

WHAT SHOULD WE TEACH OUR STUDENTS ABOUT INTEREST RATES DETERMINATION

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ABSTRACT

Introductory macroeconomics textbooks determine interest rates either by liquidity-preference, or loanable-funds approaches, or both. Instructors face problems explaining the effects of fiscal policy when only liquidity-preference approach is introduced, whereas impacts of monetary policy are difficult to explain if only loanable-funds approach is used for interest rates determination. Some authors introduce both the approaches at two different places and use them for different purposes. Students wonder why they need to use two models to explain one concept. Other authors struggle to reconcile, but fail to show how the two approaches lead to the same interest rate. By redefining the concept of the supply of loanable-funds in the light of excess reserves, we present our model of interest rates determination that is capable of tracing the impact of both monetary and fiscal policies on short- and long-run nominal and real interest rates together with the dynamics of its adjustments. Our model is also capable of explaining the effects of changes in required reserve ratio or discount rate on the interest rates. We believe that our model will greatly help the students to understand the concept of interest rates determination better.

JEL Classification Codes:

A22 - Economic Education and Teaching of Economics (Undergraduate)

E43 - Macroeconomics & Monetary Economics (Interest Rates: Determination, Term Structure, and Effects)

INTRODUCTION

In the standard macroeconomics principles textbooks, some authors present only the liquidity-preference (LP) approach, others present only the loanable-funds (LF) approach, and the rest present both the approaches to the modeling of interest rates (r). The LP approach determines the nominal r in the money market where the equilibrium nominal r is the rate that equates quantity of nominal money supplied (M) by the central bank with quantity of nominal money demanded by the public. Among the textbooks we examined, Baumol and Blinder (1999), Boyes and Melvin (2011), McEachern (1997), O'Sullivan, Sheffrin and Perez (2010), and Schiller (2010) belong to this group, who use only the LP approach to determine equilibrium

r. The LF approach, on the other hand, determines the real r in the LF market where the equilibrium real r is the rate that equates the quantity supplied of LF, which consists of private saving (S), with the quantity demanded for LF, which consists of investment (I) and bond financed government deficit ($G - T$). Instead of viewing budget deficit ($G - T$) as a part of the demand for LF, some authors prefer to view it as negative amount of government saving, and incorporate that in the supply of LF. Needless to say, the conclusions drawn from these two different representations are identical. Cowen and Tabarrok (2010) are the authors who use only the LF approach for equilibrium r determination. The rest of the authors we examined use both the approaches to explain equilibrium r ; however, the presentation of the two approaches differs significantly among these authors. Bade and Parkin (2011), Frank and Bernanke (2009), Hall and Lieberman (2005), Hubbard and O'Brien (2010), Mankiw (2007), Miller (2011), and Sexton (2002) keep the two approaches completely separate. They use the LP approach to determine the short-run nominal r , and the LF approach to determine the long-run real r without showing any relationship between them. Colander (2010), Gwartney, Stroup, Sobel, and Macpherson (2009), Krugman and Wells (2009) and Parkin (2010), on the other hand, put the LF and the LP diagrams side-by-side in order to reconcile the two approaches. Since often there is a close connection between movement in the short-run nominal r and the long-run real r , these authors assume zero inflation expectation to make the real r the same as the nominal r . Since the choice of approach to explain equilibrium real and nominal r in the short- and in the long-run differs significantly among authors, we classify these leading authors into four different groups according to their choice of approach:

1. Authors using only the LP approach
2. Authors using only the LF approach
3. Authors using both the approaches but keep the purpose of the two approaches separate.
4. Authors using both the approaches and try to reconcile them to explain equilibrium r both in the short- and in the long-run.

In this paper, we will discuss the problems and shortcomings of each of these groups' coverage of this topic and suggest remedies for these inadequacies.

AUTHORS USING THE LP APPROACH ONLY

The advantage of applying one approach over two is that it is definitely less confusing to the students. All the authors in this category argue that an open market purchase shifts the supply of money curve to the right that leads to a lower r ; however, this r is the rate when both income (Y) and prices (P) are held constant. This is the money market clearing r which we will call the "immediate-run" equilibrium, a level that is reached before the short-run equilibrium

when Y adjusts while P is held constant. The short-run r will be higher than the immediate-run r , as an increase in Y will shift the demand for money curve up.

One of the down sides of using only LP approach is that it cannot effectively explain how a change in the government budget deficit affects r . While trying to explain the concept of crowding-out, Boyes and Melvin (2011, p.247) and Schiller (2010, p.255) state that an increase in government borrowing drives up r ; but do not explain how that happens in terms of the LP diagram. Other than O'Sullivan, Sheffrin and Perez (2010), none of the authors in this group attempts to determine the long-run r . O'Sullivan, Sheffrin and Perez (2010) however use the LP diagram (p.339), and explain that an increase in the government budget deficit will increase wages and prices, and hence demand for money in the long-run raising r .

McEachern (1997) explains in words only (p. 329), whereas Baumol and Blinder (1999) are the only authors in this group who explain in terms of the LP diagram (p.309), the short-run adjustment of r after conducting an expansionary fiscal policy. They argue that an increase in government purchases increases aggregate demand that leads to greater Y , which in turn increases money demand. For a given supply of money (M), an increase in money demand leads to a higher r . The problem with this argument is that an increase in the budget deficit affects r only indirectly through an increase in Y . That gives rise to a few issues:

1. In the LP model, increase in the budget-deficit has no immediate-run impact on r . If that be the case, how can the Fed sell bonds in the first place at the same r ?
2. Interest rate according to the LP model does not change in the short-run when expansionary fiscal policy has no net effect on aggregate demand and hence Y , i.e. when crowding-out is complete.

AUTHORS USING THE LF APPROACH ONLY

Using the LF approach alone makes it difficult to explain the effects of monetary policy on r . Cowen and Tabarrok (2010) are the authors who use only the LF approach to explain equilibrium r . According to them, the quantity supplied of LF consists of private saving, and four major factors determining saving are: smoothing consumption, impatience, marketing and psychological factors, and r . The demand for LF, on the other hand, consists of investment and bond financed government budget deficit. They use the LF diagram to explain how an increase in government borrowing crowds out private consumption and investment by increasing r (p. 160). However, six chapters later, when time comes to explain the effects of an open market purchase on r , they couldn't use the LF model. Instead, they use a third model (that may be referred to as the "bond market model") where the price of bonds, which is inversely related to r , is determined by the demand and the supply of bonds:

“When the Fed buys bonds, it increases the demand for bonds, thus lowering the interest rate. So buying bonds stimulates the economy through two distinct mechanisms, namely higher money supply and lower interest rates.”(P. 296)

Cowen and Tabarrok (2010) mention that the Fed controls real r only in the short-run and not in the long-run (p. 297). They argue that expansionary monetary policy lowers r through increased price of bonds in the bond market and not by the LF model. A few points need to be noted:

- The authors in fact use two models to explain the movements of r . The effects of fiscal policy are analyzed through the LF model while the short-run effects of monetary policy are explained through the bond market model.
- The question remains as how the change in r in the bond market affects r in the LF market.
- How to explain with the help of the LF diagram, what happens to r when the Fed reduces the required reserve ratio or discount rate.
- Neutrality of money implies that the real r will increase in the long-run to its original level after an expansionary monetary policy. The dynamics of adjustment is completely absent in their analysis.

AUTHORS USING BOTH THE APPROACHES BUT FOR DIFFERENT PURPOSES

These authors place the two approaches of r determination far apart in two separate chapters in the text. The LF approach is usually explained early in the textbook in the ‘Saving and Investment’ chapter, whereas the LP approach is presented much later in the ‘Monetary Policy’ chapter. Their idea is that long-run real r is determined in the LF market whereas short-run nominal r is determined in the money market. The two approaches are viewed as independent of one another and are used to determine two different interest rates. Mankiw (2007) is very clear about this:

“The different theories of interest rate are useful for different purposes. When thinking about long-run determinants of interest rate, it is best to keep in mind the loanable-funds theory. ---- By contrast, when thinking about the short-run determinant of the interest rates, it is best to keep in mind the liquidity-preference theory.” (p. 478)

Having no connection between the two approaches, the dynamics of adjustment from short- to long-run equilibrium is missing in their analyses. With the help of the LP diagram and the short-run aggregate expenditure diagram, Hall and Lieberman (2005) demonstrate how an increase in

government purchase affects the short-run r . What is missing from their analysis is the determination of the long-run r .

The idea of two approaches to determine r is one of the major sources of confusion among students. While discussing the LF market, these authors explain the effects of an increase in the government budget deficit and avoid discussing the effects of an increase in the money supply on r . This can be explained by pointing out that the LF diagram depicts a long-run model and an increase in the government budget deficit increases r while increase in the money supply has no effect on r in the long-run. However, this argument bypasses the questions: how expansionary monetary policy affects r in the short-run, and how the long-run equilibrium is reached from the short-run equilibrium. Similarly, in the money market, these authors explain only the effects of an increase in the money supply on r in the immediate-run. Thus, their approach to r determination fails to show the effects of an increase in the government budget deficit on r in the short-run. Bade and Parkin (2011) talk about long-run value of money determination and never mention its relation with long-run r .

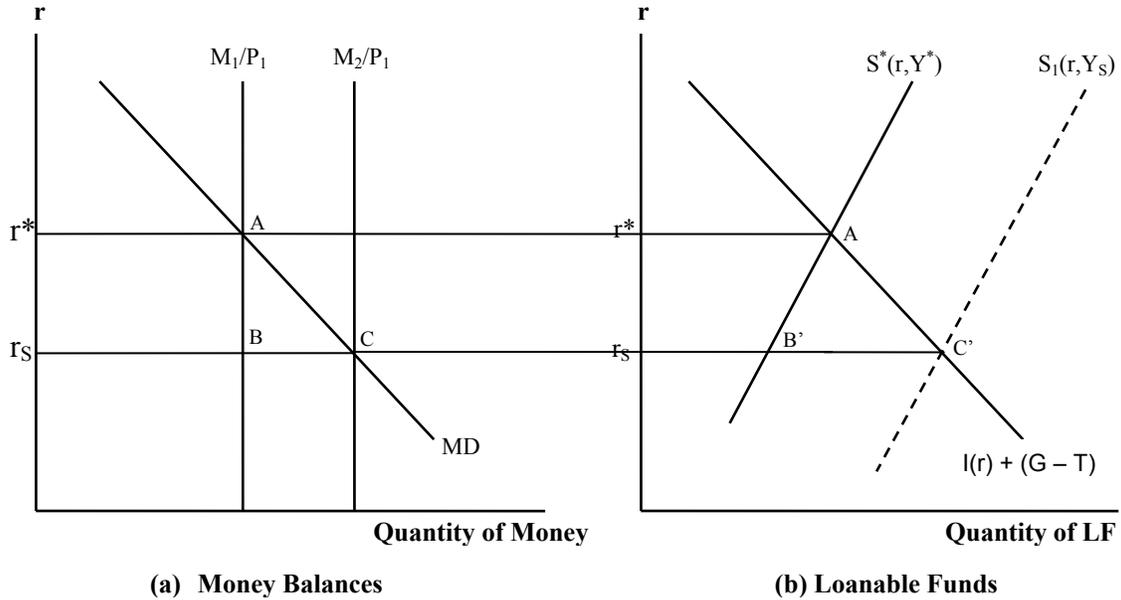
AUTHORS TRYING TO RECONCILE TWO APPROACHES

Colander (2010), Gwartney, Stroup, Sobel, and Macpherson (2009), Krugman and Wells (2009) and Parkin (2010) try to reconcile the two approaches by presenting side-by-side graphs of the money and the LF markets. They depict the money market on the left side in panel (a), and the LF market on the right side in panel (b). We reproduce their graphs in **Figure 1**.

To illustrate the effect of an increase in the money supply resulting from an open market purchase, they start from an initial long-run equilibrium at point A in panels (a) and (b). They argue that an open market purchase simultaneously shifts the money supply curve and the supply of LF (S_{LF}) curve to the right. The S_{LF} curve shifts because an increase in money supply will increase Y due to lower r in the money market causing an increase in S in the LF market at each r . This is shown in **Figure 1** where the short-run decline in r is the same in each market (i.e., r^* to r_s in **Figure 1**). While their effort to reconcile the two approaches is commendable, they fail to explain two things:

1. Why and how the two markets equilibrate at the same r after the economy is out of initial equilibrium. In their approach, they implicitly insist on an invalid constraint that an increase in the money supply will shift both the money supply and the S_{LF} curves in such a way that both the markets will lead to a unique r in the short-run. In other words, they fail to show why the S_{LF} curve shifts exactly by the amount of $B'C'$ due to an increase in money supply of BC in the money market, no more no less.
2. If an increase in Y shifts the S_{LF} curve to the right, why it failed to shift the demand for money curve up in their models?

**Figure 1: Interest Rate Adjustments after an Increase in Money Supply
(According to GSS&M, and Krugman & Wells)**



Note that the first point can easily be explained by arbitrage opportunities which will ensure that the r will be the same. The second point can be explained by considering the net effect - the demand for money curve will shift up as the S_{LF} shifts left from S_1 (Fig 1), but doesn't shift as far as S_1 in the first place. The resulting r is somewhere between r^* and r_s . Although both the points can be explained very easily, none of the textbooks we looked at actually explained it. We understand that the existing approach keeps the matter simple, but it is at the expense of confusion on the part of the students.

OUR APPROACH TO INTEREST RATES DETERMINATION

We believe that students will be better served if we use only one model for r determination. Our objective is to determine real and nominal r in the immediate-, short- and in the long-run by a single model. We also want to explain how r reaches from one long-run to another long-run equilibrium via immediate- and short-run adjustments after an initial disturbance in the economy. To that end, we need to look in to the concept of the S_{LF} more in depth.

Given Y , households decide on its distribution between consumption (C) and saving (S) at different r . In the traditional sense, S constitutes the S_{LF} as households decide on how much of S will be in the form of direct lending (DL) such as buying bonds and how much will be in the form of indirect lending (IL), i.e. deposits in banks. Mankiw (2007) puts it eloquently:

“The supply of loanable funds comes from people who have some extra income they want to save and lend out. This lending can occur directly, such as when a household buys a bond from a firm, or it can occur indirectly, such as when a household makes a deposit in a bank, which in turn uses the fund to make loans.” (p. 280).

$$S_0, S = DL + IL.$$

However, IL, which constitutes households’ deposits in banks, becomes the total reserves (TR) from which the banks make loans. Note that the entire TR cannot be loaned out and hence cannot be included in the S_{LF} as banks have to keep, by law, a part of their TR as required reserves (RR). The part of IL that is available to a bank for loan purposes is actually the rest of the reserves, known as excess reserves ($ER = TR - RR$). We know that one bank can create money by giving loans up to the amount of its excess reserves. However, the whole banking system can give loans up to its excess reserves times simple deposit multiplier, which is $1/\text{required reserve ratio}$; i.e. ER/RRR where RRR is the required reserve ratio. Hence, the total supply of loanable funds available from the whole banking system out of the total household deposits of IL (TR) is ER/RRR . To sum up, households distribute their given Y into C and S where only a part of S constitutes the S_{LF} :

$$S_{LF} = DL + (TR - RR)/RRR = DL + ER/RRR$$

(Note that if banks choose to hold an additional amount of reserves (AR) on the basis of their daily business requirements, the desired reserves (DR) will be equal to $RR + AR$. At that time excess reserves (ER) = $[TR - (RR + AR)]$ and the $S_{LF} = DL + ER/DRR$, where DRR is the desired reserve ratio). In the LF diagram, the quantity supplied of LF changes (movement along the S_{LF} curve) when r changes ceteris paribus, whereas there will be a shift of the S_{LF} curve when any non-interest determinant of the S_{LF} changes. An increase in TR will increase ER shifting the S_{LF} curve to the right, whereas any increase in RRR will reduce ER shifting the S_{LF} curve to the left. A transfer of funds from DL to TR (i.e. households selling bonds and deposit the money in banks) will increase the S_{LF} for every r shifting the curve to the right. It is important to note that the above statement is true when $RRR < .5$. A \$1 transfer from DL to IL reduces DL by \$1 but increases IL by $(1-RRR)/RRR$ so that the S_{LF} increases by $(1-RRR)/RRR - 1$. When $RRR = .5$, increase in the S_{LF} is zero in that case and negative when $RRR > .5$. Since historically RRR is much less than .5 we stick to the fact that open market purchase by the Fed (household selling bonds) shifts the S_{LF} curve to the right. Note that this result is significantly different from the traditional conclusion that the S_{LF} is unaffected when the composition of S (between DL and IL) changes for a given S.

The demand for LF remains exactly the same; i.e. it is the sum of investment demand (I) and bond financed government budget deficit ($G - T$). Together with the newly defined S_{LF}

mentioned above, we propose a comprehensive analysis of the real and nominal r in the immediate-, short-, and in the long-run noting the following characteristics of Y and P in the immediate-, short-, and in the long-run already established and accepted in the discipline:

1. Y is constant at potential level of output (Y^*) in the long-run. It is constant in the immediate-run, but variable in the short-run. Y increases when aggregate demand is higher than aggregate supply and vice versa.
2. P is constant in the immediate- and in the short-run. In the long-run, P will rise when short-run Y is higher than Y^* and vice versa.

Following the standard practice, we measure the real r on the vertical axis and the quantity of LF in the horizontal axis to draw the demand and the S_{LF} curves. We start with the long-run equilibrium r with zero percent inflationary expectation. We then introduce a monetary/fiscal policy shock and trace the movement of the real r back to its long-run level via immediate- and short-run equilibrium. As long as inflation expectation doesn't change, the real and the nominal r will be the same. If inflation expectation changes in the process, the nominal r will be higher than the real r by the amount of the expected inflation. The nominal r at that time can be derived by adding the expected inflation rate to the real r .

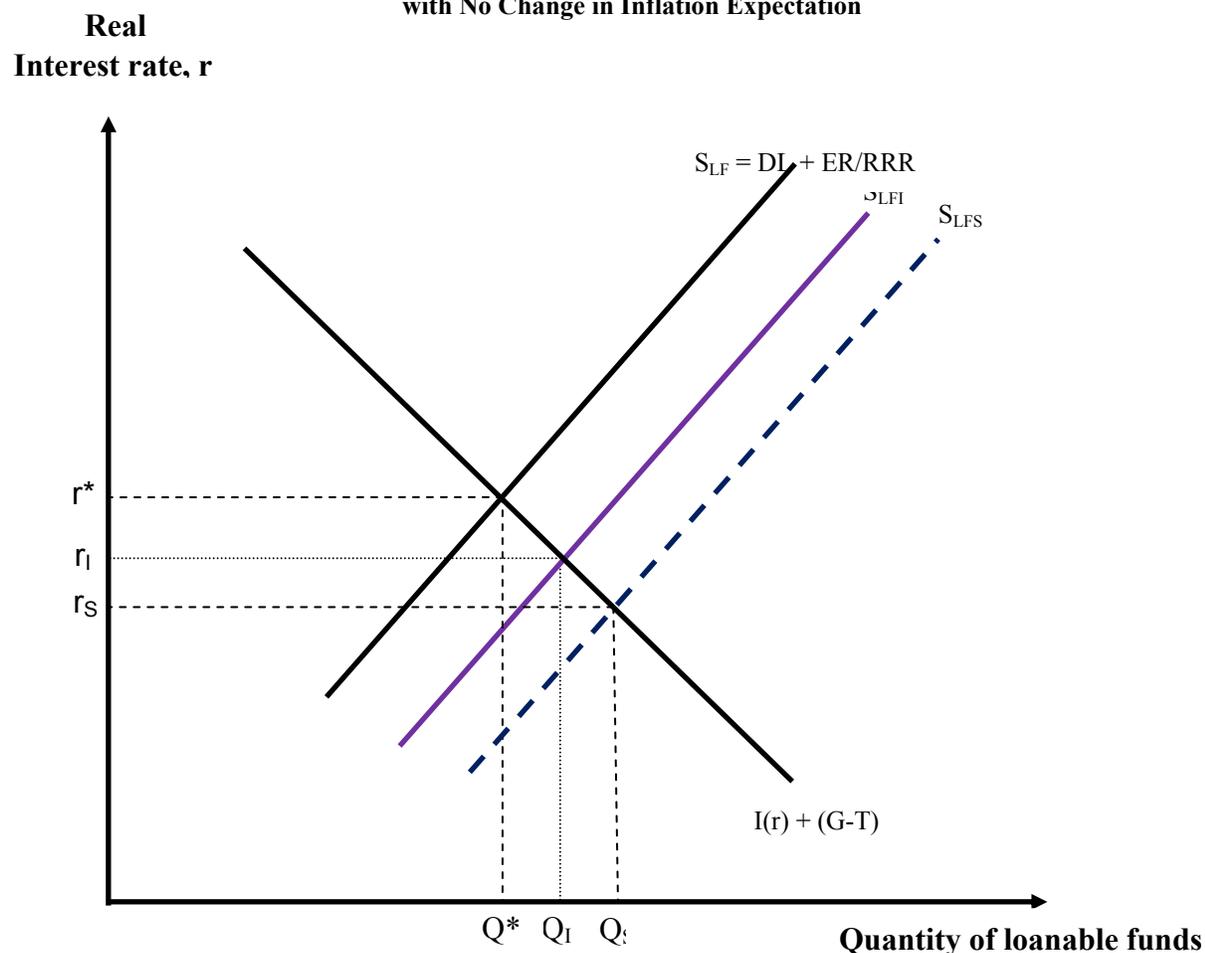
THE EFFECTS OF AN INCREASE IN MONEY SUPPLY IN OUR MODEL

In **Figure 2**, we analyze the effects of an open market purchase on r with no change in inflation expectation.

Initially we start with a long-run equilibrium r (r^*) position where the quantity of LF demanded, $[I(r^*) + (G - T)]$, equals the quantity of LF supplied at Y^* . Given Y^* and r^* , saving S^* (at Y^* and r^*) is also given with its distribution between DL^* and IL^* (TR^*) where DL^* is the desired bond holdings of the households in the long-run. As pointed out earlier, the S_{LF} available for loan at r^* is $DL^* + (TR^* - RR)/RRR$. Note that in the traditional model, when the households sell bonds to the Fed (open market purchase), DL decreases and TR increases by the same amount while Y and hence the S_{LF} curve remain the same. Interest rate changes only in the short-run when expansionary monetary policy increases Y and hence S . This result is problematic because Fed has to offer a higher price of bonds (lowering r) in order to lure households to sell bonds. That is, r has to be lower in the immediate-run in order for the Fed to get all the bonds it wants to buy. In our model, however, when the Fed buys bonds and writes a check in return, households now have more deposits in the banks and less in the form of bonds in the immediate-run. As TR increases by the same amount of the decrease in DL , it increases the S_{LF} at constant r , shifting the S_{LF} curve to the right. Note that open market purchase directly affects r in the immediate-run in our model rather than indirectly affecting it through the Y change. It creates a surplus in the LF market at r^* pushing r down from r^* to r_1 . However, this is

not a short-run equilibrium position as Y hasn't adjusted yet. It is, in fact, the 'immediate-run' equilibrium position where both Y and P are constant. Short-run r , r_S is attained when Y increases beyond Y^* due to expansionary monetary policy. Higher Y increases S and hence DL and TR , shifting the S_{LF} curve further to the right.

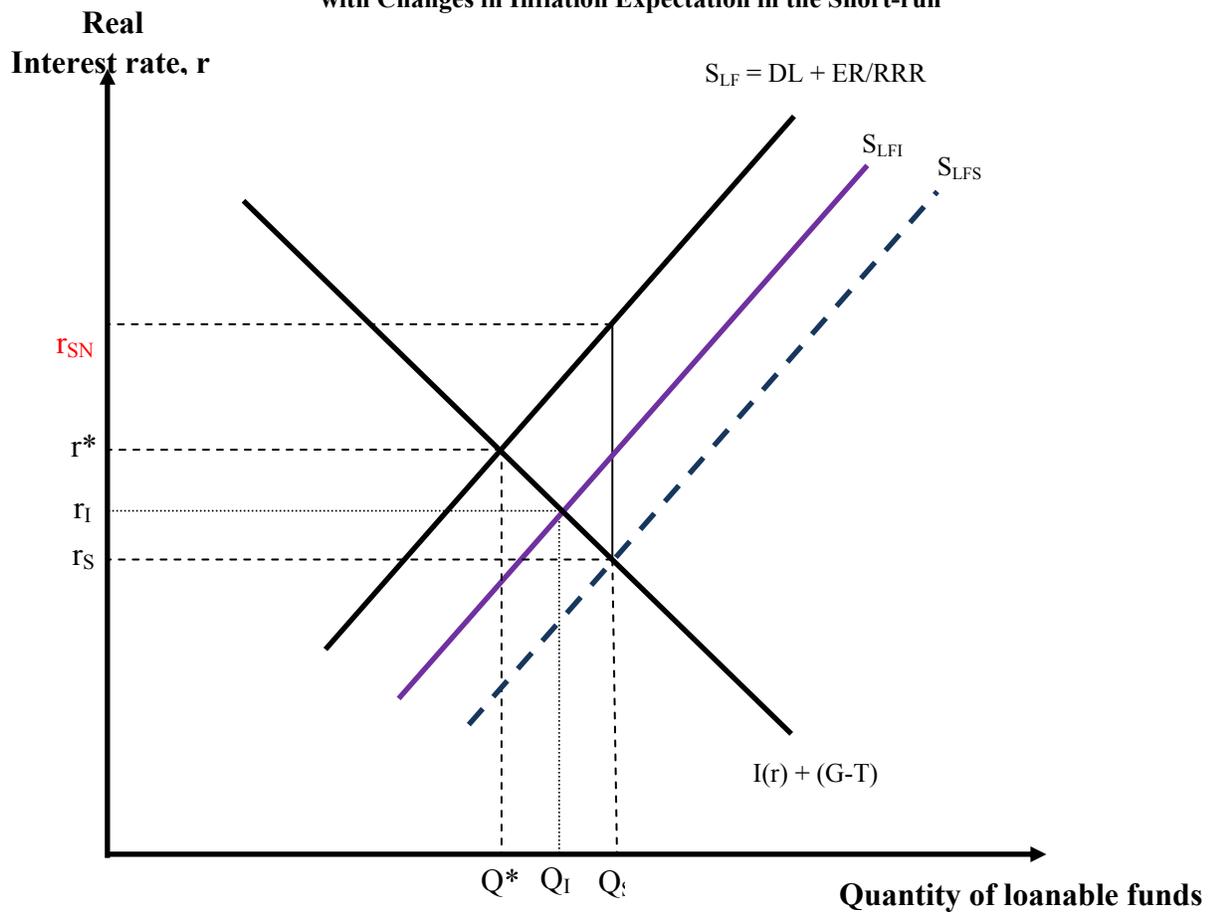
Figure 2: Effects of an Open Market Purchase with No Change in Inflation Expectation



In the absence of any change in inflation expectation, the nominal and the real r will remain the same in the short-run. In the long-run, equilibrium Y higher than Y^* will push P up reducing Y back to its original level Y^* . The S_{LF} curve moves back from S_{LFS} to S_{LFI} . Expansionary monetary policy increases TR and reduces DL below the long-run desired DL^* . When households buy bonds and reduce TR to reach their long-run desired saving portfolio, long-run equilibrium r will be restored at r^* again; i.e. the neutrality of money is achieved when households adjust their long-run saving portfolio to DL^* , its pre-monetary expansion level.

Macroeconomics principles textbooks assume constant inflation expectation to keep the subject matter simple. We don't recommend incorporating it in the principles of macro texts either; however, the strength of our model can be tested here by checking its robustness. If inflation is expected in the short-run, the nominal r will diverge from the real r by the amount of the inflation expectation. One case is depicted in **Figure 3** where inflation is expected by the amount of $(r_{SN} - r_S)$. The short-run real r will remain at r_S , but the short-run nominal r will be r_{SN} , higher than r_S by $(r_{SN} - r_S)$. Here, the market will see a rise in the nominal r with a lower real r in the short-run – a result which is known but was never modeled before. In the long-run, however, as P and saving portfolio adjust, the real and the nominal r will merge at r^* and the inflation expectation will come down to zero percent again. The nominal r will decrease and the real r will increase to reach r^* in the long-run. It shows that expansionary monetary policy has no long-run effect on r .

Figure 3: Effects of an Open Market Purchase with Changes in Inflation Expectation in the Short-run



THE EFFECTS OF A DECREASE IN THE RRR OR THE AR IN OUR MODEL

One of the most important contributions of our model is that it can also explain the effects of a change in the required reserve ratio (RRR) or discount rate on r , which the LF model cannot. If the Fed reduces RRR, required reserve will decrease for the same TR increasing ER for all r shifting the S_{LF} curve to the right. This will reduce r in the immediate-run. Again, if the discount rate is reduced, banks will be encouraged to borrow more money from the Fed increasing their TR and hence ER, shifting the S_{LF} curve to the right. In both of these cases, long-run r will be r_I and not r^* due to lack of further saving portfolio adjustments in the long-run.

THE EFFECTS OF AN INCREASE IN THE BUDGET DEFICIT IN OUR MODEL

To analyze the effects of an increase in budget deficit on r , we again start with a long-run equilibrium r (r^*) in **Figure 4** where the quantity of LF demanded, $[I(r^*) + (G - T)_0]$, equals the quantity of LF supplied. An increase in the budget deficit from $(G - T)_0$ to $(G - T)_1$ will shift the demand for LF curve to the right creating a shortage of LF at the old equilibrium r , r^* . The new immediate-run r is r_I . Expansionary fiscal policy will increase Y in the short-run shifting the S_{LF} curve to the right depressing r to r_S . The increase in government borrowing is financed by $Q^* - Q_C$ of reduced investment (crowding out) and $Q_S - Q^*$ of reduced consumption. The short-run equilibrium Y is higher than Y^* . So P starts to rise in the long-run reducing Y to Y^* . S decreases to its original level shifting the S_{LF} curve to the left to its starting point. It raises the long-run r to r^{**} which is the same as immediate-run r , r_I . The long-run crowding-out will be higher with higher r . An expansionary fiscal policy thus increases the short-run r and in the long-run it pushes it up further.

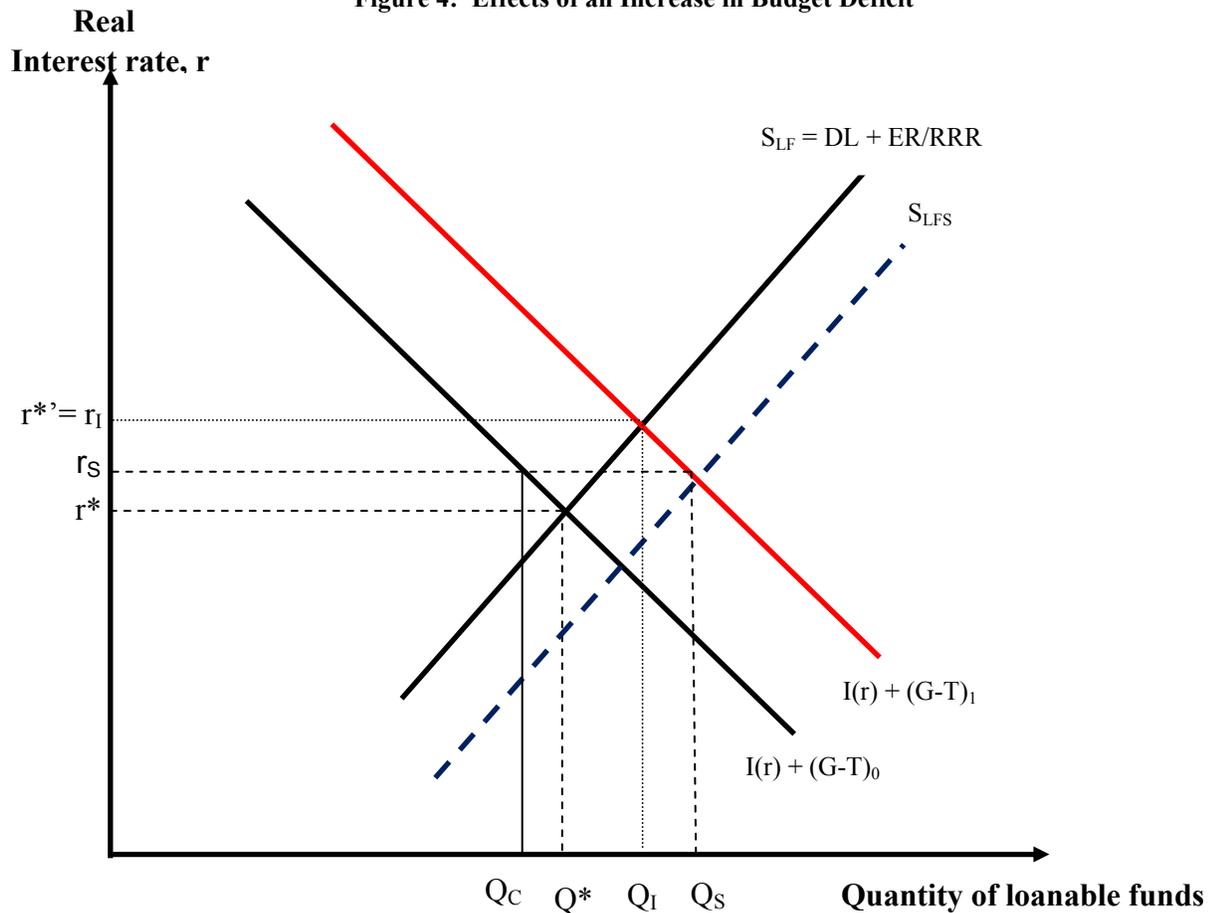
CONCLUSION

Currently, available principles of macroeconomics textbooks present either one or two different approaches to interest rate determination. The authors choosing only one approach made it easy for the students; but left lots of questions unanswered. When two approaches are presented, they are mainly in two different chapters with no relationship with one another. In the context of the LF model, the textbooks don't talk about the short-run monetary policy impact on r . The bonds market needs to be introduced to show the short-run impact. In the context of the LP model, the textbooks talk only about immediate-run and avoid short-run and long-run impact of fiscal policy. Students have to remember to use the LF model to find the long-run real r , the bonds market model to find the short-run real r , and the LP model to find immediate-run nominal r . Students wonder why two (actually three if one includes the bonds market) models are needed

to explain r . Authors trying to reconcile the two approaches again leave the students wondering how the two approaches lead to the same interest rate.

Students are introduced with the concept of excess reserves in the “Money and Banking” section of the text. By redefining the supply of loanable-funds in the light of excess reserves as the source of loanable funds, we present a model of interest rates determination that is capable of tracing the impact of both monetary and fiscal policies on immediate-, short- and long-run nominal and real interest rates together with the dynamics of its adjustments. Our model is also capable of explaining the effects of changes in required reserve ratio and discount rate on the interest rate. We believe that it will greatly help the students understand the concept of interest rates determination better.

Figure 4: Effects of an Increase in Budget Deficit



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