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UNCONVENTIONAL MONETARY POLICY IN THE IS-LM MODEL

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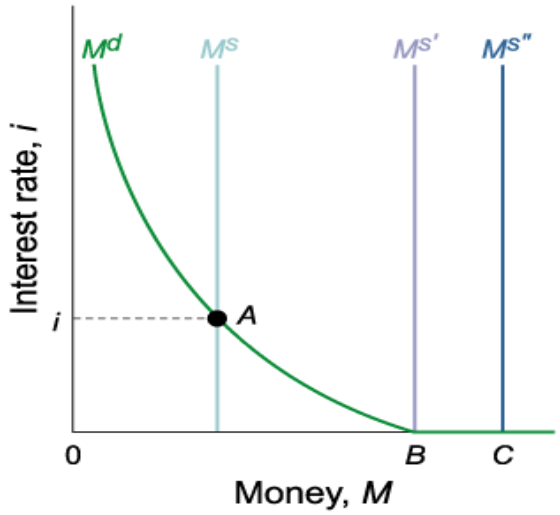
Abstract

Financial Frictions play a crucial role in financial markets nowadays and have to be taken into account when making monetary policy decisions. The financial crisis led central banks to rely mainly on unconventional monetary policies also known as Quantitative Easing. Such measures were unavoidable in order to help the economy out of the recession. In my thesis I analyzed several approaches of unconventional monetary policy to work out why traditional models are no longer sufficient for explaining the recent financial crisis. In this respect I modified Woodford´s IS-MP model (2010) to assess how central banks should behave when stuck in a liquidity trap. The main reference point for the model´s framework was a work by Curdia and Woodford (2010). Moreover the unconventional measures conducted by the Fed and ECB have to be analyzed in a critical way since they changed the composition of the central bank´s balance sheet.

1) Introduction: The Liquidity Trap and Fed responses during the crisis

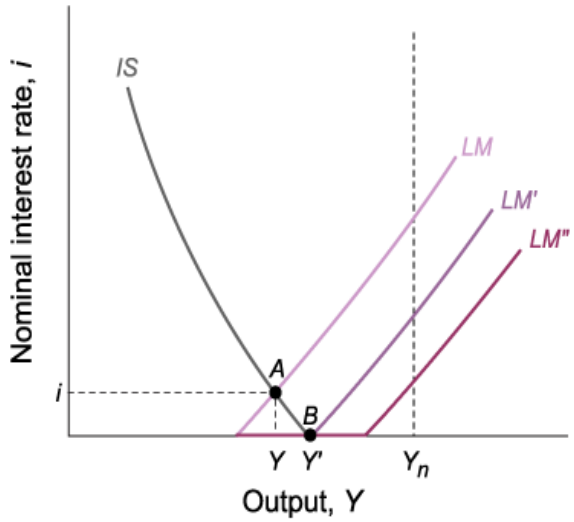
The liquidity trap is a situation in which monetary policy becomes ineffective. When the central bank injects money in the economy through an expansionary monetary policy the change in the money supply has no effect on the interest rate which is near zero. This effect can be seen in graph A. When the money supply $M^{s'}$ is fixed at point B, where the nominal interest rate is already zero, a further increase in $M^{s'}$ leads the money supply to shift rightwards to $M^{s''}$ (point C) without affecting the interest rate. Since the nominal interest rate cannot be negative, the central bank can no longer stimulate the economy through open market operations. Hereby it normally buys bonds and creates money by paying for them. Moreover at a zero nominal interest rate people are indifferent between holding money and bonds since both pay no interests. The infinite interest elasticity of the money demand at the zero lower bound implies that the money demand curve is horizontal beyond point B in the graph A. This in turn leads the LM-curve to become flat on the left-side as it is show in graph B.[1]

(A) Effect on an increase in money supply on interest rate



[1] O. Blanchard, Macroeconomics, 5th edition, p.495-499

(B) Effect of loosening monetary policy on interest rate and output



Source: The IS-LM Model (Prof. Giovianna Vallanti, Lecture slides 2011/12)

Normally a loosening of monetary policy shifts the LM-curve to the right leading to a higher output and a lower interest rate. But in a liquidity trap there is a limit of how much monetary policy can increase output. Consequently a further rightward shift of the LM-curve has no effect on the equilibrium output and a monetary expansion may not be able to bring output back to its natural level Y_n. This is exactly what happens at point B in graph B. The level of output is not affected through an increase in the money supply since the intersection remains at point B. As a matter of fact the central bank can no longer stimulate the economy at this point.[2]

Consequently measures of conventional monetary policy in which the central bank manages the target of the short-term interest rate become ineffective in a liquidity trap. Normally a cut in the federal funds rate by the Fed lowers also the long-term interest rate. This in turn has positive effects on the economy as it encourages purchases of long-lasting consumer goods, houses, capital goods. In this way it can influence the economic cycle by providing a stimulus during downturns and pushing down the inflation during booms.

By controlling the liquidity conditions the central bank makes sure that its main goal of price stability is reached. In normal times the central bank

[2] See Blanchard, p.497

provides liquidity only in return of highly liquid assets as collaterals in order to minimize its balance sheet risk.[3]

To overcome the problems of the liquidity trap unconventional measures have been introduced by the Fed during the financial crisis in 2008. The most important aims of unconventional measures are to counteract a deflation and ensure that banks and financial institutions are provided with enough liquidity.[4]

According to the member of the Executive Board of the European Central Bank Lorenzo Bini Smaghi "unconventional measures can be defined as those policies that directly target the cost and availability of external finance to banks, households and non-financial companies".[5] Such measures can include liquidity assistance of the banking system in order to guarantee financial stability, fairly long-term refinancing, acquisition of bonds and commercial papers by the central bank. Furthermore it is also possible to reduce the risk premium in specific market segments. The aim hereby is the avoidance of liquidity constraints and the activation of trading activity in certain markets.[6]

2) Lessons from the Great Depression and consequences for monetary policy during the recent crisis

From the lessons of the Great Depression it becomes clear that financial and economic stability have to be guaranteed by the central bank. For this reason central banks act in their traditional role as the lender-of-last-resort during bank panics in order to provide financial institutions with enough liquidity.[7] A bank panic occurs when lenders withdraw their deposits from financial institutions because they lose confidence in them or fear that other lenders do so. To avoid the banks´ failure or bankruptcy, banks can replace the losses of deposits with short-term loans from the central bank.

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[3] J. Danthine, Geldpolitik ist nicht allmächtig, p.1-6

[4] H.Schuberth, Geldpolitik und Finanzkrise-Die Bedeutung nicht-konventioneller geldpolitischer Maßnahmen,p.490-493

[5] http://www.ecb.int/press/key/date/2009/html/sp090428.en.html

[6] See Schuberth, p.490 ff.

[7] F. Mishkin, The Economics of Money, Banking and Financial Market, 9th edition, p.385 ff.

In exchange their assets act as collateral for the central bank.[8] The traditional discount window, Term Auction Facility, PDCF, and TSLF fall into this category. During the crisis the Fed expanded the institutions and market covered by the Fed´s lender-of-last resort actions and included broker-dealers such as Lehman brothers, commercial paper borrowers, money market funds and asset-backed securities markets.

Furthermore in order to guarantee economic stability the central bank conducts monetary policy. As a matter of fact the federal funds rate was cut to 0-25 basis points in December 2008 as can be seen in the graph below.[9]

Source: http://econproph.com/2011/09/21/what-a-liquidity-trap-looks-like-in-pictures/

3) The traditional IS-LM model

In this section the Hicks IS-LM model based on Keynes "General Theory" is described. It is important to understand the fundamental features of the traditional short-run model in order to point out why it cannot be used for the full understanding of the unconventional monetary policy during the crisis. A crucial assumption of the IS-LM model is that there is only one interest rate. Relating the interest rate to output a short-term equilibrium can be found in the goods and financial markets. Moreover the IS-LM model assumes a fixed price level meaning that nominal quantities equal real ones.

[8] See Mishkin, p. 201
[9] M. Brecht, Michael Quantitative Easing-Vergleich der Maßnahmen in Japan und den USA, p.10f

3.1) The Goods Market

3.1.1) The IS-curve

I will describe the goods market only shortly to provide a complete framework of the model. More concern will be laid on the financial market.

The IS-curve is described by the following equation:

$$\boldsymbol{Y = C(Y - T) + I(Y, i) + G + NX}$$

Equilibrium in the goods market is reached at the point where output Y is equal to the demand for goods Z. For this reason Z can be substituted for Y in the equation above:

$$Z = C(Y - T) + I(Y, i) + G + NX$$

With the help of graph C it is now possible to understand what happens when the factors of the equation change.
All factors such as consumption C , investment *I*, (exogenous) government spending *G* and net exports *NX* are positively correlated with output Y.

3.1.2) The demand for goods

Consumption depends on autonomous spending c_0 and disposable income Y_D which is the part of the income that remains after tax payments and government transfers. Since every household has to decide about the proportion it wants to spend more when their Y_D increases, a parameter c_1 is added to measure the propensity to consume. Moreover autonomous spending is always a positive factor and doesn´t depend on Y_D. This means that even if the income should be zero in particular situation, households still have fixed costs like for example for food or rent. The consumption equation is therefore equal to:

$$C = c_0 + c_1 Y_D$$

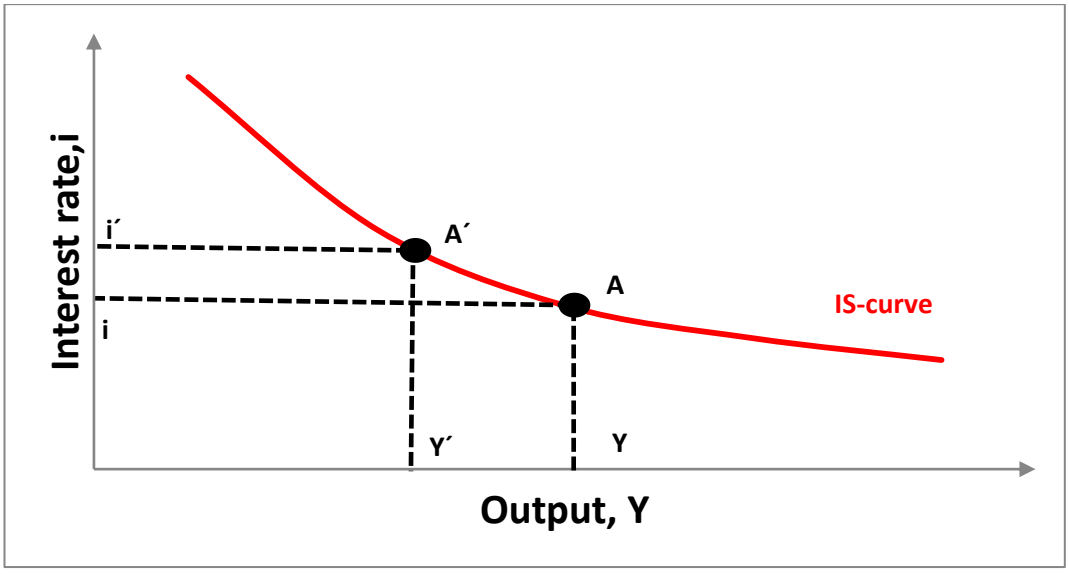
Y_D can be rewritten as $Y_D = income\ (Y) - taxes\ (T)$.

This means for example that when consumption increases due to an increase in autonomous spending c_0 demand for goods increases as well. To come up with the higher demand, firms need to increase their

production. Moreover this implies a higher income with further positive effects on demand. Since the increase in output is finally greater than the initial increase in autonomous spending the multiplier effect has taken place. This is shown in graph C where the spread of ZZ´<YY´.[10]

Investments have a similar effect on output. According to the equation investment depends on the interest rate and sales level. For instance, in order to satisfy a higher sales level due to a higher demand for goods a firm has to increase its production. To do so it has to invest in physical capital, like for example factories, plants, machineries and raw materials. Since most of the firms have to borrow in order to invest, the interest rate on loans becomes a crucial point for investment decisions. Even if the firm has enough liquidity to make investments it can still be better off by investing its money elsewhere. This is the case when interests on securities, like for example on bonds, are high. The higher opportunity cost for investment decreases planned investment spending. As demonstrated interest rates have a negative impact on investment. A high interest rate leads to a lower level of investment which in turn decreases the aggregate output with further negative effects on consumption and investment. For this reason the IS-curve is downward-sloping.[11]

A: Effect of an increase in the interest rate on output



[10] See Blanchard, p. 67-75
[11] See Blanchard, p. 108-111

Another channel through which interest rates can affect output is net exports. Since the interest rate moves in the same direction as the export rate, a low interest rate level implies high net exports. This is true because a decrease in the interest rate in the home-country leads to a decreased demand for home assets and a fall in the exchange rate. The explanation for the fall is that home assets become less attractive relative to assets denominated in foreign currencies. Since domestic goods are cheaper than foreign ones due to the lower value of the home-country currency, the demand for domestic products increases net exports. The positive relation between output and net exports also increases output. Nevertheless in a closed economy, the net exports are equal to zero.

Only an increase in taxes has a negative impact on Y since it results in a lower level of disposable income and thus reduces consumer expenditure. [12]

3.1.3) Factors that shift the IS-curve

All factors leading to an increase in the demand for goods at a given level of interest rate shift the IS-curve rightward as can be seen in the graph. This can be a reduction in taxes, an increase in government spending or optimistic expectations about the future made by households or firms.[13]

To make clear how these shifts work through the IS-curve, it is assumed the output is determined by Y and interest rate by i (point A) in graph B before the changes. A new discovery makes people become more optimistic about their future and thus change their consumption behavior. Graph C shows that the goods market is in equilibrium at point A before the change. Due to the optimistic expectations, households and firms increase their autonomous expenditures and the demand for goods rises to point A´ in graph C. This in turn has a positive impact on the output which increases to Y´. At a given interest rate, the IS-curve shifts rightward to point A´ in graph B.[14]

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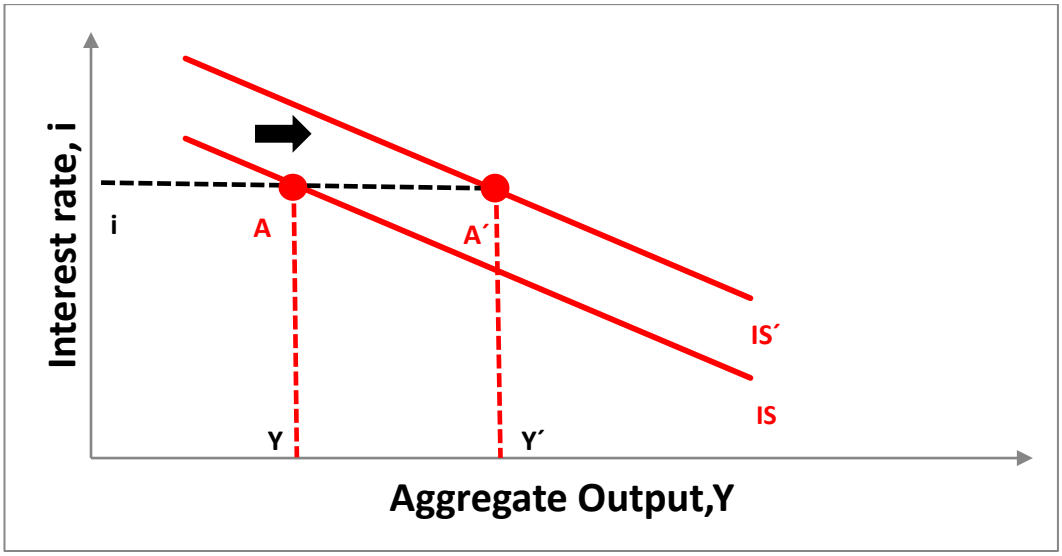
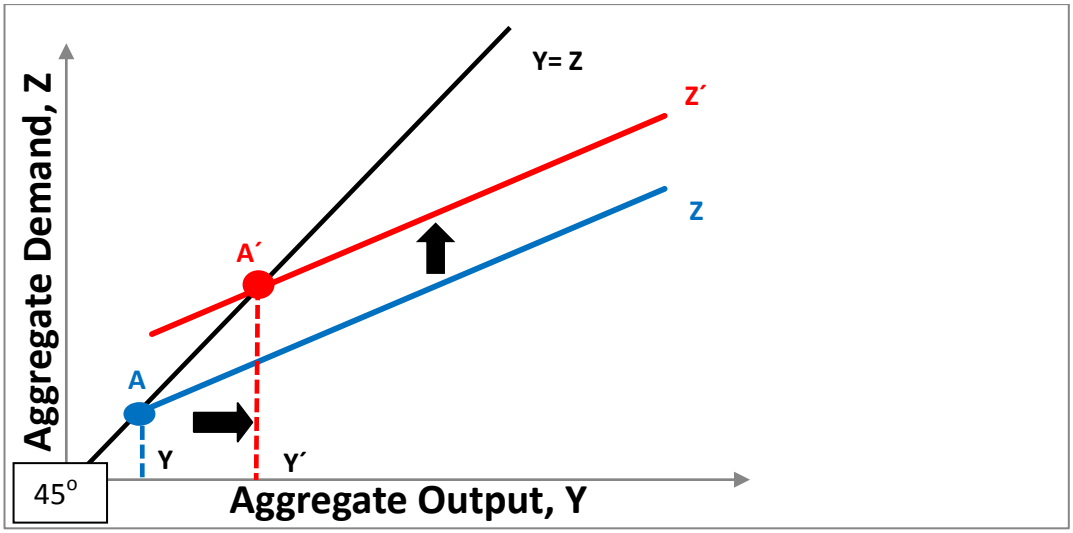
[12] See Mishkin, p.533-535
[13] See Blanchard, p.110 f.
[14] See Mishkin, p. 543-545

B: Rightward shift of the IS-curve



C: Effects on Output when autonomous spending increases



3.2) The financial market

3.2.1) The LM-curve

The LM-curve is described by the following equation:

$$\frac{\boldsymbol{M}}{\boldsymbol{P}} = \boldsymbol{Y}\, \boldsymbol{L}(\boldsymbol{i})$$
$$(+ \quad -)$$

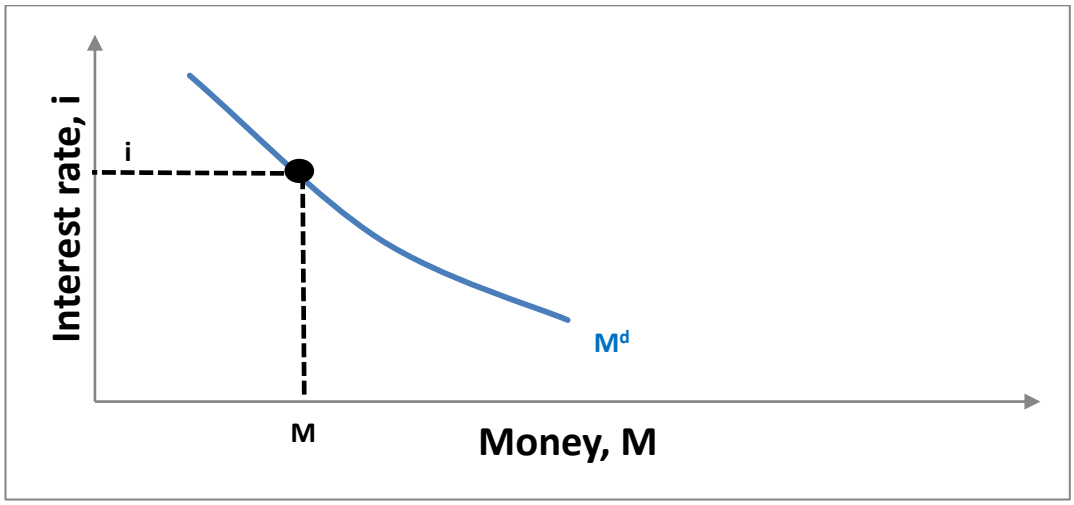
Equilibrium in the money market is reached at the point where money supply equals money demand. The LM-curve summarizes all combinations of interest rates and income in which the money market is in equilibrium.

3.2.2) The Demand for Money

The overall money demand can be determined by two important variables: the level of transactions and the interest rate on bonds. Since the nominal income increases proportional to the level of transactions, nominal income is taken as a transaction measure. Moreover a lower interest rate on bonds makes it more attractive for people in the economy to hold money and thus increases their demand for money M^d, for a given level of income. This is the reason for a downward sloping demand curve shown in the graph below. The money demand is determined by an interest rate function $L(i)$ and nominal income $\$\, Y$.

$$M^d = \$\, Y\, L(i)$$

A: The demand for money

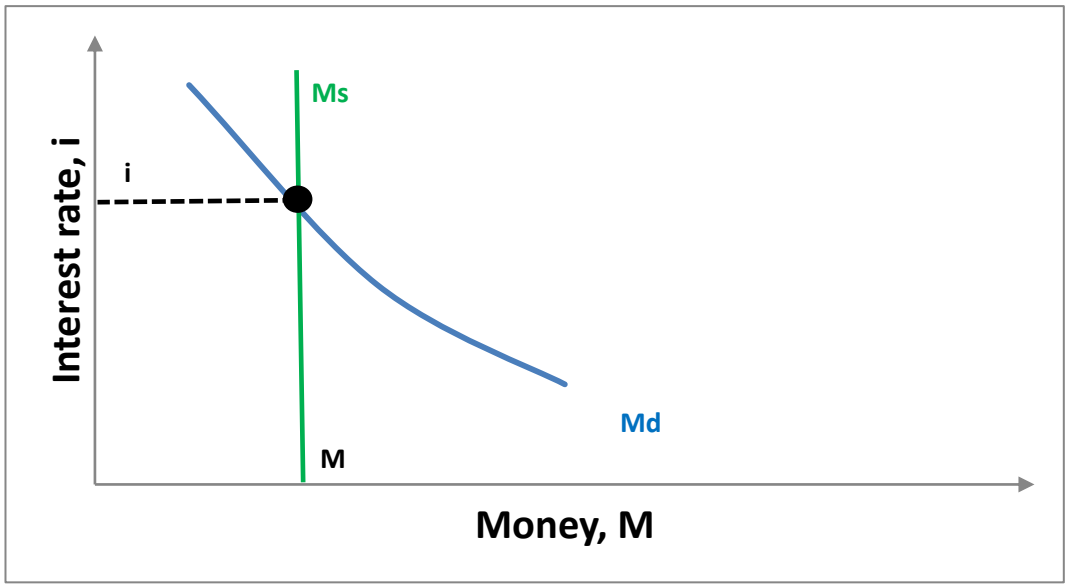


The equation furthermore points out that for a specific interest rate an increase in nominal income shifts the demand for money to the right.

To be in equilibrium money demand has to be equal to money supply. Moreover this implies that at a certain level of income, the interest rate can be determined since the amount of money people want to hold equals the money supply. The vertical money supply line indicates that the M^s is independent of the interest rate. For simplicity it is assumed that only the central bank is able to decide on the money supply level. For this reason we come up with $M = M^s$. Putting this in relation to the money demand the following equation determines equilibrium in financial market: [15]

$$M = \$\, Y\, L(i)$$

B: The Determination of the Interest Rate

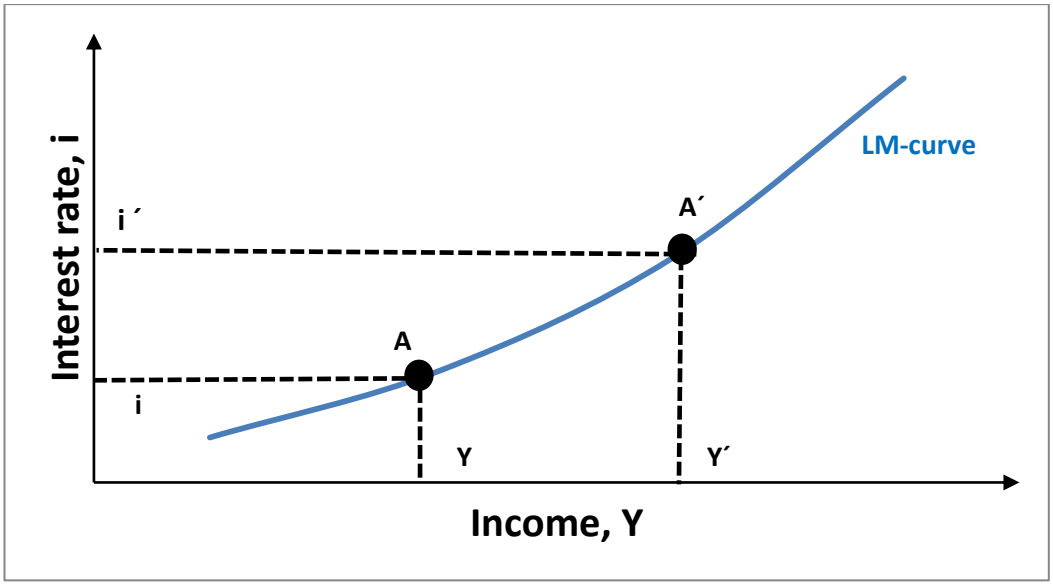


When deriving the LM curve we change our nominal quantities to real ones and thus have to include the price level P. We are now able to determine money and income in terms of goods. What money really can buy depends on the inflation rate and thus has to be included in our equation.

$$\frac{\boldsymbol{M}}{\boldsymbol{P}} = \boldsymbol{YL(i)}$$

[15] See Blanchard, p. 88-92

C: The LM-curve



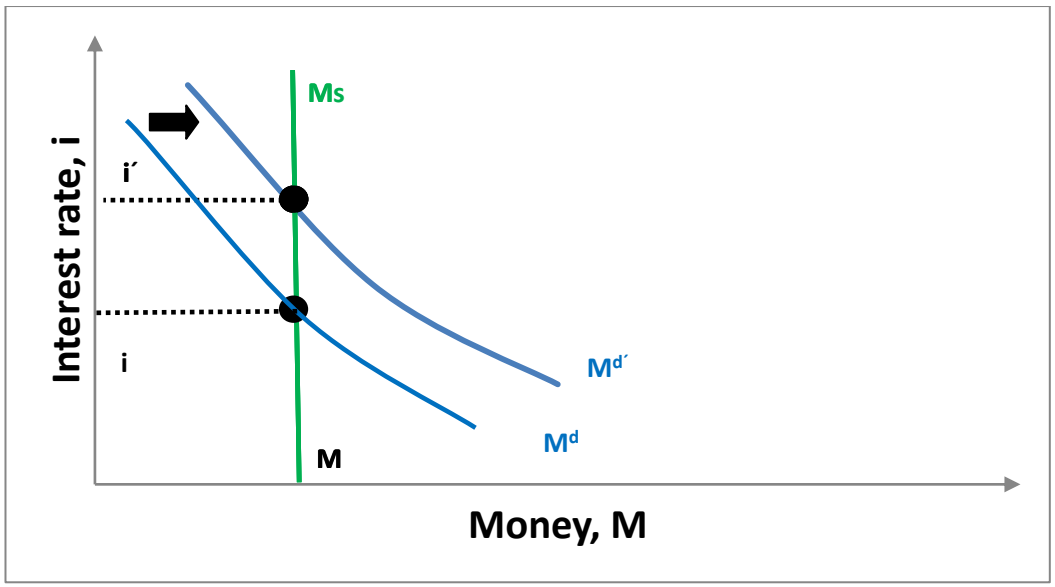
Equilibrium in the financial market implies that a higher level of income leads people to increase their demand for money at a given interest rate. As a matter of fact the money supply is fixed and determined by the central bank. This determines the upward-sloping LM-curve.

$$Y \uparrow \rightarrow M^d \uparrow \rightarrow i \uparrow$$

From the equation it can be concluded that an increase in nominal income leads to a higher interest rate since people increase their transaction level. In order to satisfy the higher transaction level they have to increase their money demand. At the given interest rate, $M^d > M^s$. To reestablish equilibrium the interest rate has to increase leading to an upward shift of the downward-sloping money demand curve. At the same time the money supply is given. For this reason the interest rate has to increase as long as the two different effects on the money demand (the higher income leading people to prefer money and the higher interest rate leading to hold less money) compensate each other. This means that the interest rate has to increase up to the point where the money demand equals again the unchanged money supply.[16]

[16] See Mishkin p.538-539, Blanchard p.113-114

D: Effect of an increase in money demand on interest rate



The same result is reached also by Keynes liquidity preference theory.

3.2.3) Keynes Demand for Money Theory

According to Keynes liquidity preference theory there is a positive relation between the demand for money and income. He also assumes that money supply is determined in real terms, as described before. On the one hand as income rises, households have more money available and increase their demand for goods. This results in a higher transaction level and increases the demand for money. On the other hand the higher income increases the demand for money because of the increase in the wealth of the individual. In such a situation people want to hold more assets, one asset is considered as money. Moreover this increases their money demand too. Since holding money means that no interest payments can be received by the households this implies an opportunity cost. The money demand decreases as the opportunity cost rises. This is exactly the reason why the money demand curve slopes downward.[17]

When the interest rate is higher for a given level of income than predicted by the LM-curve there is an excess supply of money. In this case people

[17] See Mishkin, p.537

would like to reduce their cash holdings and buy bonds in order to make the bonds price rise leading the interest rate to fall. The contrary happens when the interest rate is below its equilibrium level. Because of the very low interest rate, it is less attractive for people to hold bonds and thus they want to increase their cash holdings. In order to increase their money demand they have to sell their bonds. By selling them the price on bonds goes down increasing the interest rate up to equilibrium.[18]

3.2.4) Factors that shift the LM-curve

Changes in the nominal money supply, the price level or autonomous changes in money demand will shift the LM-curve leading to a different interest rate.

3.2.4.1) Monetary Expansion

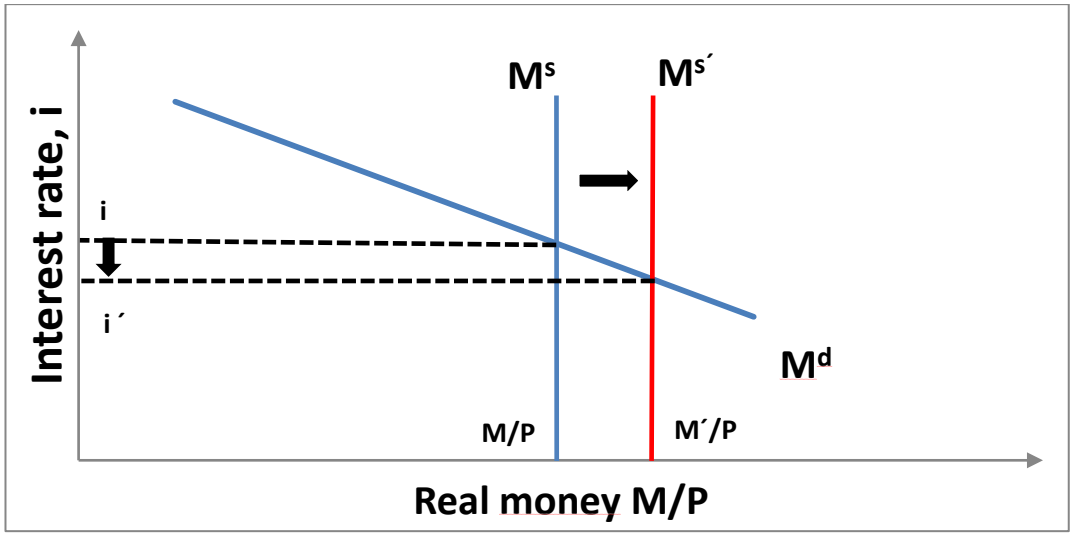
When the central bank conducts an expansionary monetary policy, it decides to increase the nominal money supply through an open market operation. Hereby it buys bonds and injects liquidity in the economy. At a given price level the increase in the nominal money supply leads to a higher real money supply. This in turn shifts the money supply line to the right. At a given level of income this lowers the interest rate (graph A).

$$M^s \uparrow \rightarrow \frac{M^s}{\bar{P}} \uparrow \rightarrow i \downarrow$$

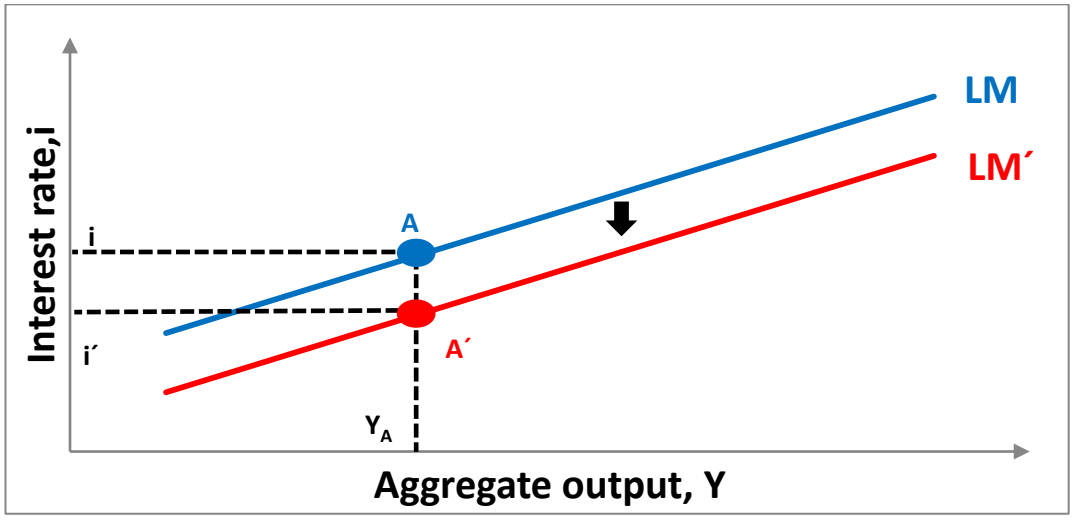
The lower interest rate stimulates economic activity through higher investments and increases income. A downward-shift of the LM-curve is expected (graph B). Moreover this has no effects on the IS-curve which remains unchanged. Expansionary monetary policy is better than expansionary fiscal policy in order to induce firms to invest. Since the level of transaction increases, firms are more likely to make investments in physical assets. The low interest rate implies a low opportunity cost for investments.

[18] See Mishkin, p. 538 f.

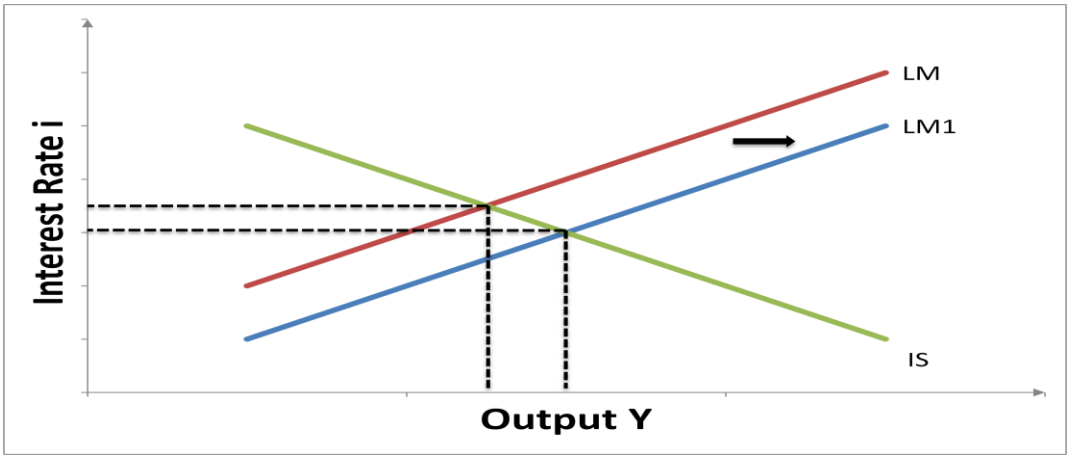
A: Effects of a monetary expansion



B: Effects of a monetary expansion (2)



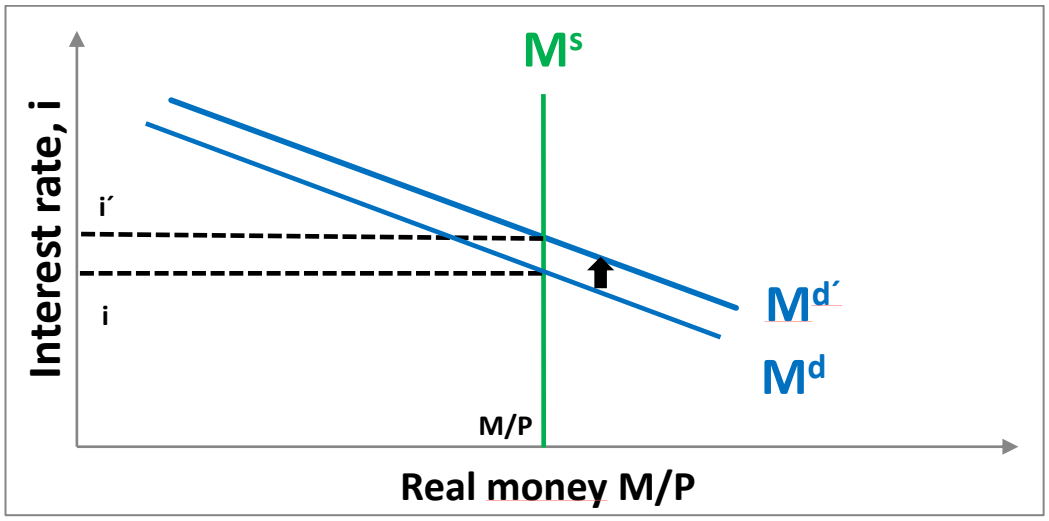
C: Effects of an expansionary monetary policy in the IS-LM model



3.2.4.2) Autonomous Changes in Money Demand

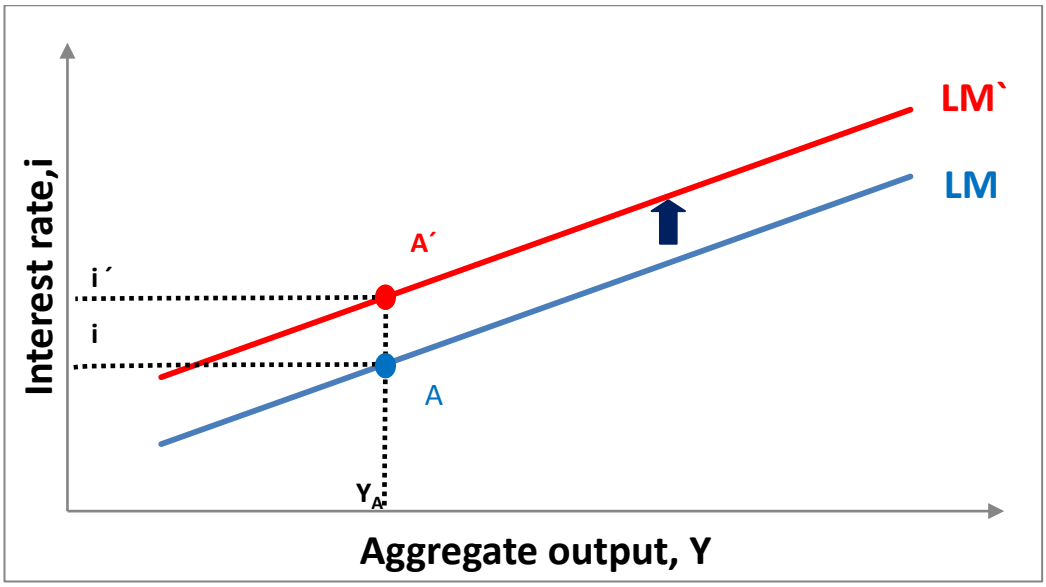
Shifts in the LM-curve can also occur through changes in the money demand that are independent of the price level, output or interest rate. During the financial crisis people became more risk-averse since companies and financial institutions fell into bankruptcy. Fearing a bank run they no longer want to hold bonds because they consider them as riskier than before. This in turn leads them to increase their money holdings. At any given interest rate and output, their demand for money will increase. This effect is demonstrated in the graph A by the upward-shift of the M^d-curve leading to a higher interest rate. Moreover this shifts the LM-curve upwards (shown in graph B). [19]

A: Effect of a change in autonomous money demand on the interest rate



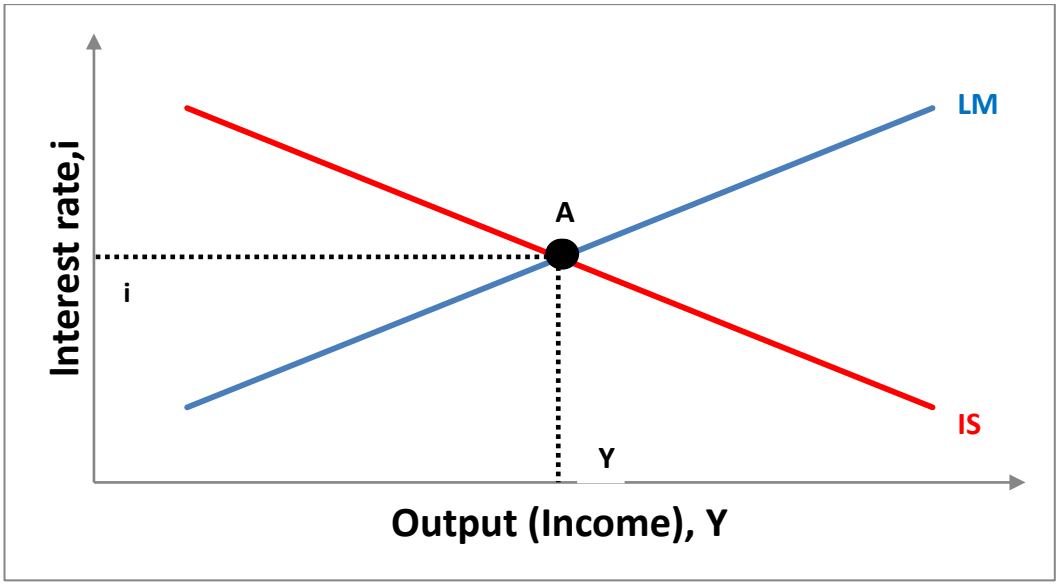
[19] See Mishkin, p. 546-548

B: Effect of a change in autonomous money demand on the LM-curve



3.3)The IS-LM diagram

Combining both equations from the IS and LM curve we get the intersection point A of the goods and the money market. Every point on the IS-curve determines equilibrium in the goods market and every point on the LM-curve is an equilibrium in the money market. Only where both curves meet equilibrium is reached in both markets.[20]



[20] See Blanchard, p. 115

3.4) The Role of banks in a frictionless system

People determine the amount of money they want to hold according to their level of transactions. The rest is hold in checkable deposits at a bank account. Such deposits are liabilities for banks since they can be drawn out by the depositor at any time. According to reserve requirements, banks are forced to hold a certain amount of reserves at the central bank. The money demand is determined as before by:

$$(1) \quad M^d = \$\, YL(i)$$

It implies a positive relationship between level of transactions and money demand and a negative one between interest rate and money demand. This is true because as the interest rate on bonds increases, more people want to hold bonds instead of money leading to a lower money demand. Consequently people have to decide on the proportion of money they want to hold in currency (CU) and in deposits (D). For this reason one comes up with the following equations:

$$(2) \quad \boldsymbol{CU^d = c\, M^d}$$

Whereby c is a fixed proportion hold in currency (the rest is hold in deposits → (1-c)

$$(3) \quad \boldsymbol{D^d = (1-c) M^d}$$

Since banks have to be concerned only about the deposits D in reference to reserve R, the following relation between R and D can be pointed out:

$$(4) \quad \boldsymbol{R = p\, D^d}$$

P is fixed, since it is determined by the central bank in accordance to the reserve ratio (normally 10 percent in the United States)

Replacing D^d from equation (4) with equation (3) R^d is determined:

$$(5) \quad \boldsymbol{R^d = p\,(1-c) M^d}$$

For this reason the demand for central bank money is the sum of the demand for currency and the demand for reserves. Putting all the

information together, the demand for central bank money is explained by the following equation:

$$(6)\ \boldsymbol{H^d = CU^d + R^d}$$

Replacing CU^d from equation (2) and R^d from equation (5) the demand for central bank money is determined in equation (7):

$$(7)\ \boldsymbol{H^d = [c + p(1 - c)]\$YL(i)}$$

To have an equilibrium, demand for central bank money has to be equal to the supply for central bank money that is determined by the central bank. Consequently we get $H^s=H^d$.

Furthermore the IS-LM model is based on the "bank lending channel" and implies that banks primarily fund themselves with deposits. As will be pointed out later on this was a critical point during the crisis. A reduction in the supply of reserves requires the volume of deposits to be reduced. This means less lending by commercial banks and becomes a problem when banks lack other sources of funding and are forced to rely only on deposits.

In the traditional model it is assumed that there are no credit frictions and for simplicity banks don't make loans. For this reason banks assets are determined only by reserves and bonds. Although it shouldn´t make a great difference whether a bank lends money to a firm or the government, liquidity terms have to be taken under consideration. When a bank purchases a government bond it can easily resell it in the bonds market. This means that government bonds are very liquid assets. Instead, when a bank makes a loan to households or businesses, loans cannot be reconverted that easily because of its illiquid nature. Assume for example that a firm lends money from a bank in order to come up with a higher demand for goods. To increase production it has to buy new machines and plants. Since some investments by private parties are risky, the bank has to be aware of the fact that some loans will not be repaid. In such a situation a bank panic (as described above) can occur. [21]

[21] See Blanchard, p. 95-100

4) Deviations from the ISLM model

4.1) Woodfords Financial Intermediation and Macroeconomic Analysis

The article points out why conventional models working through the "bank lending channel" cannot be used to explain the current financial crisis. In this model the majority of borrowers has no possibility to borrow from capital markets and is therefore forced to rely on credits from commercial banks. Those in turn held deposits by central banks primarily with the aim of fulfilling legal reserve requirements.[22] In this respect banks play an essential role in the provision of credit. When the central bank conducts an expansionary monetary policy the increase in bank reserves and furthermore deposits leads to a higher quantity of bank loans available. The increase in bank loans has a positive effect on the economy since more investments are made.[23]

Due to important changes and innovations in the financial system other nonbank financial intermediaries nowadays can act as substitute in providing credits. This is a result of the increasing importance of securitization. Mishkin defines it as "the process of transforming otherwise illiquid financial assets (…) into marketable capital market securities". Hereby the financial institutions construct a portfolio of mortgages and receive interest and principal payments on those loans. They sell these securities to third parties providing them with the interest and principal payment. Financial institutions can charge a fee for their service and thus making profits without taking any risk.[24]

Furthermore the importance of deposits as main source of funding has decreased, leading to new "broad credit channel". As a result M. Woodford developed a model that takes account of factors that can influence the efficient supply of credit and emphasize the role of financial intermediation. Curdia and Woodford make some important assumptions in their dynamic stochastic general equilibrium (DSGE) model such as "(i) (…) financial

[22] See M. Woodford, Financial Intermediation and Macroeconomic Analysis, p. 23-26
[23] See Mishkins definition for the bank lending channel, p. 605-606
[24] See Mishkin, p. 289

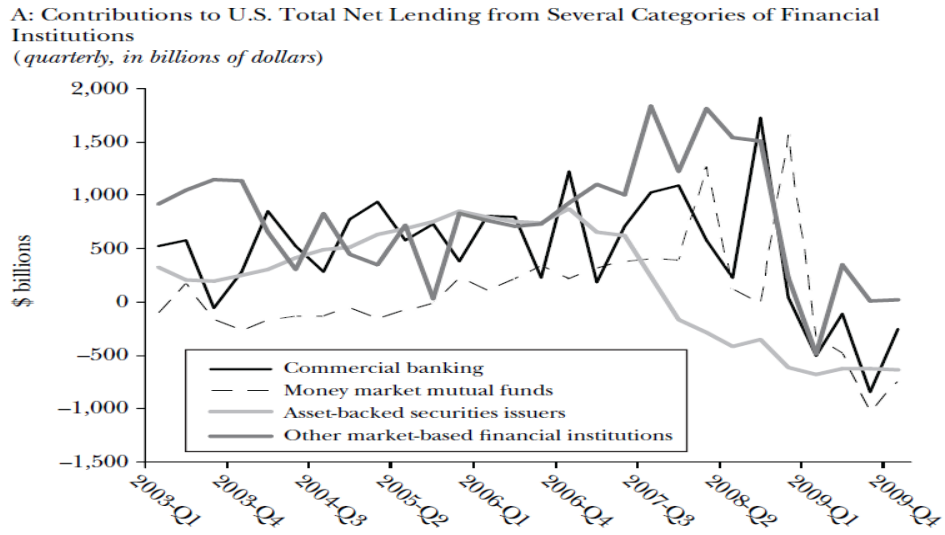
intermediation matters for the allocation of resources; (ii) imperfections in private financial intermediation and the possibility of disruptions to the efficiency of intermediation for reasons (are) taken here as exogenous; (iii) additional dimensions of central bank policy, by explicitly considering the role of the central bank´s balance sheet in equilibrium determination and by allowing central bank liabilities to supply transaction services".[25]

In order to fully understand the financial crisis one has to be aware of the fact that the financial innovations resulted in a disturbance of the credit supply. Woodfords IS-MP model is an extended version of the traditional IS-LM model and implies that monetary policy is active. Since central banks follow a specific interest rate target rather than fixing its money supply, the LM curve changes to the MP-curve.

4.1.1) A market-based approach

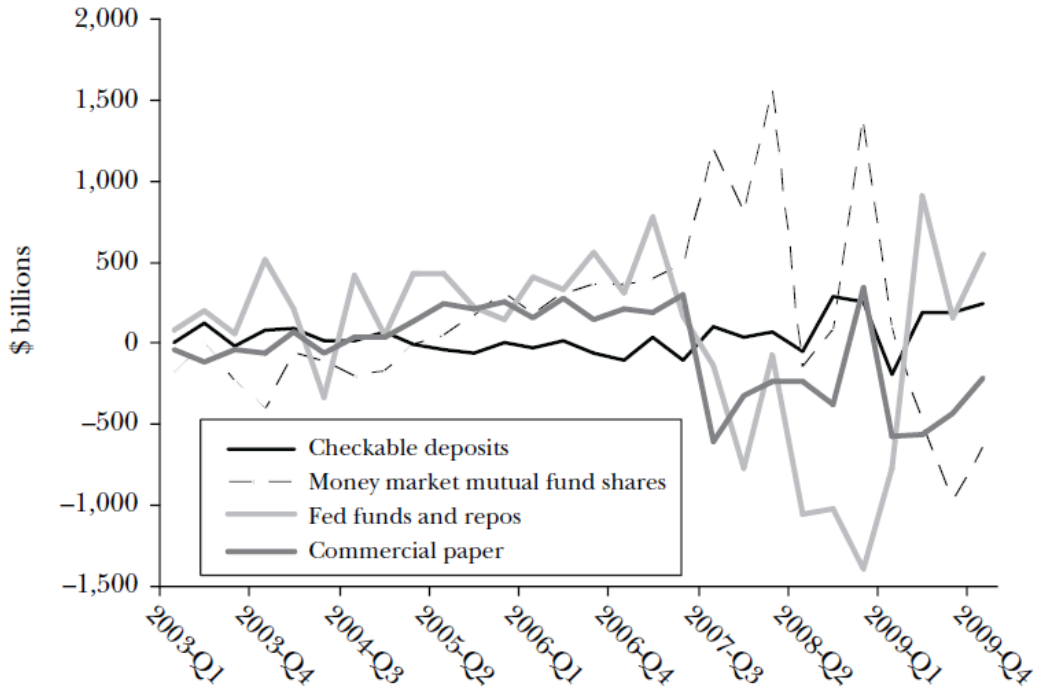
Referring to the graphics it can be concluded that the role of commercial banks in the provision of credit decreased during the crisis. Instead money market mutual funds and asset backed securities (until mid 2007) became an important source of lending. Moreover checkable deposits decreased sharply in the late 2008. This implies that other sources of funding became more important.

Figure 1
Financial Flows over the Most Recent Credit Cycle



[25] V. Curdia, M. Woodford, Conventional and Unconventional Monetary policy, p. 232

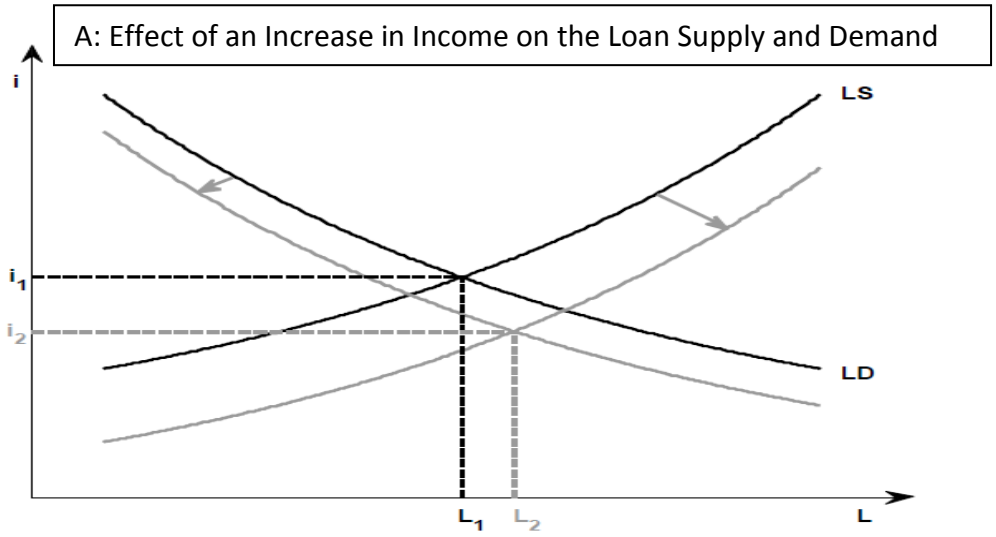
B: Contributions from Several Sources of Funding to the Net Increase in the Liabilities of the U.S. Financial Sector
(*quarterly, in billions of dollars*)



Source: Federal Reserve Board, Flow of Funds Accounts

4.1.2) The ISMP Model without credit frictions

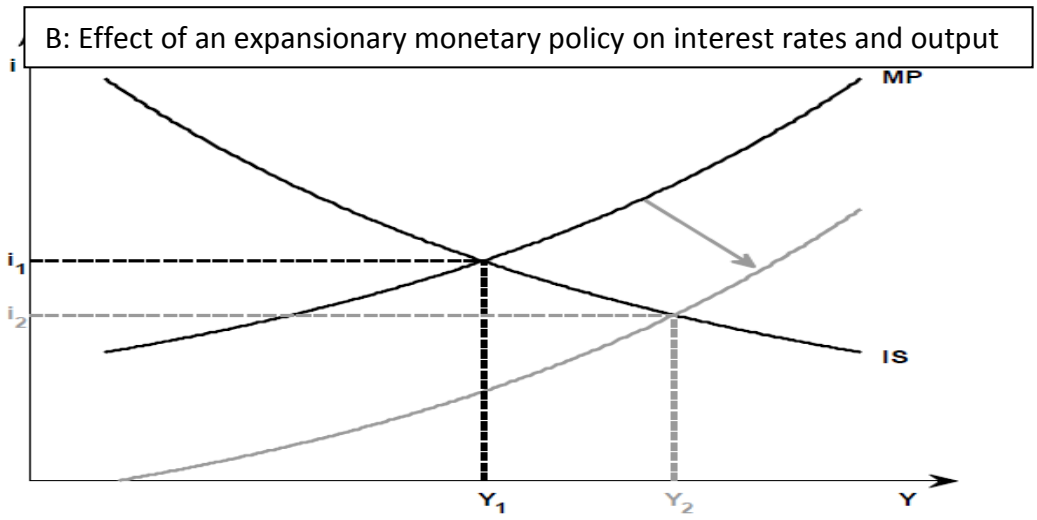
In conventional models as for instance in the traditional IS-LM model savers and lenders rely on only one interest rate. This means that all interest payments by the borrower are received at its full amount by the saver. In this sense financial institutions are led without profit opportunities. Therefore a higher interest rate implies a lower volume of lending since lenders have to pay more for lending money. With the assumption of a particular level of income, equilibrium is reached at the point where the loan supply and demand curves meet determining the interest rate and the volume of lending. An increase in the aggregate income leads to a shift of both curves.



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p. 27)

This happens because savers and lenders have more current income available and don´t consume all the additional money if their future income expectations remain the same. Savers increase their lending and borrowers reduce it. As a consequence we expect the loan supply curve to shift rightwards and the loan demand curve to shift leftwards. In the graph we can also see that the shift of the LD curve is smaller than the one of the LS curve. This is a result of the higher interest-elasticity of borrowers' expenditure. Combining the determined interest rate and the assumed level of income the IS-curve can be reconstructed. Since the central bank has to maintain a specific interest rate target the money supply can´t be held fixed as it is assumed by the LM curve. For this reason the LM curve becomes the MP curve for a given inflation rate. An expansionary monetary policy has the same effect as in the traditional IS-LM model. It shifts the MP curve to the right leading to a lower interest rate and higher income (shown in graph B).[26]

[26] See Woodford, p. 26 ff.



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p. 27)

4.1.3) Limitations

The model needs to be extended since it is an unrealistic simplification to include only one interest rate. This is the first reason why the IS-LM model is not sufficient in explaining the recent crisis. As a matter of fact interest rates don´t move together and cannot be seen as perfect substitutes. In this sense we need to include an interest rate differential that allows our borrowing and saving rate to be different.

$$\boldsymbol{i^b - i^s = d(Y)}$$

Whereby $d(Y)$ allows for disruption and assumes that i^b is the same for all borrowers, and i^s the same for all savers independent of quantities.[27]

It can be concluded that there is no financial sector since the interest rate differential $d(Y)$ is equal to zero meaning that there is no margin between the borrowing and lending rate. As a result we come up with $\boldsymbol{i^b = i^s}$. The loan supply is positively related to income and interest rate while instead the loan demand depends negatively on the two factors:

$$\boldsymbol{L^s = L^s(Y, i)}$$
$$(+\ +)$$

$$\boldsymbol{L^b = L^b(Y, i)}$$
$$(-\ -)$$[28]

[27] See Curdia, Woodford, p. 234

The only difference to the traditional IS-LM model is that monetary policy is more concerned about the central banks´ interest rate reactivity to the inflation rate which can be calculated by the Taylor rule. As a consequence it takes account of the real interest rate instead of the nominal one.

4.1.4) Extension of the model including several interest rates

Financial intermediation plays a crucial role and in reality there are many different interest rates. The main distinction can be made between the interest rate paid to savers i^s and the one paid to borrowers i^b. Whereas the interest rate differential $d(Y)$ was zero in the case of only one interest rate, $d(Y)$ is positive now.[29] Furthermore intermediaries need to decide on the quantity of reserves, M_t, the want to hold at the central bank. In return they receive the nominal interest rate i^m. The interest rate differential will always be positive for two reasons: "(i) resources are used in the process of loan origination or (ii) intermediaries may be unable to tell the difference between good borrowers (…) and bad borrowers (…)".[30]The latter reflects the adverse selection and moral hazard problem described in the next section.

Moreover the loan supply curve LS changes to the funding supply curve as intermediaries overtake the role of direct lending. This implies that savers fund financial institutions. The demand curve remains as before with the only difference that borrowers need to pay a different interest rate as a result of the positive interest rate differential. Consequently this difference creates a profit opportunity for intermediaries.

$$\boldsymbol{i^b = i^s + d(y)}$$

It is important to realize that in the presence of intermediaries the crossing-point of the two curves is no longer relevant in determining the interest rate and lending volume. As long as the spread $d(Y)$ increases it will reduce the equilibrium of credit volume.

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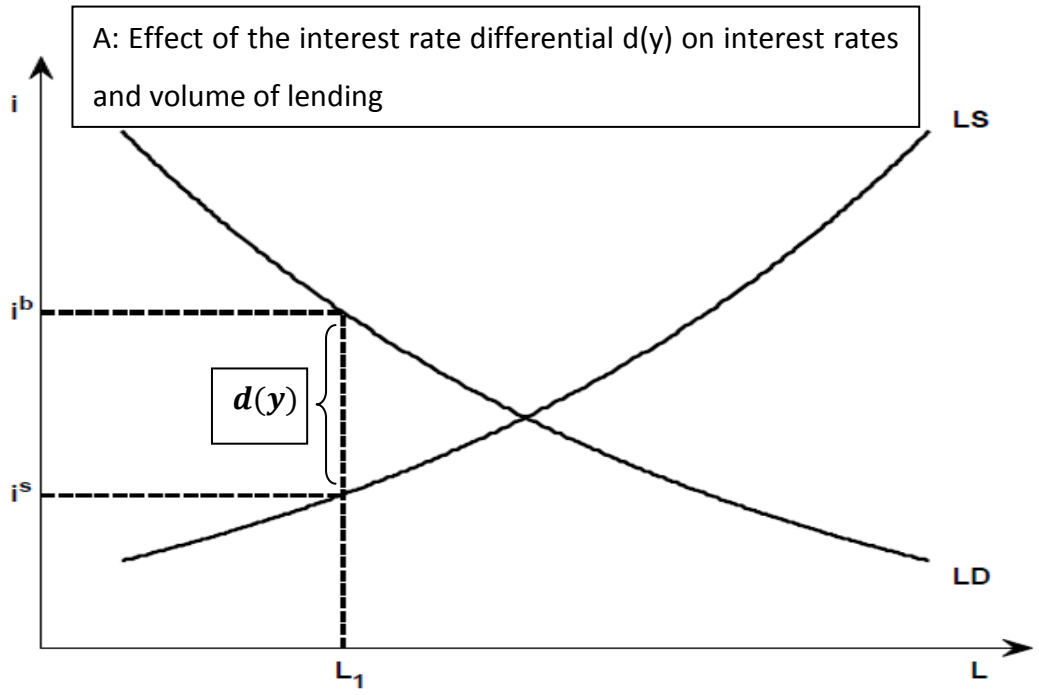
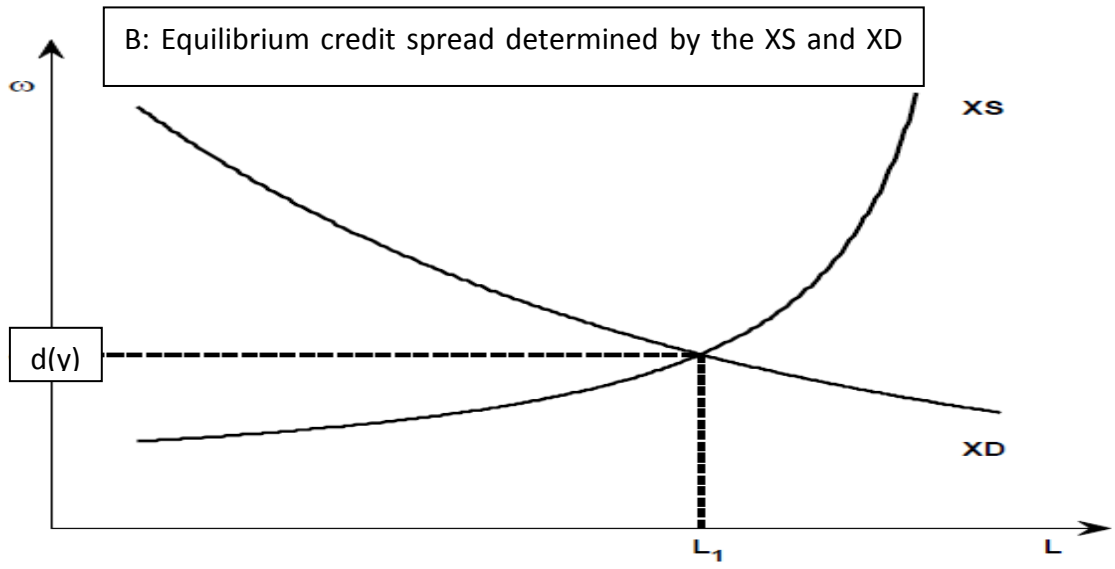
[28] C. Groth, A Note on Woodford´s Financial Intermediation an Macroeconomic Analysis
[29] See Woodford, p. 29
[30] See Curdia, Woodford, p. 238



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p. 30)

The demand for intermediation is determined by the XD curve that represents a relation between the quantity of intermediated credit and the credit spread. The slope of the curve points out the willingness of the borrowers to pay a higher interest rate than the one received by savers.

To find the equilibrium credit spread and the equilibrium volume of credit financial institutions need to decide about the volume of lending they are willing to transfer. This determines the supply of intermediation XS.



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p. 30)

There are limits for intermediaries in their supply of funds. Financial institutions can leverage their position only up to a specific level. It has to be pointed out that the higher the $leverage\ ratio = \frac{assets}{capital}$ the riskier the bank.[31] The interest rate differential depends mainly on two factors. The first factor is banks capital that is determined by regulation or the banks creditors. When loans are not repaid by the banks clients the banks´ capital decreases. This fall in turn increases leverage. In order to restore leverage the bank can increase capital by looking for new clients or decrease its assets by reducing the loans volume. The second factor that determines the interest rate differential is firms´ capital. In order to get a loan the firms´ capital can act as a guarantee. When loans exceed the firm's capital meaning that they cannot be guaranteed by the firms´ capital any longer they become risky for banks. For this reason banks charge a spread called external finance premium to overcome this problem.[32]

Referring to the crisis it can be concluded that the relative small shock to the value of bank assets resulting from losses on subprime and mortgages was enlarged through the large leverage ratios and produced losses in banks capital. As a consequence banks raised their external finance premium which decreased investment activity by firms.

4.1.5) Disruption of the credit supply

Any disturbance in the supply of intermediation shifts the XS schedule up. This means that borrowers can lend money only at a higher interest rate while lenders are left with lower interest payments for a given economic activity. Moreover the spread increases while lowering the volume of lending. The IS-curve shifts down because the equilibrium value is determined by the i^s. When monetary policy is unchanged the upward-shift of the XS-curve will decline the interest rate and has negative consequences on the economic activity. Leverage constraints have also an important impact on reduction of credit supply. When leverage constraints are tightened intermediaries suffer some losses because they

[31] See Woodford, p.29 ff.
[32] http://catalogue.pearsoned.co.uk/assets/hip/gb/hip_gb_pearsonhighered/samplechapter/M20_BLAN8009_01_SE_C20.pdf, p.424 ff.

sell assets in order to fulfill the new leverage constraints. The problem arises when many intermediaries sell similar assets at the same time. The losses reduce their capital having a negative effect on the amount that they can borrow. This in turn leads to further asset sales, decreasing the credit supply.[33]

4.1.6) The IS-MP model with credit frictions: Woodfords explanation of the financial crisis

Woodfords model includes credit frictions and thus gives us a much better explanation of the recent crisis than the traditional IS-LM model. In order to make clear that the IS-LM model is not sufficient, the zero interest rate differential $d(Y)$ leads the XS curve to be horizontal determining a fixed volume of lending. According to this theory the economic activity is not affected by impairments on credit supply and thus has no influence on the IS-curve. Furthermore shifts in the IS-curve can´t work through the credit channel. In order to prove this one has to look again at the IS-equation.

$$\boldsymbol{Y = C(Y - T) + I(Y, i) + G + NX}$$

There is no channel through which changes in the capital of intermediaries or tightened leverage constraints could affect the output Y. We consider this characteristic as a great weakness especially when talking about the crisis.

Curdia and Woodford come up with the following equation in their analysis that includes the intermediary sector in the IS-curve:

$$Y_t = \pi_b c^b\left(\lambda_t^b;\xi_t\right) + \pi_s c^s\left(\lambda_t^s;\xi_t\right) + G_t + \Xi_t,$$

Expenditure demand function for borrowers	Expenditure demand function for savers	Exogenous government spending	Resources consumed by intermediaries

λ_t^b and λ_t^s are state variables, determining the marginal utilities of borrowers and savers.

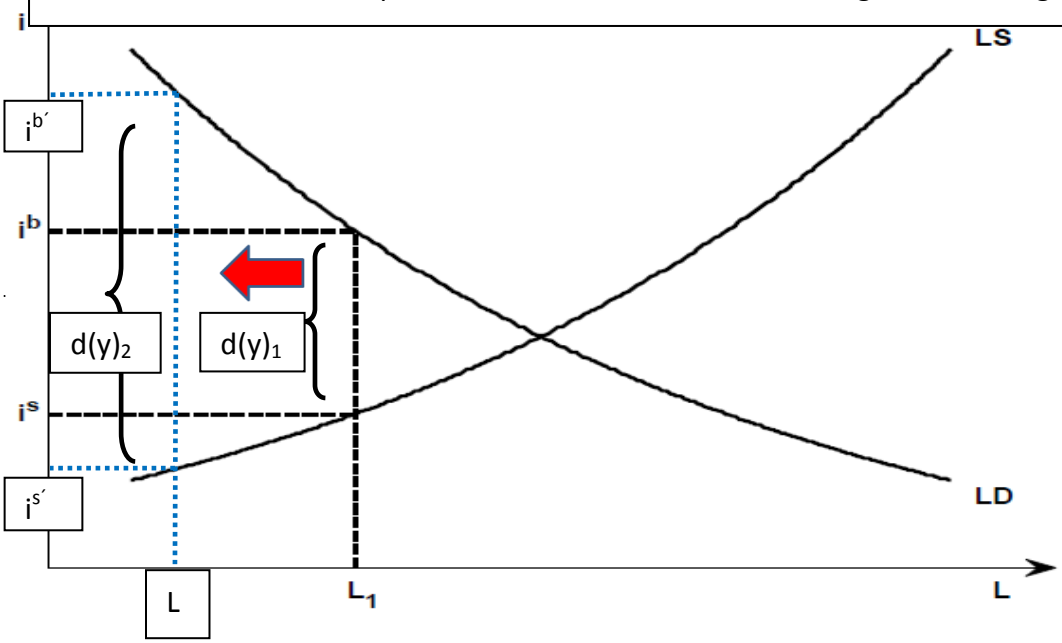
[33] See Woodford, p. 33-36

They are important since they include imperfect financial intermediation in the allocation of expenditure. Frictions are always in place when $\lambda_t^b/\lambda_t^s \geq 1$.[34]

Referring to Woodfords extended model I will explain the different channels that led to a sharp decrease in output during the crisis.

During the crisis creditors decreased banks´ leverage ratios as a result of the increased perceived risk. As a matter of fact this resulted in a liquidity crisis for issuers of asset-backed securities which were concerned as riskier assets and impaired the capital of financial institutions. This effect can be seen in graph B by the leftward shift of the XS-curve. Moreover this increased the credit spread and reduced lending. A larger credit spread means that borrowers have to pay a higher interest rate in order to get loans and savers have to accept a lower rate when financing financial institutions. Assuming that the volume of lending was determined by L_1 and the credit spread by $d(y)_1$ before changes in the leverage ratio, the spread increase led to a lower volume of lending. This is shown in the graph A.[35]

A: Increase of the credit spread as a result of a reduction in degree of leverage



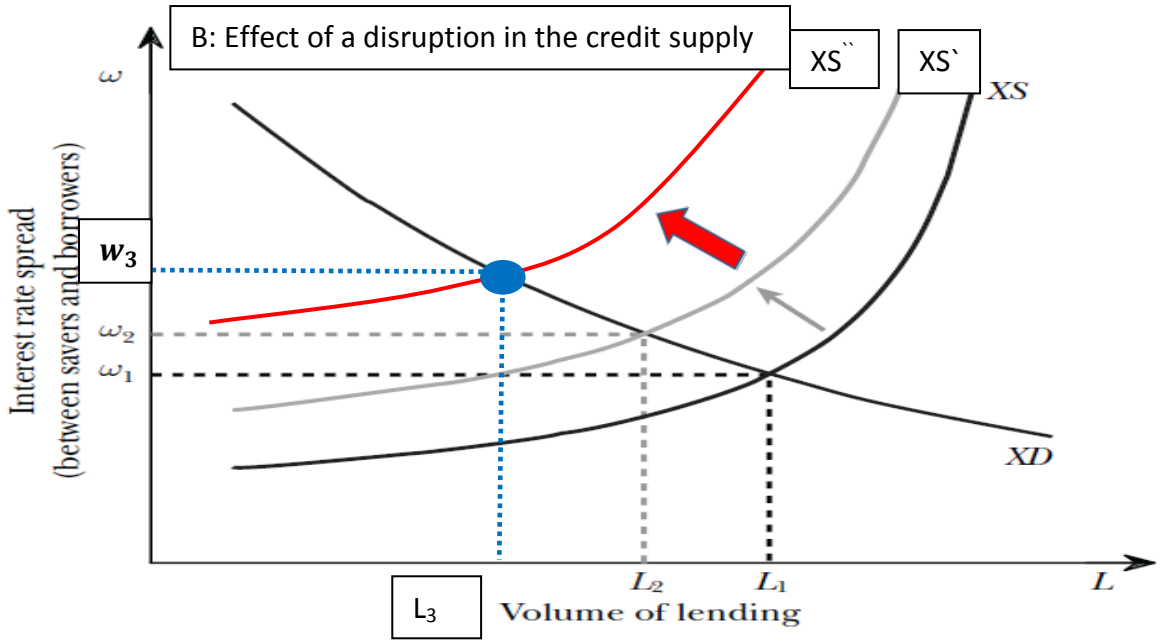
Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p.30), own modification

[34] See Curdia, Woodford p. 235/36
[35] See Woodfords explanation of financial crisis, p. 36-39

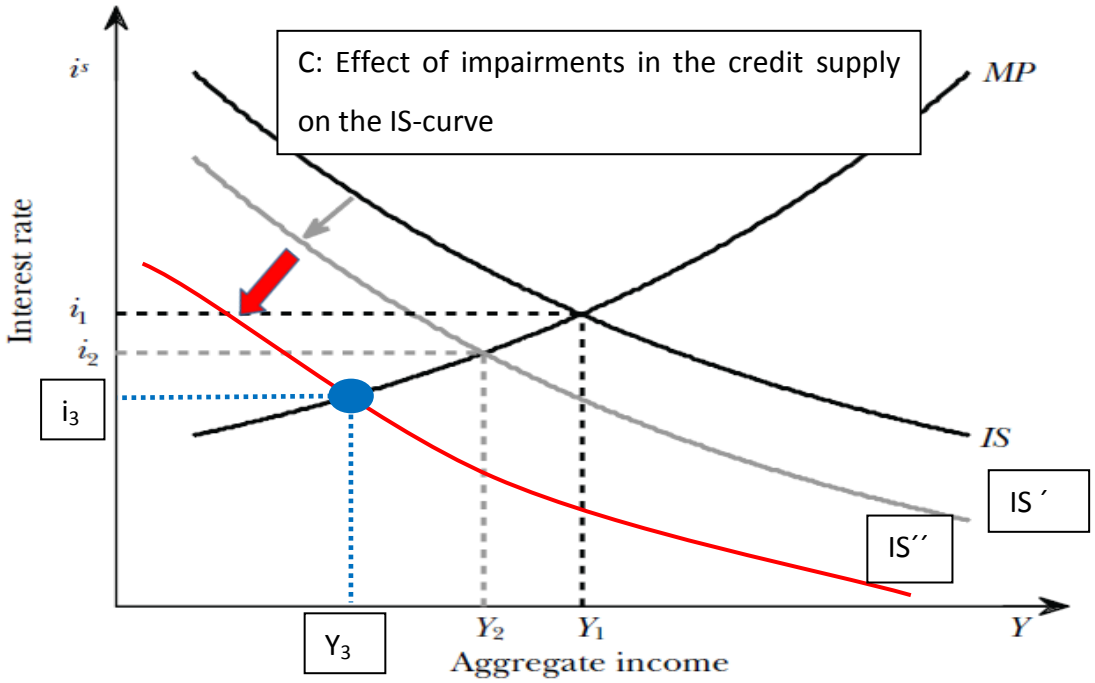
This led to additional impairments in the credit supply because it increased the adverse selection and moral hazard problem. Since borrowers with bad credit risks projects are more likely to make loans when the interest rate is high, financial institutions become more risk-averse and are less willing to make loans. As a consequence this further disrupts the credit market.[36] Curdia and Woodford include this problem in their analysis since they take account of a fraction of bad loans $X_t\,(L_t), where\ X_{t,}^{'}\ X_t^{''} \geq 0$. It is assumed that financial institutions are able to calculate the fraction of bad loans.[37]

Although the Fed cut its federal funds rate to support banks lending activities, the IS-curve shifted leftward. At the low interest short-term interest rate people increased their holding in deposits. Moreover the increase in deposits was not enough to reestablish the previous credit flow. Uncertainty about the future led people to further decrease their demand for goods and investments by increasing their saving ratios. This shifted the IS-curve further leftwards up to a point where it was very difficult to stimulate the economy any longer. Further cuts in the federal funds rate through expansionary monetary policy by the Fed led the MP curve shift rightwards until the zero lower bound. This is shown is graph D. We end up with a level of output where it is no longer possible to hold output near potential through open market operations since monetary policy has become ineffective.[38]

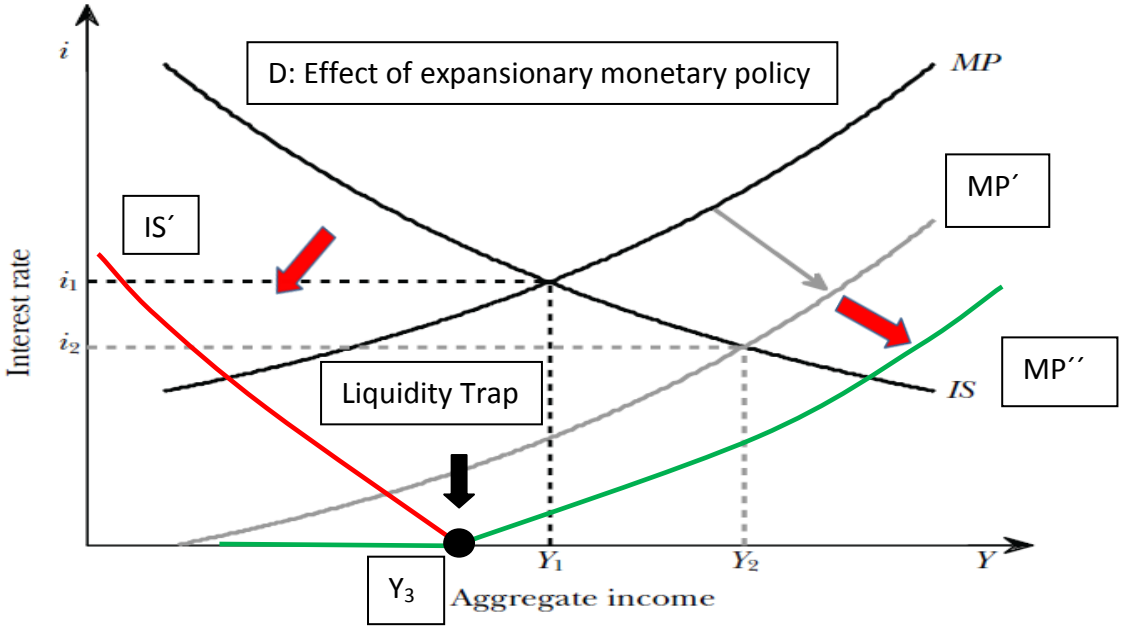
[36] See Mishkin, p. 174
[37] See Curdia, Woodford, p. 238
[38] See Woodford, p. 36 ff., Alstadheim, Ragna (2011). Credit Frictions and Unconventional Monetary Policy p.1-42



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p.34), own modification



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p.34), own modification



Source: Financial Intermediation and Macroeconomic Analysis (Woodford, 2010, p.27), own modification

It has to be pointed out that the supply of intermediation is dependent on the capital of intermediaries in order to understand what happened during the crisis. A disruption in the supply of intermediation will shift the XS curve to the left, increasing the credit spread while lowering the lending volume. This has also a negative effect on the aggregate output and shifts the IS curve to the left.

4.1.7) Solution to the problem

From our graph D it can be concluded that the only solution to stimulate the economy in a liquidity trap is to remove the impairments in the credit supply in order to induce financial institutions to pump money in the economy. This in turn should shift the XS-curve back rightwards decreasing the credit spread with a positive effect on lending. Since borrowers now have to pay a lower interest rate, they are more willing to lend money and this in turn has a positive impact on the overall economy due to an increase in investments by households and firms. As a consequence the IS-curve shifts upward.

4.1.8) Realization in Practice

First of all M. Woodford suggest a modification of the Taylor rule in order to set a specific target for the federal funds rate. Hereby it is important to subtract the credit spread from the standard Taylor Rule:[39]

$$\begin{aligned} &Federal\ funds\ rate\ target \\ &\quad = inflation\ rate + equilibrium\ real\ fed\ funds\ rate \\ &\quad + \frac{1}{2}\ (inflation\ gap) + \frac{1}{2}(output\ gap) \\ &\quad - [LIBOR - OIS\ spread] \end{aligned}$$

In a deep recession like in the current crisis it is fundamental to incorporate the credit spread (here: labor-ois spread) in the equation since it increased a lot. For this reason the federal funds rate target has to be set lower than during normal times in order to stimulate the economy. As we have seen above even this approach did no longer work in the crisis. The Fed cut the federal funds rate to zero with no effects on output. For this reasons unconventional monetary policies have to be put in place. Referring to the liquidity trap described in graph D, the IS-curve shifted that far that stimulating the economy would imply a negative interest rate. That is not possible in reality. The central bank has only two alternatives: reserve-supply policy or credit policy.[40] The former works through the interest paid on reserves. Hereby it can extend the credit conditions of the financial sector, enabling them to get liquidity by offering riskier assets as collateral. This in turn has effects on the size of intermediary's balance sheet by increasing its leverage ratio. In the latter case the central bank directly funds specific private segments in the economy. It can directly purchase debt claims by private borrowers and thus reconstructs the credit flow. More concern about unconventional policy measures will be laid in the next section.

[39] See Woodford, p. 412
[40] See Curdia, Woodford, p. 240

4.2) Credit, Money, and aggregate demand (Bernanke, Blinder)

4.2.1) Description of the model

Blinder and Bernanke developed a model that includes another financial asset, bank loans, and therefore takes account of intermediaries in the provision of credit. This deviation from the conventional IS-LM model assumes that money and bonds can no longer be seen as perfect substitutes. In contrary to the standard IS-LM model focusing on the money only view, this model includes three assets: money, bonds, and loans. Moreover it is assumed that bonds and loans have different interest rates and according to them borrowers and lenders decide which asset to hold. The loan demand is given by:

$$\boldsymbol{L^d = L(p, i, y)}$$

With $L_\rho < 0;\ L_i > 0;\ L_y > 0$

(i determines the interest rate on bonds and p the interest rate on loans).

It is important to point out that p has a negative impact on the loan demand meaning that as p rises the demand for loans goes down since it is more attractive to hold bonds. The contrary is true for the interest rate i . To develop the loan supply we need to understand the bank's balance sheet:

Assets	**Liabilities**
Reserves = required reserves (rD)+ excess reserves E (here: $E = 0$)	**Deposits D**
Loans L^s	
Bonds B^b	

Assuming the L^s is a positive function of p and a negative function of i we come up with:

$$\boldsymbol{L^s = \gamma\,(p, i)D(1 - r)}$$

$$\frac{\partial \gamma}{\partial \rho} \equiv \gamma_\rho > 0;\ \gamma_i < 0$$

(with similar equations for the shares of B^b and E)

Consequently the loan market clears when:

$$\boldsymbol{L}\,(\boldsymbol{p},\boldsymbol{i},\boldsymbol{y}) = \boldsymbol{\gamma}\,(\boldsymbol{p},\boldsymbol{i})\boldsymbol{D}\,(\boldsymbol{1}-\boldsymbol{r})$$

The money market is described by the equation:

$$\underset{(\,-\ +\,)}{\boldsymbol{D}(\boldsymbol{i},\boldsymbol{y})} = \underset{(+)}{\boldsymbol{m}\,(\boldsymbol{i})\,\boldsymbol{R}}$$

People increase their deposits when their income increases and decrease it when the interest rate i on bonds go up implying a higher opportunity cost for deposits. It is assumed that banks hold excess reserves $E = \varepsilon(i)\,D\,(1-r)$ and the deposit supply is given by $D^S = R\,m(i)$, where m(i) stands for money multiplier.

$$\boldsymbol{m}\,(\boldsymbol{i}) = \frac{\boldsymbol{1}}{[\boldsymbol{\varepsilon}(\boldsymbol{i})(\boldsymbol{1}-\boldsymbol{r})+\boldsymbol{r})]}$$

To prove this we have to be aware of the fact that $R = rD + E$. Now we can substitute our given formula in E ending up with the previous result.

The goods market is determined by a conventional IS-curve with the equation

$$\underset{(-\ -)}{\boldsymbol{y} = \boldsymbol{Y}\,(\boldsymbol{i},\boldsymbol{p})}$$

When replacing $D(1-r)$ of the first equation by $(1-r)m\,(i)\,R$ our first equation can be solved for p as a function of i, y, R

$$\underset{(+\ +\ -)}{\boldsymbol{p} = \ \emptyset(\boldsymbol{i},\boldsymbol{y},\boldsymbol{R})}$$

By substituting this equation into the goods market equation we get

$$\boldsymbol{y}\ = \boldsymbol{Y}\big(\boldsymbol{i},\emptyset,(\boldsymbol{i},\boldsymbol{y},\boldsymbol{R})\big)$$

This is our commodity and credit curve which shifts by monetary policy (R) and by credit-market shocks affecting the $L(\cdot)\ or\ \gamma(\cdot)$ functions.

When the loan market is irrelevant loans and bonds can be seen as perfect substitutes. This implies also that the elasticity of the loan supply is

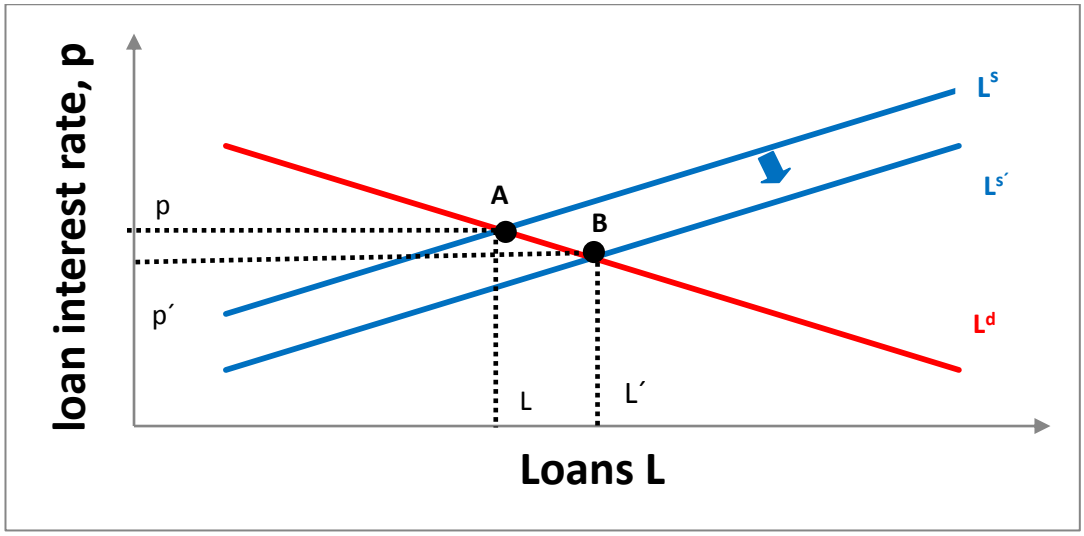
not infinite with respect to the loan rate. It would reduce our CC curve to the traditional IS-curve. This is known as the money-only view. When money and bonds are perfect substitutes the LM-curve becomes horizontal. This is known as the credit view. Since the CC-curve is affected by monetary policy, it is not ineffective in a liquidity trap. I will explain now what happens when the central bank conducts an expansionary monetary policy in the CC-LM model. [41]

The first channel through which monetary policy works is exactly the same as in the IS-LM model. When the central bank increases its money supply it will lead to a lower interest rate *i* on bonds. This in turn stimulates the economy through higher investment activity. As a result the LM-curve shifts rightward. In the graph B this implies a shift from point A to point B, lowering the interest rate and increasing the output. In the traditional model the economy would stop at point B. Including the credit channel in our model, also banks find it less attractive to invest in the bonds market because of the decreased interest rate *i*. For this reason they extend their credit supply to make profits. This works through the bank lending channel. Since the expansionary monetary policy leads to an increase in bank reserves and deposits, banks can easily increase the quantity of bank loans. This in turn lowers their interest rate on loans p as can be seen in graph A below. Household and firms are more willing to lend money at the low loan rate and thus increase their credit financed demand, like for example firms are more likely to buy plants and machinery. As a matter of fact banks still play an important role in the provision of credit since not all individuals and businesses have access to other financial markets. This can have a very positive impact on investment activities especially for small firms because they have to rely more on bank loans than multinational firms with large liquidity reserves and other financing possibilities.[42] This in turn shifts the CC-curve to the right and is demonstrated by the movement form point B to C increasing output and interest rate *i*. It can be concluded that the monetary policy has further expansionary effects on the economy when the credit channel is

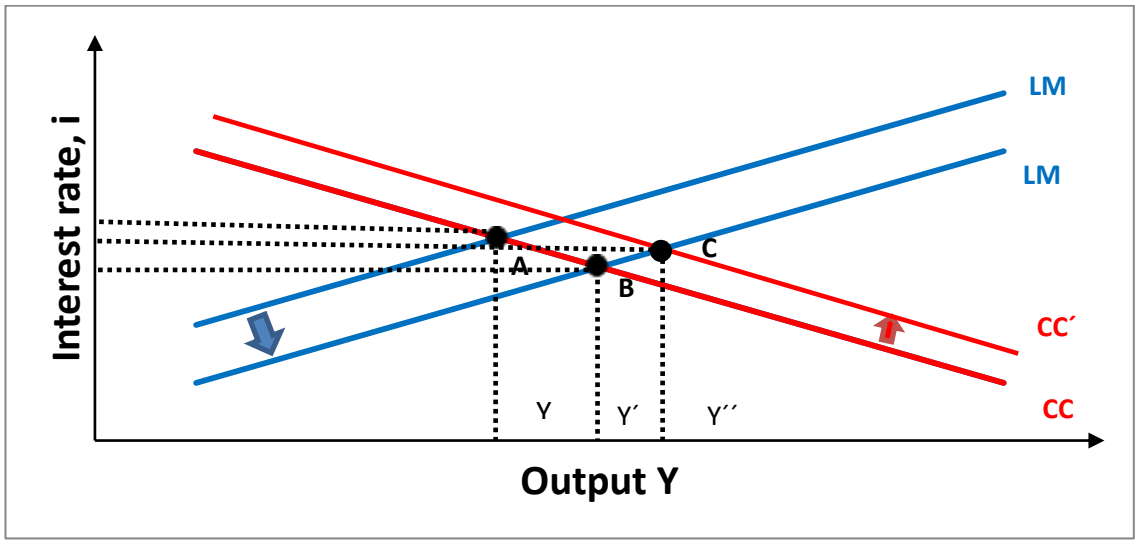
[41] Blinder, Bernanke, Credit, Money and Aggregate Demand, p. 435-439
[42] See Mishkins explanation of the bank lending channel, p. 605 f.

included in respect to the IS-LM model where the credit market is largely ignored.

A: Effect of an expansionary monetary policy on the loan supply of banks



B: Effect of monetary expansion on the interest rate i and output Y in the CC-LM model



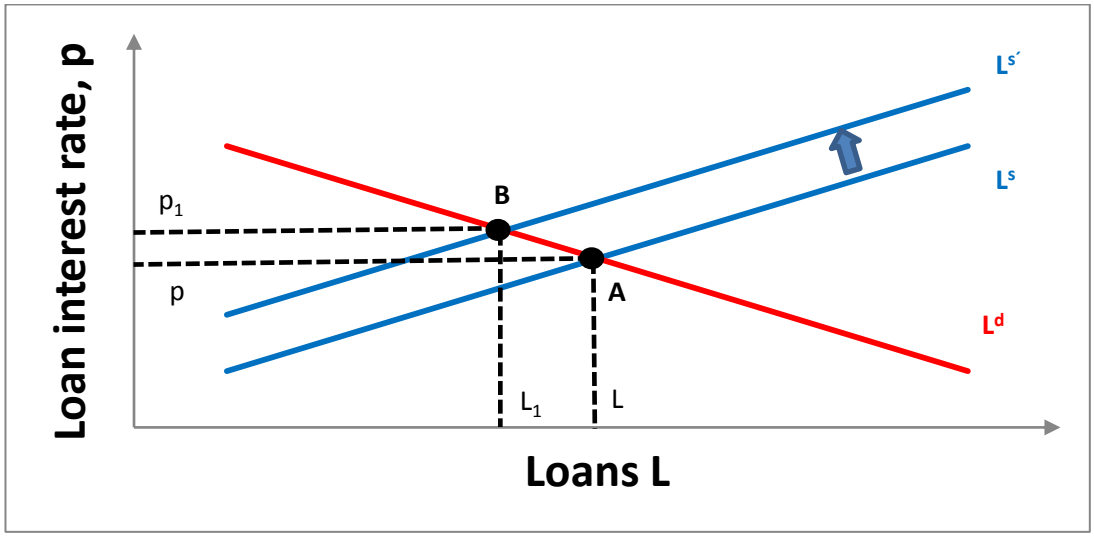
4.2.2) The CC-LM Model: A better Explanation of Reality

As a difference to the traditional IS-LM model the CC-curve is also affected through monetary policy because of its relation to the credit market. This is a crucial point in order to understand what happened during the crisis. As a matter of fact the credit supply function is included in the CC-curve and implies that any impairment will shift the curve leftwards. The perceived riskiness of loans increased during the crisis and

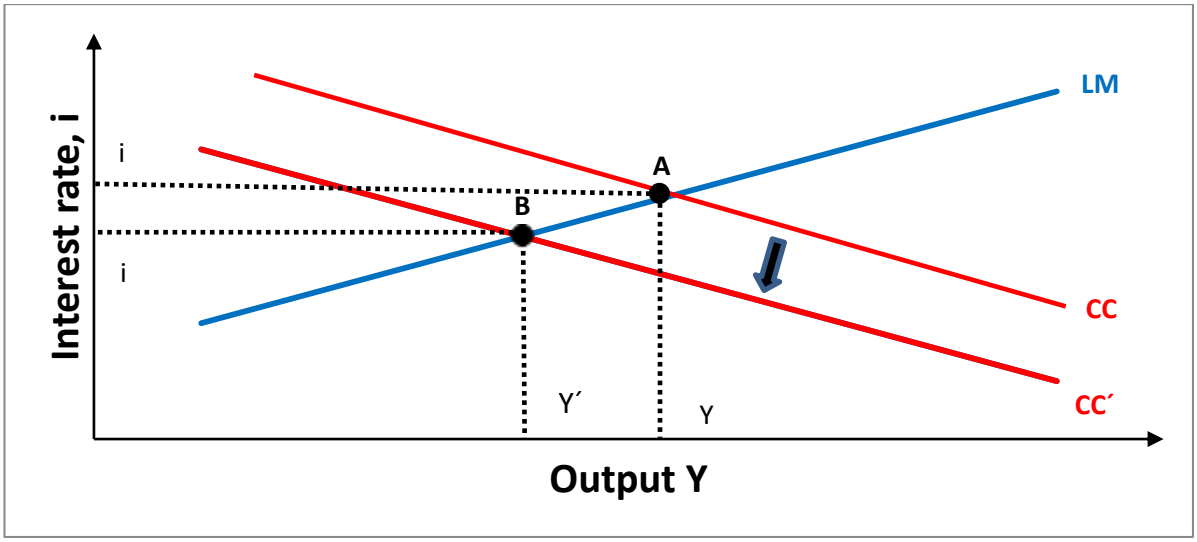
banks were afraid that loans couldn´t be repaid by their borrowers. Securities provided by borrowers acting as a guarantee for the bank in case that the loan cannot be repaid decreased as well. As a consequence banks decreased their credit supply while increasing the loan interest rate p as it shown in graph A.

Furthermore this increased the monitoring costs in order to distinguish between good and bad borrowers resulting from the adverse selection and moral hazard problems, had further negative consequence on the loan supply of banks. Because of the inverse interest rate structure the increase in the loans interest rate p, decreased the interest rate in the bonds market. This shifted the CC-curve to the left having negative effects on income and interest rates.

A: Effect of a decrease in loans supply on the interest rate



B: Effect of impairments of credit supply in the CC-LM model



5) Measures of unconventional monetary policy

5.1) Expectation channel

Central banks have several monetary policy options in a liquidity trap. The first option works through expectations. Hereby the central bank explicitly commits to hold the short-term-interest rate at a certain, low level over a specified period or until an inflation target level is reached. Therefore it guides households and business expectations about long-term interest rates in the future. The important point here is that the commitment has to be credible.[43] Referring to the expectation theory "the interest rate on a long-term bond will equal an average of the short-term interest rates that people expect to occur over the life of the long-term bond"[44], economy can be stimulated when interests are low through increased investments. Moreover the commitment to a low short-term interest target influences inflation expectations because of their inverse relationship and thus prevents inflation expectations from declining. This in turn avoids a rise in the real interest rate.

[43] B. Bernanke, Conducting Monetary Policy at Very Low Short-Term Interest Rates, p. 85-86
[44] See Mishkin, p. 132

This approach cannot be considered as quantitative easing since the size and composition of the central banks´ balance sheet remains the same.

5.2) Quantitative Easing

Situation in which quantitative easing can be effective

When interest rates are near zero, banks can still make money by buying treasury bills without taking any risk. This exactly happened during the crisis. Banks hold additional money in their reserves as a buffer and were not willing to lend to the economy. The reason for this behavior was that they were afraid of making bad loans with high risks that the loans couldn't be repaid. This approach was also explained in the CC-LM model. As a matter of fact the credit market was frozen. In order to induce businesses to make investments and unfreeze the financial markets, the central bank can conduct quantitative easing.

Quantitative easing can be defined as varying the amount of aggregate reserves to influence the spread between the federal funds rate and the interest rate on reserves. This in turn should influence the liabilities of the Fed´s balance sheet. The central bank hereby injects money in the banking system and in return buys for example asset-backed securities from banks. Moreover it also purchases treasury bills. By increasing their demand, the price for treasury bills goes up leading to a lower yield. As a consequence banks have no longer incentives to buy treasury bills because of their low yield. The central banks´ hope is that banks will unfreeze their lending channel and supply credit to the economy. To sum up by purchasing bank (bad) securities the central bank takes pressure from the banks and gives them less incentives to buy treasury bills because of their low profit opportunities. It should be more attractive for banks to lend money to businesses with safe investment projects.
This leads to an increase in the size of the central banks´ balance sheet.[45]

[45] Blinder, Alan S. (2010). Quantitative Easing: Entrance and Exit strategies, p. 1 ff.

5.3) Investing in longer-term treasury bonds

Another option for the central bank is the extension of liquidity to financial institutions. Hereby the central bank lends funds with longer maturities to banks and is willing to accept not only high quality collaterals. This should have a positive effect on the banks credit supply, such as it increases new credit. This in turn flattens the yield curve. As the risk premium shrinks the aggregate demand is boosted.[46]

5.4) Credit easing

The central bank changes the composition of the central banks´ balance sheet through purchases of private securities. Since financial assets differ in liquidity and risk composition they cannot be threaten as perfect substitutes. If for example the central bank decides to purchase riskier assets, such as stocks or corporate bonds, it automatically alters its balance sheet. With this approach the central bank is able to inject liquidity directly in market segments, supporting businesses with liquidity problems. It can do this by the acquisition of commercial papers, corporate bonds and asset-backed securities. While the effect on the money supply is the same as when buying financial assets from banks, the central bank now increases its risk profile on the balance sheet. This happens because it deals directly with the private sector. According to Paul Krugman (2008) “the Fed is taking the role of a private bank- by investing in assets with much higher risk than its non-risk treasury bills”. Critiques point out that the increase in demand resulting from the $2 trillion purchases of private assets is not enough to increase their price. The reason is the great extend of the market for private assets so that the change in price is not sufficient to create a new equilibrium.[47]

[46] Blanchard, Unconventional choices for unconventional times, p. 7-11
[47] See http://www.ecb.int/press/key/date/2009/html/sp090428.en.html

6) Comparison between the Feds and ECBs monetary policy measures

6.1) Fed´s monetary policy during the crisis

The Fed Reserve´s policies can be summarized by three categories. I will mainly ignore the interest rate policy since the federal funds rate already reached the lower zero bound in 2008. It is nevertheless important to point out that the Fed pays interests on required reserves and excess reserves held by commercial banks. In this sense it created a new policy instrument by changing the spread between the federal funds rate and the rate on reserves. When following a quantitative policy the Fed changes the size and compositions of its liabilities. The credit policy channel was the most important one during the crisis as it is concerned about the composition of the asset side of the Feds balance sheet.[48]

The conventional monetary policy channel was exhausted because of the liquidity trap described before. In December 2007 the Fed introduced its TAF (term auction facility) program. With this program it was possible to enlarge the narrow circle of banks that could have access to central bank liquidity. Through regular auctions banks were able to lend federal funds for one month instead of the overnight option. The extended version of the TAF program, called TSLF (Term Securities Lending Facility), enabled banks further to change illiquid securities or commercial papers against liquid government bonds.[49] Moreover the Fed relied more and more on foreign exchange swap-lines with foreign central banks to improve the dollar-liquidity abroad. Although these programs increased the amount of credit created, the Fed lowered its treasury holdings by almost the same amount in order to hold its balance sheet constant. Furthermore direct credit support was given to debtors and investors with programs such as AMLF (Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility, CCPFF (Commercial Paper Funding Facility), MMIFF (Market Investor Funding Facility), TALF (Term Asset-Backed Securities

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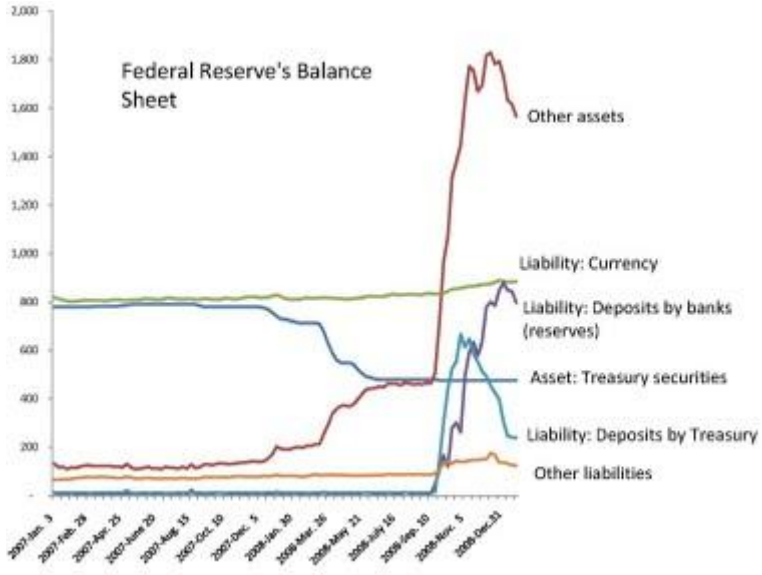
48 http://www.peri.umass.edu/fileadmin/pdf/conference_papers/SAFER/Rude_World_Economic.pdf

49 See Schuberth, p. 493-495

Loan Facility. The aim of these programs was the re-establishment of financial stability. Hereby the Fed lent treasuries to primary dealers and allowed them to widen the collateral range by giving them access to the discount window. Through this approach the Fed altered the asset side of its balance sheet by replacing highly liquid treasuries and loans with a wide range of collaterals. Consequently the Fed no longer followed its traditional interest rate policy. Since it was no longer possible to influence the long-term interest rate through the short-term interest rate channel, the Fed had to influence long-term interest rates directly. It did this by large scale purchases of treasury and government sponsored enterprise (GSE) mortgage related securities. These programs also known as quantitative easing were conducted in March 2009 and December 2010. Such actions had an enormous effect on the Fed´s balance sheet and boosted it by more than $ 2 trillion.

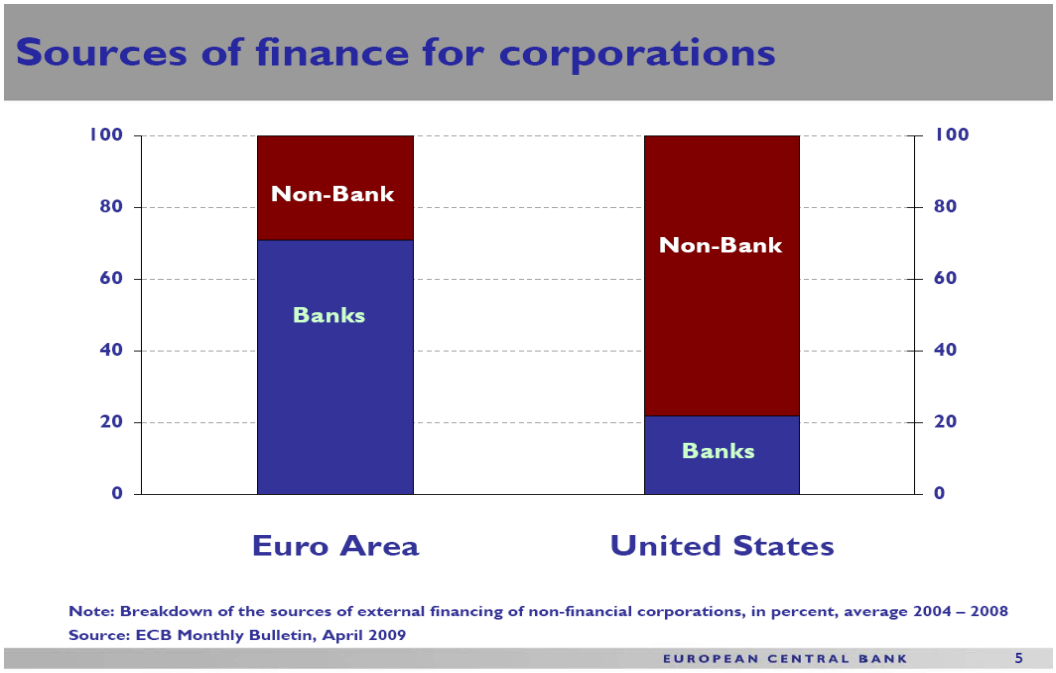


This in turn reduced the supply of treasury and GSE securities and increased their price. Because of the inverse relationship between prices and yields, investors had to accept lower yields. As a consequence of the lower long-term interest rates the economy was stimulated. Moreover the reduced availability of treasury and GSE led investors to switch to other assets, such as corporate bonds and in turn lowered their yields as well. The net effect of these actions was to lower yields across a broad range of securities. All these purchases were financed by adding to the reserves held by banks at the Fed without affecting the amount of money in

circulation. Finally these quantitative easing programs were successful in lowering the long-term interest rate, for instance the 30 year mortgage loan rate fell to 4 percent.[50] Moreover the Fed improved its communication channel by making monetary policy decisions more transparent and setting a clear target for price stability at 2 percent in the medium run.[51] This should help investors to better understand policy actions. Furthermore the Fed also gives guidance to investors and the public about future expectations of the federal funds rate.

6.2) ECB´s monetary policy during the crisis

The ECBs unconventional monetary policy was different from the one conducted by the Fed. When conducting monetary policy the ECB has to be mainly concerned about the banking sector. The economy of the euro area can be described by many small-medium sized firms that rely primarily on the credit supply from banks. They have no direct access to other credit markets and for this reason they are very limited in their sources of credit. By contrast companies in the U.S rely much more on market based credit (as can be seen in graph). More than 75 percent of external finance is made up of non-bank institutions.



[50] R. Reis, Interpreting the U.S. Monetary Policy of 2007-2009, p. 119-129, M. Labonte, Monetary Policy and the Federal Reserve: Current Policy and Conditions, p. 9-12
[51] http://www.federalreserve.gov/newsevents/speech/bernanke20090113a.htm

For this reason unconventional measures in the EU are focused on restructuring the functioning of banking system. The President of the European Central Bank Jean-Claude Trichet names the unconventional policies conducted by the ECB as “enhanced credit support” since it has to be guaranteed that the economy has enough liquidity to operate in an effective way.[52] In order to fulfill this condition banks have to be able to provide sufficient credit to households and firms.

After the collapse of the Lehman brother the refinancing rate was cut to 1 percent, a decrease of 325 basis points. When in august 2007 the interbank market was disrupted seriously for the first time during the crisis, the ECB increased its demand of liquidity by 95 billion euro. This was done through an operation on a full allotment at policy mode which led to the evolution of the fixed tenders with full allotment in September 2008. Hereby the repo rate is preannounced and all other main refinancing operation rates are equal by construction. Because of the full allotment the cover- to- bid ratio is one. With this new tool it was possible for banks to get unlimited liquidity in an interbank market where it was difficult for several financial institutions to borrow from each other. Furthermore the ECBs´ list for collaterals was extended even more and allowed financial institutions to have liquidity against their riskier assets. It has to be pointed out that the list has been quite broad even before the crisis in contrast to one in the U.S and included also private papers. Moreover the ECB lengthened also the maturities of their refinancing operations up to one year. In its first operation it injected 442 billion euro in the banking system and gave banks the possibility to increases their credit supply giving a stimulus to the economy. In order to make this new system function banks have to recognize that they have to expand their long-term assets. This means they should support profitable investments by providing households and firms with low long-term interest rates. It has to be made sure that banks don’t park the excess liquidity in their reserves at the central bank. Moreover in order to overcome liquidity problems at an international level, swap agreements have been made by the ECB and

[52] http://www.cesifo-group.de/portal/pls/portal/docs/1/1185986.PDF

several other central banks. In May 2009 the ECB decided to purchase covered bonds at an amount of 60 billion euro. This should help reviving important market segments such as the infrastructure and housing market. Covered bonds played a crucial role in the refinancing of banks and thus the ECB had to make sure that the market did not shut down in the long run.[53]

7) Conclusion

Once the economy is stuck in a liquidity trap unconventional monetary policy becomes unavoidable to stimulate the economy. During the financial crisis central banks had to find new ways and instruments of monetary policy intervention in order to soften the tight credit market. The structure and composition of the financial markets changed fundamentally during the last years. Whereas households and firms relied only on bank loans a couple of years ago, they now have several options to choose from due to the broad credit channel. Examples are the money market mutual funds and the asset backed securities.

Starting from the macroeconomic IS-LM model it has been shown that a new approach to implement credit frictions and impairments of the credit supply is needed for the understanding of the financial crisis. Taking account of the fact that also the goods market is affected when disturbances in the financial market play a crucial role is important, especially nowadays. Although the traditional model gives a sufficient explanation of the effects on monetary policy during normal times, the missing link between the credit market and the goods market has to be underlined as a great weakness of the traditional model. Curdia and Woodford therefore realized that the only explanation for the deep recession was a disturbance of the credit supply affecting also the IS-curve by shifting it sufficiently leftward. They concluded that the economy could only return to the natural output level by removing these impairments and therefore shifting the IS-curve back to previous level. Such findings are not fundamentally new and the cornerstones were already worked out by Blinder and Bernanke (1988). By including bank

[53] See Schuberth, p. 493 ff.

loans in their model, they found an additional channel through which impairments in the credit supply could affect the economy by shifting the CC-curve leftward. Nevertheless Curdia and Woodfords stochastic general equilibrium model is much better in explaining the crisis since it is especially focused on the structural change of the financial markets and includes an interest rate differential between borrowers and savers. Even though Blinder and Bernanke take account of the loan market in their model, it is still not adequate in explaining the crisis. The reason is an extreme increase in the credit spread during the crisis leading to a sharp decrease in the lending volume and therefore to a sufficient leftward shift of the IS-curve. By not implementing the interest rate differential between borrowers and savers in their model, the consequences of an increasing spread can´t be captured and don´t hurt the economy that much as it was the case during the crisis.

The new unconventional monetary policy approach is still controversial since the central bank should be independent in its traditional role. During the financial crisis central banks faced a big conflict between targeting its main inflationary goal and helping the economy out of the recession. On the one hand the quantitative easing program avoided a deeper recession and implementing these policies was effective and can be seen as a benefit in such a particular situation. Due to the interconnection of the financial markets around the world it was especially important for the Fed to counteract such a great recession in order to reduce the damage in other economies. Nevertheless unconventional monetary policies have high costs and should never be implemented as an additional lever. One has to be aware of the fact that implementing such policies increases also the risk profile of central banks and undermines the control of inflation.

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