Basic Macroeconomics
–
the IS-LM Model

An application to policy evaluation in the context of the current economic downturn

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Abstract: First of all, this course aims at giving the basic graphical representation of the $IS - LM$ model and intuitive interpretation of the underlying mechanisms and the main economic concepts. Second, the model is used to provide insights to the effects of monetary and fiscal policies that have been implemented since the beginning of the current economic downturn. The course refers to current economic debates about policy options. Third, the course concludes with some extensions of the basic $IS - LM$ model.

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This course is designed to be introductory, and strong simplifications have been made to keep the analysis simple. Yet, it remains quite powerful at giving intuitive insights into crisis scenarios and policy responses. In such a perspective, the main goals of a macroeconomic model is to explain short-run fluctuations of aggregate variables, especially GDP, and to serve as a tool to simulate different policy options. Throughout this course, we make the implicit assumption that increasing GDP favours employment, and reduces unemployment. We take this relationship as granted, as a discussion of the conditions under which it holds, or may be dampened, are beyond the scope of this course. Such issues will be extensively treated in other modules of the Summer School (see, notably, the ones related to Okun's law).

This course first derives the $IS-LM$ model, and highlights the main assumptions and mechanisms at work. An application to the current economic crisis is then proposed within this framework, concluding by some extensions of the model that have been considered.

1. The $IS-LM$ model: derivation

The $IS-LM$ model is a graphical representation of a Keynesian model of the macroeconomy, that has been first introduced by John R. Hicks in 1937[1]. We first highlight the underlying assumptions of the basic version of this model. We then derive the two curves, IS and LM, and the corresponding equilibrium, and eventually give some intuitions about the results that can be obtained within this framework.

1.1. Main underlying assumptions of the basic $IS-LM$ model

As any modelling exercise, simplifications are required in order to obtain a tractable and useful representation of the economy. Hereafter are the main ones that underlie the basic version of the $IS-LM$ framework. Section 3 refers to extensions of this basic model which relax some of those assumptions but, for the sake of simplicity, we stick to them throughout this section and the major part of Section 2. As it will become clear, the basic model is already a powerful tool to investigate the functioning of the economy and assessing policies.

1. **Short-run perspective**: the model has a Keynesian background, and therefore accounts for short-run fluctuations of the economy (typically within months), whereas long-run implications are usually tackled through the neoclassical theory.

   Accordingly, there exists a potential output level which is a full-employment level. In a Keynesian perspective, unemployment is due to a lack of aggregate demand and there is room for policy makers to increase it to bring back the economy at its full-employment output level. Box 1.1 provides further details on the origins of unemployment.

2. **Fixed prices (and wages)** In the short-run, prices and wages are sticky[2]. Therefore, the $IS-LM$ model relies on the assumption that prices and wages remain

[1] Mr Keynes and the Classics: A Suggested Interpretation, *Econometrica*, 5(2), April 1937, pp. 147-159.

[2] Imperfect adjustments of prices and wages can be explained by the costs that firms face when resetting their price (the so-called "menu costs"), and by employment contracts which set nominal wages over a given period, and prevent them to adjust immediately. Imperfect information about the

fixed (predetermined), and their dynamics remain out of the analysis. In particular, this assumption implies that real and nominal variables perfectly coincide, inflation expectations are zero, and a single interest rate denoted by i prevails. The consequences of relaxing this assumption are investigated in Sub-sections 2.2 and 2.3.

3. **A two-market world**: the model considers interactions between a goods market (where firms sell their production to households for consumption) and a capital market (where households purchase bonds with their savings to finance firms' investment).

4. **A two-asset world**: on the capital market, only one asset is traded (bonds), and households keep their remaining savings as money (i.e. as cash-on-hand, or liquidity). Money does not earn any interest rate, contrary to bonds.

5. **One single good**: every quantity in the model (either goods supply, goods demand, firms' investment, households' income, government expenditures...) is expressed as units of a single representative good (a composite good).

6. **A three-agent world**: only two types of agents interact in the two markets (i.e. households and firms), and the State may intervene through monetary and/or fiscal policies.

   In particular, financial intermediaries (mainly banks) are let out of the picture of the economy. The interest rate is the same whether it is paid on households' bank deposits on the `money market` or it is charged on firms' loans on the `capital market` (see Figure 18). The underlying rationale for the unique interest rate is the absence of uncertainty (i.e. a stable economic environment), and the perfect competition between banks which prevents them from adding a mark-up on the interest rates. This assumption is released in Sub-section 2.3.

7. **A closed economy**: the basic version of the model excludes international trade of goods and financial assets, and corresponding exchange rates issues. The analysis is restrained to a closed economy world. One possible interpretation is to consider the world economy as a single economy[3].

In line with these assumptions, the model consists of two curves, one standing for the goods market (the IS curve) and one representing the financial market (LM curve). We now derive each of them.

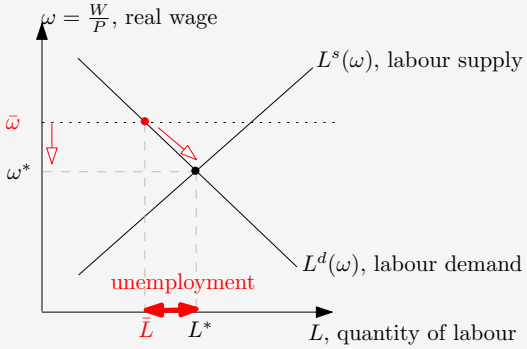
exact price level which will equalize demand and supply also causes prices and wages not to adjust immediately following a change in market conditions: imperfect information implies the necessity of search and information collection through "tÃćtonnement" processes, gradual adjustments, wait-and-see behaviour... All these forms of behaviour delay wage and price adjustments.

[3]For an overview of those issues within a basic macroeconomic model, see the Mundell-Fleming model.

Box 1.1 : Wage stickiness, lack of aggregate demand and unemployment

Labour demand comes from firms and is negatively related to the real wage level (i.e. nominal wage over the price level). Intuitively, as a unit labour becomes more expensive, firms are less willing to hire new workers, while households are more willing to supply labour to the firms.

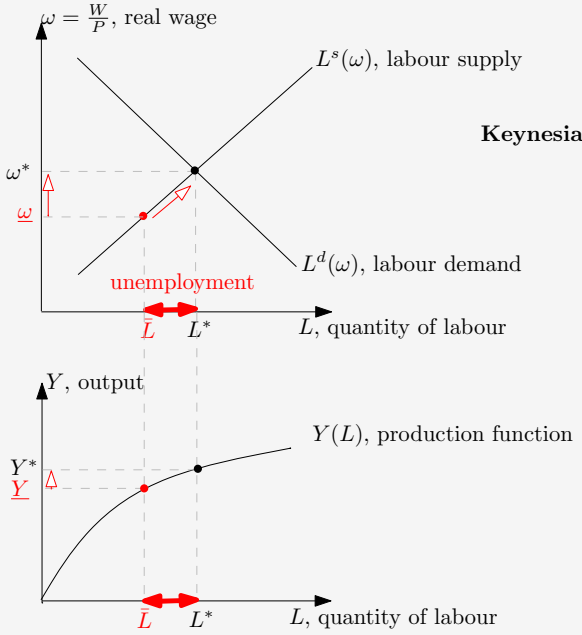
Two kinds of unemployment have been contemplated in economic theory. First, *classical unemployment* originates from wage rigidities, which prevents the labour market from clearing, i.e. equalizing labour supply from households and labour demand from firms. The effective real wage level $\bar{\omega}$ is higher than the market-clearing level ω^*, and unemployment arises. This is illustrated in the following figure:



Neoclassical unemployment

In the long-run, wages adjust so that the real wage level is cut down to ω^*, unemployment decreases, and hired labour converges to the full-employment level L^* (we suppose that L^* is fixed, and corresponds to the active population in the economy). The remaining unemployment can only be *voluntary*.

Second, the Keynesian theory takes the view that unemployment does not arise as a consequence of disequilibrium on the labour market, but comes from a lack of expected demand (the so-called effective demand) in the goods market. As a result, firms' production, and hence labour demand, lie below the potential level ($\underline{Y} < Y^*$), leading to a rise in unemployment. This is illustrated in the following figure:



Keynesian unemployment

The point $(\bar{L}, \underline{w})$ does not lie on the firms' labour demand curve. The solution is hence to increase effective demand to increase firms' labour demand, and bring back the economy to its full-employment level. This implies an increase in real wage (and, hence, households' demand on the good market), and unemployment is *involuntary*. This is the view that is taken thorough the course, and which is implicit in the $IS - LM$ model.

1.2. The IS curve (Investment-Savings)

The IS curve depicts equilibrium situations on the goods market, i.e. situations in which aggregate demand (coming from households' consumption) equals aggregate supply (coming from firms' production). We first explain how such an equilibrium is made possible within the theoretical framework of the $IS - LM$ model, then show what determines aggregate demand, and derive the IS curve.

1.2.1. Equilibrium in the goods market and prevalence of the aggregate demand

Firms are supposed to adjust the amount of goods that they put on the market to variations in aggregate demand (i.e. in households' demand). This adjustment operates through variations in their inventories. The underlying mechanism is represented by the Keynesian cross diagram (see Figure 1), and can be described as follows. For any given level of aggregate demand, firms make their production decisions according to the level of demand that they expect to face (the so-called Keynesian principle of "effective demand"). The expected demand may differ from the actual demand once households and firms enter the goods market. As a first step, if supply turns out to be higher than the actual demand, firms satisfy the demand, and accumulate the remaining unsold products as inventories. Conversely, if the actual demand is higher than the supply, firms use their inventories to meet the demand. As a second step, if the expected demand turns out to be lower than the actual one (resp. higher), firms adjust downwards (resp. upwards) their production level. These adjustments correspond to transitions from point A to A^*, and from B to B^* on Figure 1. A decrease (resp. increase) in goods supply leads to a corresponding decrease (resp. increase) in income, and then in aggregate demand. These feed-back adjustments correspond to translations from point A^* to B, and from point B^* towards E in the case of excess supply compared to actual demand, and to translations from point C^* to D, and from D^* towards E when supply is less than the actual demand.

In conclusion, **equilibrium in the goods market operates through variations in aggregate supply Y.**

Consequently,

i) The $IS-LM$ model depicts a situation in which the goods market is in equilibrium (in the short-run), i.e. aggregate supply Y^{as} has been adjusted through variations in inventories to match aggregate demand, and both are denoted by Y (either the income or the production in the economy, expressed in units of the composite good). This correspond to point **E** on Figure 1, and the associated GDP level is Y^E. We thus have:

$$Y^{as} = Y^{ad} = Y^E \qquad ([1])$$

ii) 1s aggregate supply passively adjusts to aggregate demand in the short-run, GDP is only demand-driven (Keynesian model), and policies should focus on aggregate demand, and aim at bringing it close to the full-capacity level of the economy through monetary and/or fiscal policies.

iii) As the model is demand-driven, any short-run fluctuations in aggregate variables, especially GDP, originates from fluctuations in aggregate demand. These fluctuations are

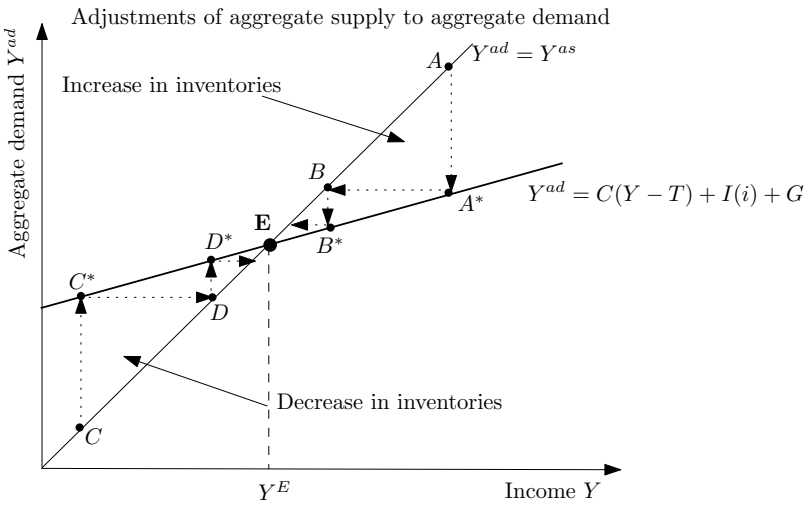


Figure 1: The Keynesian cross diagram: adjustments of inventories and convergence towards a short-run equilibrium in the goods market

The 45 deg. line expresses the accounting identity that aggregate demand is equal to aggregate supply, both equalling aggregate income.

due to shocks on its components, i.e. exogenous modifications of the determinants of aggregate demand. We now make explicit what these shocks are.

1.2.2. Components of aggregate demand

Aggregate demand is denoted by Y^{ad}, and encompasses the three following components, all expressed in units of the composite good:

- **Households' consumption**, which is an increasing function of households' disposable income[4], i.e. income Y minus taxes T, therefore denoted by $\mathbf{C}(\underset{+}{\mathbf{Y}} - \underset{+}{\mathbf{T}})$.
- **Firms' investment**, which is a decreasing function of the interest rate i, and therefore denoted by $\mathbf{I}(\underset{-}{\mathbf{i}})$. The intuition behind this relationship can be stated as follows: when interest rates on bank loans increase, it becomes more expensive for firms to lend money and purchase investment goods, and investment falls.
- **Public expenditures**, which are exogenously fixed by the government, and therefore denoted by $\mathbf{G}$.

Aggregate demand is hence given by:

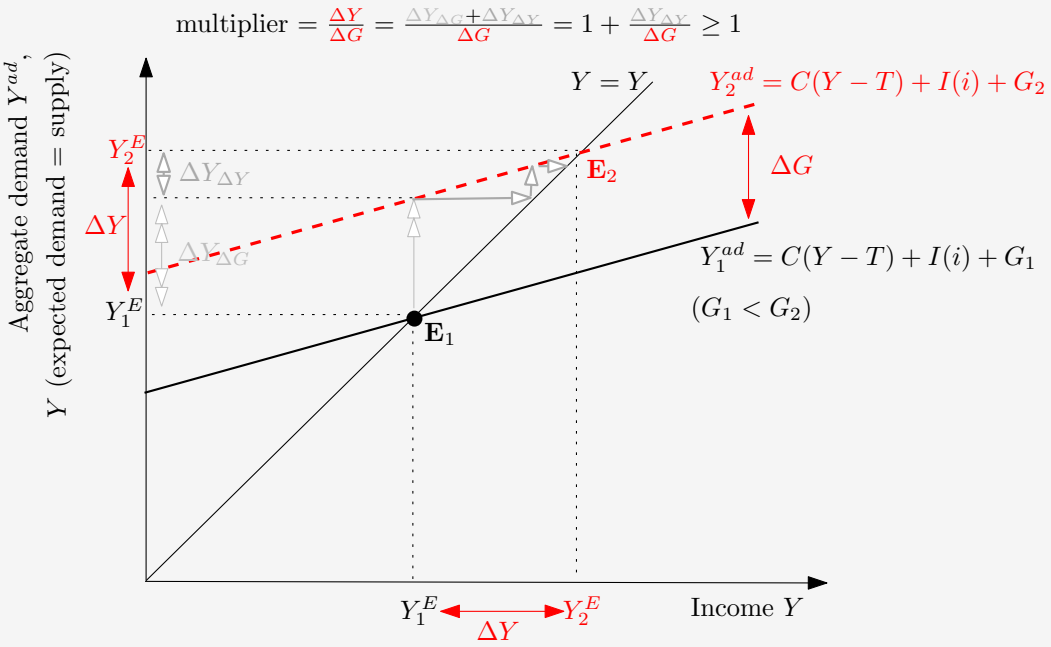
$$Y^{ad} = C(\underset{+}{Y} - \underset{+}{T}) + I(\underset{-}{i}) + G \qquad ([2])$$

and, *ceteris paribus*, is an increasing function of income Y and public expenditures G, and a decreasing function of interest rate i and taxes T (see Figure 2, upper panel, on page 10). As aggregate supply adjusts to aggregate demand, equilibrium in the goods market is such that:

$$Y^{as} = Y^{ad} = Y^E = C(\underset{+}{Y} - \underset{+}{T}) + I(\underset{-}{i}) + G \qquad ([3])$$

[4]We assume that only households pay taxes.

Box 1.2.2 : Short-run variation in GDP and the Keynesian multiplier – the case of the multiplier associated with public expenditures



The Keynesian cross diagram

Before the public expenditure shock, the goods market is in equilibrium (point E_1), and the corresponding GDP is Y_1^E.

The shock increases G from G_1 to G_2.

The *impulse effect*, i.e. the immediate effect on aggregate demand due to the increase in G, denoted by $\Delta Y_{\Delta G}$, shifts aggregate demand upwards (from Y_1^{ad} to Y_2^{ad}). This effect is strictly proportional, i.e. an increase by one unit of G increases Y^{ad} by one unit as well (see Equation ([1])). We thus have $\Delta Y_{\Delta G} = \Delta G$.

However, the increase in aggregate demand in turn leads to an increase in aggregate supply (as firms adjust their production to the new demand), which further increases income by gradual adjustments towards the new equilibrium E_2. At this point, GDP is higher (Y_2^E). This second effect is the *induced effect*, denoted by $\Delta Y_{\Delta Y}$.

The *overall effect* of the increase in public expenditure on GDP is the sum of these two effects ($\Delta Y_{\Delta G} + \Delta Y_{\Delta Y}$) which, *within the $IS - LM$ framework*, turns out to be stronger than the initial increase in G (ΔG). This means that the *multiplier*, defined as the ratio between the GDP variation and the initial shock ($\frac{\Delta Y}{\Delta G}$) is assumed to be higher than unity. In other words, changes in GDP are amplified relative to the initial change in aggregate demand thanks to the induced effect.

As explained above, short-run fluctuations in GDP are due to fluctuations in aggregate demand, as a result of shocks on its components. These shocks can be a change in interest rate i, in tax T or in public expenditures G, which in turn affect either C, I or G and, hence, aggregate demand (see Equation ([1])).

Each of these shocks affects GDP through two effects. As a first step, a change in consumption $C(Y-T)$, investment $I(i)$ or public expenditure G directly modifies aggregate demand Y^{ad}, see Equation [2]. This is an *impulse effect*. As a second step, aggregate supply adjusts to changes in aggregate demand, and changes in aggregate supply in turn yield changes in income Y and, hence, in aggregate demand (through the mechanism depicted in Figure 1). This "second-round" effect is an *induced effect*. The overall effect (i.e. the sum of the impulse and the induced effects) may be stronger than the initial increase in aggregate demand. This is the concept of multiplier. Box 1.2.2 highlights the effect on GDP of a positive shock of public expenditures, and the related concept of *multiplier*. Similarly, a multiplier can be defined for each component of aggregate demand: the monetary multiplier (in case of change in GDP due to an initial change in interest rate and, hence, in investment); fiscal multipliers (in case of changes in GDP due not only to change in public expenditures, but also in tax or government transfers).

1.2.3. Derivation of the IS curve

The IS curve describes the equilibrium in the goods market in the (Y, i) plane. It represents all the pairs (Y, i) for which aggregate supply equals aggregate demand. Put differently, for any level of the interest rate, the IS curve gives the corresponding equilibrium level of GDP. As aggregate demand is a decreasing function of interest rate i, the resulting IS curve is downward sloping (see Figure 2). The slope depends on the sensitivity of aggregate demand to changes in interest rate and on the multiplier values. The higher the sensitivity to interest rate and the higher the multipliers, the stronger the variation of GDP as a result of a given change in i, and the flatter the IS curve.

The IS curve can be shifted by fiscal policy, i.e. a change in public spendings G or in tax T. A rise in public expenditures G directly increases aggregate demand Y^{ad} (through Equation ([2])) as G is a component of Y^{ad}. Therefore, the IS curve is shifted upwards, delivering a higher-income equilibrium associated with a lower interest rate. The opposite is true in case of a decrease in G (see Figure 3a). Similarly, a drop in the tax level T leads to an increase in households' disposable income and, hence, in consumption and aggregate demand (and vice-versa, see Figure 3b)[5].

Besides government policies, developments in the private economy may also shift the IS curve. For instance, a fall in consumer confidence leads them to increase their precautionary savings, and decrease consumption for a same level of disposable income. The resulting effect is similar to an increase in tax T: the IS curve is shifted downwards and output and interest rate fall. Changes in consumer confidence are an important determinant of short-run fluctuations. Examples include the drop in confidence in the U.S. following Iraq's invasion of Kuwait in the summer of 1990; the stock market crash of October 1929 which created tremendous uncertainty among consumers and contributed to

[5]The shift in the IS curve implied by the change in T is however different from that implied by a change in G, as changes in T affect the slope of the curve, while changes in G shift the intercept. See equations in Box A.1, in Appendix A.

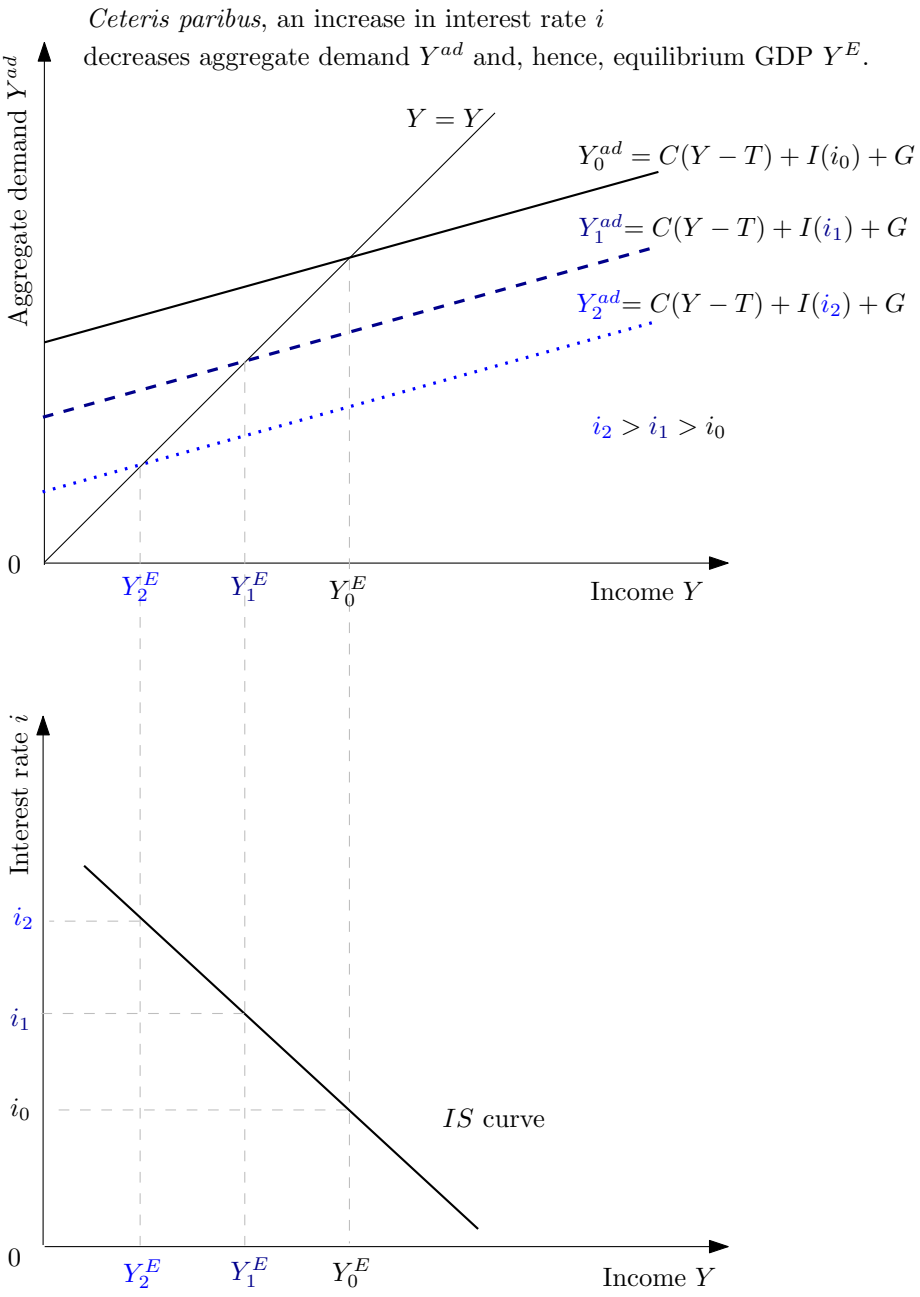
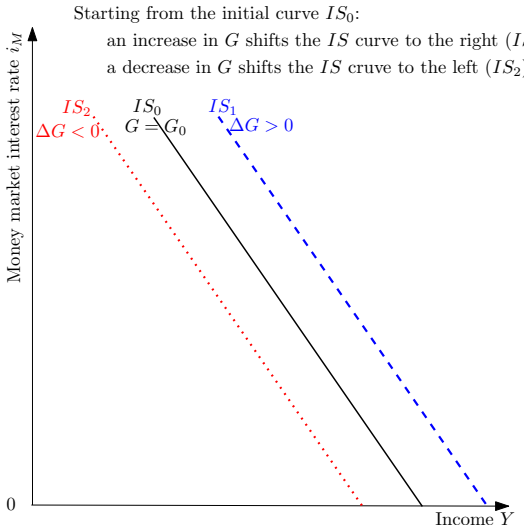


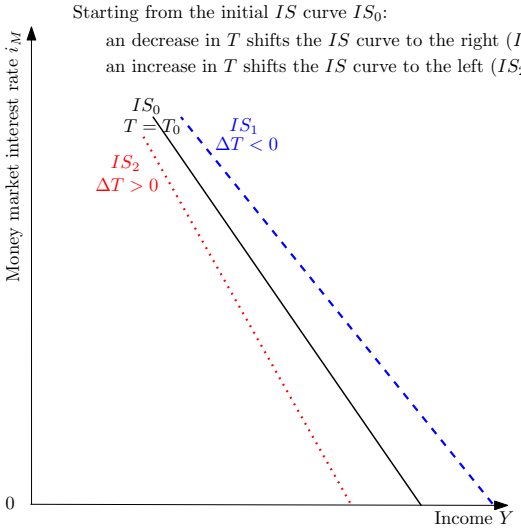
Figure 2: Aggregate demand as a function of interest rate and income and derivation of the IS curve

the emergence of the enormous economic downturn; the loss on confidence following the bankruptcy of Lehman Brothers in September 2008. Sub-section 2.3 explicitly integrates these elements into the $IS - LM$ framework to explain their effects on the real economy of the current financial crisis.

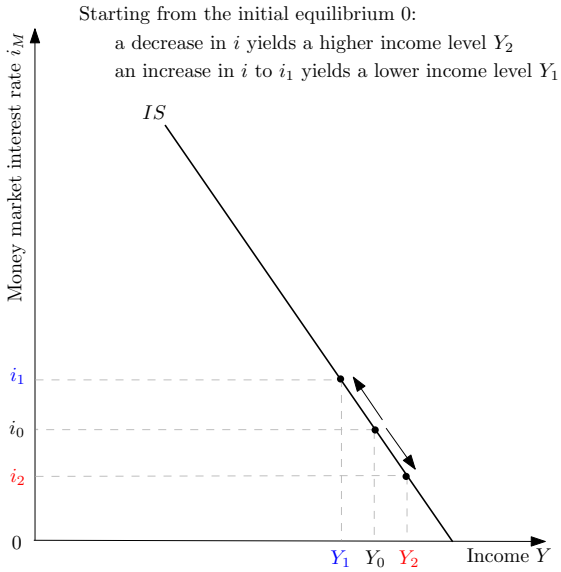
It should be noted that changes in interest rate do not shift the IS curve, neither upwards or downwards, but the economy moves down or up along the IS curve, and reaches a different level of income Y (see Figure 3c). In Section 2.3, we use these comparative statics exercises to apply the $IS - LM$ model to policy evaluation.



(a) Effect of a change in public spendings G (fiscal policy)



(b) Effect of a change in tax T (fiscal policy)



(c) Effect of a change in interest rate

Figure 3: Shifts of the IS curve

It should be clear from this sub-section:

i) How the equilibrium in the goods market operates,

ii) Why the $IS - LM$ model is demand-driven,

iii) What influences aggregate demand.

We continue by explaining how the interest rate is determined in the financial market, and derive the LM curve.

1.3. The LM curve (Liquidity - Money)

Besides the goods market, the $IS - LM$ model incorporates a money market. Money supply is provided by the Central Bank, while demand for money comes from households. Equalizing the two gives the level of the interest rate i[6].

1.3.1. Money supply

In the $IS - LM$ model, money supply M is fixed and set at an exogenous level by the Central Bank. Money supply is an instrument of the monetary authorities, who control its level (as an intermediary target) in order to achieve the ultimate goal of monetary policy: either a targeted level of inflation or GDP, or both. This view of central banking has been prevailing until the beginning of the 90s, and we keep this approach in the following analysis. Sub-section 3.1 proposes an extension of the $IS - LM$ model, the $IS - MP$ model, which explicitly fits into the new paradigm of monetary policy, that is that Central Banks actually use the interest rate directly as an instrument to achieve their final goal (either in terms of inflation, or economic activity, or both).

1.3.2. Demand for money

The demand for money balances L comes from households. According to the Keynesian theory, money serves two main purposes.

Money is a unit of account and facilitates exchanges of commodities. Performing transactions is the primary motive for holding money. How much agents can purchase obviously depends on their income, so that *transaction demand for money* is an increasing function of income Y.

Money is also a store of wealth. When households make savings decisions, they face a trade-off between keeping savings as money balances (at a zero-interest rate) and putting savings into an interest-earning bank account (see Figure 18). As mentioned above, there are only two assets in the $IS - LM$, so that interest rate-bearing investments are essentially bonds, which pay an interest rate i. Households may want to hold part of their savings as cash-on-hand at a zero-interest rate even if there are other kinds of interest-bearing assets because of the inherent uncertainty surrounding the rate of return of any asset. This behaviour is called *liquidity preference* and, in that case, holding money fills

[6]The relevant interest rate on the money market is the nominal interest rate, whereas the real interest rate is on the good market. However, as we adopt a short-run perspective where prices are assumed to be fixed and inflation expectations to be zero, both rates correspond, and we keep the same notation i for convenience. This assumption is relaxed in Sub-sections 2.2 and 2.3.

a precautionary motive. The demand for money balances depends on the interest rate i, which corresponds to the opportunity cost of holding money. If the interest rate on bank deposits increases (resp. decreases), putting money on interest-bearing accounts becomes more (resp. less) beneficial than keeping it at zero-interest rate. The opportunity cost of holding money instead of earning bank interest rates increases (resp. decreases), and the demand for money decreases (resp. increases).

According to those two motives for holding money, the demand for money from households is a function of income and interest rate: $L(\underset{+}{Y}, \underset{-}{i})$.

1.3.3. Derivation of the LM curve

Equilibrium in the money market occurs when money supply, M, of the Central Bank equals the demand for money balances $L(Y, i)$ from households, i.e. when $M = L(Y, i)$.

We can draw this equilibrium in the (M, i) plane (see Figure 4, left panel). Money supply, M, is represented by a vertical line, as it is exogenously given (equal to M_0 in the figure). For any given level of income Y ($Y_0 < Y_1 < Y_2$), there is a corresponding level of demand for money ($M_0^D < M_1^D < M_2^D$). As money supply is given, for each demand point for money, there is a certain interest rate level that clears the money market ($i_0 < i_2 < i_2$). The higher the income Y, the higher the demand for money M^D, and the higher the interest rate i[7].

In the money market, demand adjusts to the exogenous supply through the interest rate: if the demand for money is higher than the supply, the interest rate increases up to the point that equalizes the two (and vice-versa). These adjustments operate through households' trade-off between money and bonds: if the money supply is not enough to meet all the demand for money balances, the remaining cash-on-hand will be invested in bonds, and demand for bonds will increase. As a result, the interest rate increases, and adjusts the demand for money downwards to the point that it meets the money supply. The opposite mechanism applies in the case of an excess of money supply[8]. For each level of income Y (or, equivalently, for each level of the demand for money balances), there exists a level of interest rate so that the money market is in equilibrium.

The LM curve is the representation in the (Y, i) plane of all market-clearing configurations (for any exogenous level of money supply M): it gives the interest rate level i for any given level of income Y (see Figure 4, right panel). As shown above, the higher the income, the higher the demand for money balances, and the higher the interest rate. The LM curve is therefore upward-sloping in the (Y, i) plane. The slope depends on the sensitivity of the demand for money to income and to interest rate. The higher the sensitivity to income, the steeper the LM curve. The higher the sensitivity to interest rate, the flatter the LM curve. As depicted in Figure 4 (right panel), the LM curve exhibits a flat part, known as the *liquidity trap*. This situation and its implications, notably concerning monetary policy, are fully discussed below, in Box 1.3.3 and in Section 2.

[7] Interestingly, we see that the demand for money becomes flat as the interest rate drops to zero, whatever the level income. We treat that specific case in Box 1.3.3, and extensively refers to in Section 2, when dealing with the current economic crisis.

[8] An intuitive way to understand those adjustments is to think of money as a good, the interest rate i being its price (i.e. the opportunity cost of holding money and not bonds): increasing the amount of available goods decreases its price for an unchanged level of the demand, and vice-versa.

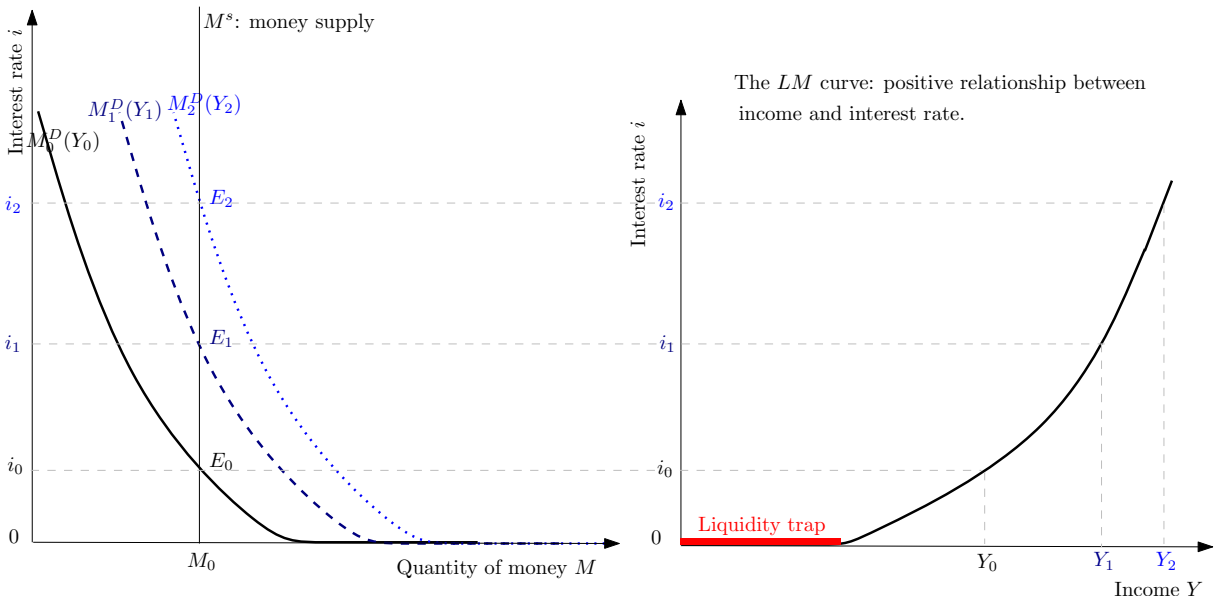


Figure 4: Money supply, money demand, income and interest rate: derivation of the LM curve.

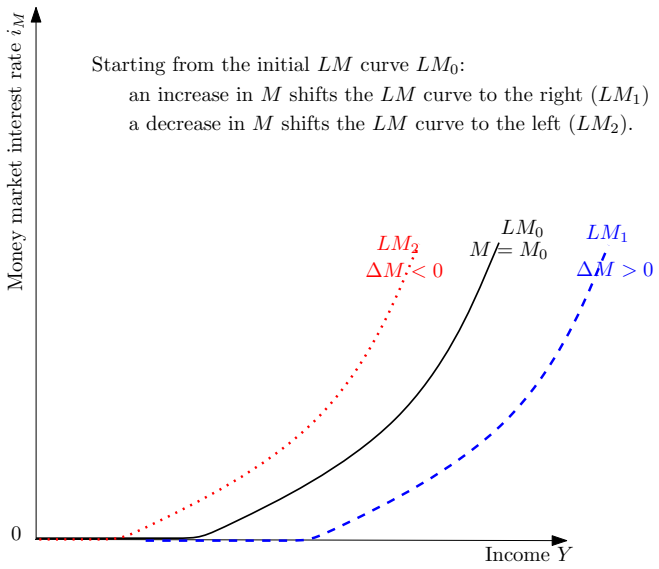
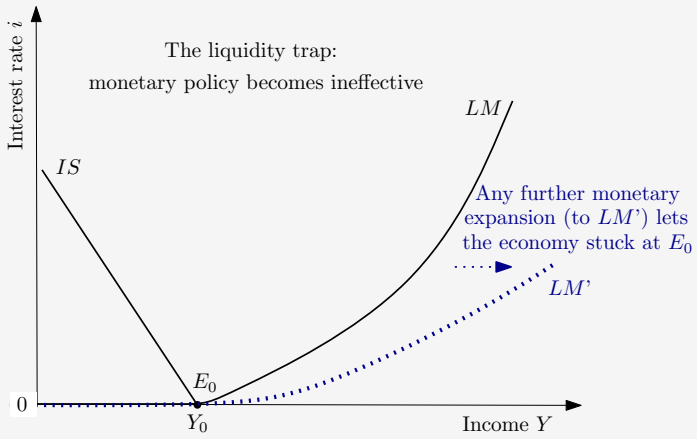


Figure 5: Effect of a change in money supply (monetary policy)

The LM curve is mainly shifted by monetary policy, i.e. a change in money supply by the Central Bank. An increase in money supply decreases the market-clearing interest rate (the interest rate level at which money supply and demand equalize). This implies a rightward shift of the LM curve (see Figure 5). The opposite effect occurs in case of a decrease in money supply.

Box 1.3.3 : The liquidity trap and effectiveness of monetary policy



Nominal interest rates are bound by zero, as banks cannot charge a negative interest rate on firms' loans (meaning that banks would actually loose money and go bankrupt), nor pay a negative interest rate on deposits (as households would immediately withdraw all their savings and keep it as cash-on-hand). When interest rates drop towards zero, putting money on interest-earning account provides no advantage compared to holding money as cash-on-hand. If the Central Bank increases money supply, so that it exceeds the demand for money, we have shown above that adjustments through a substitution of bonds to money should operate, leading to a drop in the interest. However, the interest rate cannot fall further, below zero. Buying bonds with money does not provide any advantage compared to keeping savings as liquidities (in both cases, the rate of return is zero). As a consequence, the excess supply of money will eventually be kept as money by households, increasing further the demand for money. This situation is known as the *liquidity trap*, and corresponds to the coloured area on Figure 4 (right panel), and the flat part of money demand curves on Figure 4 (left panel).

Figures 7 depict the impact on the economy of policies when the equilibrium lies in the upward-sloping part of the LM curve, i.e. in "normal times". However, the picture is different when the economy lies in the flat part of the LM curve, i.e. the liquidity trap. The interest rate reaches zero, and cannot fall further: any increase in money supply extends the flat part of the LM curve: monetary policy turns out to be ineffective. Nevertheless, changes in public expenditures or taxes (i.e. fiscal policy) are still able to shift the IS curve. This is discussed in details in Sub-section 2.1, referring to the current economic situation.

Zero interest rates had been rare in reality (an example is Japan since the 1990's) and the liquidity trap was mainly regarded as a historical curiosity which was useful to understand the Great Depression of the 1930's. However, since the end of 2008, nominal interest rates have been cut to zero in most developed countries as a reaction to the financial crisis in 2007 and followed by the Great Recession, and the liquidity trap turns out to be a extremely relevant concept to understand in the current context. This is discussed in Section 2.

Shifts if the LM curve can also be a result of changes in the demand for money balances, e.g. changes in payment habits, a loss of confidence in other interest-bearing financial assets, or bank panics. Section 2 provides insights regarding such shocks since the beginning of the current financial and economic crisis.

We now turn to the equilibrium in the $IS - LM$ model.

1.4. The $IS - LM$ equilibrium

As shown above, on one hand, interest rate (i) is determined in the money market through the LM curve. The interest rate (i) in turn determines aggregate demand and, hence, the equilibrium in the goods market (Y) through the IS curve. On the other hand, the demand for money depends on income Y, which determines the interest rate in the money market through the LM curve. Consequently, the money market and the goods market are interdependent. There exist a value of income Y^* and a value of interest rate i^* that solve for equilibrium in both markets, taking the other variables and parameters[9] as given. These values define the $IS-LM$ equilibrium, that is the short-run macroeconomic equilibrium, at which both money and goods markets are in equilibrium (meaning that demand for goods equals the goods supply and, simultaneously, demand for money equals the money supply). In other words, the economy is lying both on the IS and on the LM curves. It is represented by point (Y^*, i^*) in Figure 6.

The income equilibrium level may match the full-employment level discussed in Box 1.1. In that case, there is no need for policy intervention. However, every time the economy is pushed below this level by a shock (i.e. the IS and the LM curve crosses below Y^*), there is room for fiscal and/or monetary policies to stimulate the demand, and drive output towards its full-employment level[10].

As any model, the $IS - LM$ framework is designed to serve as a laboratory in which we can simulate various economic configurations and policy responses. In order to do so, we have to figure out in what direction and to what extent would economic changes and resulting implemented policies shift the IS or/and the LM curves, where the new equilibrium would lay, whether it would involve a higher income level or not.

1.5. Policy evaluation within the $IS - LM$ framework

Shifts in the IS or/and the LM curve imply different resulting equilibrium values of Y and i, and those delivering a higher level of income are regarded preferable. It should be kept in mind that the two markets are interdependent, and the $IS - LM$ model allows for an *integrated* analysis. The basic exercise performed in Box 1.2.2 or in Figures 3 and 5 does not take into account feed-back effects between the money and the goods markets (i.e. it does not take into account shifts of the LM curve which may result from a shift of the IS curve, and vice-versa). In the following subsections, we discuss those interdependent effects.

[9] They are the government expenditures G, tax level T, the money supply M, and the model parameters, see Box A.1 for the details of the equations.

[10] In a short-run perspective, structural/long-run policies are left out of the picture, and we only focus on short-run policy reactions to shocks.

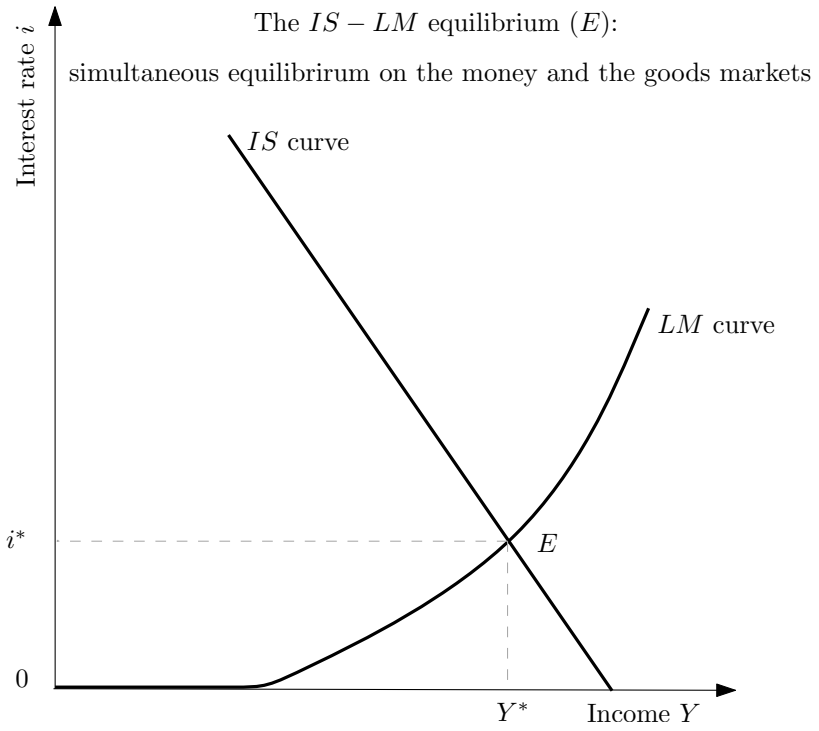


Figure 6: The complete $IS - LM$ model: equilibrium

1.5.1. Fiscal policy evaluation

Let us take the overall effect of an increase in public expenditures G as an example[11].

The very short-run effect is an increase in income Y. This effect is even amplified compared to the initial impulse in G due to the multiplier effect (see Box 1.2.2). The increase in income (Y) results in an increase in interest rate through an increased demand for money.

However, a higher interest rate in turn depresses investment, which is a component of aggregate demand: this is called the *crowding-out* effect, and this effect clearly acts negatively on income.

These two effects (the multiplier and the crowding-out effects) play in opposite directions, and the overall positive effect on income of an increase in public expenditures is likely to be dampened[12]. The crowding-out effect arises as a consequence of any shift in the IS curve.

The higher the multiplier, the stronger the initial positive effect and the stronger the overall effect. The lower the sensitivity of money demand to income, the less the resulting increase in the interest rate following an increase in income, the weaker the crowding-out effect, and the stronger the overall effect. In other words, expansionary fiscal policy is more efficient when the LM curve is flatter.

[11] The same analysis applies in the case of a cut in tax T.

[12] Taking into account the negative crowding-out effect, the overall effect is called the *global multiplier*, which is usually lower than the multiplier effect described in Box 1.2.2.

1.5.2. Monetary policy evaluation

As for expansionary monetary policy, its effectiveness depends on the extent to which increasing money supply actually decreases the interest rate and stimulates aggregate demand. The higher the sensitivity of investment to interest rate (the flatter the IS curve), the more efficient an expansionary monetary policy. However, if the economy is stuck in a liquidity trap (see Box 1.3.3 for further details), such policy becomes ineffective. Furthermore, the way monetary policy is described in the $IS - LM$ model is criticized, as monetary authorities are assumed to control the money supply (the so-called *money view*), whereas most of the Central Banks have been acting directly on the interest rates since the nineties. Sub-section 3.1 investigates the consequences of this change in the conduct of monetary policy within the $IS - LM$ model.

The main message of the $IS - LM$ model can be summarized follows:

i) Short-run fluctuations of the economy away from its potential level are due to variations in the demand for goods and services.

ii) Public policies (mainly fiscal and monetary policies) can counteract these fluctuations, at least to some extent.

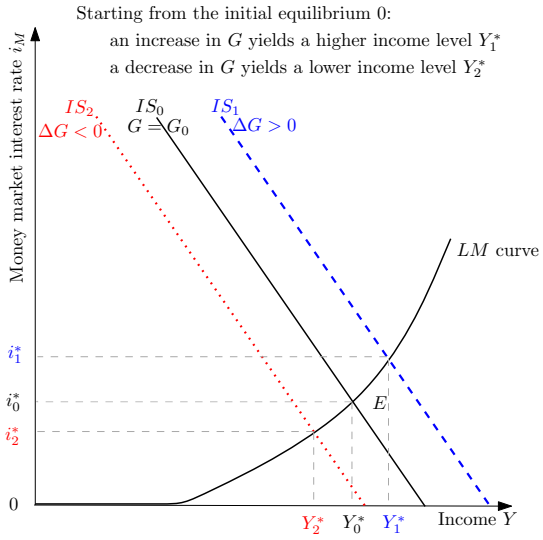
iii) An expansionary fiscal policy increases income, but this increase can be dampened by the resulting rise in the interest rate (crowding-out effect).

iv) An expansionary monetary policy increases income if it actually does decrease the interest rate. This is not the case notably if the economy is stuck in a liquidity trap.

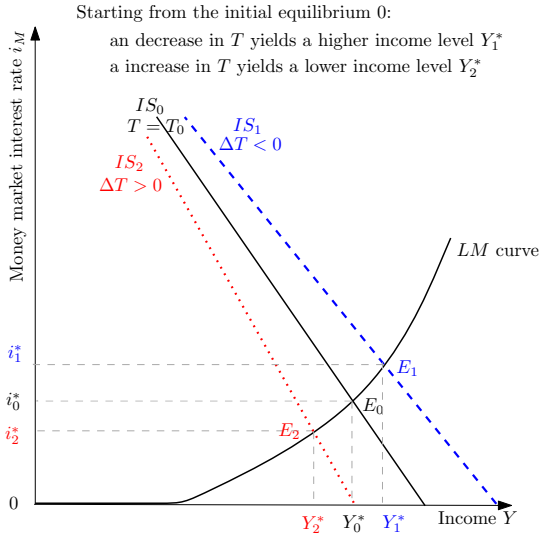
We now turn to an application of the theoretical $IS - LM$ model in the context of the current financial and economic crisis. It should be mentioned that this course does not explain what causes bubbles to form, how to prevent financial crises from arising, and what kind of regulations the financial industry needs. It only analyses within the $IS - LM$ framework how a financial crisis badly affects the macroeconomic situation and what policy makers may do to offset (at least partially) the negative effects.

2. The $IS - LM$ model: an application to the current economic crisis

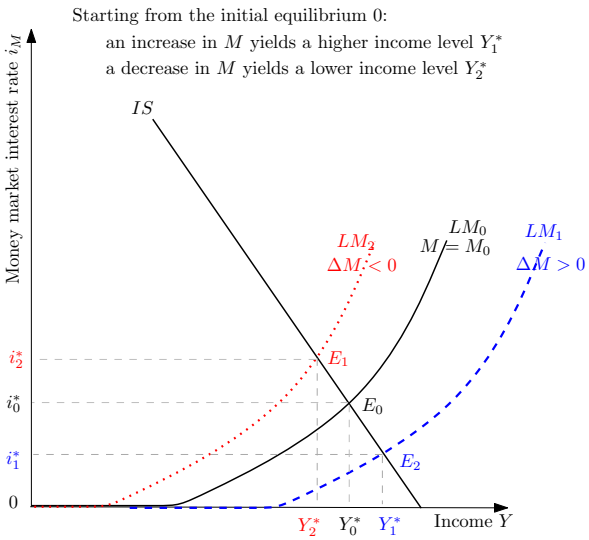
The current economic crisis has often been compared to the Great Depression in the years 1929-1933 in its size and the threat it poses to all economies. Consumption, investment, GDP and inflation rate fell, whereas unemployment rose and money supply shrank (see Figures 8). However, huge government stimulus policies and injections of liquidity into the banking sector, as well as bailouts of financial institutions have been implemented as a response to this financial crisis, whereas the priority was given to fiscal consolidation in the earlier 1930's. In what follows, we evaluate the expected effects of such policies within the $IS - LM$ framework, and contrast them with the 1930's economic downturn.



(a) Effect of a change in public spendings G (fiscal policy)

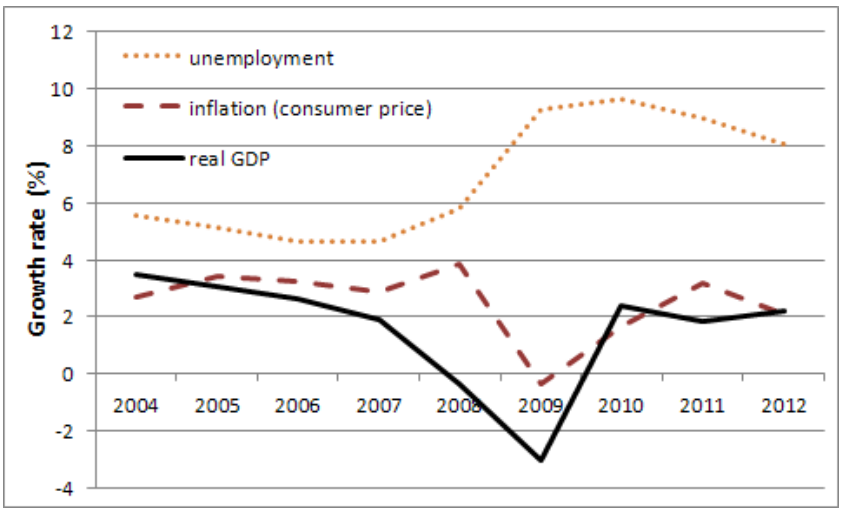


(b) Effect of a change in tax T (fiscal policy)

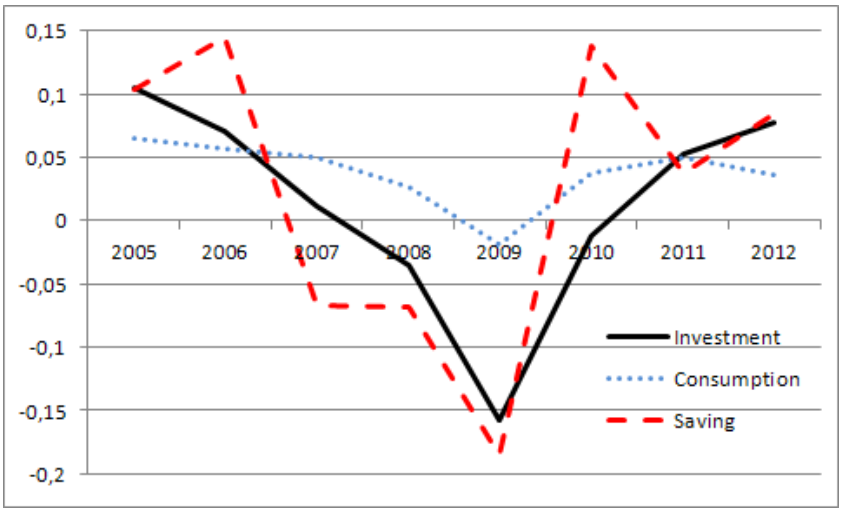


(c) Effect of a change in money supply (monetary policy)

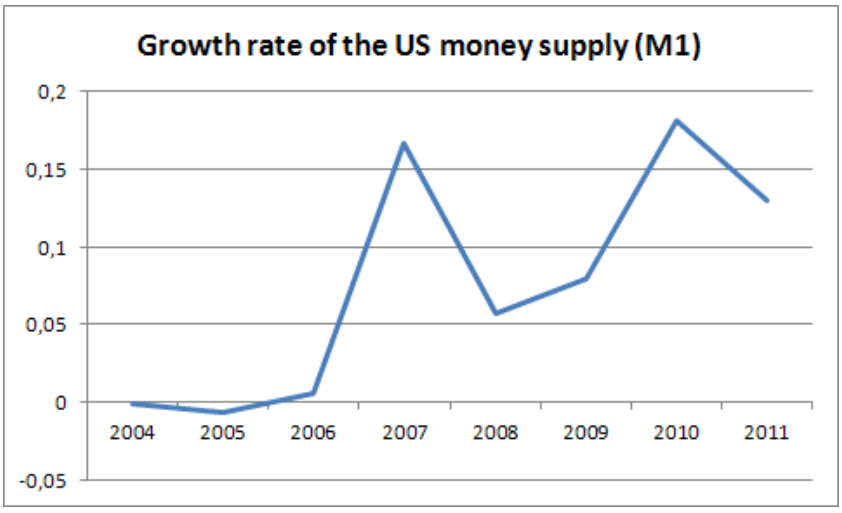
Figure 7: Fiscal and monetary policies within the $IS - LM$ model



(a) Economic developments in the US



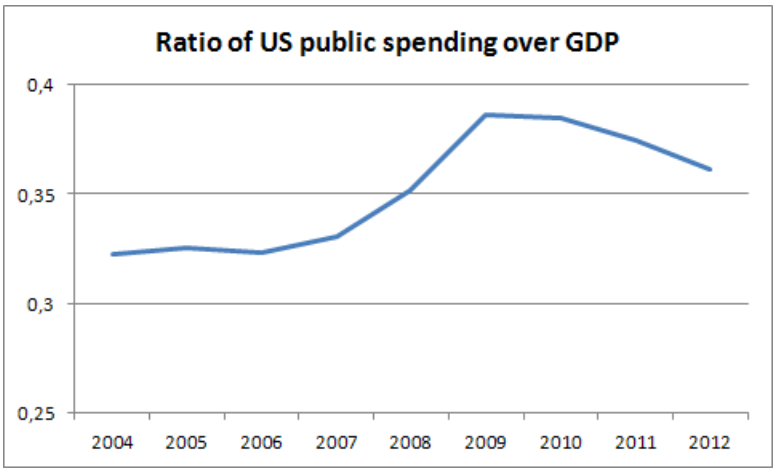
(b) Growth rates (%) of aggregate demand components in the US



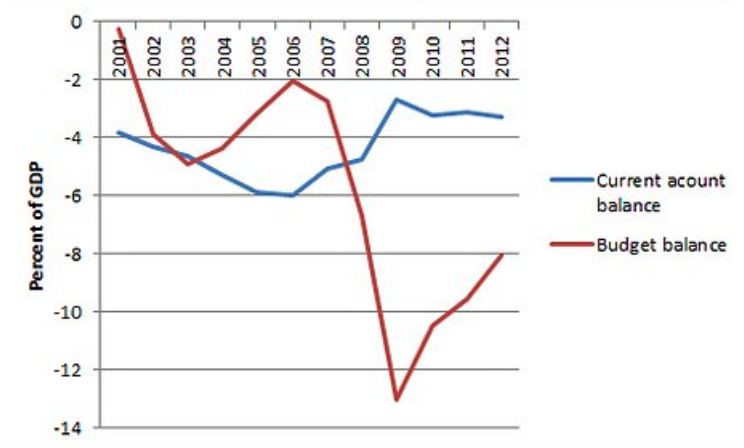
(c) Growth rates (%) of money supply in the US

Figure 8: Economic downturn in the U.S. following the 2007 financial crisis

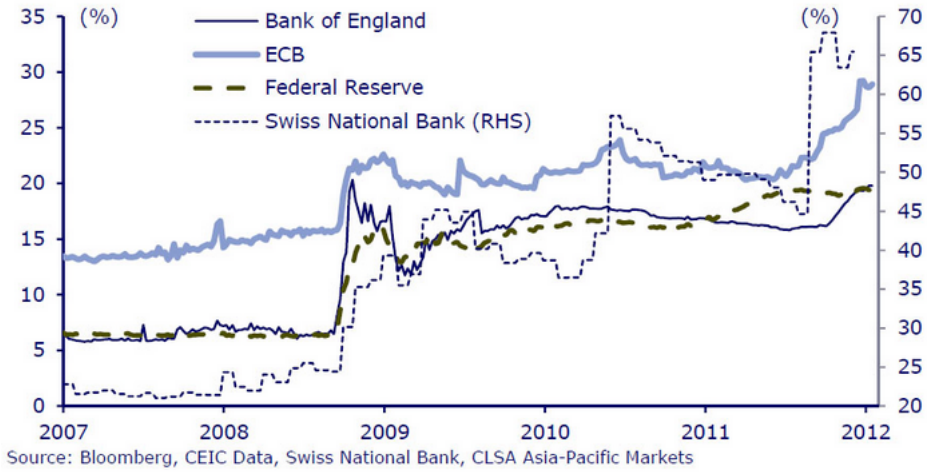
Source: IMF and FRED.



(a) Ratio of public expenditures to GDP in the US



(b) Budget deficit in the US



(c) Balance sheet of major Central Banks

Figure 9: Policy responses following the 2007 crisis

Source: IMF and FRED.

2.1. Evaluation of stimulus policies

Fiscal policies may be dampened by the crowding-out effect, and monetary policy becomes ineffective when the interest rate drops towards zero. Since the beginning of the crisis both kinds of policy have been carried out: very expansionary fiscal and monetary policies (see Figure 9). For instance, total assets of the Federal Reserve have increased from 869 USD billion on August 8, 2007 to well over 2 USD trillion. This policy combination is called a *policy mix*, and is expected to be more efficient than either fiscal policy alone, or monetary policy alone. The idea behind is that the expansionary monetary policy is expected to offset a potential crowding-out effect of fiscal policy, and fiscal policy remains effective if the economy falls in a liquidity trap where monetary policy turns out be ineffective.

2.1.1. The policy mix

Figure 10 illustrates the effects of the crisis on the LM and the IS curve[13]:

1. Equilibrium $E_1 = (Y_1, i_1)$ corresponds to the situation before the crisis (IS_1-LM_1).

2. Equilibrium $E_2 = (Y_2, i_2)$ corresponds to the situation after the crisis.

   As a first step (Step 2a), in the U.S., the sharp fall in house prices put large strains on financial institutions that had invested heavily in housing-related assets, mainly mortgage-backed securities (this is the so-called *subprime* crisis). This led to banks bankruptcies (the most famous with no doubt being Lehman Brothers in September 2008), collapses of investors' confidence, liquidation of assets and credit market disruptions. These translate into an increase in the demand for money and an increase in interest rate (the LM curve shifts to the left, to LM_2 and the interest rate reaches i_1'). The rise in the interest rate and the loss of confidence create a very large drop in consumption and investment, which depresses aggregate demand, and therefore the level of activity. The economy moves along IS_1 towards Equilibrium E_1', and GDP decreases from Y_1 to Y_1': the financial crisis turns into an economic crisis and a recession.

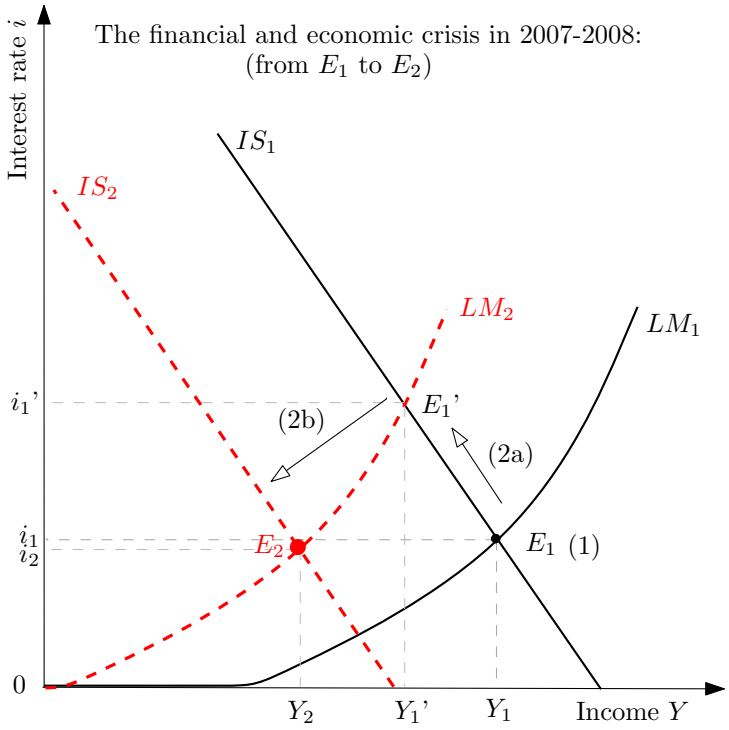
   As a second step (Step 2b), the recession further depresses agents' expectations, raising precautionary savings of households, and decreasing consumption. A similar effect decreases the demand that firms expect to face in the future and depresses investment. A conjugate drop in investment and consumption shifts IS to the left: the interest rate decreases, which offsets the initial rise in interest rate ($i_2 \simeq i_1$), but the drop in income is accentuated (from Y_1' to Y_2). The economy reaches Equilibrium $E_2 = (Y_2, i_2)$, with IS_2 and LM_2 curves (cf. Figure 10a).

3. The policy mix is implemented as a reaction to the crisis.

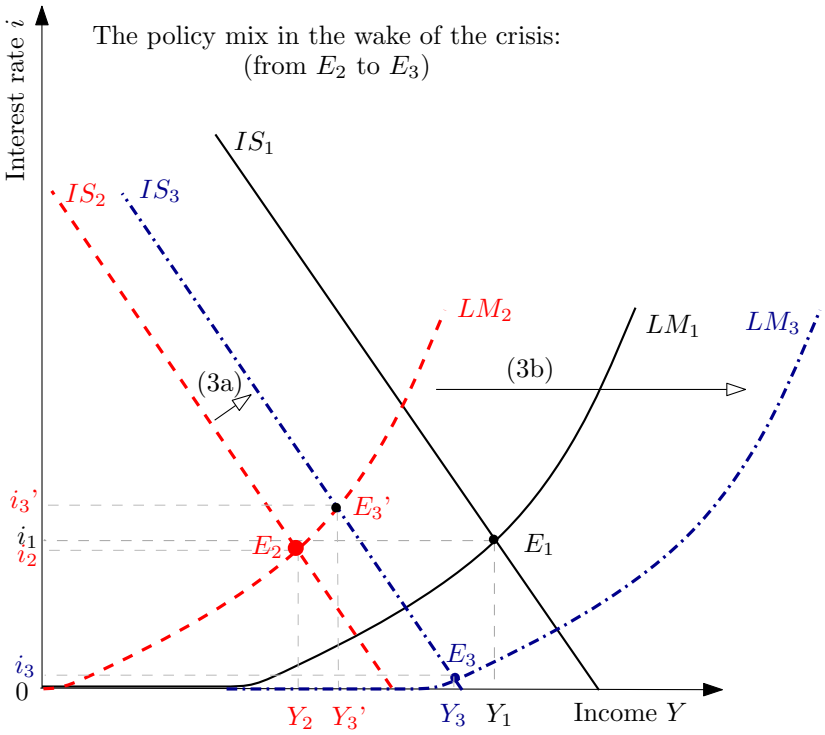
   The expansionary fiscal policy (Step (3a)) increases income to Y_3' and interest rate to i_3'.

   The huge expansionary monetary policy (the *quantitative easing*, Step (3b)) further increases income, offsets the rise in interest rate, and even drops the interest rate towards zero (from i_3' to i_3). The economy is now on Equilibrium $E_3 = (Y_3, i_3)$.

[13] The following steps correspond to the number on the figure.



(a) Effect of the 2007-2008 crisis



(b) Effect of the policy mix

Figure 10: The crisis and policy mix within the $IS - LM$ model

The effectiveness of these policies depends on the slopes of the IS and LM curves. In most developed countries, nominal interest rates have been cut to zero, so that the state of the economy resembles a liquidity trap, in which further monetary expansion is likely to be ineffective, as represented on Figure 10b[14]. In that case, other types of policy have been advocated, and are discussed in Sub-section 2.2.

The policy mix illustrates the so-called *Tinbergen principle* : a policy must have at least as many instruments as objectives in order to succeed. Here, policy makers aim at increasing income while decreasing interest rate, and they must have two instruments: fiscal and monetary policies.

2.1.2. Limits of fiscal policy

However, fiscal policy is not a panacea, nor a costless way to escape a liquidity trap. The effectiveness of fiscal policy partly depends on how public expenditures are financed. Tax financing may depress consumption and aggregate demand. Bond financing raises concerns about government debt, which could eventually require higher taxes and/or lower public expenditures in the future. This expected negative shock in fiscal policy in turn may encourage households to save more and firms to invest less. In extreme cases, households and firms may develop serious doubts on the ability of the government to pay back its debt, and may worry about the possibility of default, financial crisis and disruption in the economy. We may take Greece in the recent years as an example. Expectations of default and significant economic downturns and expected tight fiscal policies in the future create uncertainty and bad prospects. It encourages households to rise precautionary savings and lower consumption, and depresses firms' investment.

Furthermore, if firms and households are paying off high levels of debt, tax cuts and transfer increase may be used, as least partially, to decrease their debt level, dampening consumption and investment. For all these reasons, fiscal policy may fail to move the IS curve rightward.

Furthermore, for the government to spend and borrow more when people have to reduce their spendings and pay more taxes could be politically very risky, as it makes voters angry.

Finally, the $IS - LM$ model ignores important features which that could dampen the positive effects of fiscal policy. In particular, the model represents a closed economy. International capital and goods markets are absent from this framework, and exchange rates issues are left out of the analysis[15].

Apart from fiscal and monetary stimulus that we have been able to analyse within the $IS - LM$ model, governments have implemented other types of measures, such as bailout packages and broader communication with the public. These policies aim at restoring confidence, mostly in the financial institutions, and driving households' and firms' expectations towards a more optimistic state. These policies are all the more needed that the economy is close to a liquidity trap, where interest rates have been cut to

[14] See also Sub-section 2.3 for a comparable discussion following a financial crisis.

[15] Depending whether the financial crisis affects the domestic economy, the rest of the world or both, whether its effects in the home and the foreign markets are symmetric or not, whether it originates in the money or in the capital market, the exchange rate regime (fixed or flexible) affects the way the financial crisis and the resulting policies impact the economy. On that point see the references provided at the end of this lecture.

zero. We now develop how expectations and confidence play a critical role on economic developments, and how it can be analysed within the $IS - LM$ model.

2.2. Managing inflation expectations to avoid a deflationary spiral

The importance of expectations and their self-fulfilling effect on the economy has been recognized very early by the Keynesian theory[16]. Nowadays, expectations lie in the heart of mainstream macroeconomics. For instance, M. Woodford, the author of the masterpiece textbook in macroeconomics[17] writes "*Not only do expectations matter, but very little* else *matters*", p. 15). Indeed, the new paradigm in monetary policy emphasizes the role of central banks much more as managers of expectations rather than interest rate setters.

Until now, we have considered that prices are fixed in the short-run, so that inflation expectations are zero, and nominal and real interest rate coincide. In what follows, we explicitly model inflation expectations, and differentiate between the real and nominal interest rates.

2.2.1. Liquidity trap and deflationary spiral: the case of the Great Depression (1929-1933)

In the U.S., the eruption of the financial crisis in 1929 cuts the level of real income from an index value of 108 in year 1929 to 77 in 1933 and unemployment rate rose from 3% to 25% over the same period. As a consequence of insufficient demand, deflation sets in and prices fell by 25%, despite an expansionary policy from the Federal Reserve system: interest rates were cut from 6% to 2%, indicating that there was still some room for further cut-off (see Figure 11). Other countries exhibit a similar pattern. Such a situation is known as a **deflationary spiral**.

In order to understand this phenomenon, we integrate inflation expectations within the basic $IS - LM$ model. Recall that the IS curve is a function of the real interest rate, defined as:

$$r = i - \pi^e \qquad ([4])$$

where i is the nominal interest rate which clears the money market (and then enters the LM curve), and π^e is the expected level of inflation. When the real interest rate rises, investment falls, and so does aggregate demand, moving up the economy along the IS curve (see Figure 12). The intuition behind this is clear: firms are not willing to borrow money to finance investment if they expect that the real cost of their borrowing will rise. This effect is even stronger in case of deflationary expectations (i.e. $\pi^e < 0$). Once the economy is stuck in a liquidity trap, the nominal interest rate i is close to zero and cannot fall further[18]. From equation [4], we see that the real interest rate equals $-\pi^e$, and

[16] See, for instance, Robinson, J., *The Generalisation of the General Theory and others essays*, 2nd edn, the MacMillan Press LTD, p. 153: "*Past experience is no doubt the major element in expectations but* [...] *compounded in the market with a variety of theories and superstitions and the whole amalgam is played upon from day to day by the influences (including the last bank chairman's speech) which make up what Keynes called the "state of the news"*".

[17] Woodford, M., 2003, *Interest and Prices : Foundations of a Theory of Monetary Policy*, Princeton University Press.

[18] Figures 11 indicate that nominal interest rates remained strictly positive during the Great Depression. However, in Sub-section 2.3, we show how a loss in confidence on financial markets can generate a

inflation expectations turn out to be the only driver of the real interest rate.

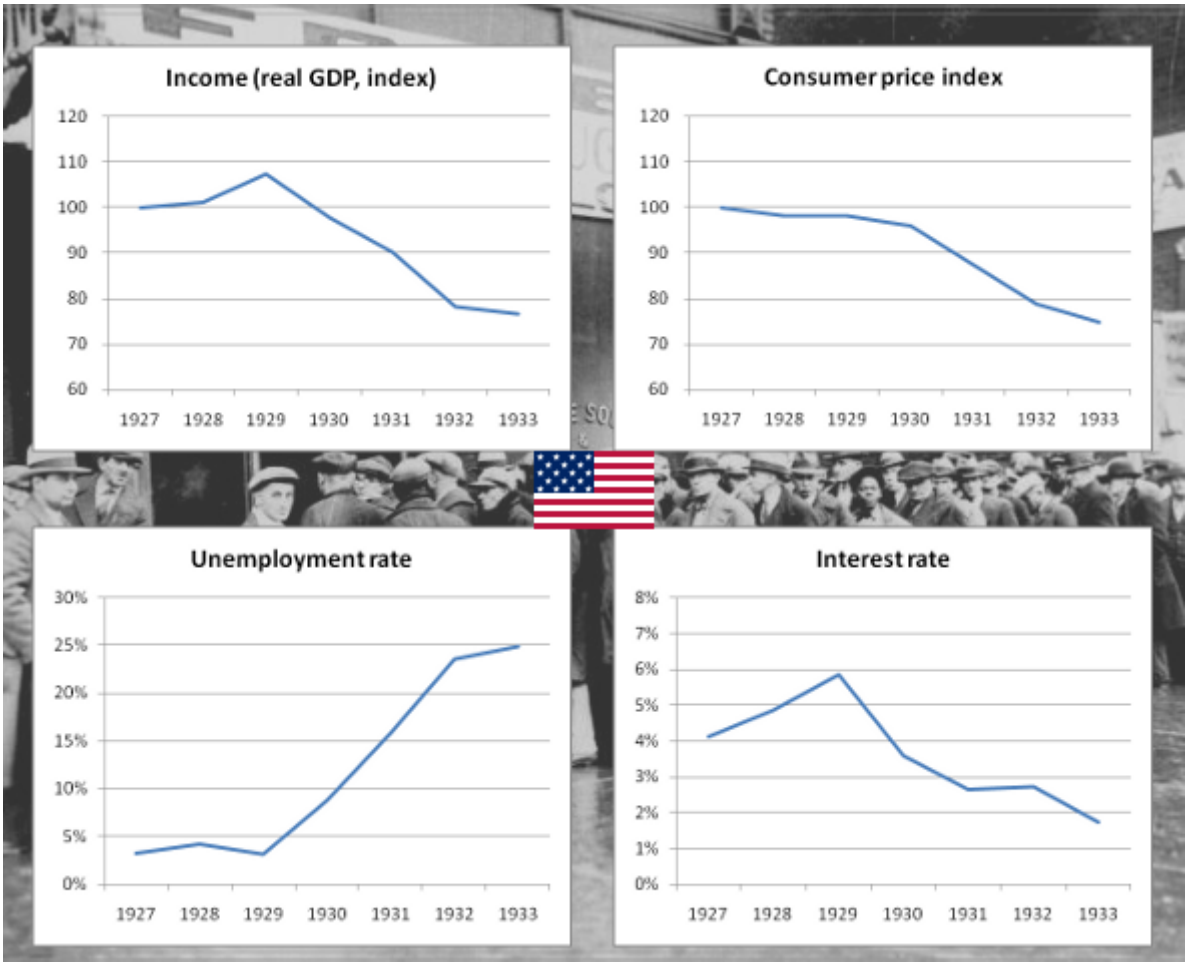


Figure 11: Economic situation during the Great Depression in the U.S.

Source: http://www.eurmacro.unisg.ch/xercises/crisis.html, St. Gallen University.

This highlights a **very important aspect of monetary policy**: while monetary authorities control the nominal interest rate i, what is relevant for aggregate demand is the real interest rate r. Once we allow for non-zero inflation expectations, the two rates differ, and inflation expectations can prevent the Central Bank from setting the desired level of the **real** interest rate.

A deflationary spiral within the $IS - LM$ framework is illustrated on Figure 13.

Starting from a situation where inflation expectations are fixed and equal to zero (Equilibrium E_1), a drop in inflation expectations raises the real interest rate. This shifts the IS curve to the left, leading to a drop in income. A fall in income in turn decreases the demand for money, which decreases the nominal interest rate: the economy goes from Equilibrium E_1 to Equilibrium E_2, where the interest rate i_2 is lower than i_1. However, because of negative inflation expectations, the real interest rate that prevails, r_2, is higher than in the initial equilibrium E_1 ($r_2 > r_1$). As a result, the economy shifts to the left along the IS curve.

liquidity trap at strictly positive level of interest rate.

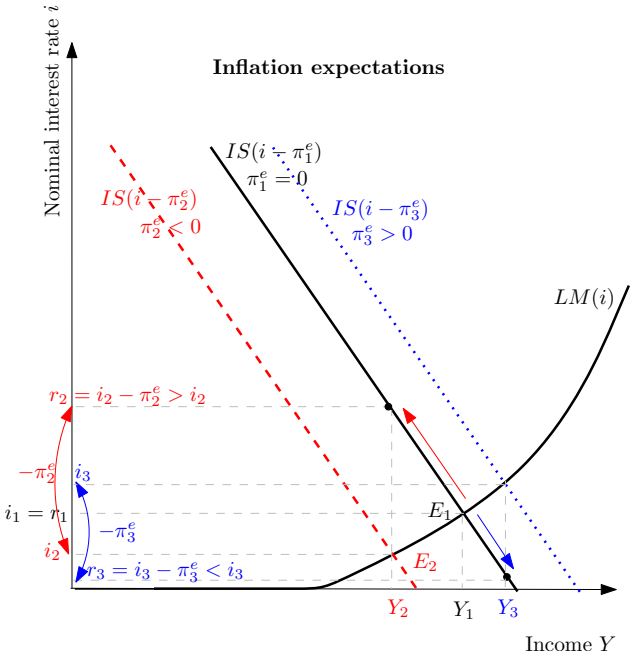


Figure 12: The effect of inflation expectations in the $IS - LM$ model.

If inflation expectations are low enough (i.e. negative enough) to push the economy into a liquidity trap (see Equilibrium E_3), the zero-lower bound of the nominal interest rate becomes a binding constraint ($i_3 = 0$), and the real interest rate is only determined by inflation expectations (and equals $-\pi_3^e$). The economy is further depressed ($Y_3 < Y_2 < Y_1$).

This raises the issue of what determines inflation expectations. One very robust stylized fact is the strong and positive correlation between actual and expected inflation: higher inflation rates tend to create higher inflation expectations, while lower inflation rates tend to dampen inflation expectations. As a result of the drop in income (at Point Y_3), the lack of aggregate demand pushes prices down, and tends to lower inflation. This in turn tends to maintain inflation expectations at a low level. As long as inflation expectations remain negative, the economy spirals off to deflation and depression. This describes what happened during the years following the 1929 crash.

However, such a situation has been avoided during the current economic downturn: inflation has been kept at low but positive levels and output has been languishing below the pre-crisis level, instead of falling further and further. The reason behind this difference between the Great Depression and the current economic crisis appears to lie in the **anchoring of inflation expectations**. As inflation expectations have been kept at a positive level, then the real interest rate remains at a low and negative level, and inflation expectations cannot trigger a deflationary spiral. We now review the various ways that have been considered for the Central Banks to influence – or *manage* – inflation expectations.

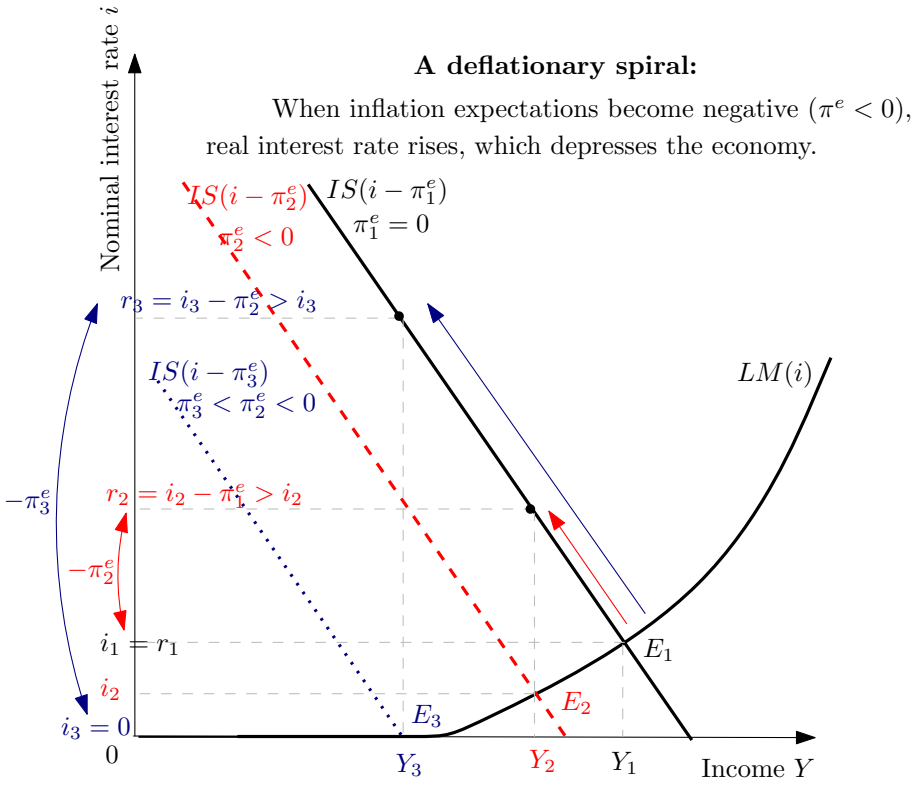


Figure 13: A deflationary spiral in the $IS - LM$ model.

2.2.2. The current challenge: keeping inflation expectations anchored

As nominal interest rates have been cut to zero, whether the Central Bank can actually control the real interest rate while it sets the nominal rate turns out to be a crucial issue. The only way to cut the real interest rate is to raise inflation expectations (π^e)[19]. This is illustrated in Figure 12, page 27. When inflation expectations are positive, the nominal interest rate is higher than the real interest rate ($r_3 < i_3$), while the latter is relevant for investment decisions, the economy moves down along the IS and output is stimulated ($Y_3 > Y_1$).

While increasing inflation expectations appear desirable, our analysis does not say anything on how central banks can achieve it. Expectations are endogenous, i.e. they are formed by private agents, and depend on various factors (the level of actual inflation, confidence, Central Bank's public statements...). The only chance for the monetary policy makers to rise inflation expectations is to *credibly commit* to deliver higher inflation rates in some future than the one currently prevailing. One way to do so is to deliver statements about future interest rates and future monetary policy (the so-called *policy guidance*). This strategy has been adopted by several major central banks once they brought the nominal interest rate down to almost zero in the wake of the current crisis.

[19] While not explicitly considered within our setting, increasing expectations of future output is also relevant to increase aggregate demand today: a firm is more likely to undertake an investment if it believes that demand prospects will be higher than today, and households are more likely to spend more today if they anticipate that their income will be higher in the future. This statement recalls the central place of expectations in the state of the economy.

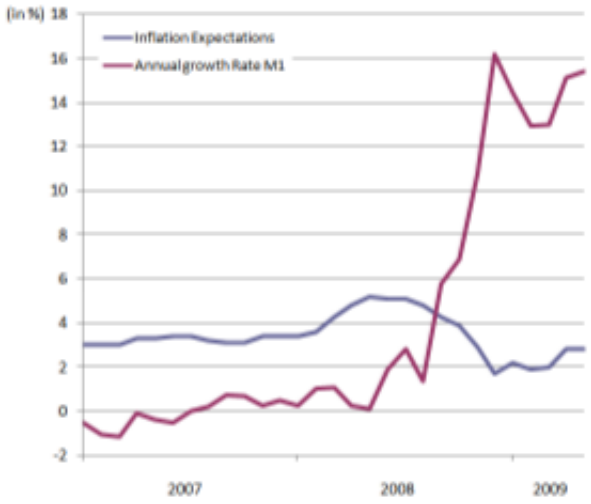


Figure 14: Evolution of money supply and inflation expectations in the US (source: Michigan survey and Fed)

For instance, in December 2008, the Federal Reserve stated that it "anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time". In August 2011, it made the time horizon more precise, and stated "low levels at least through mid-2013". In May 2013, the Fed stated that it "expects that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the asset purchase program ends and the economic recovery strengthens".

However, these statements do little to overcome the credibility problem, and may translate the pessimistic views of central banks about future economic developments, and even depress further consumer and business sentiment, so that inflation expectations may actually decrease.

Indeed, when the economy is stuck in a liquidity trap, the associated income gap (GDP being less than before the crisis and the fall in the trap) justifies a fall in inflation expectations, and even deflationary expectations. In such a trap, monetary policy turns out to be ineffective and the Central Bank cannot use an increase in the money supply to decrease interest rate and create inflation expectations. This disconnect between money supply and inflation expectations is a typical feature of the current economic crisis, see Figure 14.

Furthermore, in many countries, both developed and developing, the conduct of monetary policy has been embedded in institutional frameworks which forbid the pursuit of other objectives than price stability. The most popular monetary policy frameworks is *inflation targeting*, and has been adopted by 27 countries. Credibility of central banks' commitment to price stability has taken time and considerable efforts from monetary authorities to build such a reputation. It is hard to conceive that the central banks could convince the public that they would tolerate and even create inflation above their inflation target.

Changing monetary policy objectives A more radical solution that has been advocated by some leading economists[20] is to increase the inflation target. Indeed, within their institutional framework, many central banks have adopted an explicit medium-run target for price stability (usually around 2% in developed countries). This regime is known as *inflation targeting*. Increasing the central banks' objective, say to 4%, may **credibly commit** monetary policy makers to deliver higher inflation in the future: the public would be able to judge the actual inflation regarding the announced target.

However, the main drawback of this solution is that the Central Bank is addressing a temporary issue (the liquidity trap arising due to the current economic crisis) with a permanent solution (increasing inflation in the medium run). Furthermore, inflation is not a panacea, and is associated with long-run costs. This is illustrated in Figure 15: with a 4%-inflation target, price level is permanently raised in the long-run, much faster than with a 2%-inflation target. For this reason, it has been proposed that the Central Bank targets a *price-level path* (*price-level targeting*).

Let us look at what happens in the case of a recession (Figure 15). In normal times, the price level is rising slowly at the targeted inflation rate 2%. At point t_1, the crisis pushes the economy into a recession, and slows down inflation. Prices continue to rise, but at a slower rate than before, so that the price level falls gradually below the path that it was following before the recession (dashed blue line). Now, imagine that the economy is recovering at point t_2, and the price level starts increasing again at 2%: it will permanently remain below the pre-crisis targeted path (dotted black line). Now imagine that the Central Bank adopts a 4%-inflation target. The new path will cross the pre-crisis path (2%), resulting in a price level exceeding the level had it followed the pre-crisis path, by more and more (dashed-dotted red line). On the contrary, if the Central Bank targets the 2%-growth price level path, its goal is to bring the price level back to that path (the pre-crisis path), and to keep it along. This would require a higher inflation rate in the short-run (to catch-up the path), but its long-run inflation target remains unchanged.

Although this solution sounds very appealing, its quantitative effects have been evaluated as small, and the amount of expected inflation which could be created by such a change in policy objective would be negligible, at least in the U.S. For that reason, it has been proposed to *target the nominal GDP path* (i.e. the product of real GDP and the price level), because it has fallen by much more than the price level (around 10% in the US between 2007 and 2012), and the quantitative effects are likely to be higher than in the case of price level targeting, see Figure 16[21].

Lowering other interest rates It should be underlined that for the sake of simplicity, our framework encompasses a single interest rate. However, in reality, there are many interest rates, and most of them remain positive even if the interest rate which is controlled by the Central Bank is set to zero (see Figure 17). For instance, the Federal Reserve conducts policy in terms of its target for federal funds rate, which is the interest rate

[20] See, *inter alias*: Blanchard, O., Dell'Ariccia, G. & Mauro, P., *Rethinking Macroeconomic Policy*, IMF Staff Position Note, January 2010; Krugman, P., *Two Percent is Not Enough*, The New York Times, 2012.

[21] Exchange rate depreciation has also been discussed, but as this course abstracts from an open economy framework, we do not discuss it further.

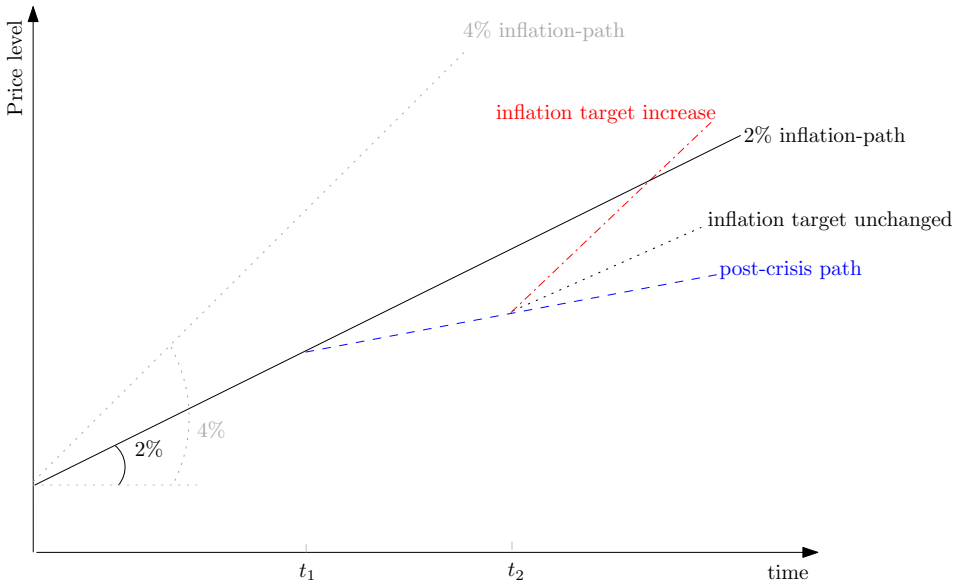


Figure 15: Price level-targeting versus inflation targeting.)

on very short-term loans between banks where the risk of default is very small. Even if this rate has been set to zero, mortgage interest rates, corporate bond rate, interest rates on risky short-term loans, on long-term government debts, etc... remain positive, and are relevant for households' or firms' spendings. What the Central Bank can do is to undertake actions to lower these other interest rates. For instance, it can directly buy various bonds or debt-related assets, such as long-term government bonds and mortgage-backed securities to drive their interest rates down. This is exactly the purpose of the Fed's **quantitative easing** policies from 2009. Fiscal policy makers can also indirectly push down interest rates on particular types of loans by various subsidies, such as tax benefits, or by providing State guarantees. All these measures lead to higher investment for a given zero riskless interest rate, and act within the $IS-LM$ model exactly as an expansionary fiscal policy, i.e. it shifts the IS curve to the right, and increases output.

This view is however strongly challenged by the Austrian explanation of business cycles and crises, according to which artificially maintaining low interest rates through very accommodative monetary policy is likely to further accentuate the disequilibrium which gave rise to the current economic crisis. This point of view is discussed in Appendix, in Sub-section A.2.

This last point related to other interest rates reminds us that we have ignored the multiplicity of interest rates because it simplifies the analysis without obscuring the main messages. However, when it comes to credit and financial market disruptions, this assumption prevents us from understanding what is happening in the model. We now relax this assumption and analyse the effect of financial crisis and the associated loss of confidence on investors within the $IS-LM$ framework.

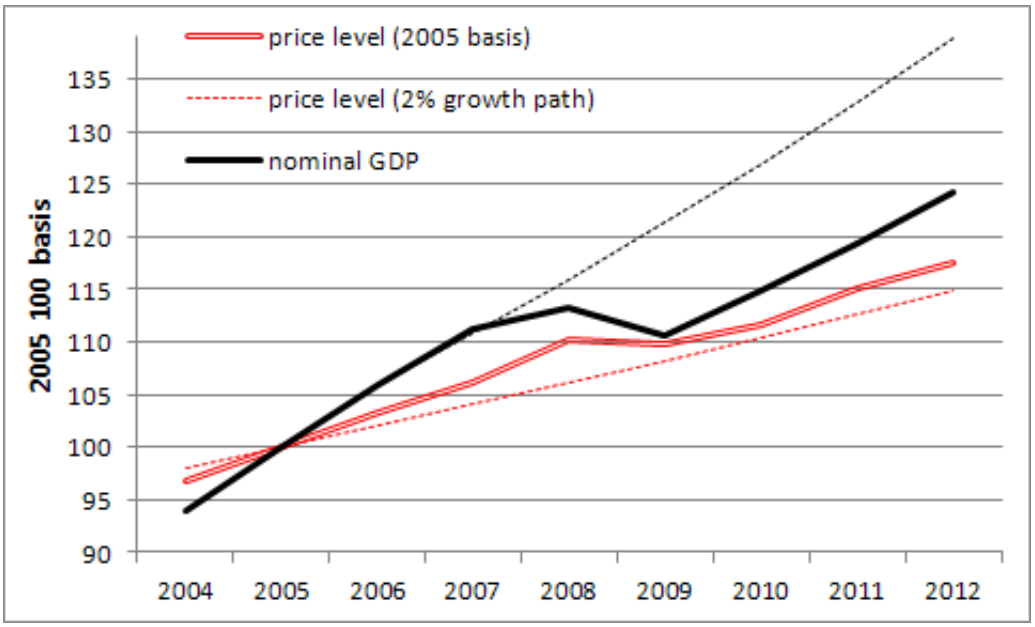


Figure 16: Evolution of price level and nominal GDP in the US (source: Fed)

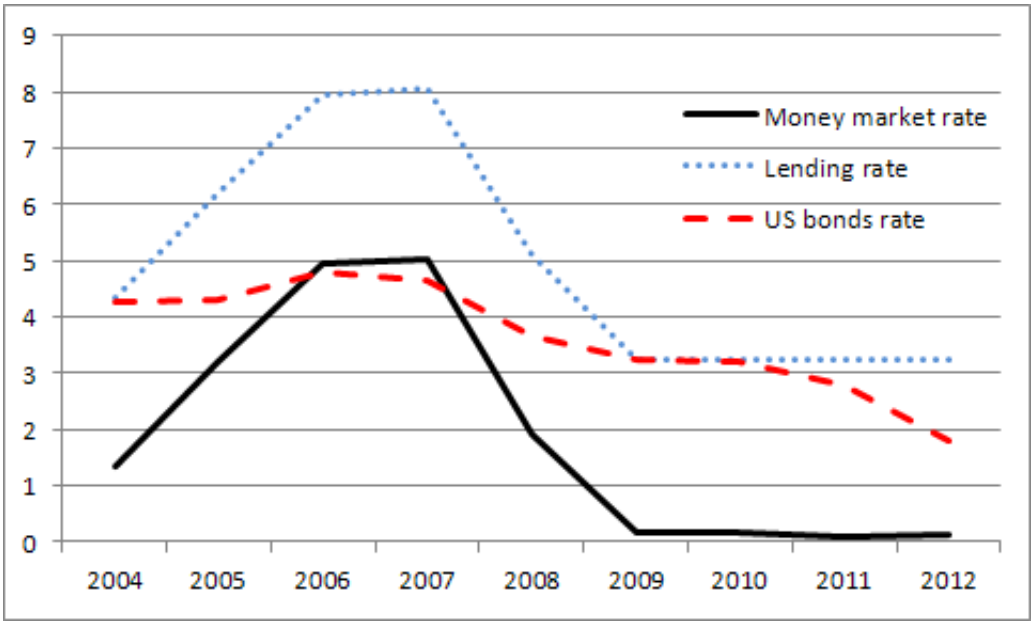


Figure 17: Evolution of interest rates in the US (source: IMF)

2.3. Restoring confidence on financial markets

Before turning to the analysis of the impact of a credit disruption and a financial crisis on the economy within the $IS - LM$ framework, we should first define some explanatory elements about financial markets[22].

The financial sector encompasses two different markets[23]: the *money market*, where households hold their savings as bank deposits with a given interest rate, and the *capital market*, where firms apply for bank loans, and pay a given interest rate. The very function of banks is to allocate households' savings to match firms' demands for financing. As mentioned in Section 1, in the standard $IS - LM$ model, the two interest rates (on households' deposits and on firms' loans) are assumed to be the same, as banks are ignored. This simplification may be a minor one in stable macroeconomic environment, but when a crisis arises, leaving banks out of the analysis cannot hold any longer. Indeed, a financial crisis primarily affects the agents' confidence in both money and capital markets: households begin to loose confidence in banks' solvency, and banks begin to loose confidence in firms' ability to pay back. Examples of financial crises include the Great Depression in 1929-1933, the Asian crisis in 1997-1998, the *dot-com* bubble in 2000, and, of course, the recent financial crisis initiated by the US *subprime* crisis and Lehman's Brothers bankruptcy.

Interest rates depend on the degree of riskiness of the borrower – being much higher for those who are on the brink of default than for those who are virtually riskless, and on the lengths of time – being much higher for loans over decades than for loans within few days. In what follows, we will assume that there are two interest rates in the model[24]. Although this is an assumption which remains far from reality, it is enough to capture the main effects of financial market disruption and related consequences for the economy.

2.3.1. Interest rate differential and the financial accelerator in the $IS - LM$ model

The first interest rate is the **saving rate**, denoted by i_M and corresponds to the one households earn on their savings. Households' savings are quite a safe asset (think of a bank account or government bonds). The second interest rate is the **borrowing rate**, denoted by i_c, and is paid by the firms when they borrow money to finance their investments. It is natural to consider the borrowing rate as more risky than the saving rate, so that $i_M < i_c$. Another reason why the borrowing rate is higher is related to the cost of financial intermediaries, mainly banks. Households do not directly lend money to firms, but delegate the task to banks, which spend significant resources for selecting and managing the loans (see Figure 18). Central banks focus on quite safe interest rates, and we assume that they control the saving rate. However, it is the borrowing rate which is relevant for investment decisions and, hence, for aggregate demand (i.e. in the IS curve).

[22] A large part of this section can be founded at `http://www.eurmacro.unisg.ch/xercises/crisis.html`, University of St. Gallen, and in Gärtner & Jung (2009).

[23] Although this is a very simplistic description of a financial market, it is enough to capture the main effects of a financial crisis within the $IS - LM$ model.

[24] We abstract from considerations about inflation expectations, and consider that they equal zero so that real and nominal interest rates correspond.

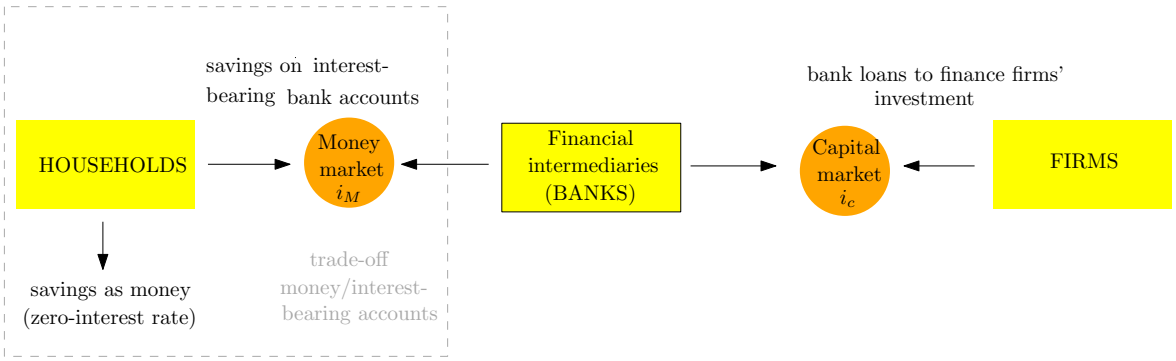


Figure 18: Financial markets: money and capital markets

We define the spread d as the difference between the borrowing and the saving rates: $d = i_c - i_M$. The spread negatively depends on output, i.e. $d = d(\underline{Y})$. The idea behind this assumption is that when the economy is booming, firms' financial situation is better, the value of their assets they use as collateral for loans is higher, and their probability of default is lower than during an economic downturn, so that their loans are less risky. The spread is also influenced by investors' confidence and perception of risk, regardless of the evolution of output. We investigate this point in more details in Sub-Sub-section 2.3.2. For the moment, we focus on the negative relationship between the spread and output.

As monetary policy is concerned with the saving rate, the LM curve is not modified. Without any spread, the $IS - LM$ model would be the same as in Section 1. As the borrowing rate affects investment and hence aggregate demand, the introduction of the spread modifies the IS curve. Specifically, it becomes flatter, so that effects of demand shocks are magnified.

Intuitively, if aggregate demand falls, as a result of a drop in consumer confidence for instance, the IS curve shifts to the left, and output and interest rate fall (see Figure 19). However, in the presence of an interest rate differential, the fall in output rises the spread d, as firms' demand prospects and financial situation deteriorate. For a given level of the saving rate, the borrowing rate rises and investment is further depressed. The rise in the spread acts as an additional force pushing down the economy. This phenomenon is referred to as the **financial accelerator**, and is illustrated in Figure 19[25].

2.3.2. Loss of confidence, credit disruptions and financial crises

A credit market disruption is a situation where it becomes harder for borrowers to obtain a loan, for a given level of output and saving interest rate. It can be due notably to a decline in asset prices, which lowers the value of debt collateral, the revelation of new information about risks or the failure of some financial intermediaries, which alter investors' confidence. In the model, it is translated into an increase in the spread d for a given level of output Y. This results in a drop in investment, that shifts the IS curve downwards, decreasing

[25]The same effect plays in opposite direction in the case of an increase in aggregate demand. When the economy is booming, the financial health of firms is likely to improve, making their loans less risky and decreasing the spread. For a given level of the saving rate, the borrowing rate decreases and investment and aggregate demand are stimulated. This force pushes further up the economy.

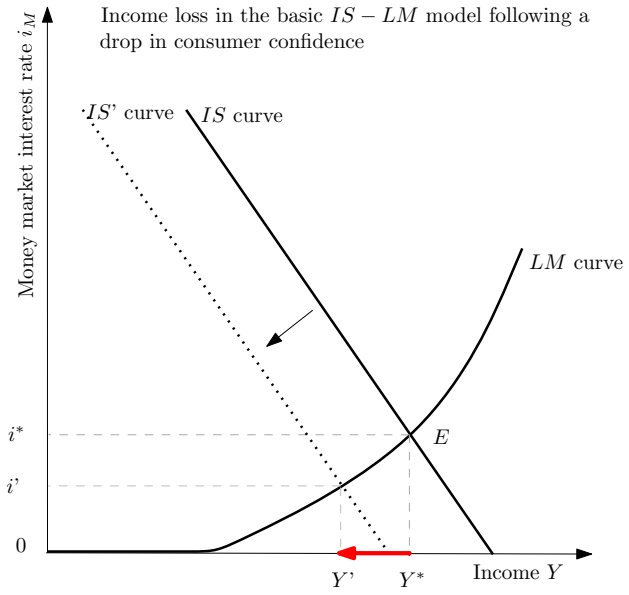


Figure 19: Interest rate differencial and the financial accelerator

both the income level and the interest rate. A full-blown financial crisis as the one we are experiencing can be simply modelled through a very large downward shift of the IS curve. For instance, when Lehman Brothers collapsed in September 2008, the interest rates paid by borrowers skyrocketed, while saving rates held steady or even fell.

As mentioned above, the reason behind this rise in the spread also lie in the loss of confidence of investors. If households loose confidence in banks' solvency, they will ask for a *risk premium* to let their savings on a bank account. For instance, if they expect that during the next periods, one bank out of the 50 that are operating in the money market will go bankrupt, keeping money at a bank implies a risk of $1/50 = 2\%$, meaning a potential loss of 2% on the deposit interest rate. This 2% corresponds to the `risk premium`, denoted by RP_M. The new interest rate is then given by $i = i_M - RP_M$. This will move the LM curve up, 2% higher than before the loss of confidence (see the red dashed LM curve on Figure 20a). The resulting equilibrium on the money market will be given by:

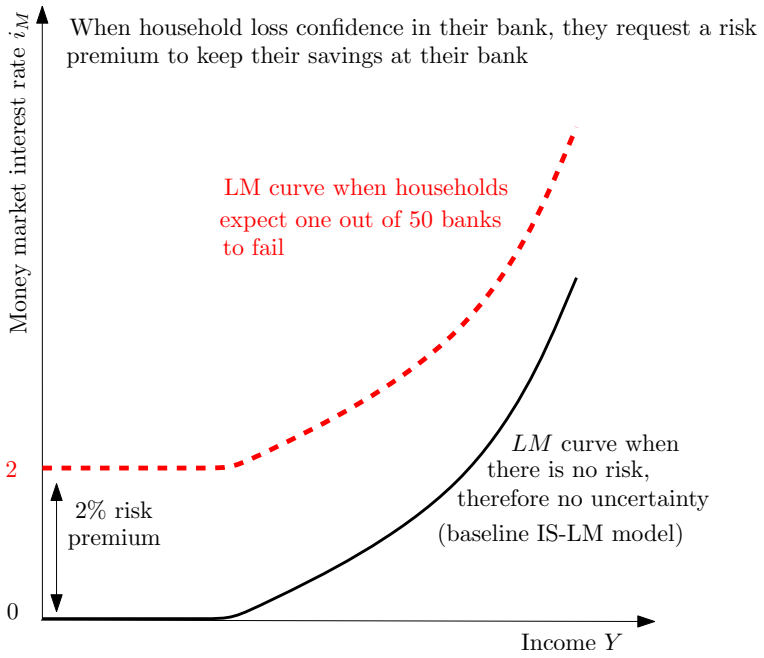
$$M = L(Y, i_M - RP_M) \qquad ([5])$$

Similarly, if banks loose confidence in firms' ability to pay back their loans, they will ask for a risk premium too, in order to cover the risk of failure. If banks expect 3% of firms to go bankrupt within the next periods, then a 3% risk premium, denoted by RP_C will be extra charged on firms' loans. The new interest rate will then reach a higher level, $i_c = i + RP_C$, investment will fall, and the IS curve shifts down (see the red dashed IS curve on Figure 20b). The resulting equilibrium in the goods market will imply:

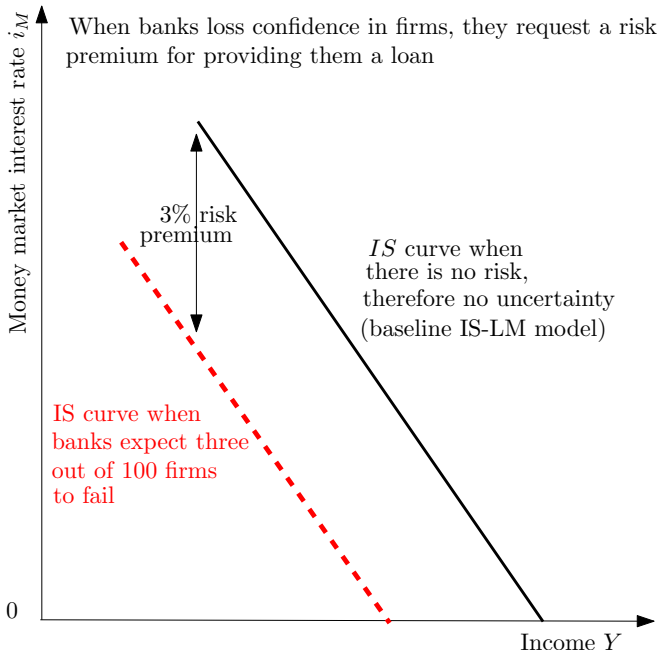
$$Y = C(Y) + I(i_M + RP_C) + G \qquad ([6])$$

Looking at the recent evolution of risk premium in the US money market and the US capital market (see Figure 21), we clearly see that such risk premiums have been playing a significant role since the beginning of the current crisis, especially in the capital

market (banks loosing confidence in firms much more than households loosing confidence in banks).



(a) Shift of the LM curve when households loss confidence in banks.



(b) Shift of the IS curve when firms loss confidence in firms.

Source: http://www.eurmacro.unisg.ch/xercises/crisis.html, St. Gallen University.

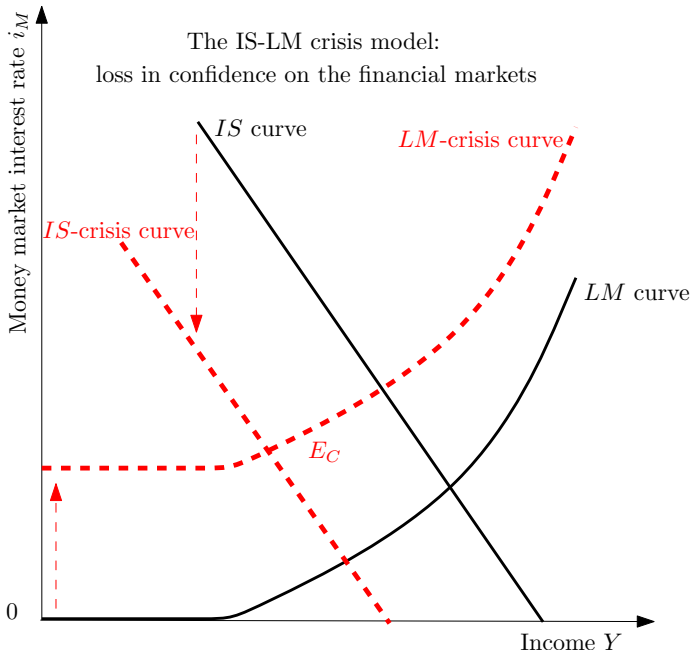
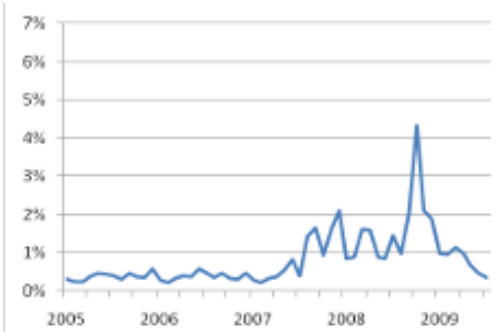
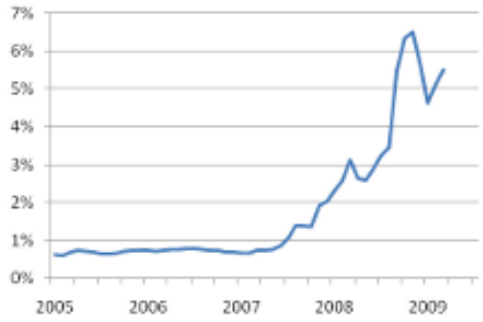


Figure 20: The $IS - LM$ model during a financial crisis



(a) Risk premiums in the money market: Libor – Government bond yields



(b) Risk premiums in the capital market: Corporate – Government bond yields

Figure 21: Risk premiums during the recent financial crisis on the US financial market

Source: U.S. Department of Labor and Zurcher Kantonalbank

2.3.3. Policy evaluation when confidence has been weakened

Assume that the economy is characterized by a new equilibrium E_C, at the intersection of the IS-crisis and LM-crisis curves (see Figures 20 and 22).

An expansionary monetary policy (aiming at decreasing the interest rate by increasing the money supply M) turns out to be ineffective as soon as the economy reaches the equilibrium $E2$, i.e. as soon as the IS curve crosses the flat part of the LM curve. Further increase in money supply has no effect on the interest rate, and only makes the LM curve flatter (see Figure 22a). This situation is exactly the same as the one where the economy is stuck in a liquidity trap (see Box 1.3.3), but in this case, the liquidity trap occurs at a strictly positive nominal interest rate i_M. That is due to the risk premium RP_M. The interest rate which is relevant for households decisions is $i_M - RP_M$, and this one is close to zero.

On the contrary, an expansionary fiscal policy (i.e. an increase in government expenditure G or a decrease in tax t) can move the IS curve to the right, and increase income until the economy exits the liquidity trap (see Figure 22b).

However, as emphasized in Sub-Subsection 2.1.2, the effectiveness of fiscal policy is limited. Fiscal policy is a short-run solution, which has to be implemented by taking into account the financial position of the states. As a long-run process, rebuilding confidence in financial markets appears to be a necessary step.

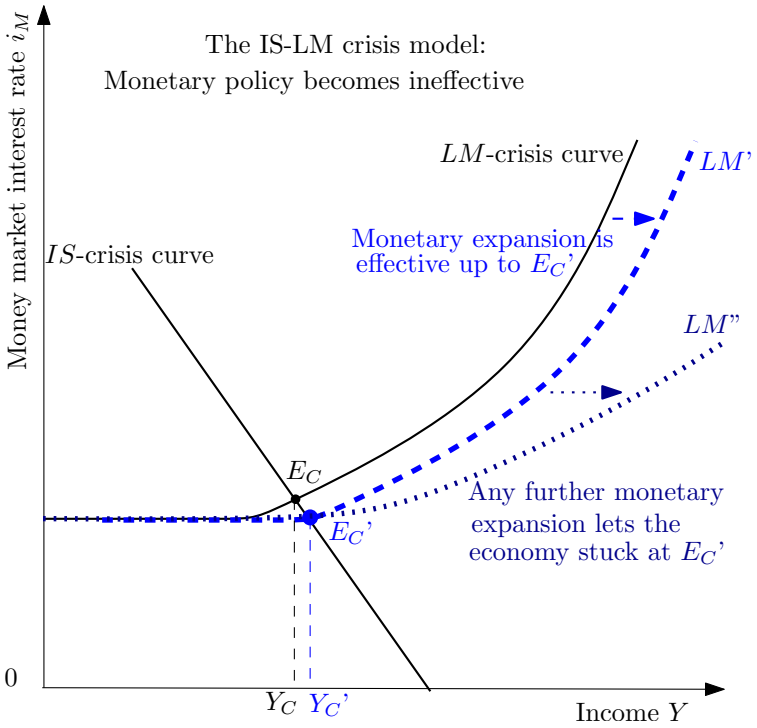
As a conclusion, modest financial crises can be dealt with by expansionary fiscal or monetary policies. However, if the crisis is severe enough to push the economy in a liquidity trap, fiscal policy becomes more important. It should be noted that this statement holds for a closed economy, and should be reconsider in the case of a small open economy, notably depending of the exchange rate regime.

3. Further extensions of the basic $IS - LM$ model

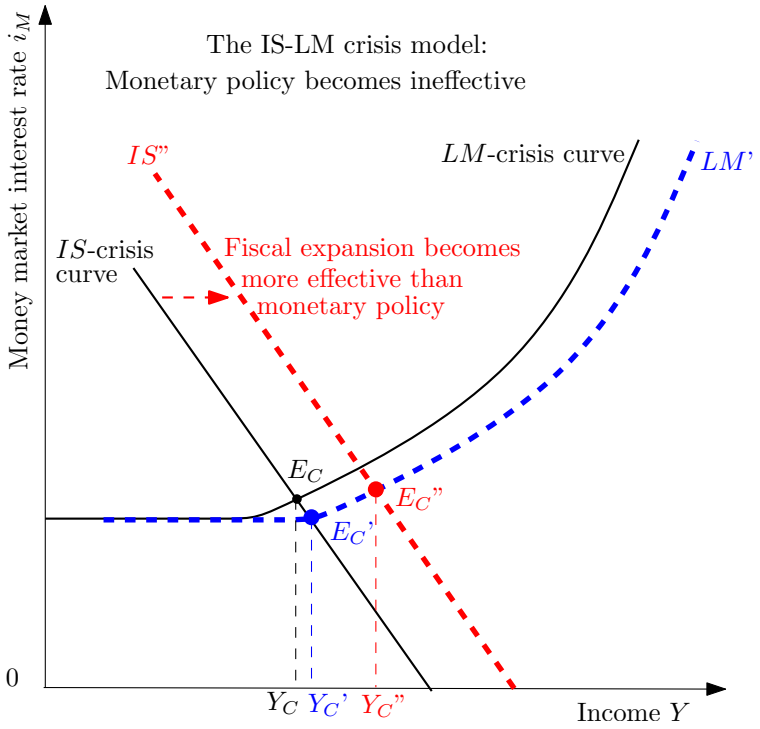
3.1. When the LM curve turns out to be flat

A structural criticism towards the $IS - LM$ model refers to the way monetary policy is modelled: the Central Bank is supposed to control the money supply. However, since the nineties, monetary targets have been abandoned by monetary authorities, and most of them now directly sets the interest rate as the instrument[26]. Several explanations can be given for this change in the conduct of monetary policy: the lack of a predictable relationship between monetary aggregates and the ultimate goal of monetary policy (mainly the control of inflation); the imprecise relationships between the instruments and the goals complicate communication with the public on the conduct of monetary policy; and optimal monetary targets may change according to economic conditions and advances in economic understanding. As a result, the monetary policy instrument is now the interest rate. Figure 23 derives the LM curve when the Central Bank adjusts the money supply M in order to meet a targeted level of interest rate $\bar{i}$, instead of targeting a given level of the money supply. The resulting LM curve turns out to be flat.

[26] Of course, monetary authorities do not set the interest rate by decree. They only directly control the money supply, that they adjust in order to reach the targeted level of interest rate. Rising the money supply cuts the interest rate, while cutting the money supply increases it.



(a) Effects of monetary policy during a financial crisis



(b) Effects of fiscal policy during a financial crisis

Figure 22: Stimulus package during a financial crisis

Source: `http://www.eurmacro.unisg.ch/xercises/crisis.html`, St. Gallen University.

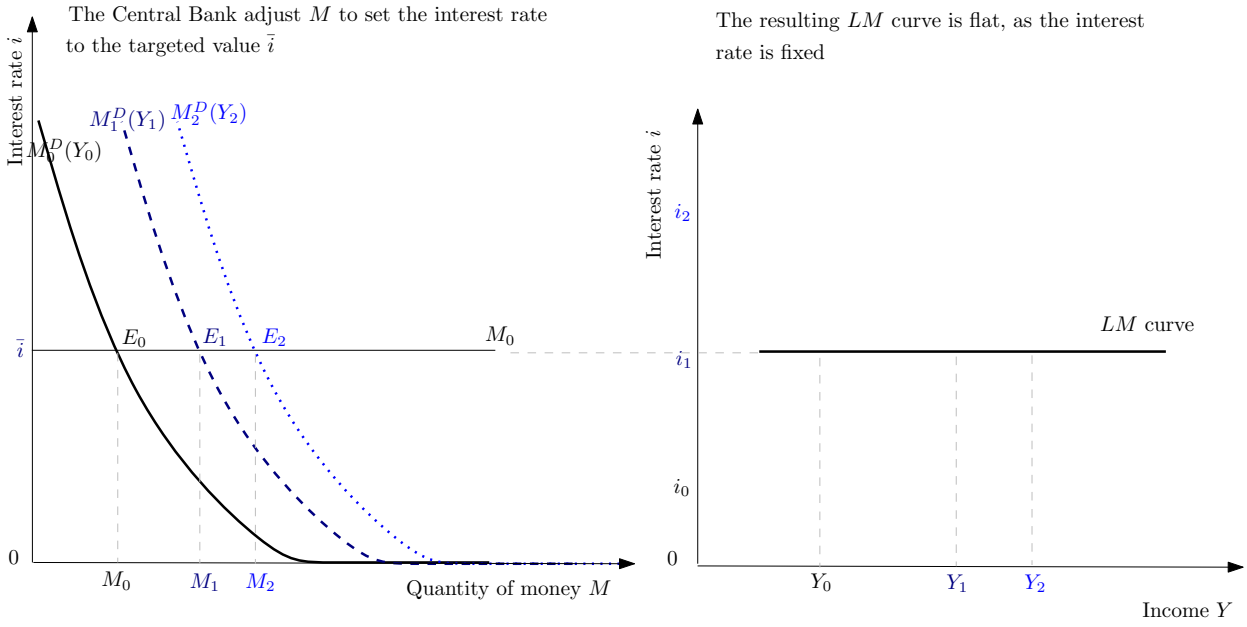


Figure 23: Interest-rate setting: the LM curve is flat

Interest rate setting can be described through a **policy rule**, which prescribes that the interest rate must be raised when output rises. This rule stems from monetary authorities' goals in terms of output and inflation. When output declines, the Central Bank cuts the interest rate to stimulate investment and aggregate demand. However, keeping implementing such a policy would make firms operate above their usual capacities, and would lead to an overheating of the economy, and an increase in inflation[27]. As Central Bankers primary aim at keeping inflation within a targeted range (usually around 2% in developed countries). This increase in inflation leads them to raise the interest rate. Therefore, interest rate is an increasing function of output. This can be represented by the MP (Monetary Policy) curve. The IS curve is left unchanged and we obtain the $IS - MP$ diagram (see Figure 24).

We do not enter into the details of the $IS - MP$ model, as most of the implications for fiscal and monetary policies that are derived in the $IS - LM$ model remain unchanged. In particular, analysis in Subsection 2 still applies within the $IS - MP$ model, and the existence of a liquidity trap remains an issue[28]. Indeed, the Central Bank controls the nominal interest rate, assuming some level of inflation expectations. Together they determine the real interest rate which is relevant for aggregate demand (notably investment). As long as inflation is not too low (and therefore inflation expectations are not too low), the real interest rate is determined by the monetary policy rule, and falls when inflation falls (because this indicates a fall in income). But when inflation becomes sufficiently low, and so do inflation expectations, the zero lower bound of the nominal interest rate becomes a binding constraint. It prevents the Central Bank from setting its desired level

[27] Inflation could be caused by so-called cost-push shocks, like a rise in the price of raw materials and oil for instance. In that case, output would be depressed whereas inflation would rise, creating a trade-off between the Central Banks' two objectives. We abstract from that specific case in this course, and refer to more advanced monetary policy courses for further elements.

[28] It should be noticed that the MP curve exhibits a flat part, just like the LM curve.

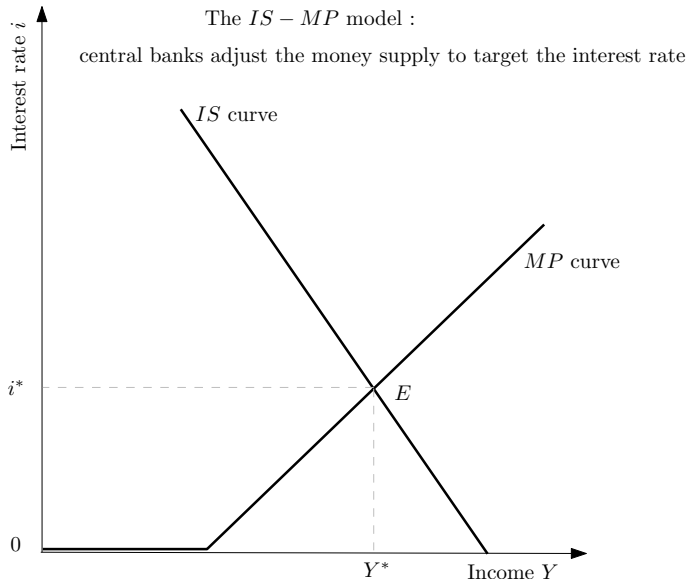


Figure 24: The $IS - MP$ model

of real interest rate, as the latter is given by $r = i - \pi^e = -\pi^e$. Consequently, a fall in inflation lowers inflation expectations but rises the real interest rate, and further depresses aggregate demand and GDP. The zero lower bound therefore eliminates a key stabilizing mechanism: in normal times, falls in output lower inflation, and the Central Bank cuts the nominal interest rate to stimulate aggregate demand. In a liquidity trap, a fall in output lowers inflation and inflation expectations, which further increases the real interest rate, and depresses economic activity.

For a deeper analysis of the $IS - MP$ model, see Romer (2013).

3.2. The need to account for banks and credit

The basic $IS - LM$ model neglects the credit business of the banking systems with firms (and households)[29]. This is more problematic in countries where corporate bonds do not play a critical role in firms' investment financing (as in Europe notably, compared to the US).

For this reason, extensions of the basic $IS - LM$ model incorporate loans and reserves that the banks hold with the central bank besides money and bonds[30]. These extensions have been referred to as the credit view. The basic mechanism can be described as follows: legal reserve requirements on deposits provide central banks with direct leverage over the quantity of funds that banks may obtain and, hence, over lending and the spending of borrowers (firms' investments and households' consumption). According to that view, monetary authorities affect aggregate demand by affecting the amount of available credits in the economy. However, the empirical importance of this transmission channel of monetary policy has turned out to be hard to establish. As a response, a *banking view* has been developed. This approach mostly relies on the financial accelerator and credit

[29]That is the reason why the basic $IS - LM$ model has been also referred to as the *money view*.

[30]See the $CC - LM$ model in the seminal contribution of Bernanke, B. & Blinder, A., Credit, Money, and Aggregate Demand, *The American Economic Review*, Vol. 78, No. 2, May 1988, pp. 435-439.

rationing that have been discussed in Sub-section 2.3; for further details, consult Bofinger (2001).

To conclude, the Keynesian $IS-LM$ model provides a simple framework to intuitively introduce some interesting economic concepts, e.g. the multiplier effect, the crowding-out effect, to describe the effects of economic crises, and to assess the effectiveness of policy responses. Furthermore, dusting off the neglected concept of liquidity trap and adding the possibility of inflation expectations, differentiated interest rates and risk premiums turns the basic $IS-LM$ model into a simple but powerful and sophisticated tool to understand the effects of the current financial and economic crisis, and to analyse policy alternatives.

A. Further elements

A.1. Equations of the $IS - LM$ model

Box A.1 : equations of the $IS - LM$ model

On the money market
Demand for money: $L(Y, i)$
Money supply: M (fixed by the Central Bank)
Equilibrium: $L = M$

On the goods market
Demand for goods : $Y^d = C + I + G$
with
Consumption (households): $C = c(Y - T)$
Investment (firms) : $I = -b \times i$
Tax revenue (government): $T = tY$
Public expenditure (government)
Goods supply: Y^s
Equilibrium: $Y^s = Y^d$

with parameters c: marginal propensity to consume, t: marginal income tax rate, i: interest rate, b: sensitivity of investment to interest rate.

A.2. An alternative view to Keynesianism and the origins of crises: the Austrian business cycles theory

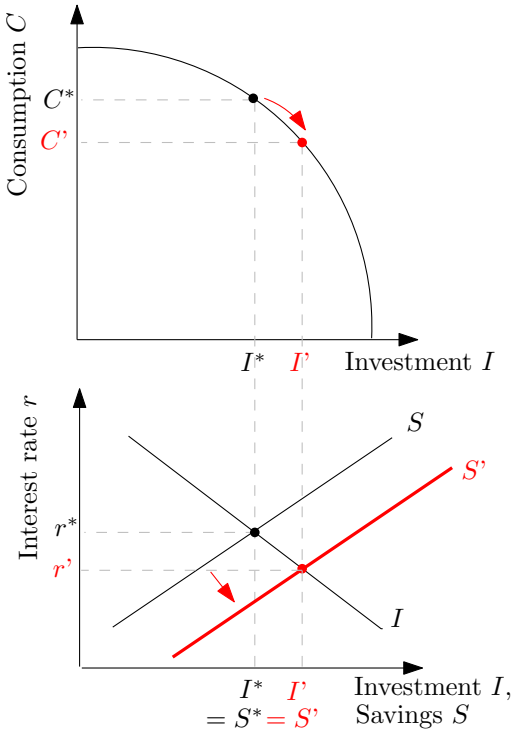
The Austrian school of through has been grounded, inter alia, by Ludwig von Mises and the Nobel Prize laureate F. Von Hayek[31].

In order to envision economics from an Austrian point of view, two assumptions have to be changed from the Keynesian framework:

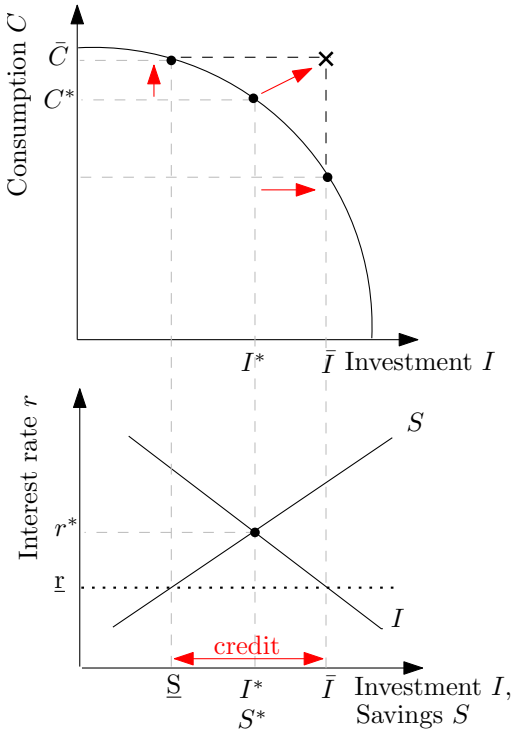
- While Keynes assumes that investment and consumption are two additive components of aggregate demand, and can move together in the same direction, Austrians assume that there is a trade-off between the two. This arises from the assumption that loanable funds are savings, which correspond to the non-consumed part of income. The market of funds (in which demand is investment from firms, and supply is savings from households) clears through the interest rate. Investment always equals savings, and increasing investment requires increasing savings and, hence, decreasing consumption. Investment and consumption are therefore substitutes, and not complementary elements of aggregate demand, as Keynesian theory assumes. This is illustrated in Figure 25a. Increasing savings decreases the interest rate, and increases investment (and vice-versa).

- While Keynesian through operates at a very aggregate/macroeconomic level, Austrian through considers different stages of production: from early stages, like housing, which are very capital-intensive and provide a flow of services to late stages, like

[31] For an introductory lecture, see *Time and Money, The Macroeconomics of Capital Structure*, R. W. Garrison, Routledge, 2001.



(a) Sustainable savings/consumption trade-off



(b) Unsustainable savings/consumption trade-off

retail inventories. Accordingly, stage-specific labour markets are considered, which clear through the adjustment of the wage rate, as in the neoclassical theory. Early stages are assumed to be investment-driven: an increase in savings decreases the interest rate, stimulates investment and, hence, production and employment in these sectors. On the contrary, late stages are assumed to be consumption-driven: an increase in savings depresses consumption and, hence, production and employment in these sectors.

According to the Austrian view of business cycles, inappropriate monetary policies destabilize the relationships between investment and savings on the market of loanable funds, and create mismatches between the two. Decreasing the interest rate to stimulate aggregate demand (through a decrease in savings/increase in consumption and an increase in investment) creates an unsustainable growth path. This is illustrated in Figure 25b. In order to understand how, let us consider only a three-stage production process: housing, manufacturing and retail trade (this simplification does not alter the analysis).

First, as a short-run effect of such a decrease in interest rate, credit is made cheaper, and savings less attractive. Credit is therefore the adjustment variable between saved and invested funds. *In the short-run*, consumption (through a decrease in savings and an increase in households' debt) and investment (through cheap credit) both increase.

Malinvestment The increase in investment mostly feeds the early stage of production (the housing sector in our simplified framework) as early stages are investment-driven. This transfer of resources toward housing arises at the expense of manufacturing and

retail trade. This spite effect is called *malinvestment*, and reflects the misallocation of capital during a boom. The demand for housing is fed by cheap credit, so that a bubble starts to emerge on the housing market.

Overconsumption The increase in consumption is directed towards the last-stage of production (the retail activities), as this stage is demand-driven. As assets (especially real estate assets) appreciate in the wake of the bubble, a *wealth effect* makes households fell richer, and further increases their consumption of retail goods. Capital goods in manufacturing are consumed in order to produce retail goods and, hence, depreciate. This transfer of resources toward retail goods acts at the expense of manufacturing, where capital goods depreciate and lack investment. This is all the more salient when retail goods are imported. In that case, home manufacturing further lacks invested resources to maintain capital goods. This spite effect is called *overconsumption*, and is the second salient feature of an economic boom.

However, in the long-run, the housing bubble will peak and burst. In that case, all sectors in the economy experience a crisis, followed by a drop in consumption and investment. The drop in consumption originates from the bursting of the housing bubble because the wealth effect now acts in a negative way: households fell poorer as their real estate assets depreciate, and postpone as much as consumption as possible. Yet, early stages of production crash heavier than later stages do, and experience a higher rate of unemployment. Investment projects need to be abandoned, resources (investments and workers) have to be transferred to later stages of production, notably manufacturing. However, this transfer takes time, workers have to adapt from housing to manufacturing, and retrain in order to be hired in these later stages of production. This need for time explains the high unemployment rates that arise in the aftermath of a financial crisis. Some evidence from the US goods markets seem to confirm this story about the recent economic crisis (see Figure 25, and `http://mises.org/daily/4682` for a debate).

Austrian theory and the current economic crisis According to the Austrian economists, Greespan's monetary policy of low interest rates in the aftermath of the *dot.com* bubble in the beginning of the 2000's is responsible for the development of the housing bubble, and the following financial and economic crisis, the underlying mechanism at work being the one that we have just exposed above.

Furthermore, Austrian economists reject the Fed's intervention on financial markets and the banks' bail-out. Indeed, as exposed during this lecture, these policies aim at cutting interest rates in order for the economy to recover though investment and consumption stimulus. According to the Austrian theory, artificially maintaining interest rates close to zero through accommodative monetary policy is likely to act exactly as under Greenspan's area: another credit bubble is likely to arise, as money is directed towards repurchasing "toxic" assets and buying government bonds, instead of being invested in capital goods.

However, the policy recommendations of the Austrian economists suggest to let the financial markets get rid of disequilibrium by themselves, without policy intervention, until the interest rate equalizes again investment and savings, and the economy returns on a sustainable growth path. In the mid-term, unemployment remains high as time is needed to reallocate workers from early stages of production to later ones. This lack of

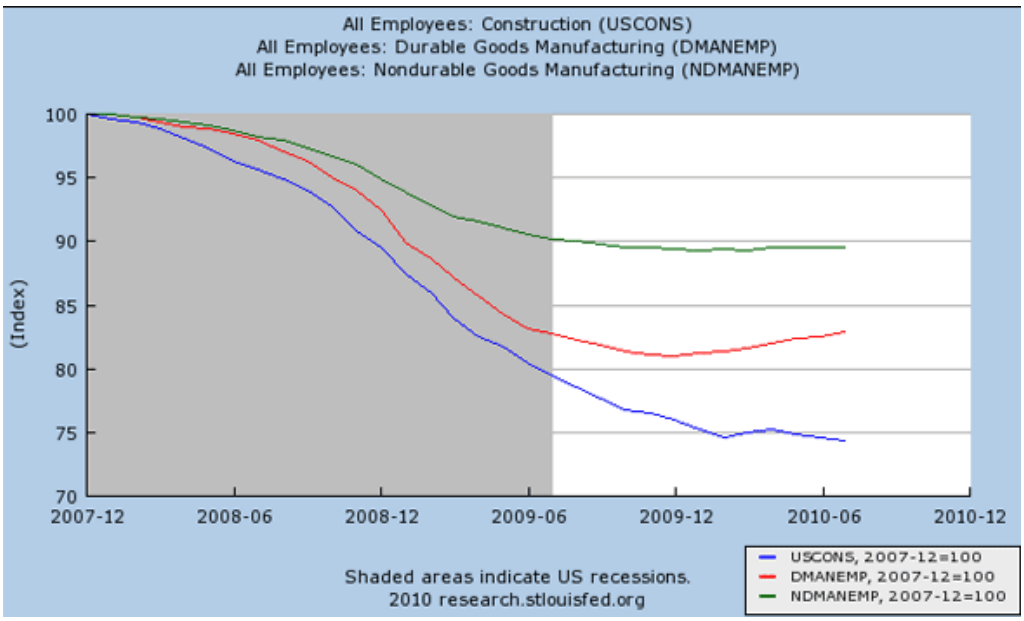


Figure 25: Evolution of employment in the aftermath of the 2007 crisis in the US.

room for policy intervention is the reason why the Austrian theory of unemployment has been given the nickname of "hangover theory" by its opponents.

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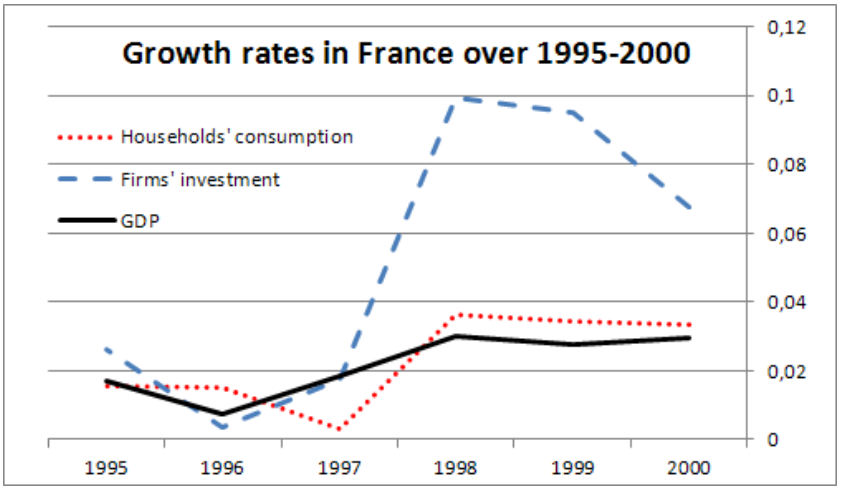
C. Exercises

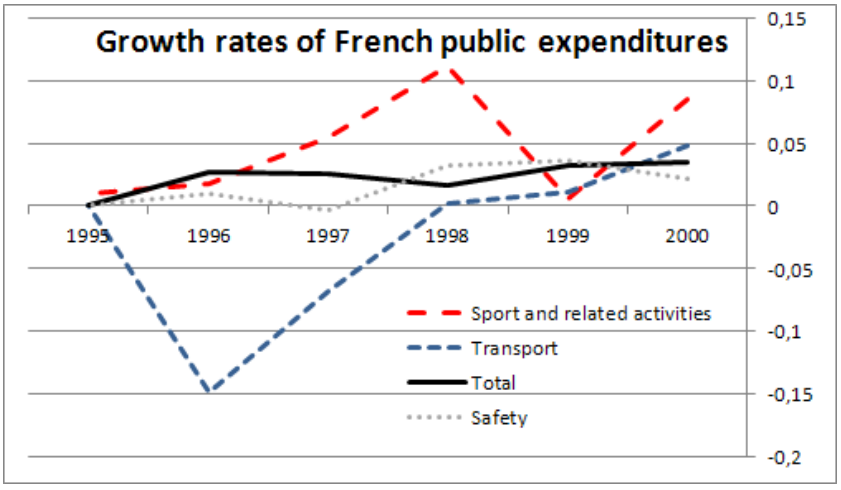
C.1. Exercise 1: the *World Cup* effect within the $IS - LM$ model

This exercise aims at analysing the potential economic spill-overs that result from hosting the FIFA World cup, and winning it, especially when the winner is the hosting country. We take the case of France in 1998 as an example. Growth rates of households' consumption, firms' investment and GDP are displayed on Figure 26a over the period 1995-2000, and Figure 26b gives the evolution of public expenditure (as a whole, and dedicated to specific purposes) over the same period.

1. Describe how hosting an international and highly popular sport event like the FIFA World Cup can be expected to influence the development of the economy (you can also use Figures 26a and 26b).



(a) Growth rates of macroeconomic data



(b) Growth rates of public expenditures

Figure 26: Tracing through the 1998 World cup's effects on the French economy

Source: INSEE

2. Starting from a given equilibrium situation $E^* = (Y^*, i^*)$, how such an event would shift the IS and/or the LM curve ?

   What is the new equilibrium ? Compare to the initial situation E^*.

Correction

1. Expected economic effects of hosting and winning the World Cup.
   - **Public expenditures** are expected to rise to finance investment in sport infrastructures, in improvements in transport services and safety, and to finance the organisation of the event: increase in G.

     In France, total costs of hosting the World Cup in 1998 are estimated to 1.56 Billions of euros (10 billion of FF), including 1.1 billion in transport and sport infrastructures and 0.46 billion in organisational expenses[32]. Financing has been supported by public spendings (State, public companies and local authorities), and by private companies (as sponsorship activities).
   - **Private investments** are expected to rise due to private companies who sponsored the event: increase in I
   - **Consumption** is expected to rise due to several factors: the flow of supporters coming from all over the world boosts the tourism sector, the public popularity of the sport and the event boosts the TV and HIFI equipments sector. Furthermore, following a win, the overwhelming joy among the population puts people in better mood and boosts households' consumption[33] and workers' productivity. This results in an increase in C.

2. The increase in public expenditure, private investment and households' consumption increases aggregate demand Y^{ad}, which shifts the IS curve upwards. The resulting equilibrium implies a higher equilibrium income level (supply adjusts to this higher demand) and a higher interest rate (because the transaction demand for money increases, which increases the interest rate)[34]. See Figure 7a.

   Of course, only part of this increase should be imputed to the World Cup event. Other explanations for this economic growth notably include the recovery of the US economy and the corresponding spill-over effects on the European economies.

[32] *L'organisation de la Coupe du monde de football*, 1998, Cour des comptes report, p. 266 Ãă 293).

[33] Falter, J-M., Perignon, C. and Vercruysse, O., "*Impact of Overwhelming Joy on Consumer Demand: The Case of a Soccer World-Cup Victory*", 2005, available at SSRN: http://ssrn.com/abstract=650741: they demonstrate that consumer demand has positively, significantly, and durably shifted following the 1998 World Cup in France.

[34] French GDP only grew at a 2.3% rate in 1997, but at 3.5% rate in 1998 and around 3% in 1999-2000. Other World Cup hosts which saw higher GDP growth rates include Spain, the US, and Italy. See also "World Cup hosts score real GDP gains", Times News Network, 3 juin 2006.

C.2. Exercise 2: The Japanese stimulus packages over 2008-2013

The Japanese economy has been lying in a liquidity trap since the 1990's. The current inflation target of the BoJ is close to 1%. Hardly impacted by the current economic crisis and the Fukushima disaster in March 2011, the Japanese governments have launched five major stimulus packages since 2008, for a total of rough 20% of the GDP:

1. August 2008: 91 billions of euros.
2. October 2008: 227 billions of euros.
3. December 2008: 194 billions of euros.
4. March 2009: 200 billions of euros.
5. January 2013: 175 billions of euros.

This amount of money aims at financing tax cuts, direct transfers to households, subsidized loans, subsidies to small companies, tax incentives to invest, public contracts from the public sector for infrastructures renovation and reconstruction of the North-East part of the countries (following the tsunami). These packages have been partly financed thought tax increase (VAT), public debt (even if the public debt ratio to GDP reaches 220%), and accommodative monetary policy (increase in holdings of government securities and adoption of a 2% inflation target).

Trace though the expected effects of those stimulus packages and their potential limits.

Correction : see the discussion thorough Section 2.

C.3. Exercise 3: Inflation targeting and the liquidity trap

This exercise is designed to investigate, within the $IS-LM$ model, how increasing inflation expectations may be able to push the economy out of a liquidity trap. We denote by π^e inflation expectations.

1. Suppose that the economy languishes in a liquidity trap, and that inflation expectations equal zero (we abstract here from risk premiums and multiple interest rates consideration). Represent this situation within the $IS-LM$ model. We note Y_0 the corresponding output value.

   What are the values of the nominal and the real interest rates in such a situation?

2. Can monetary policy makers do something to push the economy away from the liquidity trap?

3. Now suppose that inflation expectations are well-anchored at the 2% inflation target but that the economy still lies in a liquidity trap. What is the impact on the IS and/or LM curves? Draw the new equilibrium and explain your answer.

   What is the resulting effect on output? (denoted by Y_2)

   What are the values of the nominal and the real interest rates?

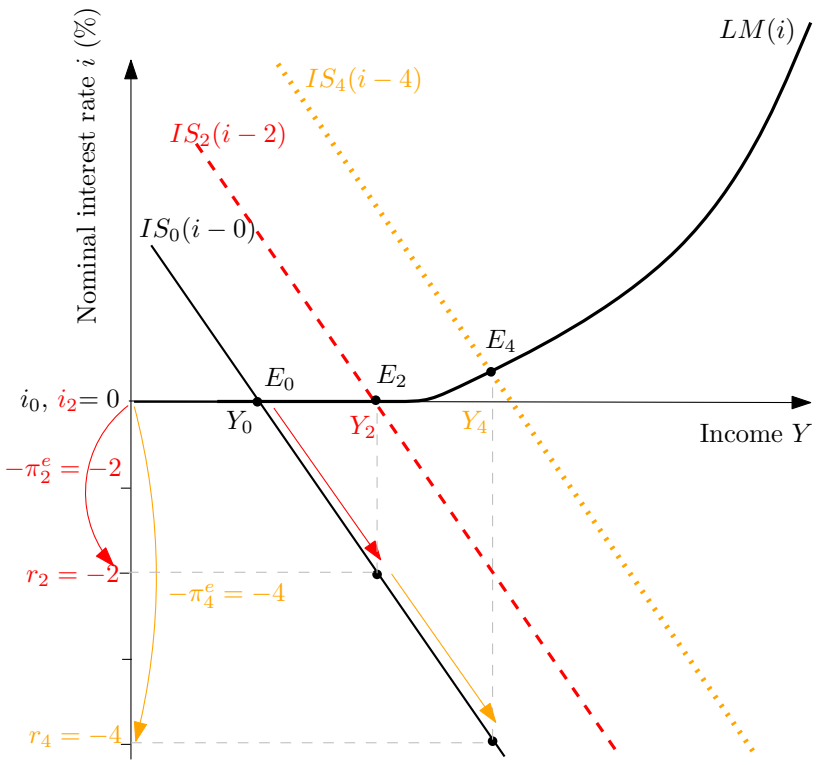


Figure 27: Rising the inflation target in a liquidity trap

4. Now suppose that the policy makers decide to increase the inflation target from 2 to 4%. Furthermore, suppose that this change in monetary policy does push the economy out of the liquidity trap. Represent the resulting equilibrium on the $IS-LM$ diagram.

   What are the values of output, nominal and real interest rates at the new equilibrium?

5. What happens if the change in the inflation target is not credible ? Draw the resulting equilibrium.

Correction : see Figure 27.

1. See Configuration 0 on Figure 27. As inflation expectations equal zero, the nominal and the real interest rates coincide and are equal to zero.

2. The traditional monetary policy action (i.e. rising money supply to decrease the nominal interest rate on order to boost aggregate demand) turns out to be ineffective because the zero lower bound of the interest rate is a binding constraint in a liquidity trap (the nominal interest rate cannot fall further, below zero). Other actions can yet been undertaken, notably rising inflation expectations to decrease the real interest rate (which is relevant for aggregate demand)[35].

[35] As we abstract here from multiple interest rate considerations, we do not discuss the effect of lowering other interest rates, notably on private loans.

3. The real interest rate falls from 0 to -2%, which boosts aggregate demand through investment. This effect acts as if the IS were upwards shifted. The resulting output value is higher ($Y_2 > Y_0$) but as we assume that this is not enough to push the economy away from the liquidity trap, the nominal interest rate remains zero (i.e. the IS curve still intersects the LM curve in its flat part). See Configuration 2 on Figure 27.

4. See Configuration 4 on Figure 27. The IS curve now intersects the LM curve in its upward-sloping part. Output is higher ($Y_4 > Y_2 > Y_0$), the nominal interest rate becomes positive and the real interest rate is $i - 4\%$.

5. If the change in the inflation is not credible, the public do not believe that the Central Bank is actually able to/ willing to deliver a higher inflation rate in the future, and inflation expectations do not change. The IS curve is not affected by the policy change. If we assume that inflation expectations were 2%, the economy stays in Equilibrium E_2, if they were 0%, the economy stays in Equilibrium E_0. In both cases, the economy stays in a liquidity trap.