, the data were retropolated with the quarterly OFHEO index (Office of federal housing enterprise oversight) after adjustment.

All variables, with the exception of interbank rates, interbank spread and volatility, are expressed in logarithm. They are all Hodrick-Prescott (HP) detrended (lambda=133100)[33]. Like Denis and al. (2006), to limit the end point bias problem with the HP filter, the series have been extended for three years (namely until December 2011) on the basis of a simple equation (a linear trend and an autoregressive term of order 1), before to be detrended.

[33] The HP filter can be considered as a low-pass filter, where the cut-off frequency • is related to the parameter • by the following formula (Iacobucci and Noullez, 2005): $\lambda = \left[2\sin\left(\pi\upsilon.\Delta t\right)\right]^{-4}$, with •t = 1/12 for monthly series. For a cut-off frequency associated to 10 years (• = 0.1), this formula gives the value • = 133 108 (it gives • = 1 649 for quarterly series, which is close to the usual value 1 600).

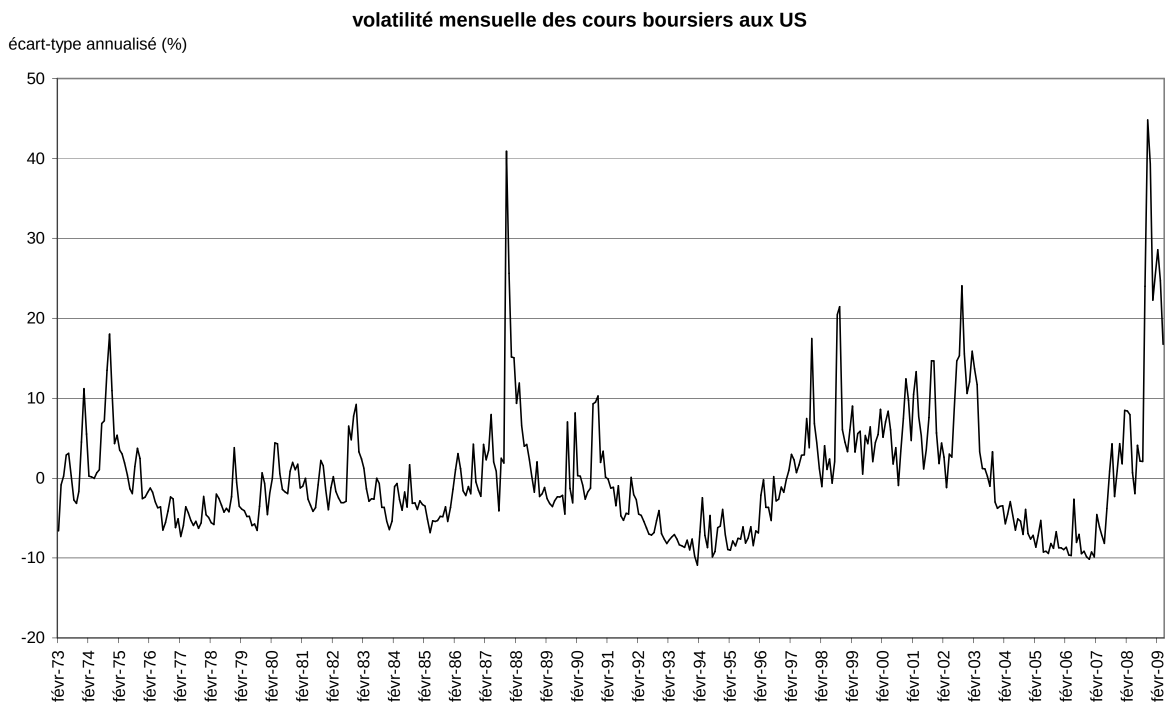
Appendix 2: chronology of interbank spread and stock volatility in the US

Figure 2A: interbank spread in the US



Sources: Federal Reserve, IMF, global Insight.

Figure 2B: stock volatility in the US

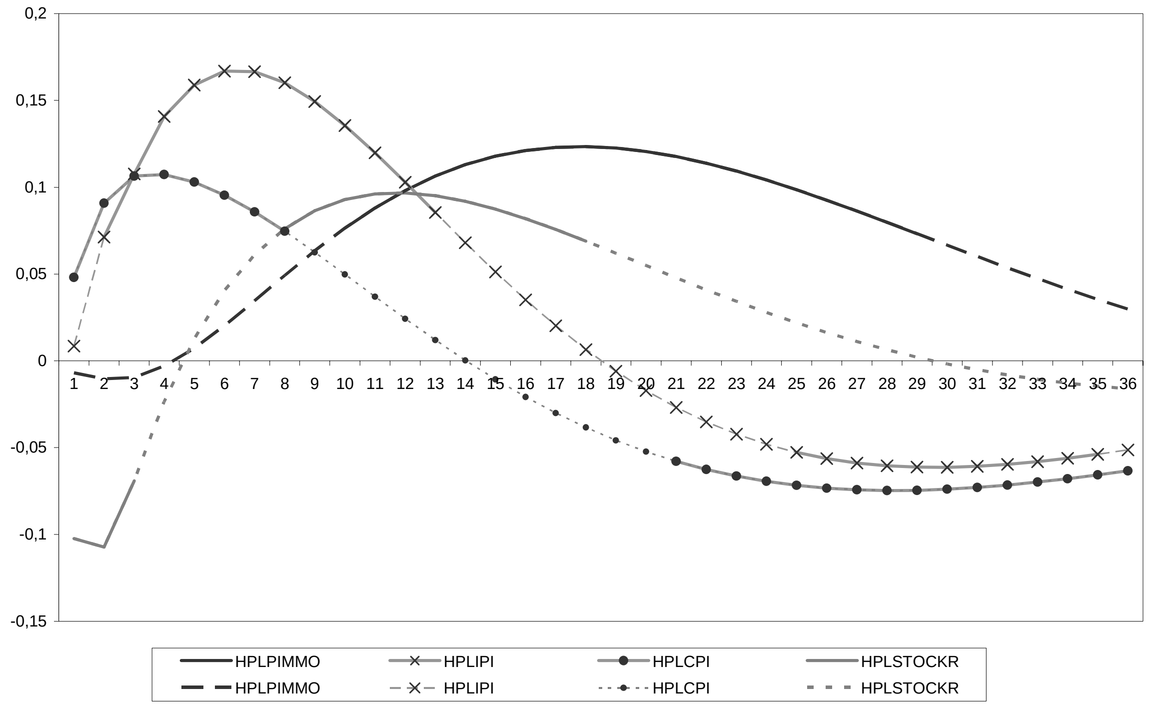


Source: Datastream

Note: the volatility is centered.

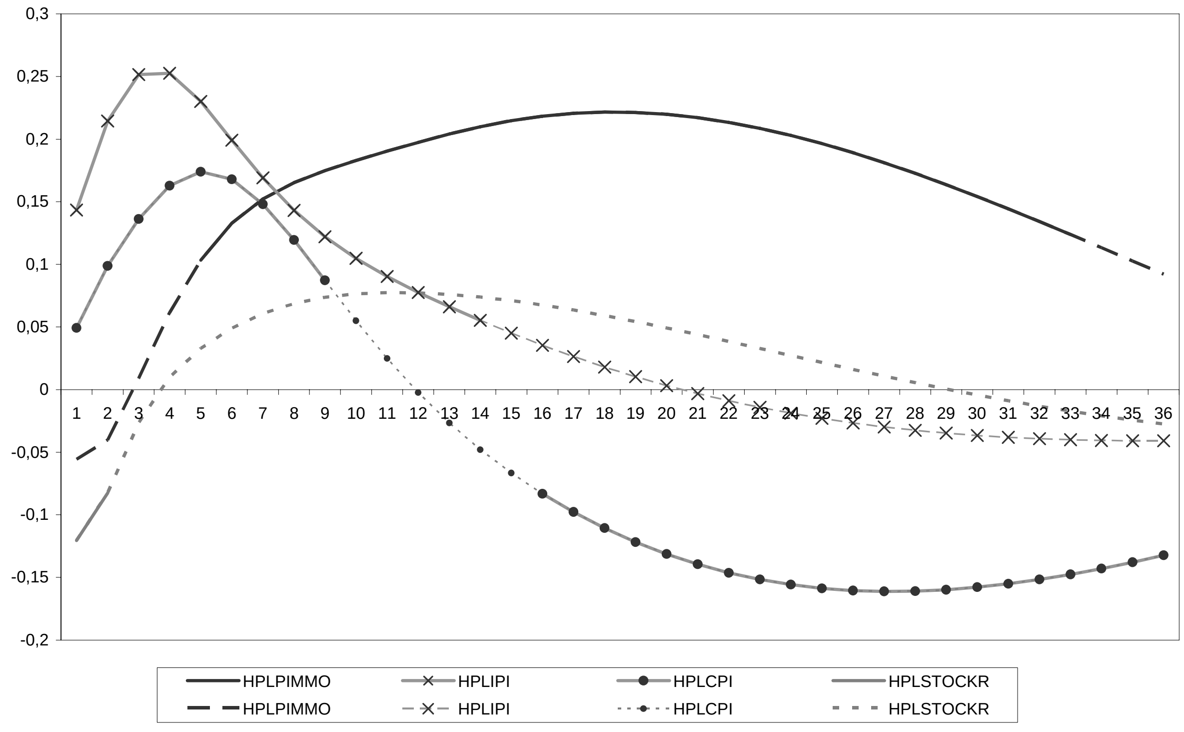
Appendix 3: Generalized impulse response functions

Figure 3A: Response of the 3-month interest rate to shocks (France)



Note 1: The responses of interest rate to the various shocks are represented by continuous lines when significant and by dotted lines otherwise. The confidence intervals were generated using Monte Carlo simulations with plus or minus 1.65 standard error, namely at the 10% level.
Note 2: HP (…) for Hodrick-Prescott filter; L (...) for Log; PIMMO for housing prices; IPI for industrial production; CPI for consumer price index; STOCKR for stock exchange index.

Figure 3B: Response of the 3-month interest rate to shocks (the United States)



Note: same legend as in the previous figure.