Monetary Transmission Channels Around the Subprime Crisis: The US experience

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This study focuses on the US monetary policy rule during the subprime crisis. Two stances could be taken: a totally ineffective monetary policy or an insufficiently effective one. To arbitrate between those two positions, the effectiveness of each monetary transmission channel around the crisis period is estimated across the time. Our results point to an intermediate position. The monetary transmission channels, dealing with the main financial sectors where the sources of the crisis are found, are clearly ineffective. Nevertheless, other channels may still be effective but not enough to counterbalance the quite simultaneous ineffectiveness of the previous transmission mechanisms.

Field of Research: Causal Intensity, Monetary Transmission, Subprime Crisis

1. Introduction

From a wide literature (Caballero, 2006; Akermann, 2008; Barrell & Davis, 2008; Bordo, 2008; Buiter, 2008; Calomiris, 2008; Hetzel, 2009; Diamond & Raghuram, 2009), one of the main causes of the subprime crisis can be asserted as such: a "great moderate" macro-environment. A sustained economic growth, a controlled inflation coupled with lower international interest rates and incentives to homeownership in the US allow apparent certainty on future investments profitability. When a reversal in the belief that "business could go on" occurs, the risk assessment becomes difficult because of the challenge to distinguish toxic from safe assets. Systemic risk has spread on the real sphere. In this context, owing to the Federal Reserve's mandate concerning the inflation and the economic growth, it is normal that monetary policy seems to be one of the privileged tools to struggle against the financial turmoil. Monetary policy is based on monetary transmission channels. More precisely, the quality of the monetary regulation depends on whether or not the monetary transmission is effective. The various channels that convey a change in the monetary policy interest rates are explained in the special volume 9 of the Journal of Economic Perspectives in 1995 (Bernanke & Gertler; Meltzer; Mishkin; Taylor), (Kuttner & Mosser, 2002), and more recently in line with the recent turmoil in (IMF, 2008; Tobias & Shin, 2008b; Bhatia, 2007).

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How to define the effectiveness here? In a first level, a channel is effective if it concretely exists. However, the existence of any phenomenon says nothing on its intensity; hence there is a second analysis level. Effectiveness implies a certain extent of existence of the studied phenomenon being studied. Consequently, the question is how US monetary transmission effectiveness evolves around the subprime crisis. Is the Fed failure to reverse the crisis due to the ineffective monetary transmission or to an effective but not sufficient monetary transmission intensity? The aim of this paper consists of further arguments to guide the answer. The strategy consists in estimating the level of effectiveness for each monetary transmission before and during the subprime crisis. This paper seeks to identify which monetary transmission channels may be responsible for the US monetary policy failure to manage the crisis.

To achieve it, section 2 comes back to the effective US monetary policy guide around the subprime crisis as analysed in the literature. It puts in relation the theoretical monetary transmission channels and the financial instability that has interacted with in order to establish the crisis. Section 3 explains the method followed to value the monetary transmission effectiveness from a dynamic procedure and gives further details on the database. Section 4 interprets the result leading to conclude that breakdowns in the US monetary transmission explain in some extent (particularly during the first quarters of the crisis) the difficulty the central bankers face to avoid the financial crisis turning into an economic recession. New evidences on the accuracy to use monetary instruments beyond the Fed Funds Rate (*FFR*) are also provided.

2. Review on the Origins of the Crisis

Each theoretical source could partially explain the financial instability initiated and propagated through the subprime crisis. It is about the theory of financial instability (Minsky, 1977), the huge uncertainty and a reversal confidence (Shaffer, 1986), the disaster myopia and the credit rationing (Herring & Watcher, 1999), runs and liquidity crisis (Diamond & Dybvig, 1983), the spread linked to shifts in market prices (Adrian & Shin 2008a). These sources comply with the historical sequence of the crisis. Before the crisis, there is a sustained economic growth characterized by a positive output gap and a controlled inflation in the United States. These national features in favour of certainty on future investments are coupled with lower international interest rates due to the increasing amount of liquidity since 2001 from emerging countries such as China. The Chinese positive current account explains more than half the cutting of real international interest rate during the 90s and the early 20s (Barrell & Choy, 2005). These trends generate more opportunities to free lending operations and increase the assets prices before the crisis. As a consequence, there is huge profitability in prospect inside the financial system thanks to the extent of the business cycle and to the developing financial innovations.

Simultaneously, the US government gives several incentives to homeownership. On the supply side, it leads creditworthy borrowers to mortgage leverage. On the demand side, those who have gained access to

credit would have never been financed had they been closely scrutinized. Consequently, the too low credit rationing allows bad quality borrowers to obtain credit that in turn sustains the glooming US housing market. Hence, the link between both credit and real estate markets is established. The research of more profitability by lenders on the credit market meets the need for new types of housing demands to be financed. But, the real estate price bubble promotes risky lending provided that housing prices are still increasing.. A lax US monetary policy appears as a determining factor of credit and asset pricing dynamics (Bordo & Wheelock, 2007). The interest rate is too low in comparison to the theoretical rates obtained from a Taylor rule between the fourth quarter of 2001 and the first quarter of 2006 (Taylor, 2007 & 2009).

Fig.1 Actual and Taylor Rule Federal Funds Rate
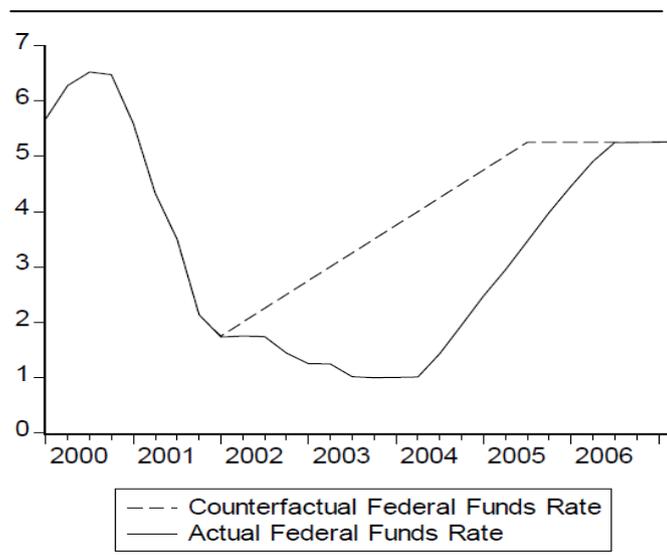
*Source: Taylor (2007), p. 5.*

If demographic arguments justify the housing price booms, the central bankers' stance is deeply involved in the expansion of subprime mortgages (Akermann, 2008). The balance sheet of financial intermediaries gives evidence of raising (lowering) leverage during asset price booms (burst) (Tobias & Shin, 2008a). The Fed stance is taken after the stock assets prices bubble from 2000 to 2003. But, the boom in the housing sector during 2003-2004 balances the previous losses in the stock market linked to the monetary policy. However, no monetary policy early prevents the sharply increasing dynamics on the real estate sector. As the assets bubble is linked to a furious research of profitability associated with the acceptance of higher risk levels, in 2006-2007, the structure of financial innovations move to more and more complexity. Banks move from a finely assessed pull of borrowers in their lending activity to authorized dealers of asset-backed securities. Simultaneously, they use more frequently Special Investment Vehicles (SIVs) to still conform the Basel rules on capital ratios.

The securitization is designed to partition the whole risk among several financial market insiders that each share a shorter extent of it. Securitization

is not detrimental *per se.* For instance, Vaugirard (2001) focuses on the need of securitization to increase the capacity of insurers to manage risks associated with catastrophic events. Nevertheless, in line with the recent financial crisis, the risk assessment associated with financial assets becomes more difficult because the distinction among toxic and safe assets is challenged (Gorton, 2008). Incidentally, rating agencies lose credibility in their workmanship. By this way, a major condition favourable to amplify the crisis emerges when it occurs (Brunnermeier, 2008). Indeed, when any default risk moves to reality, not only it diminishes the net value of the direct creditor linked to the default borrower, but also, it puts doubts on the net value of all the market participants that are related to this creditor. As a consequence, before 2006, the monetary transmission mechanisms associated with the future destabilizing factors can be depicted as follows
(Inspired by Mishkin, 2009; Kuttner & Mosser 2002).

Fig. 2 Theoretical monetary transmission mechanisms before the crisis
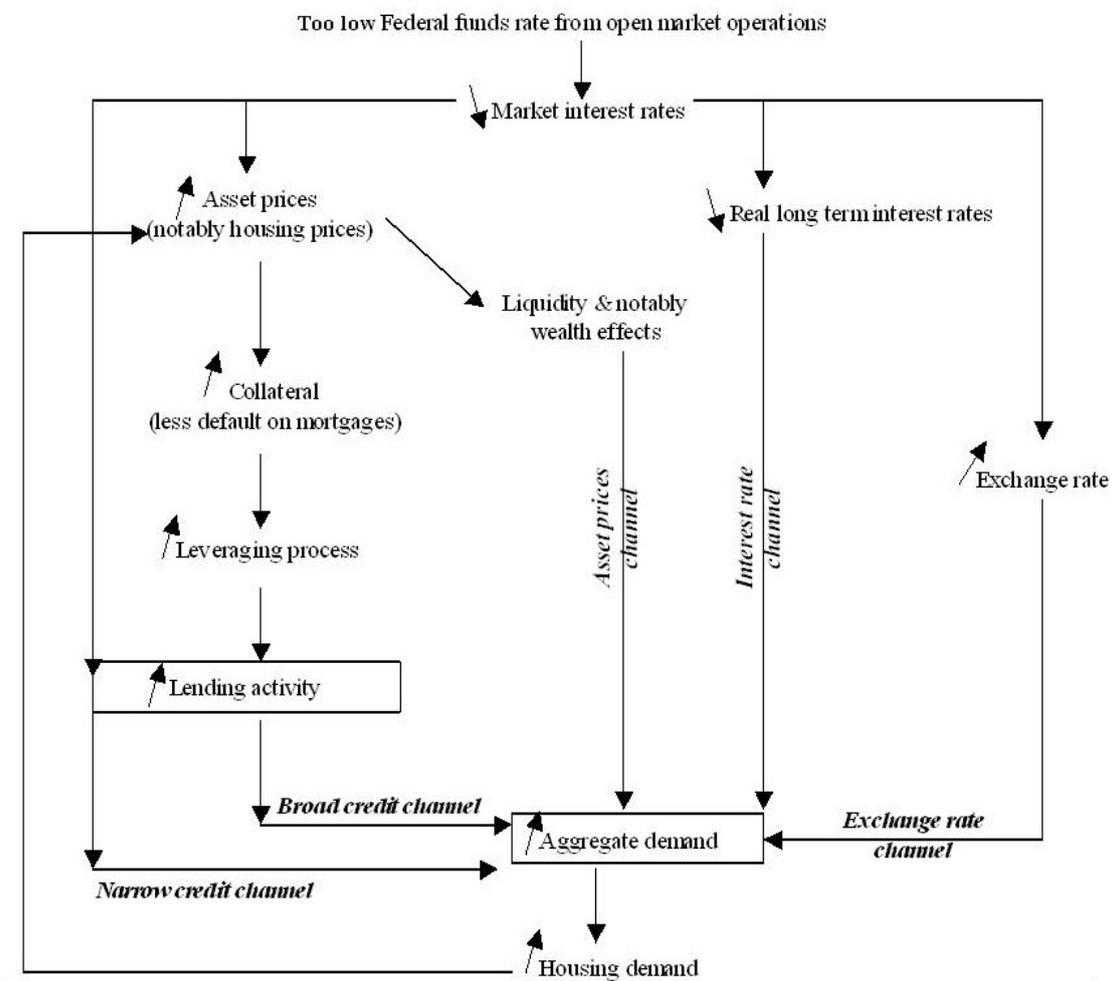
The two key quarters of the crisis are the third quarter of 2007 and the fourth one of 2008 (IMF, 2008; Brunnermeier, 2008; Greenlaw et al., 2008). The first date defines the first default on the interbank market in August. The second associated with the news about the Lehman Brothers failure constitutes the origin of the systemic dimension of the crisis at an international level. It is not

desirable over the longer term for the Fed effectively to stand as a lender of last resort for institutions over which it has no supervisory powers. Nor is it desirable for the Fed to allow institutions over which it could exert a salutary influence to evade its guidance by going to alternative official sources of dollar liquidity. By borrowing from the European Central Bank rather than from the Fed between March and September 2008, Lehman Brothers was able to resist the Fed's advice to raise more capital (Acharya & Backus, 2009).The recent financial crisis teaches important lessons regarding the lender of last resort function. Large swap lines extended in 2007-08 from the Federal Reserve to other central banks show that the classic concept of a national lender of last resort fails to address key vulnerabilities in a globalized financial system with multiple currencies. The propagation velocity of the crisis at an international scale is unprecedented owing to the globalization and the uncomplicated securitization process. As the location and the assessment of the risk become more and more uncertain, all the financial institutions that own subprime securities contribute to spread the crisis. Therefore, the confidence necessary to a non-destabilizing circulation of liquidity within the global economy disappears quite rapidly. Thus, drying interbank markets appear, sometimes where it is not forecasted. Developed as well as developing countries have no warranty on their ability to prevent the contagion since they have no warranty on their ability to struggle against the storm.

The bursting of the financial boom deeply implicates the Fed monetary policy. The rising interest rates reveal the reality of the extent of the default risk that affects financial markets (notably the credit market) and consequently the real estate market on the real sphere. The reversal trend operated by the US monetary policy between 2006:3 and 2007:3 (with the higher *FFR* since 2000 around a value of more than 5%) shifts profitability opportunities to lose risk. Consequently, the confidence in the financial markets turns whereas it previously sustains the real expansion through the housing market. This situation results in a lack of confidence among banks on the interbank market and also between commercial banks and their respective existing customers. Anyway, the monetary policy response to the subprime turmoil first uses traditional intervention from interest rate. In August 9th, 2007, an increase in the level of temporary open market operations is registered. From the following September to December, a cumulated 100 basis points cut in target *FFR* is produced. As the financial storm still is ongoing, on December the Fed creates the Term Auction Facility and opens swap lines with the European Central Bank and the Swiss National Bank. From this month, new and traditional monetary instruments are combined in order to either try to ease the liquidity circulation inside the banking system and among financial institutions and their customers, or to avoid liquidity to become a destabilizing factor for real economic activities.

During the crisis, the Fed reproduces the same mistake in its monetary policy. It is only a year after the activation of the crisis (in September 2008), the monetary authorities clearly identify the solvency issue on the credit market. But during, the first year of the crisis, the Fed mainly focuses economic growth as the main pillar in its aims, by trying to insure a convenient liquidity

circulation inside the market. The principle that authorizes such a stance is the risk to move from a credit crunch to an economic recession, whereas one of the Fed's objectives is growth. But, whatever the amount of liquidity inside the system is, if there is no way to distinguish the solvent from the insolvent debtors, there will be no way for financial markets to sustain growth effectively, because the amount of liquidity will not circulate or even support the trade made by the riskier agents. As a result, in the early stages of the crisis, thanks to lower interest rates, an excessive lax money supply follows in favour of more liquidity in circulation and according to the belief that monetary policy should contribute to the long period of growth whereas a slowdown seems quite unavoidable and even desirable. "[The Fed] did all it could through large and aggressive cuts in the Fed Funds Rate, to prevent or at least to mitigate the necessary and inevitable slowdown, effectively interpreting the `maximum employment' leg of its mandate not as the maximal sustainable level of employment or the maximum sustainable rate of growth, but as the maintenance of high levels of current employment and current real GDP growth regardless of their sustainability" (Buiter, 2008).

Two arguments found the Fed stance (Bordo, 2008, Buiter, 2008):
  ➢ An overestimation of wealth effect linked to the boom in housing prices during the previous period.

This mislead can be explained by the extent of the housing prices bubble and the potential effect of their burst on consumer demand and hence on growth. But, a distinction should be necessary among `short' and `long' housing consumers at a micro level when wealth effect on consumption is emphasized. If it is not the case, a composition fallacy may contribute to overestimate the impact of this wealth effect on the global demand, provided there is a housing prices reversal. However, at this point the Fed is too afraid of a disruption in the economic growth due to the asset prices burst and to a reversal of the lending activity. As a consequence, the monetary policy orientation is in favour of a sharp decrease in the *FFR* in order to limit the economic slowdown.

  ➢ A focus on the core inflation instead of the headline inflation that moves the price fluctuations away from the 2% objective. Since the 20s, core inflation cannot be considered as a very good predictor of the headline inflation. This is due to an increasing ratio of the core to non-core prices because of the integration of more emergent countries in the globalization that has persistently moved the demand and supply of both core and non-core goods, hence the ratio of both related prices. As a result, on figure 3, it is clear that the core inflation gap (the spread of the core inflation with the 2% inflation objective of the monetary policy) leads to an underestimation of headline inflation particularly during the more accurate crisis period (from 2007:3 to 2008:3), if the core inflation is used as a predictor of the headline inflation. Therefore, during the crisis, the Fed tries to initiate dynamics between financial and real spheres through monetary transmission channels that go in an opposite direction with the destabilizing financial factors at the origin of the crisis. Stressing on what has really happened, there is no doubt

that the struggle has been won by these at least during the semesters around 2007-2008, what justifies the accuracy of the economic recession after.

Fig.3 Housing Price Index, Fed Funds Rate and Inflation
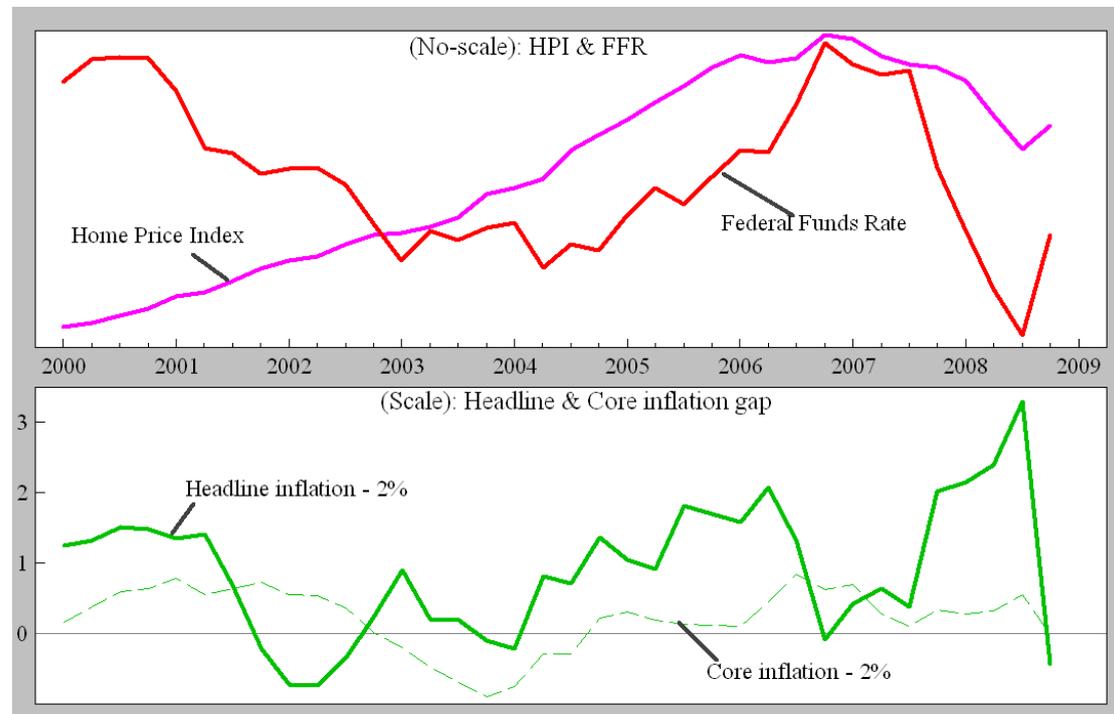
Nevertheless, there is a debate to know if such a defeat is due to a total ineffective monetary policy or a monetary policy that is not effective enough to contest the destabilizing elements. Different arguments defend the last position from a counterfactual analysis (Mishkin, 2009):

➢ Instead of decreasing interest rates, a tighter monetary policy would make the recession more severe according to the theoretical monetary transmission. As a consequence, the monetary policy would create dynamics that permit the destabilizing factors from the credit and housing sectors to lead the whole economy toward a deeper crisis.

➢ A restrictive Fed stance would not make easier the risk assessment.

➢ The easing of the monetary policy during the first periods of the crisis would have permitted to mitigate the recession but not to avoid it. The difference in the strength of the influence on the real economy of both opposite dynamics (monetary transmission and destabilizing factors) justifies the unavoidable feature of the crisis. "Monetary policy is more potent during financial crises because aggressive monetary policy easing can make adverse feedback loops less likely. The fact that monetary policy is more potent than during normal times provides a rationale for a risk-management approach to counter the contractionary effects from financial crises" (Mishkin, 2009).

Conversely, the Board of Governors of the Federal Reserve System (2008) argues that monetary policy is ineffective during the crisis because it does not succeed to avoid the fall in the lending activity even by a sharp decrease in the *FFR*. The fight between the monetary transmission channels and the destabilizing factors before and during the crisis is put forward. To give an idea of how the monetary policy has more or less performed against these factors, it is necessary to compute the empirical dynamic effectiveness of the monetary transmission mechanisms before and during the crisis.

3. Methodology and Database to Measure the US Monetary Transmission Effectiveness

As figure 2 shows, a network of transmission chains going from the instrument of monetary policy to its targets on the real sphere compose the whole monetary transmission. What are the principles that will guide the dynamic measure of monetary transmission effectiveness?

> ➢ An empirical representation of transmission

The intuition has already been used not only for a study of the interdependence between the monetary and the real sphere (Bates, 2005), but also to analyse financial contagion (Marais & Bates, 2006). Causality is one way to obtain such a representation. Monetary transmission is non-instantaneous. However, the Granger causality concept separates the instantaneous causality of the unidirectional causality, while the Sims one integrates the first in the second. That is the reason why it is appropriate to choose the Granger causality. The existence of a causal relation must be recognized on the basis of an improvement in the forecasting of the caused variable. Even though, causality is still in debate among econometricians and economists, the Feigl's representation of causation should be focused on (Zellner, 1988). Therefore, this aforementioned improvement must be confirmed experimentally from an economic framework of reference. It is about the theoretical background that justifies the causal hypothesis, as well as the implications this hypothesis has in terms of forecasting improvement.

Let us note y_1 the monetary policy control variable, y_A one transmission variable, y_2 a target on the real sphere. A monetary transmission supposes that the following null hypotheses are rejected:
H_{01}: $y_1 \Im y_A$; first link: y_1 does not cause y_A;
H_{02}: $y_A \Im y_2$, second link.

> ➢ An efficient measure of transmission intensity

Due to the traditionally used discrete data, empirical issues emerge when dealing with causality among variables of different economic spheres that implies different statistical properties. It should be better to consistently work, whatever the stationary variables orders are inside the systems of interest that model the potential monetary transmission chains at a macro scale. That is the reason why the causality test should be invariant to these statistical properties of series.However, few procedures give the possibility to measure the causal intensity that would proxy the effectiveness in an empirical viewpoint. When this measure is available (Geweke, 1982), it is useful only

for stationary data, which is not the common case. It is necessary to have a causal intensity measure that is computable whatever the variables of interest are and however easy it is to objectively interpret the intensity (low or high). Various causal procedures were taken into account. Those reasoning on groups of variables (Yamamoto & Kurozumi, 2006), on non-stationary with cointegration (Toda & Phillips, 1994; Bruneau & Jondeau, 1999), on Fully Modified Vector AutoRegression (Mill, 1998) or on counterfactual analysis principles (Bates, 2005) do not give as much satisfaction than the TYDL procedure (Toda & Yamamoto, 1995; Dolado & Lütkepohl, 1996).

Tab. 1 Comparing some potential causal procedures

Methods/Authors	Computation friendliness	Statistical validity	Discrete-time treatment	Computation of a causal intensity measure
Models selection	no: analysis of several models	uncertain	all possibilities	no
Counterfactual analysis	no: estimation of several systems	yes	all possibilities	possible
Bruneau & Jondeau	yes	yes if there is a good treatment of unit root tests and cointegration test	specific to a long-term analysis	no
Yamamoto & Kurozumi	no: matrix degenerecence issue		specific to a long-term analysis	no
Geweke	no: estimation of several systems	yes	specific to a short-term analysis	yes
Toda and Phillips	yes only one specific case	yes if there is a good treatment of unit root tests and cointegration test	short and long terms separately in a same system	no
Mill	yes	yes	short and long terms globally in a same system	no
TYDL	yes	yes	short and long terms globally in a same system	no

The TYDL procedure directly achieves the causality test while reducing the need of preliminaries such as unit root and cointegration tests. It is valid whatever the stationary order of series of interest is. The TYDL should be chosen because of its easiness coupled with its statistical validity (Swamson, Ozyldirim & Pisu, 2003). It is based on a Vector AutoRegression (*VAR*) approach, one of the still current methods to assess changes in monetary transmission through time (for instance Boivin & Giovanni 2002).

What are the different stages to measure the effectiveness from a causal intensity measure?
First step: identification of causal relations consistent with a monetary transmission mechanism

For any transmission mechanism, it is necessary to determine the optimal lag *k* of the *VAR* that includes the variables. It is necessary to add to *k* a number of lags d_{max} going from 0 to 2. This overparameterization that creates a $VAR(p=k+d_{max})$ is necessary to use an Ordinary Least Square (OLS) estimation even though the *VAR* may or may not contain non-stationary data. Therefore, d_{max} represents the maximal integration order of series in the *VAR*. In accordance with the original TYDL procedure, after estimating the *VAR*,

Wald restriction tests are made from the first *k* matrices of coefficients to reject H_{01} and H_{02}.

Second step: Measurement of causal intensity to capture monetary transmission effectiveness

It is convenient to give a measure of the causal intensity that meets the three rules (Geweke, 1982):
- To be computer-friendly and easily interpretable;
- To be strictly positive in case of causality;
- To be an increasing function of the causal strength if the causal relation is validated.

From the estimated *VAR*, it is possible to compute the elasticity of the caused variable in relation to the causal variable. But, any monetary transmission mechanism implies an intermediate variable between the monetary policy instrument and its target on the real sphere. That is the reason why an indirect elasticity could be computed instead of a direct elasticity. This indirect elasticity is the product of the direct elasticities of the caused variable in relation to the causal one of both H_{01} and H_{02}, provided that these null hypotheses are rejected in the first step.

As a result, the effectiveness of any monetary transmission (Monetary Transmission Effectiveness) is computed as follows:

$$MTE = \begin{cases} \dfrac{\left|e_{y2t/v1t}\right|}{\left(1+\left|e_{y2t/v1t}\right|\right)} \in \left]0;1\right[\text{ if } H_{01} \text{ and } H_{02} \text{ are rejected} \\ \\ 0 \text{ if any null hypothesis is accepted} \end{cases}$$

$e_{y2t/v1t}$ represents the indirect elasticity that links both extremities of the tested monetary transmission chain. Elasticity has the advantage to be a non-unit measure. It is invariant to differences of level, of unit and of nature among variables from different economic spheres. *MTE* respects the three rules defined previously. Particularly, it is an increasing function of the causal presumption degree and of the intensity of the relation between both extremities of the transmission chain. It is positive when the causal chain exists and is equal to zero otherwise.

Third step: *A dynamic measure of transmission intensity*

The previous steps are based on *VAR* models that can be re-estimated when any new time period is successively added after a first estimation on an initial sample length. The effect of monetary policy on output as well as on inflation is supposed unstable through time. As a consequence for each period in the dynamic procedure of estimation, not only the existence of the causal chain characteristic of the studied monetary transmission is tested, but also the value of its intensity/effectiveness is measured. In this way, it is possible to identify for when and which channel there is disruption in the monetary transmission.

What is the database for the analysis?

The quarterly basis sample goes from 1980:2-2008:4. Intentionally, available data for previous dates are not integrated in order to avoid treating the structural breaks observable during 1970s and the big break in the monetary policymaking with the Volcker nomination at the head of the Fed. Also, working from 1980:2 allows us to obtain a sample length consistent with a good power of the TYDL causal procedure. Related to both null hypotheses H_{01} and H_{02}, y_1 represents the *FFR*. y_2 is alternatively the output gap (*GDPgap*) and the headline inflation gap (*Pgap*), depending on the final target of the monetary policy considered to analyse one specific transmission mechanism. y_A alternatively represents the long-term interest rate (*LTIR*), the credit in volume to the private sector (*CREDIT*), the lending rate (*LR*), the share price index (*SPI*), the home price index (*HPI*), the real exchange rate index (*RER*). These variables are useful to test respectively the effectiveness of the interest rate channel, the credit channel in volume, the cost credit channel, the stock asset price one, the real estate channel and the exchange rate channel.

In this analysis, it is important to notice that the interdependence among the studied monetary transmission channels is not stressed. That is the reason why only one intermediate variable for each monetary transmission channel is chosen. Consequently, only the direct transmission channels of the US monetary policy are considered. It is not paid attention to the complementary links among transmission mechanisms that would induce a combination of intermediate variables for each monetary channel.

To give further details:

$$GDPgap = \frac{100\left(\text{GDP-potential GDP}\right)}{\text{potential GDP}}$$

For more accuracy, the potential GDP is computed from a structural unobserved component modelling (Koopman, Shephard & Doornick, 2000; Harvey, Koopman & Shephard 2004). Traditionally, filters are used to extract the GDP trend. Contrary to filtering methods or to the Beveridge and Nelson representation, this modelling is selected due to its numerous advantages:
  – Modelling in level of non-stationary data;
  – Ability to insert some structural interventions or outliers when modelling any time component;
  – Estimation of cycle periods and ability to show the presence of common time components among variables of the same sphere;
  – Ability to choose between the best univariate and multivariate modelling from several criteria: the speed of convergence toward the effective dynamics of series, the mean standard deviation of residuals, the CUSUM and CUSUM in square, the Bowman-Shenton and Doornick-Hansen normality tests and information AIC or the BIC criterion.

The Kalman filter unobserved component modelling is the most efficient method to extract the trend component (Harvey, 1989; Koopman, Shephard and Doornick, 2000) and to seasonally adjust data.

$$Pgap = \text{Inflation rate - 2\%}$$

LTIR is proxied by the 10-year government bonds yield.

It is quite difficult to empirically split, the narrow from the broad credit channel. Nevertheless, for both, there are transmission chains that operate through the price (the credit cost *LR*) and others that transit through the volume (*Credit*). This distinction between the cost and volume credit transmissions is all the more convenient that spreads between *LR* and other rates with a short maturity do not help to differentiate with certainty the narrow from the broad credit transmissions.

SPI is the internationally harmonized share prices index computed by the International Monetary Funds statistics. There is no such international measure for real estate assets. Moreover, the traditionally used Case & Shiller index starts from 1987, that would reduce the estimation sample and hence the power of the TYDL test that needs at least 70 observations to work well. Therefore, *HPI* is a substitute index from the Federal Housing Finance Agency (ex OFHEO) (Calhoun, 1996). The Case & Shiller index is a biased measure of the overall housing market. Not only it integrates a part of the US area, but also, contrary to the *HPI* of the OFHEO it gives less accuracy to the prices of houses financed in the prime mortgage market. The used *HPI* is better to capture the consumption wealth effect of house price fluctuations because of it is more reactive to households whose consumption behaviour depends on the dynamics of their house value (Calomiris, Lonhofer & Miles, 2008). *RER* and other indicators come from the International Financial Statistics. All data is computed in real term with a 2000 basis.

4- Analysis of the US dynamic monetary transmission effectiveness

For the initial estimation sample period from 1980 to 1999, models with variables in difference perform best. Focussing on post 2003:4, the following graphics contain the historical value of the output gap, the inflation gap; and the measured *MTE* on these two monetary targets through each transmission mechanism. From figure 4, the critical periods for the output gap are 2007:3 where the dramatic slowdown starts, 2008:1 where the recession is confirmed because of a lower ongoing effective growth than the potential growth and 2008:3, which is the worst quarter in terms of growth. Considering the headline inflation gap, the crucial dates are 2006:4 where the inflation issue starts to become more and more accurate, with two consecutive quarters of wider increasing gap 2007:3-2007:4 and similarly but with less extent 2008:2-2008:3. The fourth quarter of 2008 seems to be better quarter in terms of macroeconomic stability with a sharp decrease in the inflation gap coupled with a less unfavourable output gap even if the United States is still facing in economic recession.
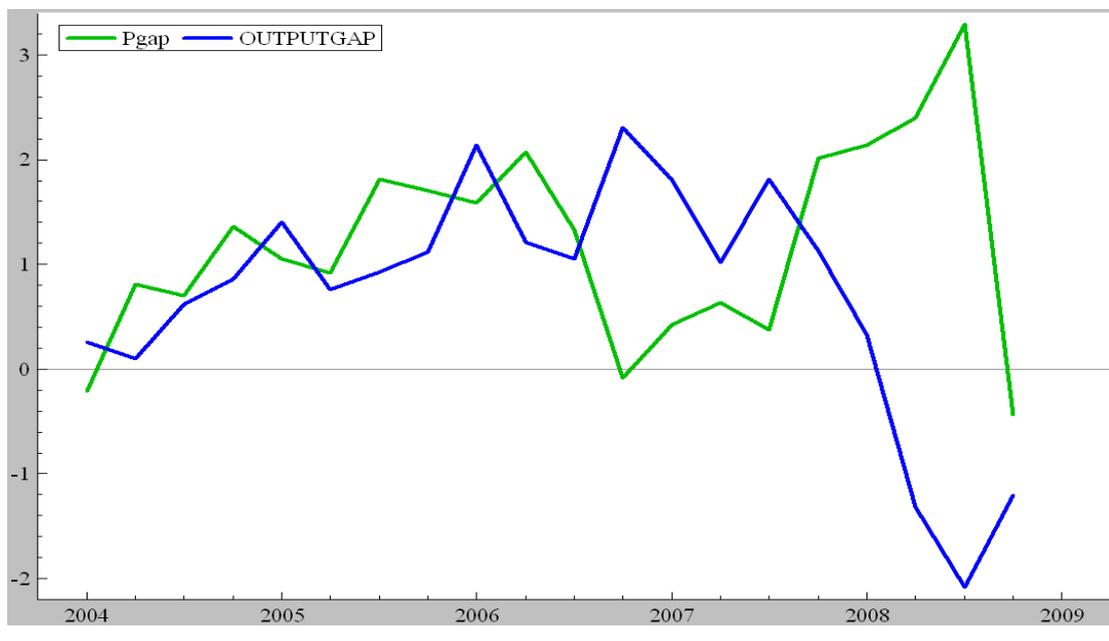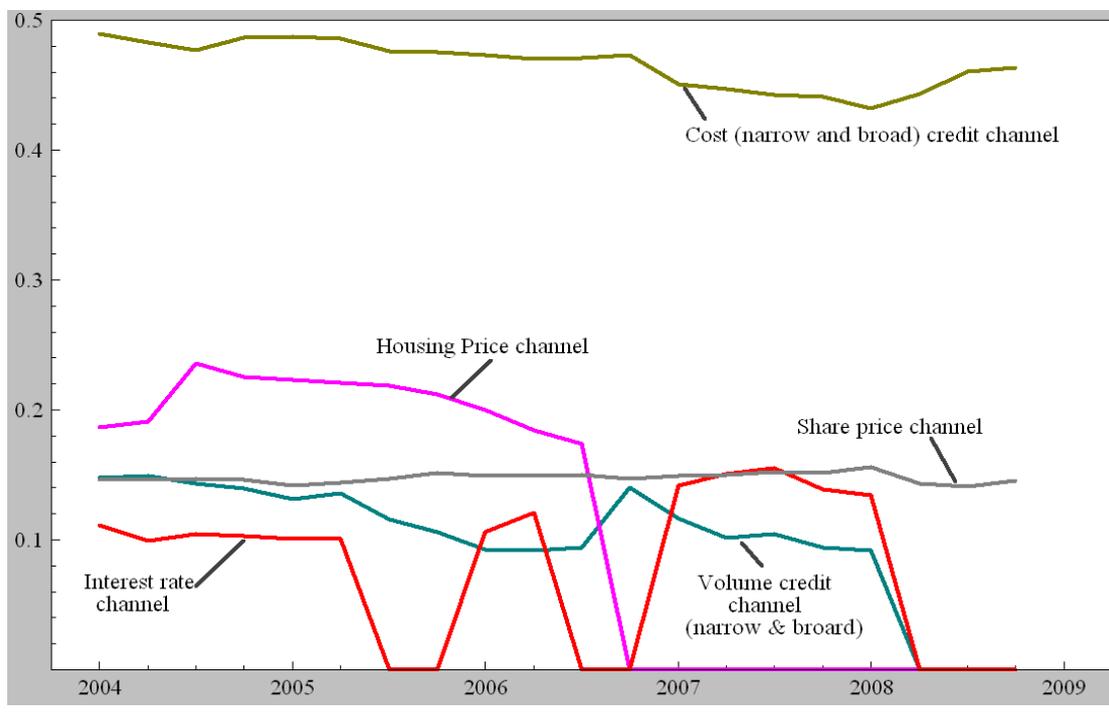
Fig. 4 Output and Inflation Gap

Fig. 5 Monetary Transmission Effectiveness on the Inflation Gap

Figures 5 and 6 give evidence of the systematic instability of the monetary transmission effectiveness.

Figure 6 shows that the main transmission channels that contribute to the failure of the monetary policy to avoid the crisis are the house asset price and the credit in volume channels.

Fig. 6 Monetary Transmission Effectiveness on the Output Gap
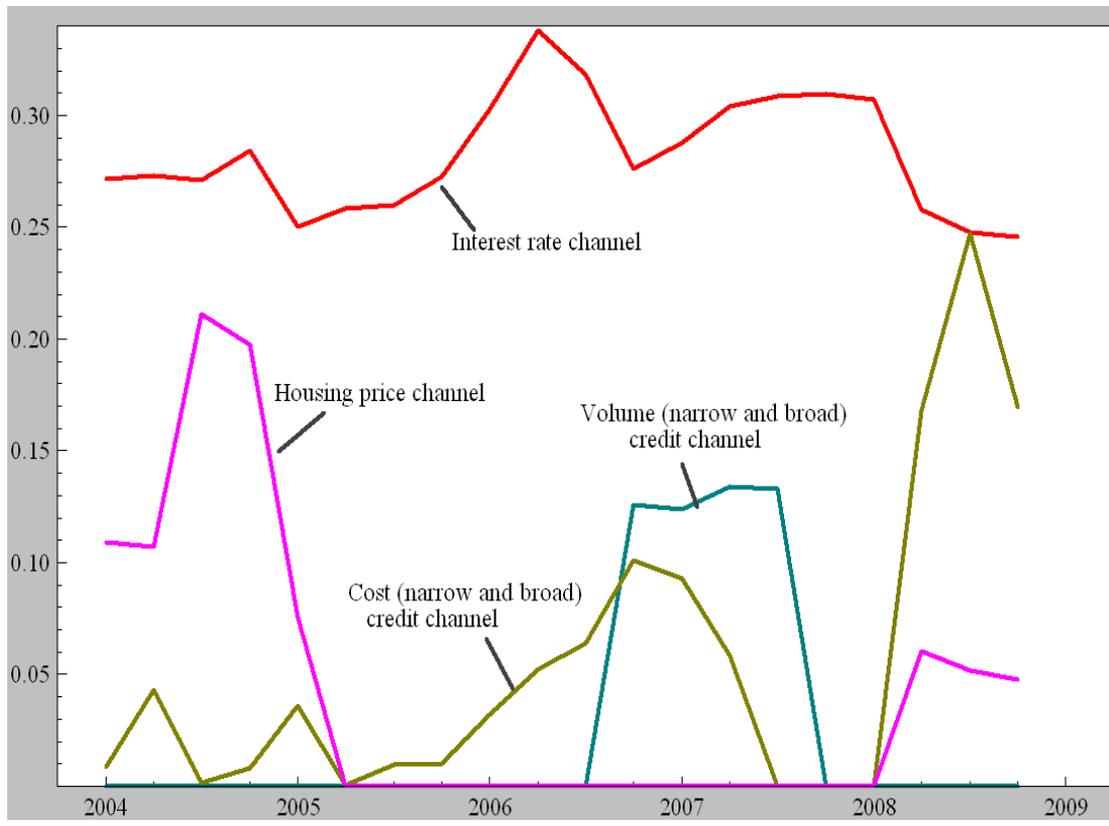
The first starts to be ineffective just before the real estate bubble in 2005:2, and the second registers a deep disruption since 2007:4 a quarter after the beginning of the growth slowdown. In a lesser extent, the cost credit channel is involved, particularly between 2007:3 and 2008:1. Nevertheless, the recovered effectiveness of the cost credit channel during the three last quarters is not coupled with a similar effectiveness for the credit channel in volume. This point is consistent with the idea that the recent US economic recession is not due to a sharp increase in the lending rate. The unfavourable adjustment for growth made by financial institutions rather involves the credit in volume. As a consequence, the housing sector loses its funding and there is no way for the monetary policy to manage effectively the aggregate demand through the real estate.

One can notice that the interest channel is effective during the period 2004-2008 without any break. Nevertheless, it is obvious that since the beginning of the crisis in 2007:3 its effectiveness on the output gap diminishes with a more rapid decreasing speed in the early quarters of the slowdown.Figure 5 also allows identifying where the failure in the monetary transmission occurs when the output gap is focussed. With no surprise, the main channels in concern are the housing price and the credit in volume channels. In other words, the same channels that justify the incapacity of the monetary policy to avoid the

slowdown in the aggregate demand are those that are involved in the bad management of the headline inflation.

Indeed, the house asset price channel starts to be ineffective just similarly to the crucial date concerning the inflation gap dynamics (2006:4). The credit in volume reinforces the ineffectiveness of the monetary policy when the inflation gap starts to skyrocket in 2008:2. In a lesser extent, the interest rate channel is responsible for the monetary policy failure to control inflation with a null effectiveness since 2008:2. Except of some transitory breaks in the interest rate channel effectiveness on the inflation gap, results show moderate fluctuations in the transmission effectiveness before the crisis period. A very short decrease in the effectiveness is sometimes identifiable. This decline of the monetary transmission effectiveness is the continuation of a same observable phenomenon when a Kalman filter Time Varying VAR on US data is used going from 1962 to 2002 (Hoppner, Melzer & Neumann, 2008). From a stylised model, a decline in the real effects of monetary policy can be explained by a central bank that mainly focuses on output gap minimization (Boivin & Giannoni, 2002), which is a specificity of the Fed in comparison with other main central banks. Whatever the specification the previous authors used, they do not integrate intermediary variables between the monetary policy instrument and the targets on the real sphere. Therefore, their conclusions do not allow the exposure of each transmission channel implication.

Our results lead to conclude in favour of an intermediate position between those claiming the ineffective US monetary policy during the crisis and those claiming an insufficient effectiveness. The monetary transmission channels, dealing with the main financial sectors where the source of the crisis is found, are clearly ineffective. Nevertheless, other channels may still be effective but not enough to counterbalance the quite simultaneous ineffectiveness of the previous transmission mechanisms. However, the aforementioned econometric study focuses only on direct transmission channels and does not consider the induced transmission initiated through the complementary links among the direct transmission mechanisms. That is the reason why the level of effectiveness is not still totally comparable among each transmission channel. That is the reason why our modelling may fail to identify transmission through the real exchange rates. As a result, the modelling should be improved from an integration of complementary effects among the studied transmission mechanisms, perhaps from the integration of combination of (intermediate) monetary transmission variables inside the estimated VAR.

Anyway, the current crisis seems to be a change in what could be found in previous periods. Indeed, from a Time Varying VAR (Garcia & Schaller, 2002) from a Markov-switching model (Lo & Piger, 2005), the effects of monetary policy are greater in a recession than in a boom, by reasoning on previous time periods. If these analyses do not integrate intermediate variables linked to the monetary transmission in their studies, our results tell that in this ongoing recession, the effectiveness level of the monetary transmission clearly matters, particularly during the first quarters of the crisis. This result justifies the accuracy to use new monetary instruments beyond the *FFR* to

restore the ability to manage both the output gap and the price stability (Cecchetti, 2008). The fall of 2007-2008 is an indisputable proof that the traditional monetary policy intervention failed, what allows innovations for monetary policymakers.At a national scale, a convenient use of the discount window should permit to solve local failure on the financial markets without changing the *FFR* (Calomiris, 2008). This may help to maintain simultaneously the price stability. The Fed created also new lending procedures (Term Auction Facility, Primary Dealer Credit Facility and the Term Securities Lending Facility...) that change the Fed balance sheet composition instead of its size (like in traditional open market operations). At an international scale, more cooperation among the main central banks clearly appears as one necessary but not sufficient condition to prevent financial instability to influence the macroeconomic stability in a globalized world. What system of emergency international financial support will best help to minimize the likelihood of future economic instability? A global lender of last resort is advocated, "the topic of financial regulation should be discussed together with the issue of a global lender of last resort" (Calvo, 2009). The IMF has a key role to play in the constellation of lenders of last resort, acting alongside national central banks (Obstfeld, 2009). As the income-level and institutional divergence between emerging and mature economies shrinks over time, the IMF may even evolve into a global last resort lender that channels central bank liquidity where it is needed.

5. Conclusion

Among the causes of the subprime crisis, the paper stresses on the Fed monetary policy responsibility. Particularly, the error in the regulation of the two pillars (output gap and inflation gap) is analysed through the macro monetary transmission effectiveness. "It is a task for empirical research to assess the macro impact of the various channels of monetary transmission and to look for changes in the channels' strength over time" (Kuttner & Mosser 2002). A dynamic measure of the strength of monetary transmission mechanisms is suggested and applied to study transmission of the interest rate, the credit, the assets prices and the exchange rate channels. The main result is that the Fed incapacity to prevent and struggle against the crisis is due a disruption of its monetary policy effectiveness on the key markets of the crisis: the credit and the real estate sector. Even if some effectiveness remains elsewhere before and along the crisis, it is not enough to counterbalance the financial markets dynamics unfavourable to the macro stability. It notably justifies the need of new tools beyond the open market operations to lead the monetary policy toward a good macro regulation and even financial one.

The next step of the research consists in integrating the complementary dimension among monetary transmission mechanisms in order to obtain a more global view on what occurred on the monetary transmission around the subprime crisis. It would be convenient to adjust the econometrics. Overparameterized VAR should be in competition with alternative and more recent VAR specifications to better give evidence of structural changes in the "systematic" varying effectiveness of the monetary transmission process.

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