AFC ASSOCIATION FRANÇAISE DE CLIOMÉTRIE

WORKING PAPERS

Nr. 7, 2010

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"*Did the financial collapse of the early 1930's have real effects on the macroeconomy, other than through monetary channel?*" (Bernanke, 1983, p. 275.)

A much debated hypothesis about the great depression of the thirties is Friedman and Schwartz's (1963) contention that a severe but non unusual recession turned into the greatest contraction of all times because the Federal Reserve failed to undertake expansionary open-market operations. They would have offset a drastic decline in the stock of money attributable to a series of banking panics.

Bordo, Choudhri and Schwartz (2002) implemented a counterfactual analysis in order to test Friedman and Schwartz's proposition. They give evidence, in a monetarist framework, that the US, the largest country in the world who had massive gold reserves, was not constrained from using expansionary policy to offset banking panics, deflation and declining economic activity. Simulations, based on a monetarist model of a large open economy, indicate that expansionary open market operations by the Federal Reserve at two critical junctures —Oct. 1930 to Feb. 1931 and Sept. 1931 to Jan. 1932— would have been successful in averting the banking panics that occurred. Had expansionary open market purchases been conducted in the 1930s, the contraction would not have led to the international crises that followed.

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The outcomes of this counterfactual analysis seem to have been well understood and applied. Indeed, current American and European monetary authorities implemented expansionary monetary policies to prevent recession in 2008 and 2009. Did it work or fail? Obviously, this does not seem to have slowdown recession. Our own argument is that this failure comes from a situation of liquidity trap[2] similar to what occurred in the thirties.

The purpose of this paper is to extend the Bordo, Choudhri and Schwartz (2002) framework introducing a situation of liquidity trap to test the relevance of expansionary monetary policy, in a situation of financial crisis. We aim at testing the appropriate strategies to get out of the financial crisis in an historical perspective. In order to highlight the present, we shall experiment whether expansionary monetary policy would have averted the international crises of the thirties in a context of liquidity trap. This will deliver a new outlook of the current situation, since international monetary authorities did not repeat what they did in thirties: indeed, today central banks act as lenders-of-last-resort to provide liquidity to their banking systems to foster economic growth, whereas in the thirties they refrained from it, probably because of fear that expansionary domestic credit would precipitate attacks on their gold reserves. The Gold Exchange Standard constraint disappeared today, but the hypothesis of liquidity trap, common to the two episodes of financial crisis, ought to be considered and tested in order to appreciate possible mistakes in monetary policies' responses, today as well as in the past.

Many attempts exist in the literature in order to deal with the current crisis in an historical perspective. The comparison between the two episodes of crises has lead to a growing interest and the amount of literature is increasing although still in progress. We review below the state of the art of this comparative literature. We shall distinguish some "chartist contributions", "the consensus view", notably developed by international institutions, and finally "Christina Romer's monetary lesson" which directly drives to

[2]"*A liquidity trap is defined as a situation in which the short-term nominal interest rate is zero. In this case, many argue, increasing money in circulation has no effect on either output or prices. The liquidity trap is originally a Keynesian idea and was contrasted with the quantity theory of money, which maintains that prices and output are, roughly speaking, proportional to the money supply.*" (Eggertsson, 2008).

our own issue, testing the efficiency of expansionary monetary policy in a context of liquidity trap.

As illustrated below, most of this literature is limited to a pure static comparison between the two periods without introducing any counterfactual hypotheses. Our counterfactual analysis should then be seen as an attempt to extend the outcomes delivered in a comparative static framework. To highlight the present, our main ambition is to simulate a counterfactual analysis on the effects of expansionary monetary policy over the period 1929-1933, in a context of liquidity trap. By that way, it will be possible to deliver a renewed monetary lesson for current monetary policies.

1. 2007-2009 in light of 1929: a state of the art

1.1 Some "chartist" contributions

The renewed interest about a comparison of the great depression and the current crisis is striking: see for example Krugman (2009), Eichengreen and O'Rourke (2009), Helbling (2009) and Romer (2009). The literature on the great depression is considerable: for the US case, one can refer to Bernanke (2000), Bordo, Goldin and White (1998) and chapter 7 in Friedman and Schwartz (1963). A global outlook is delivered in Eichengreen (1992), James (2001) etc.

We shall only recall here the main outcomes of the recent comparative literature. Krugman (2009) has compared the fall in US industrial production from its mid-1929 and late-2007 peaks, showing it has been milder this time. Referring to the current situation he qualifies it as only "half a great depression".

Eichengreen and O'Rourke (2009) consider that it is a misleading picture since as the great depression was a global phenomenon the comparison ought to be done for the world and not just for the US. Comparing the world industrial output, now and then, these authors obtain a more disturbing perspective than the single US case considered by Krugman (2009) with a similar decline in manufacturing production. Considering world stock markets, now and then, Eichengreen and O'Rourke (2009) note that they are falling even faster now than during the great depression.

Another area, where the results are worse than during the thirties, concerns international trade which shrinks: this is alarming if we refer to the prominence attached in the literature to trade destruction and protectionism as a factor compounding the great depression. Obviously, these observations are done only one year into the current crisis whereas after 1929 the world economy continued to decline for more than three years. Well-aware of this, these authors conclude that, after one year, the world economy is doing worse than during the great recession, whether in terms of industrial production, exports, or stock market. They suggest that "the great recession label may turn out to be too optimistic. This is a Depression-sized event".

What about monetary and fiscal policies' responses then and now? Eichengreen and O'Rourke (2009) use a peculiar[3] indicator calculated as a GDP-weighted average of central bank rates for seven countries. This indicator shows that in the present crisis monetary rates are lower than in the thirties and have been cut more rapidly, although with a similar lag of five month. A clear cut difference appears between the two episodes of crisis concerning the money supplies: in 2008 the global money supply continued to grow rapidly, unlike in 1929 when it declined dramatically.

An analogous picture can be drawn for fiscal policy (for 24 countries), using as indicator the fiscal surplus as a percentage of GDP. Fiscal deficits expanded only slightly after 1929 whereas they augmented in 2008-2009, illustrating the will of governments to use counter-cyclical fiscal policies on a world scale. Thus, contrarily to Krugman (2009), Eichengreen and O'Rourke (2009) conclude that "the world is currently undergoing an economic shock as big as the Great Depression shock of 1929-1930", but with opposite policy responses. They ultimately raise a crucial issue: "The question now is whether that policy response will work?"

We precisely want to answer this question using a counterfactual analysis introducing the hypothesis of liquidity trap.

[3]It would have been better to distinguish the Federal Reserve rate and the European Central Bank rate; using a weighted central bank rate introduces a bias: indeed, this can explain that the levels of interest rates found by these authors are surprisingly lower now than then; the absence of central bank cooperation over the interwar period and the Gold Standard constraint may explain the propensity of each central bank to increase its domestic discount rate in order to capture gold resources. The weighted indicator catches this effect whereas using single domestic discount rates and notably the Federal Reserve rate, the level of central bank interest rate is not so different now and then (see, for instance, Romer, 2009).

1.2 The consensus view

The European Commission delivered in 2009 a report with a full chapter devoted to a comparison between the current crisis and the great depression. Similarities and differences seem to be definitely identified, in terms of geographic origin, causes, duration, transmission mechanisms, and policy responses. This apparently broad agreement should obviously be considered with caution. The purpose of our article is precisely to call into question this very questionable consensus.

First, this report (2009) recalls that the current crisis is the deepest, most global and synchronous since the great depression of the thirties. The roots the two crises are identified as financial: in both cases, an insufficiently supervised financial sector, an uncontrolled expansion of the shadow banking system led to massive bank failures and liquidity scarcity at the peak of the panic. Each episode was either followed by a deep recession in the real economy.

Strong differences are nevertheless identified. First, we no longer live under the constraint of the Gold Standard whose attempt of restoration in the thirties is supposed to have had a contractionary impact on economic growth. The defence of the fixed rate to gold by protecting gold bullion domestic holdings deepened the depression across the world. Tightening monetary policies was the channel through which the crisis became the great depression. According to the European Commission report (2009) inadequate policy responses in the thirties contrast the appropriate monetary and fiscal policies implemented nowadays. The strong and persistent decrease in the overall price level leading to a sharp deflation in the thirties was due to the restrictive monetary policies pursued at that time. The mass unemployment which reached an unprecedented scale in the thirties has been avoided today thanks to automatic stabilisers and the efficiency of counter-cyclical fiscal policies implemented on a world scale. From these "well-understood lessons from the past", the European commission (2009) forecasts a quicker recovery than in the 1930s.

Despite larger use of financial leverage in the current crisis which may reveal the persistence and depth of financial risks today, a consensus seems to emerge among American and European institutions that monetary authorities today did not repeat the errors of the past. This presumed consensus can be summarized as follows (see, section entitled 'policy response then and now', European commission report, 2009):

- macroeconomic policy response was the major factor contributing to the gravity and duration of the great depression;
- the lack of expansionary monetary measures by the Federal Reserve accentuated the great depression;
- protectionism undertaken by major countries during the thirties amplified the phenomenon.

The European commission (2009) identifies five major lessons giving evidence that proper exit strategies from crisis are now implemented based on a correct understanding and learning from the past:

- Lesson 1: maintain the public confidence in the banking system and prevent from a credit allocation collapse;
- Lesson 2: maintain aggregate demand and avoid deflation, by means of expansionary monetary and fiscal policies;
- Lesson 3: maintain international trade and avoid protectionism;
- Lesson 4: maintain international finance and avoid capital account restrictions;
- Lesson 5: foster closer international cooperation and avoid nationalism.

Thus, comparing the salient features between the great depression and today leads this "mainstream literature" to identify similar financial and economic vulnerabilities in both episodes and opposite policies' responses to fight the crises. We consider this consensus view as highly questionable for several reasons: do these proposals rely on a correct reading of the past? Second, a consensus does not necessarily mean that the diagnosis is not wrong. Maybe some absent parallels to the great depression remain, not taken into account by this analysis. Indeed, we consider that a similarity between the great depression and the current one is completely omitted in this analysis: a similar context of liquidity trap that ought to be assessed in order to test the relevancy of

expansionary monetary policy at the two periods. Romer (2009), if not directly, evokes this point.

1.3 Christina Romer's monetary lesson

Romer (2009) draws lessons from the great depression for economic recovery in 2009. She underlines that both downturns have their fundamental causes in the decline in asset prices and failure of financial institutions. This, in turn, led to a collapse of the money supply (Friedman and Schwartz, 1963) and a collapse in lending (Bernanke, 1983), with short term interest near zero (which balances Eichengreen and O'Rourke (2009) findings of higher discount rates in the thirties, using their weighted short term interest rate, as discussed in footnote 3). We shall focus here on the policy response side of Romer's analysis. According to this author, "one crucial lesson from the 1930s is that a small fiscal expansion has only small effects". The total fiscal expansion in the 1930s was small indeed and could only have a modest impact on the economic recovery. She quantifies the fiscal stimulus as close to 3% of GDP in each of the two years after 1929, in the US. On the contrary, over the current period, massive fiscal expansion has been implemented over the world in order to counter mass unemployment.

Concerning the monetary response, Romer (2009) draws a key lesson from the thirties: "monetary expansion can help to heal an economy even when interest rates are near zero". In our perspective, this constitutes the heart of the debate, because this author clearly pinpoints a case of liquidity trap. If we refer to the historical context of the thirties, in April 1933, after Roosevelt temporarily suspended the convertibility to gold which implied a substantial depreciation of the dollar, the come back to gold convertibility at a new higher price led to massive gold inflows. Under the Gold Standard constraint, the US Treasury was allowed to issue gold certificates in proportion of its gold holdings. Following gold inflows, the Treasury issued more notes. Friedman and Schwartz (1963) calculated that the rate of growth of the money supply was 17% a year over the period 1933-1936. Thus, contrarily to conventional wisdom, expansionary monetary policy was not fully absent after the great depression. It began after the dollar's devaluation. Could it have an immediate impact on interest rates?

As judiciously mentioned by Romer (2009), "this monetary expansion could not lower nominal interest rates because they were already near zero". Very interestingly, this author suggests that "what it could do was break expectations of deflation". She argues that since expectations were a continuation of deflation, although the nominal rate was near zero, this rate was considered still exceedingly high by agents. Increasing money supply would facilitate a reverse in expectations and "break the deflationary spiral". A replacement of expectations of deflation by expectations of price stability should bring real interest rates down and enhance consumption and investment. Romer (2009) noted that "the first thing that turned around was interest-sensitive spending. Car sales surged in the summer of 1933. One sign that lower real interest rates were crucial is that real fixed investment and consumer spending on durables both rose dramatically between 1933 and 1934".

Thus, the experience of the 1930s suggests to this author that even in a situation of liquidity trap[4], "expansionary monetary policy can continue to have an important role to play even when interest rates are low by affecting expectations, and in particular, by preventing expectations of deflation". This point constitutes the heart of the debate: we completely admit with Romer (2009) that prior to 1933 consumers and businesses preferred to "sit on any cash" which designed a context of liquidity trap. We also completely admit with Friedman and Schwartz (1963) that the US had to wait for 1933 to meet expansionary monetary policy which constitutes, as underlined by Eichengreen and O'Rourke (2009), a crucial difference with the monetary policy response implemented as soon as 2008, one year only after the beginning of the current crisis.

Nevertheless, we consider that the argument developed by Romer (2009) is partly biased because this author omits that expansionary fiscal policy could have played exactly the same role and probably a more important one in the shift of expectations, from deflation to recovery. Indeed, it is largely admitted that Roosevelt's expansionary fiscal policy was stimulatory and a core source for economic recovery. This is so true, that when in 1937 the fiscal policy took a "wrong turn" (end of veterans' bonus, first

[4]Romer (2009) never mentions this Keynesian term but she describes as follows this phenomenon when economic agents continue to expect deflation (over the period 1929-1933): "Consumers and businesses wanted to sit on any cash they had because they expected its real purchasing power to increase as prices fell". By that way, this author assimilates the period 1929-1933 to a context of liquidity trap.

year of collect for social security taxes which diminished the deficit by 2.5% of GDP), the impact of these fiscal measures was sharply contractionary on economic growth.

In this article, we shall test Romer's argument: is monetary policy still efficient in a liquidity trap context? Besides, is the quicker reactivity of monetary policy today good policy?

2. Previous use of counterfactual approach in a monetarist framework

Counterfactual analysis is one of the cornerstones of the cliometric methodology.[5] It is used to measure the deviation between what actually happened and what could have happened under different circumstances. This methodological principle relies on the measurement of the influence of a factor on a development by using the difference between the development actually observed and the hypothetical development that would have been observed if the factor in question had not existed.

Our purpose here is to extend the Bordo, Choudhri and Schwartz (2002) counterfactual framework to the case of liquidity trap in order to test the relevance of expansionary monetary policy in a situation of financial crisis. The conclusion of the authors is that even with perfect or near-perfect capital mobility, gold flows would not have severely constrained the Federal Reserve's ability to determine the high-powered stock of money in the short run. The Federal Reserve would have been even less constrained under imperfect mobility in which case the absolute value of the offset coefficient would be smaller. American monetary authorities would have had more room for manoeuvre. Is this outcome robust in a case of liquidity trap? The main idea behind our empirical analysis is to evaluate Friedman and Schwartz hypothesis, i.e. the great contraction would have been attenuated had the Federal Reserve not allowed the money stock to decline following a liquidity trap context. Formally, we will adopt a structural vector autoregression (SVAR) model to simulate the behavior of output following unexpected expansionary monetary policies, under (1) normal monetary and (2) liquidity trap contexts.

[5] "*Instead, the art is to develop models of historical development which capture the essential and suppress the trivial.*" (Williamson, 1974, p. 17). See also the seminal work by Fogel (1964).

3. Data and Methodology

3.1 Data

Our data are monthly and cover the 1922:1-1933:12 time periods for five variables: the real industrial production index (considered as a proxy of the real economic activity), the consumer price index, the M2 money supply, the short-term interest rate[6], and the real deposits in suspended bank[7] (which is considered as a measure of the importance of bank failure).

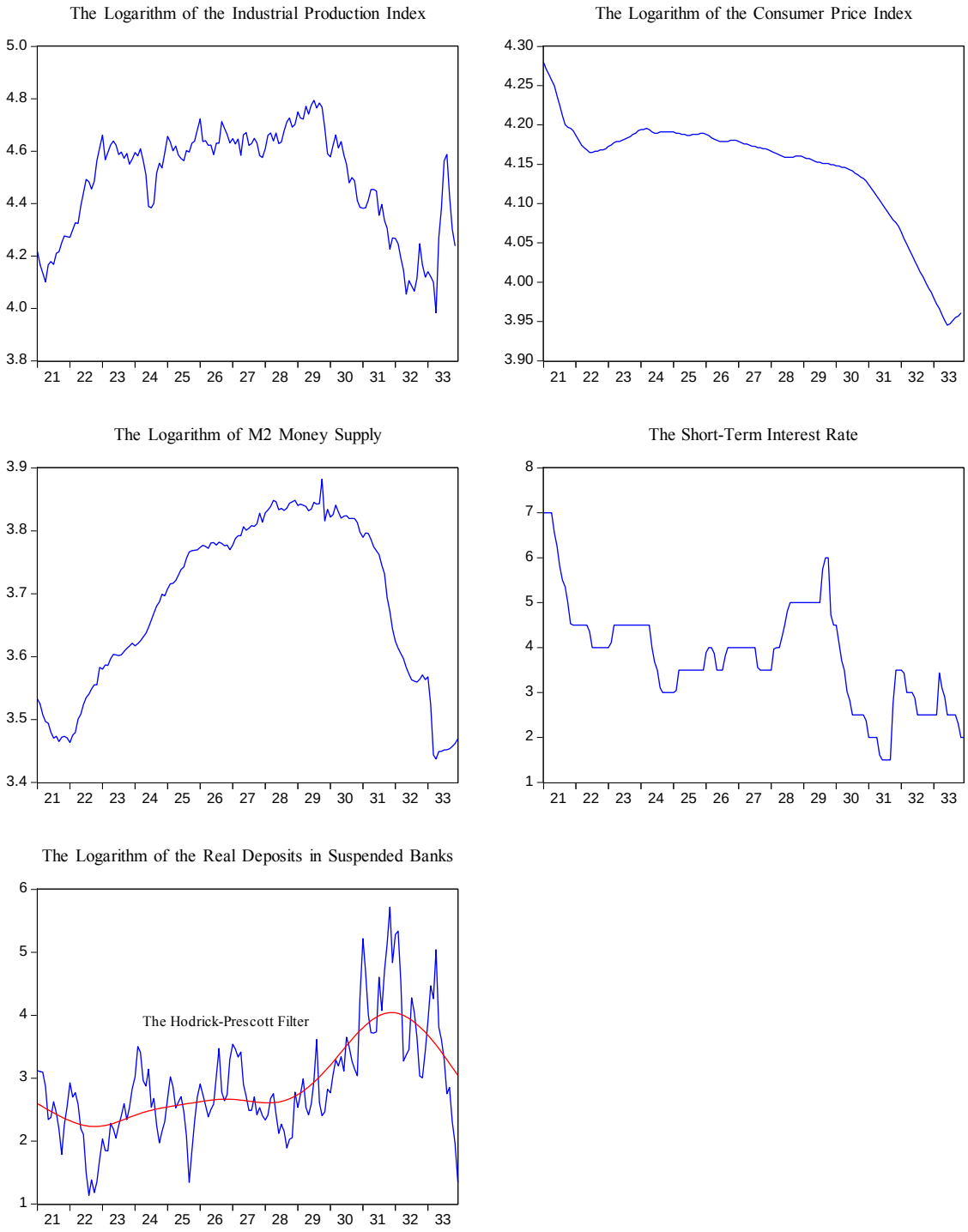
With exception of the interest rate, all variables are expressed in logarithms. The nominal M2 money supply is converted to a real variable by dividing it by the consumer price index. Finally, the inflation rates are computed as growth rates of the consumer price index.

As shown in Figure 1, the log of the real industrial production began to decline from April 1929 to the cyclical trough in 1933:1. This sharpest and prolonged decline was followed by a brief recovery at the beginning of 1933. The Consumer Price Index (CPI) plot illustrates the most severe deflation in the US history. Indeed, it declined by 23 percent from 1929 to 1933. Like the real industrial production, the log of the M2 money supply felt by more than 10% from October 1929 to March 1933. The short-term interest rate is clearly decreasing over the period. The sharp increase of the log of real deposits in suspended banks between 1930 and 1933 reflects in large proportion the fall in the money supply multiplier observed during this period. Friedman and Schwartz (1963) explained this decline of money supply by the series of banking panics which reduced the money supply and real activity through the money supply multiplier channel. The Hodrick-Prescott trend plot of the real deposits in suspended banks consolidates this finding since the banking panics outbreak precedes the decline in the money supply.

[6]Balke and Gordon (1986), Friedman and Schwartz (1963).

[7]Federal Reserve Bulletin, Sept. 1937 (http://fraser.stlouisfed.org/publications/FRB/1937/); McCallum (1990). It is also used by Bernanke (1983) as a proxy for the nonmonetary influence of the banking failure on economic activity.

Figure 1


The Logarithm of the Industrial Production Index
5.0
4.8
4.6
4.4
4.2
4.0
3.8
21 22 23 24 25 26 27 28 29 30 31 32 33
The Logarithm of the Consumer Price Index
4.30
4.25
4.20
4.15
4.10
4.05
4.00
3.95
3.90
21 22 23 24 25 26 27 28 29 30 31 32 33
The Logarithm of M2 Money Supply
3.9
3.8
3.7
3.6
3.5
3.4
21 22 23 24 25 26 27 28 29 30 31 32 33
The Short-Term Interest Rate
8
7
6
5
4
3
2
1
21 22 23 24 25 26 27 28 29 30 31 32 33
The Logarithm of the Real Deposits in Suspended Banks
6
5
4
3
2
1
The Hodrick-Prescott Filter
21 22 23 24 25 26 27 28 29 30 31 32 33

3.2 Theoretical foundations

SVAR type research is still in its infancy in cliometrics. Here we develop a SVAR model which should allow a simultaneous examination of the real economic activity reactions to an expansionary monetary policy shock without and with a liquidity trap context. In order to build the dynamic structure of our SVAR approach, we use economic theory and econometric considerations through various kinds of restrictions on the structural parameters.

The basic approach derives from the studies of Blanchard and Quah (1989), Shapiro and Watson (1988), Blanchard (1989) and others, on structural modelling. Indeed, many SVAR model identification processes define either short run (Kim and Roubini, 2000) or long run (Blanchard and Quah, 1989) restrictions.

In this paper we adopt a short-term restrictions approach within an open economy framework to analyze the contribution of monetary shock for explaining the reaction of the real US economic activity with (1) normal monetary policy and (2) a near zero nominal interest rate.

To determine the transmission mechanism shocks, we briefly summarize the SVAR modelling process[8].

In the first step we estimate the VAR reduced-form:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + \varepsilon_t \quad E(\varepsilon_t \varepsilon_t^{'}) = \Omega \quad (1)$$

Where A_i are *(nxn)* coefficients matrix and y is a covariance stationary vector process. The vector $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \ldots, \varepsilon_{nt})^{'}$ is a n-dimensional.

The structural form of (1) can be written as:

$$Ay_t = A_1^* y_{t-1} + A_2^* y_{t-2} + \ldots + A_P^* y_{t-p} + Bu_t \quad (2)$$

where $E(u_t) = 0$ and $E(u_t u_t^{'}) = I_n$

[8]For a complete mathematical presentation, see Hamilton, 1994.

The relation between reduced and structural shocks is simply obtained by multiplying the relation (2) by A^{-1}:

$$\varepsilon_t = A^{-1}Bu_t \quad (3)$$

Equation (3) illustrates the relation between the reduced-form (disturbances) and the structural-form (innovations).

The connection between these two forms is given by:

$$A_j = A_j^{-1}A_j^* \quad (4)$$

The matrix *A* allows the modelling of the instantaneous relations while *B* is a structural form parameter matrix. The identification of the structural vector autoregression requires the introduction of additional constraints since, following (3) the number of non-redundant element of Ω (n(n+1)/2) is less than the overall number of elements in the matrix *A* and *B* ($2n^2$). The identification structure is therefore achieved by imposing $2n^2 - n(n+1)/2$ restrictions, taken from economic theory and intended to represent some meaningful short term relationship between the variables and the structural shocks.

3.3 Counterfactual analysis

To perform our counterfactual simulations, we define two scenarios: an expansionary monetary policy with respectively (1) a normal monetary reaction function and (2) a zero-interest-rate bound.

3.3.1 Scenario 1

The first scenario corresponds to normal circumstances for which after an expansionary monetary policy shock, short term interest rates decreases, aggregate output, employment, profits and various monetary aggregates increase, and the aggregate price level responds very slowly.

For this scenario, our system (see equation 1) includes endogenous variables: *y* is the real industrial production index, *p* the consumer price index, *m* the M2 money supply, *r* the interest rate, and *s* the real value of deposits in suspended banks. With exception of the interest rate, all variables are expressed in logarithms. We take the log of the deposits in suspended banks, *s*, as proxy of the banking panics.

Under a normal monetary context, the architecture of our short term restrictions is characterized by the following structure:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & 0 \\ 0 & a_{42} & a_{43} & 1 & 0 \\ a_{51} & 0 & a_{53} & 0 & 1 \end{bmatrix} \begin{bmatrix} y_t \\ p_t \\ m_t \\ r_t \\ s_t \end{bmatrix} = A_1^* y_{t-1} + \ldots + A_P^* y_{t-p} + \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{pmatrix} u_{yt} \\ u_{pt} \\ u_{mt} \\ u_{rt} \\ u_{st} \end{pmatrix} \quad (5)$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & 0 \\ 0 & a_{42} & a_{43} & 1 & 0 \\ a_{51} & 0 & a_{53} & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{pt} \\ \varepsilon_{mt} \\ \varepsilon_{rt} \\ \varepsilon_{st} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{pmatrix} u_{yt} \\ u_{pt} \\ u_{mt} \\ u_{rt} \\ u_{st} \end{pmatrix} \quad (6)$$

$\varepsilon = \left[\varepsilon_y, \varepsilon_p, \varepsilon_m, \varepsilon_r, \varepsilon_s\right]$ correspond to the errors of the reduced VAR form, while the structural disturbances u_y, u_p, u_m, u_r, u_s are, by definition (IS/LM models originated by Hicks, 1937 and its extensions), aggregate supply shocks, aggregate demand shocks, supply monetary shocks, demand monetary shocks, and banking shocks:

$$\begin{aligned} &\varepsilon_{yt} = b_{11} u_{yt} \\ &a_{21}\varepsilon_{yt} + \varepsilon_{pt} = b_{22} u_{pt} \\ &a_{31}\varepsilon_{yt} + a_{32}\varepsilon_{pt} + \varepsilon_{mt} + a_{34}\varepsilon_{rt} = b_{33} u_{mt} \\ &a_{42}\varepsilon_{pt} + a_{43}\varepsilon_{mt} + \varepsilon_{rt} = b_{44} u_{rt} \\ &a_{51}\varepsilon_{yt} + a_{53}\varepsilon_{mt} + \varepsilon_{st} = b_{55} u_{st} \end{aligned} \quad (7)$$

This model is over-identified because we impose 36 restrictions, more than the 35 restrictions $(2n^2 - n(n+1)/2)$ needed for exact identification in the case of five endogenous variables (but the formal test of over-identification in not rejected by the data).

The first row of the system (5):

$$y_t = A_1^{*(1,1)} y_{t-1} + \ldots + A_P^{*(1,1)} y_{t-p} + b_{11} u_{yt} \qquad (8)$$

specifies that, except aggregate supply shock, all the others affect real activity with a lag (Sims and Zha, 2006). Such a restriction can be justified by the inter-temporal IS equation, by which the interest-sensitive expenditure is predetermined (Rotemberg and Woodford, 1999).

The relation given by the second row:

$$p_t = -a_{22} y_t + A_1^{*(2,.)} y_{t-1} + \ldots + A_P^{*(2,.)} y_{t-p} + b_{22} u_{pt} \quad (9)$$

is consistent with the specification by which the inflation rate reacts contemporaneously to output shocks (Woodford, 2003). Indeed, based on Calvo (1983), Rotemberg (2003), Rotemberg and Woodford (1999), we assume that effects on price changes on the remaining variables occur with a delay (except for the real economic activity).

The third row:

$$m_t = -a_{31} y_t - a_{32} p_t - a_{34} r_t + A_1^{*(3,.)} y_{t-1} + \ldots + A_P^{*(3,.)} y_{t-p} + b_{33} u_{mt} \quad (10)$$

corresponds to the global liquidity aggregate dynamics, which is assumed to react contemporaneously to real income, demand aggregate and the short-term interest rate shock.

The fourth equation:

$$r_t = -a_{42} p_t - a_{43} m_t + A_1^{*(4,.)} y_{t-1} + \ldots + A_P^{*(4,.)} y_{t-p} + b_{44} u_{rt} \quad (11)$$

represents the central bank reaction functions by which the Federal Reserve reacts with delay to movements in output and prices level.

The last equation:

$$s_t = -a_{51}y_t - a_{53}m_t + A_1^{*(5,.)}y_{t-1} + \ldots + A_P^{*(5,.)}y_{t-p} + b_{55}u_{st} \quad (12)$$

represents the banking shocks dynamics relevant to bank suspensions and failures.

The introduction of such shock mechanism in our specification is motivated by the contribution of a series of banking panics from 1930 to 1933 to explain through the money supply multiplier the severe decline of the money supply. Indeed, as explained by Friedman and Schwartz (1963), the banking failure generated by the absence of Federal Reserve lender-of-last-resort action, altered the public's confidence, leading to a massive decline in the deposit-currency ratio. This naturally forced the banks to reduce in turn their loans what has caused a sharp fall in the deposit reserve ratio. Bernanke (1983) also highlights the important role played by the bank failures in affecting the financial intermediation process and hence reducing the level of real output.

3.3.2 Scenario 2

For the second scenario, the architecture of our short term restrictions is:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & a_{35} \\ 0 & a_{42} & 0 & 1 & 0 \\ a_{51} & 0 & a_{53} & 0 & 1 \end{bmatrix} \begin{bmatrix} y_t \\ p_t \\ m_t \\ r_t \\ s_t \end{bmatrix} = A_1^* y_{t-1} + \ldots + A_P^* y_{t-p} + \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{pmatrix} u_{yt} \\ u_{pt} \\ u_{mt} \\ u_{rt} \\ u_{st} \end{pmatrix} \quad (13)$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & a_{35} \\ 0 & a_{42} & 0 & 1 & 0 \\ a_{51} & 0 & a_{53} & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{pt} \\ \varepsilon_{mt} \\ \varepsilon_{rt} \\ \varepsilon_{st} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{pmatrix} u_{yt} \\ u_{pt} \\ u_{mt} \\ u_{rt} \\ u_{st} \end{pmatrix} \quad (14)$$

The liquidity trap hypothesis is identified through two elements which affect equations 3 and 4 of our multivariate system.

1. The money supply does not affect the interest rate (which cannot go below its level). Contrarily to equation 3 in scenario 1, in equation 3 of scenario 2, the interest rate channel has disappeared.

2. A move or a decrease of the interest rate in the central bank reaction function cannot affect the output, because of hoarding of the money. Thus, in equation 4 of scenario 2, the output has disappeared, since the multiplier of investment cannot affect real economic activity.

These are the two channels by which the liquidity trap acts as a constraint in our modelling.

The two first rows of the system (13) are the same as in the first scenario and the specification given by Kim et Roubini (2000). They represent good markets equilibrium.

The third:

$$m_t = -a_{31} y_t - a_{35} s_t + A_1^{*(3,.)} y_{t-1} + \ldots + A_P^{*(3,.)} y_{t-p} + b_{33} u_{mt} \quad (15)$$

and fourth equations:

$$r_t = -a_{42} p_t + A_1^{*(4,.)} y_{t-1} + \ldots + A_P^{*(4,.)} y_{t-p} + b_{44} u_{st} \quad (16)$$

include the global liquidity aggregate and the central bank reaction functions. The global liquidity aggregate is assumed to react in the short term to real activity and banking shocks, while the monetary policy reaction function is consistent with the liquidity trap context by which the interest rate does not react contemporaneously to change in the monetary aggregate.

The fifth row is the same as in scenario 1.

4. Empirical results

Based on the Augmented Dickey-Fuller (1979, 1981) and Phillips and Perron (1988) tests, we find that all series are integrated of order one in levels. This empirical finding is confirmed by the Kwiatkowski *et al.* test (1992) and the unit root test with level shifts (Lanne and Lütkepohl, 2002).

4.1 Impulse response functions analysis

We will now emphasize our impulse response function (IRF) analysis on the reaction of real economic activity to different shocks, following our two counterfactual simulation scenarios. We follow the calculation procedure presented in Hamilton (1994).

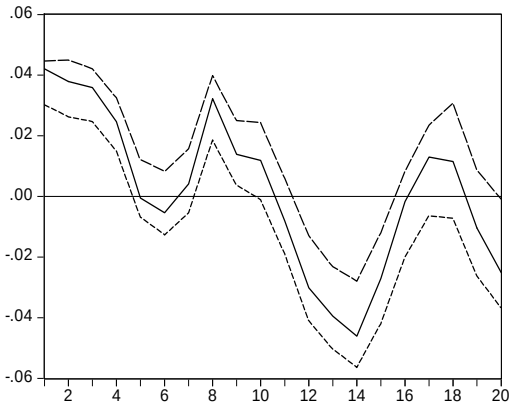
4.1.1 Scenario 1

In Figure 2, we display the real economic activity estimated by impulse response functions for normal monetary policy with 95% confidence intervals. The responses of real activity to an unexpected aggregate supply and demand shocks are in line, but only at short term, with the literature. Indeed, after one year, real activity becomes significantly negative and remains so for four months ahead. The volatility reaction of real activity to an aggregate supply and demand shocks can be explained by the difficulty to undertake structural or cyclical policies in an unstable economic environment.

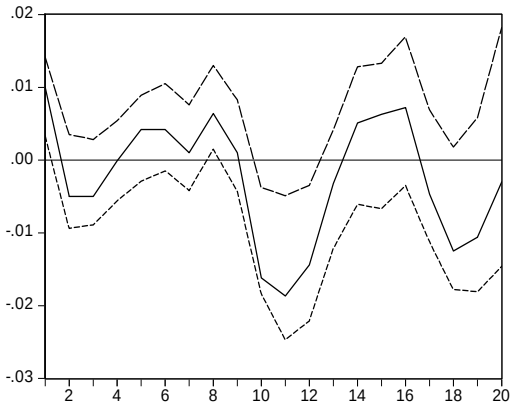
The real output increases significantly, at short term, in response to an unexpected supply monetary shock, but it begins dying off after ten months and remains so for several months. This positive impact of monetary policy only in the very short run could be explained by the existence of banking panics. Indeed, the real activity decreases sharply in the first seven months after a banking shock. We then suggest a kind of crowding-out effect of monetary policy which transits through the banking sector; we expect this effect to be higher in our second scenario, i.e. in a context of liquidity trap.

Finally, based on our IRF analysis, given by Figure 2, we can assess that the 1929's great contraction would have been attenuated with an expansionary monetary policy but only in the short term. Our results put in light the role played by the banking variable as a transmission channel. In the short term, the effects we observe are in conformity with the stylized facts. Indeed, banking panics significantly contributed to the emergence of the 1929's great contraction and would have been attenuated, at long term, had the Federal Reserve adopted an expansionary monetary policy.

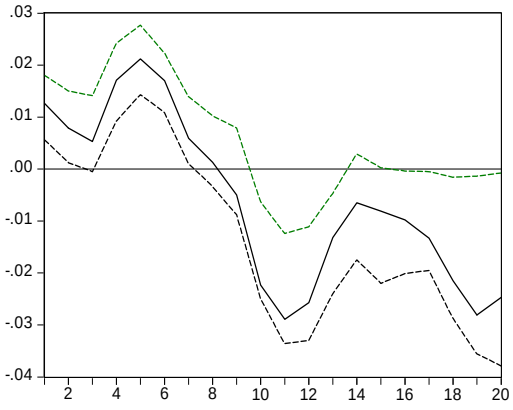
Figure 2: First scenario (without liquidity trap)



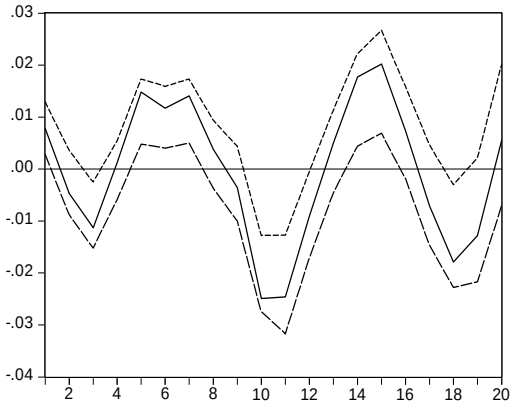
Response of real activity to supply shock



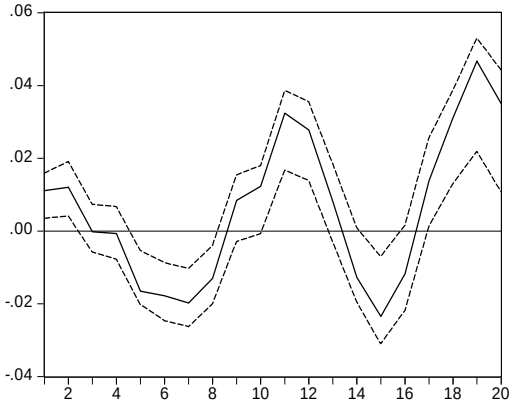
Response of real activity to demand shock



Response of real activity to supply monetary shock

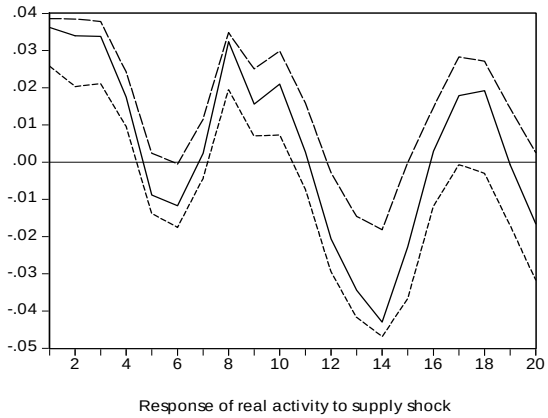


Response of real activity to demand monetary shock

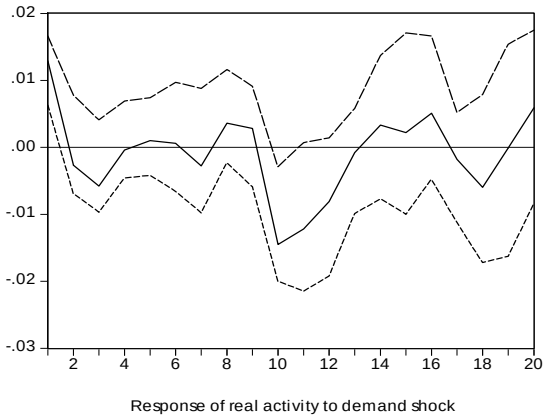


Response of real activity to banking shock

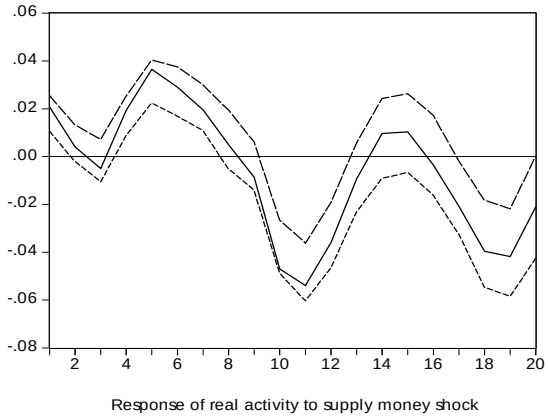
Figure 3: Second scenario (with liquidity trap)



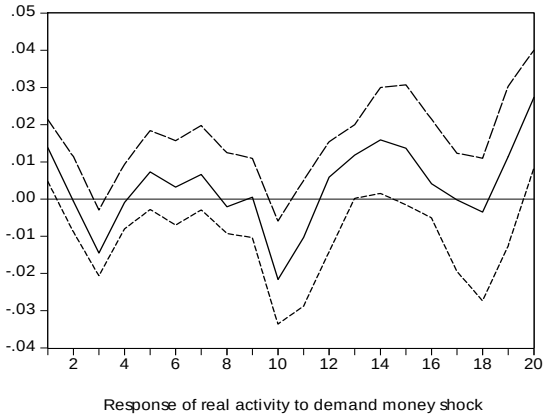
Response of real activity to supply shock



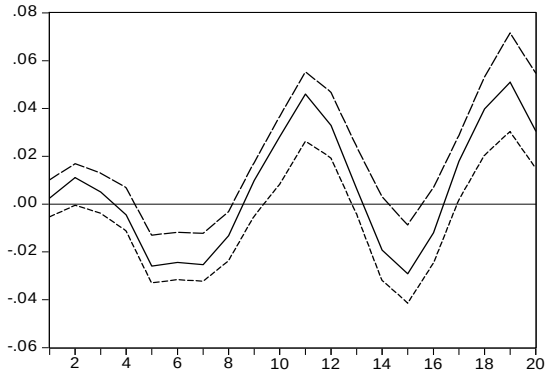
Response of real activity to demand shock



Response of real activity to supply money shock



Response of real activity to demand money shock



Response of real activity to banking shock

In other words, the positive long term effect of banking shocks on real activity could be explained by the Federal Reserve intervention as lender-of-last-resort.

4.1.2 Scenario 2

Making a distinction between a normal scenario and a scenario of liquidity trap becomes important to assess the impact of rising interest rates on economic activity in times of crisis.

The main idea is to highlight the role of an anticipated rise in interest rates on economic activity. Indeed, in a context of a liquidity trap economic agents expect a rise in interest rates, which will generate a fall in financial assets' prices and capital losses, and a decline in economic activity in the long term. A situation of liquidity trap could amplify the economic downturn, especially for where the monetary injection is dedicated largely to avoid bank failures.

Figure 3 displays real economic activity impulsion responses in a liquidity trap context. The responses of real activity to an aggregate supply shock is positive at short term but alternating between negative and positive to reach its lowest level after fourteen months. Moreover, we observe that an expansionary demand shock generates a short term significant and positive reaction followed after eight months by a sharp decrease.

For this second scenario, we note also that the level of real economic activity, following a supply money shock, is lower in a liquidity trap context than in a normal case. This underlines that the liquidity trap context minors significantly the effect of an expansionary monetary policy. Finally, as in the first scenario, the banking shock implies a similar negative effect on the real activity. This effect reinforces the liquidity trap channel.

In order to evaluate the role of the contribution of each shock with our two counterfactual scenarios, we are searching now to determine the variance decomposition of the real economic activity due to the monetary and banking shocks.

4.2 Variance decomposition analysis

Table 1 and 2 display the historical decompositions of the real economic activity, i.e. the real US output from 1929:01 to 1933:12. Columns 1 to 5 contain the portion of the real activity that can be respectively explained by aggregate supply shocks (u_y), aggregate demand shocks (u_p), supply monetary shocks (u_m), demand monetary shocks (u_r) and banking shocks (u_s).

4.2.1 Scenario 1

In Table 1 we note that after one year, a significant fraction (34%) of the real output variance is due to aggregate supply shocks and an important contribution is attributed to supply monetary shocks (37%) and banking shocks (22%).

By the way, these findings confirm our results given by the IRF figures that, in addition to aggregate supply shocks, banking and supply monetary shocks constitute the more important propagation channels affecting the real sector.

Table 1: Variance decomposition (scenario 1)

Months	Aggregate supply shocks (u_y)	Aggregate demand shocks (u_p)	Supply monetary shocks (u_m)	Demand monetary shocks (u_r)	Banking shocks (u_s)
2	0.81	0.04	0.10	0.05	0.00
6	0.62	0.02	0.22	0.05	0.09
12	0.34	0.03	0.37	0.05	0.22
20	0.30	0.02	0.34	0.04	0.30

Table 2: Variance decomposition (scenario 2)

Months	Aggregate supply shocks (u_y)	Aggregate demand shocks (u_p)	Supply monetary shocks (u_m)	Demand monetary shocks (u_r)	Banking shocks (u_s)
2	0.97	0.00	0.02	0.02	0.00
6	0.62	0.02	0.22	0.05	0.09
12	0.43	0.12	0.15	0.07	0.23
20	0.36	0.11	0.21	0.09	0.23

4.2.2 Scenario 2

We note that expansionary monetary policy is less efficient in a liquidity trap context. Indeed, as shown by Table 2, the contribution of the supply monetary shocks is, after twenty months, only about 21%, while it is 34% in the normal case. This corroborates the impact of the liquidity trap constraint which limits the efficiency of expansionary monetary policy in the short term. The results given by Table 2 confirm also the contribution of the banking shocks (23%) as another essential transmission channel for explaining the real US output variations.

5. Conclusion

This paper shows that the reaction of the real economic activity varies according to the counterfactual scenario we adopt.

1. We gave evidence that without a liquidity trap context, expansionary monetary policy affects real economic activity in the very short term. This result corroborates the "Romer effect".

2. Nevertheless, when introducing the constraint of a liquidity trap, the short term impact of expansionary monetary policy is reduced. This "keynesian effect" minors partially the previous effect.

3. The third central element of our analysis is that the channel of run deposits ("Bernanke effect") remains robust for the two scenarios: it has a permanent adverse effect on real economic activity, obviously combined with the liquidity trap effect in scenario 2. For the great depression as for today, it seems that the role played by the banking sector was a crucial channel, a decisive intermediary between the lender-of-last-resort and the public or private investor and consumer.

A global vector autoregression (GVAR) analysis (Dées *et al.*, 2007) should help us, as Bernanke (1995), Mattesini and Quintieri (1997), Reinhart and Rogoff (2009), and Temin (1989, 2008) for example, to extend these findings to a broader, more comparative approach that examines the experiences of many countries simultaneously.

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