What We Should (Not) Teach Students About Interest Rate Determination

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Abstract

There are two general approaches to interest rate determination--Liquidity Preference and Loanable Funds. The standard textbook treatment usually presents these two approaches as if they were two ways of doing the same thing. Textbook authors then switch back and forth between the two approaches depending on which seems better suited for the problem at hand. We argue in this paper that the choice between these two approaches does matter. You simply can't have it both ways—either the interest rate is determined in the money market or in the loanable funds market, but not both.

Introduction

There are two general approaches to the modeling of interest rates, the Liquidity Preference (LP) approach and the Loanable Funds (LF) approach. In the former, the interest rate is determined in the money market by the intersection of the money supply and money demand curves. In the latter, the interest rate is determined by the intersection of the flow supply and flow demand in the market for loanable funds. In general equilibrium, these two approaches equilibrate at the same interest rate (assuming that the expected inflation rate is zero). This is not surprising as the economy can have only one long-run equilibrium interest rate. It does not follow, however, that the LP and LF approaches are simply two ways of doing the same thing or that the money and loanable funds markets equilibrate at the same interest rate when the economy is out of general equilibrium. And yet this is the clear impression that one gets from looking at the majority of the most popular macroeconomics textbooks. The standard textbook treatment is to present the LP and LF approaches in separate chapters and to switch back and forth between the two models as if they were interchangeable. Thus students, and perhaps even many instructors, are left with the distinct impression that choosing between the LP and LF approaches to interest rate determination is nothing more than a matter of personal taste and that one can jump from one mode of analysis to the other depending on the task at hand.

We argue in this paper that the choice between the LP and LF approaches does matter. One can, for example, assume that the interest rate is determined in the money market. However, if one chooses to make this assumption, then it will no longer be the case that the interest rate equilibrates the loanable funds market in the short run. Conversely, if the interest rate is determined in the market for loanable funds, then the money market cannot be in equilibrium in the short run. You simply can't have it both ways. Either the interest rate is determined in the money market or in the loanable funds market, but not both.

We begin with a brief discussion of how the LP and LF approaches to interest rate determination are used interchangeably in the majority of macroeconomics textbooks. In the following sections, we develop

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these two competing stories of interest rate determination more fully, and we analyze the effect of an increase in the money supply assuming, first, that the interest rate is determined in the money market and, second, that the interest rate is determined in the loanable funds market. In both cases, we are careful to show and explain what is going on in the alternate market. We also find that the assumption one makes regarding the market in which the interest rate is determined has some interesting implications for the slope of the aggregate demand curve. Our approach is easily extended to the analysis of alternate scenarios such as an increase in the government budget deficit or an exogenous decrease in money demand.

Textbook Treatment of the LP and LF Markets

Each of the following introductory textbooks contains a discussion of the LP and LF approaches to interest rate determination: Frank and Bernanke (2001), Gwartney, Stroup, Sobel, and Macpherson (2003), Hall and Lieberman (2003), Mankiw (1998), McEachern (2003), Miller (2003), Parkin (2003), Stiglitz and Walsh (2002), and Taylor (2001).[1] The standard treatment is to present the LP and LF models in separate chapters with little or, most commonly, no discussion of the differences between them.[2] Textbook authors then switch back and forth between the two approaches depending on which appears to be a better fit for the problem at hand. For example, in the texts reviewed here, the LF approach is almost always preferred for analyzing economic growth and capital formation and the effects of budget deficits and surpluses. By contrast, the LP approach is the preferred method for analyzing the effect of a change in the money supply on the interest rate. It is rare, however, to see the two approaches applied simultaneously.

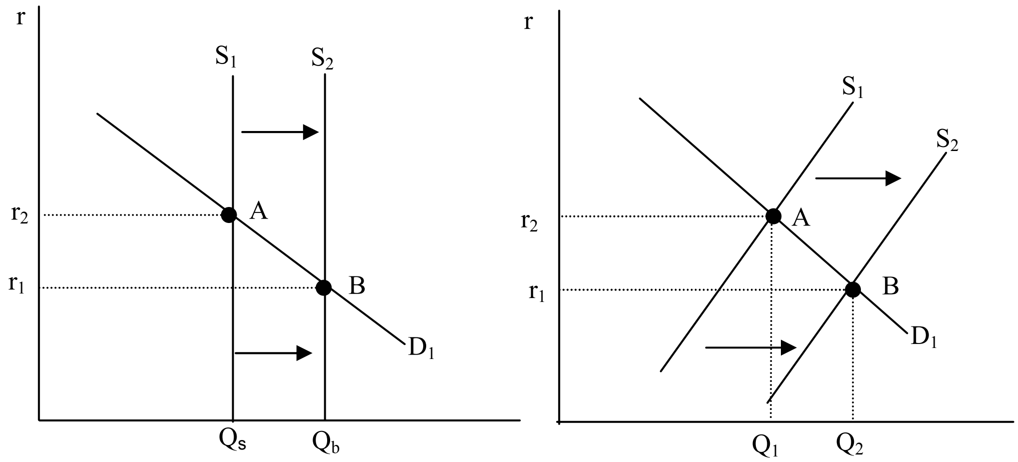
An exception to this generalization about textbook treatment of the LP and LF models is Gwartney, Stroup, Sobel, and Macpherson (hereafter GSS&M). GSS&M (pg. 324) present side-by-side graphs of the money and loanable funds markets to illustrate the effect of an increase in the money supply resulting from an open market purchase. Their graphs are reproduced in Figure 1. The money market is depicted in panel (a), and the market for loanable funds is in panel (b). Starting from an initial equilibrium at point A in panels (a) and (b) of Figure 1, an open market purchase simultaneously shifts the money supply curve and the loanable funds supply curve to the right.[3] According to GSS&M, the short-run decline in the interest rate is the same in each market (i.e., r_2 to r_1 in Figure 1).[4] While theirs is an ambitious effort to reconcile the LP and LF approaches, it ultimately fails because of their (implicit) insistence on the constraint that the two markets equilibrate at the same interest rate when the economy is out of general equilibrium. As we argue below, this is an invalid constraint. Thus, in the final analysis, GSS&M make the same mistake explicitly that most other textbook authors make implicitly. That is, they assume that the money and loanable funds markets always equilibrate at the same interest rate.

[1] Some of these texts use the LF approach without explicitly identifying it as such. What they do is graph the saving function and a function combining investment and the government deficit. The equilibrium interest rate is then determined by the intersection of these two functions. This is equivalent to the LF approach.

[2] Hall and Lieberman (2003) attempt to differentiate the two approaches (see Chapter 25) by asserting that the LF model is appropriate for the long run when the economy is at full employment while the LP model is appropriate for the short run when output is not at full employment. While we agree with Hall and Lieberman that the two approaches are distinct, we find their full vs. not-at-full employment dichotomy unconvincing. For example, immediately after arguing that the LF model should not be used to analyze short-run fluctuations in the interest rate, they proceed to do precisely this. Specifically, they use the LF model to examine the effect of a decrease in output on the supply of loanable funds, and hence the interest rate. They then argue that because the LF model is embedded in the long-run, or Classical, model, it cannot be used to analyze the effects of a change in output because, in the long run, output is constant. But clearly this is a statement about a characteristic of long-run models and not a limitation of the LF model, *per se*.

[3] We formally develop the LP and LF approaches in the next section. At this stage, we simply point out that an open market purchase that increases the money supply also raises the supply of loanable funds. This is why the rightward shift in the money supply curve in panel (a) is accompanied in panel (b) by a rightward shift in the supply curve for loanable funds.

[4] A common approach used in some of the textbooks under review, including GSS&M, is to graph the money supply and demand curves against the nominal interest rate and the demand and supply curves of loanable funds against the real interest rate. However, virtually all of the discussion and treatment of these two approaches assumes (in most cases implicitly) a zero inflation environment. What this means, of course, is that the nominal and the real interest rate are identical so that the LP and LF approaches are, in fact, determining the same interest rate.



(a) Money Balances

(b) Loanable Funds

Figure 1

The LP and LF Approaches to Interest Rate Determination

The LP approach is illustrated in panel (a) of Figure 2. Assuming that banks' holdings of excess reserves are invariant with respect to the interest rate, the real money supply curve (M^s/P) is vertical. The real money demand curve is downward sloping, reflecting the fact that the quantity of real money balances demanded rises as the opportunity cost of holding money falls. Real GDP (denoted y*) is the primary shift variable in the money demand function.[5] The equilibrium interest rate in the money market is the rate at

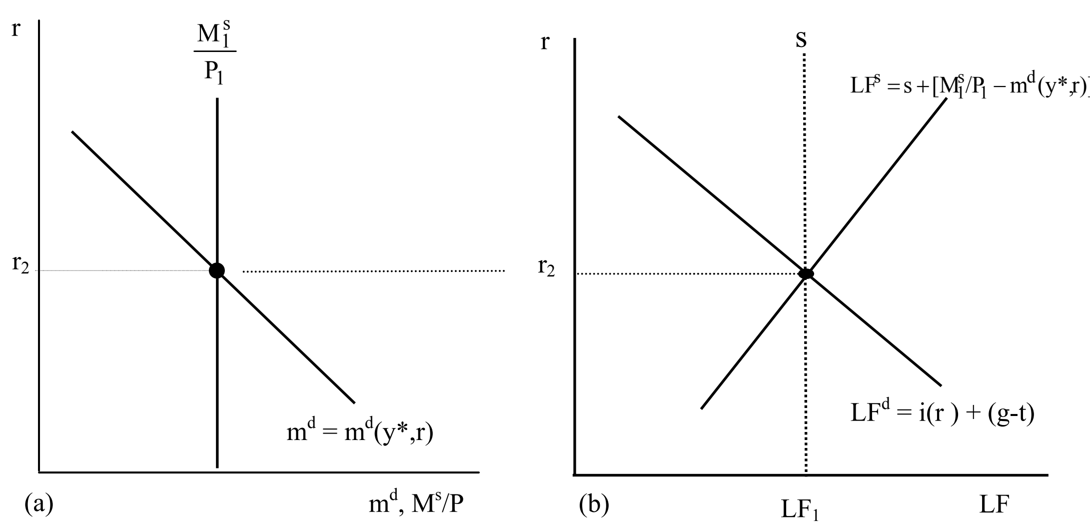


Figure 2

[5] Notice that the price level is not a shift variable because we are modeling real money demand, not nominal money demand. A change in the price level has no effect on real money demand because *nominal* money demand is homogeneous of degree one with respect to the price level. Thus, a change in the price level changes nominal money demand by the same percentage, leaving real money demand unchanged. A change in the price level does, however, shift the real money supply curve in the opposite direction. Also, we use y*, not y, to denote real GDP because our framework of analysis is the Classical model in which output always equals natural output.

which economic agents demand an amount of money that is exactly equal to the quantity supplied. In panel (a) this interest rate is r_2.

The LP approach is illustrated in panel (b). We assume, for simplicity, that household saving depends only on income. That is, s = s(y*). More particularly, saving does not depend on the interest rate.[6] Therefore, absent any spillover from the money market, the supply of loanable funds would be the (dashed) vertical line at LF_1, denoted s. However, the supply curve for loanable funds, denoted LF^s, is upward sloping when plotted against the interest rate. The reason is that a *(ceteris paribus)* increase in the interest rate results in an excess supply in the money market that spills over into the market for loanable funds. The result is an increase in the quantity of loanable funds supplied as the interest rate increases. Similarly, a decrease in the interest rate lowers the quantity of loanable funds supplied as economic agents attempt to build up their real money balances. This is an overlooked, but critically important, part of the story. If there is no spillover from the money market—that is, if the money market is in equilibrium—then the quantity of loanable funds supplied must equal household saving. For this reason, the LF^s curve intersects the saving schedule at the equilibrium interest rate for the money market. Algebraically, LF^s is expressed as $LF^s = s + [M_1^s/P_1 - m^d(y^*, r)]$. On the other side of the market, the demand for loanable funds equals investment (i) plus the government deficit (g-t), and the quantity of loanable funds demanded varies inversely with r due to the effect of a change in the interest rate on investment spending. Thus, $LF^d = i(r) + (g - t)$. The equilibrium interest rate in the loanable funds market is the rate at which the flow supply of loanable funds equals the flow demand.

Notice that the money supply and demand curves should be plotted against the nominal interest rate while the supply and demand curves for loanable funds should be plotted against the expected real interest rate. The difference between these two rates is, of course, the expected rate of inflation. To keep the analysis as simple as possible, we assume a zero inflation rate throughout. In this situation, the expected inflation rate will be equal to zero, implying that the nominal and expected real interest rates are identical. We make no further distinction between the two and denote the (common) interest rate as r. Thus, in Figure 2 and in the figures that follow, the long-run general equilibrium interest rates in the money market and the loanable funds market lie along the same horizontal line. It does not follow, however, that the *short-run* partial equilibrium interest rates in the two markets will be the same, even if expected inflation is zero. It is important to keep this point in mind during the analysis below.

LP vs. LF: The Effect of an Increase in the Money Supply

Suppose that the economy is initially in a general equilibrium.[7] This is illustrated in Figure 3 in which the money and loanable funds markets are depicted in panels (a) and (b), respectively. At the initial interest rate of r_2, both markets are in equilibrium at the points labeled A. The long-run equilibrium quantity of loanable funds supplied equals saving. Now, suppose that the Fed increases the nominal money supply from M_1^s to M_2^s. What effect will this have on the interest rate? The answer depends on whether one assumes that the interest rate clears the market for money or the market for loanable funds. We first assume that r clears the money market. In panel (a), the increase in the nominal money supply shifts the real money supply curve to the right from M_1^s/P_1 to M_2^s/P_1. The equilibrium interest rate in the money market drops to r_0. If, however, the interest rate were to remain at its original level of r_2 there would now be an excess supply of money equal to the distance AB. In panel (b), this excess supply of money spills over to the loanable funds market, adding to the initial supply of loanable funds and shifting LF^s to the right from $LF_1^s = s + [M_1^s/P_1 - m^d(y^*, r)]$ to $LF_2^s = s + \left[M_2^s/P_1 - m^d(y^*, r)\right]$. The result of this shift is an excess supply of loanable funds at r_2 that is equal to the distance AB in panel (b) and identical to the excess supply of money in panel (a). If r clears the money market, then the interest rate must fall from r_2 to r_0 in panel (a), thus returning the money market to equilibrium at point C.

[6] GSS&M do assume that saving is positively related to the interest rate, and it is for this reason that their loanable funds supply curve is upward sloping in Figure 1. We could relax the assumption that saving is perfectly inelastic with respect to the interest rate, but none of our conclusions would be affected.

[7] For simplicity, we adopt the closed-economy Classical model in which wages and prices are perfectly flexible and economic agents have perfect information. In this model, output is fixed at the natural (or full employment) level, y*.

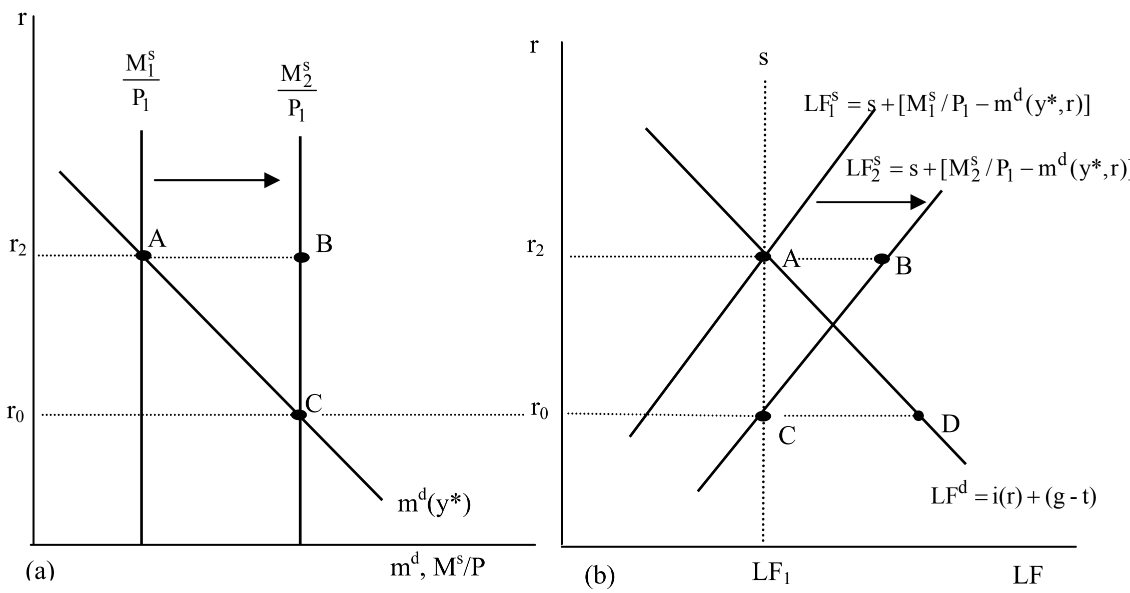


Figure 3

Next, consider the implications for the loanable funds market. Since the decline in the interest rate from r_2 to r_0 drives the excess supply of money back to zero, it necessarily follows that, at this lower interest rate, the quantity of loanable funds supplied must return to its initial level (i.e., to LF_1). This means that LF_2^s must pass through point C in panel (b).[8] Therefore, when the interest rate falls from r_2 to r_0 the corresponding movement along LF_2^s is from point B to point C. On the demand side of the loanable funds market, the decline in the interest rate to r_0 causes the number of investment goods demanded to rise which, in turn, increases the flow supply of private bonds and hence the quantity demanded of loanable funds. In panel (b), this corresponds to the movement along LF^d from point A to point D. At $r = r_0$, the money market is in equilibrium but the loanable funds market is necessarily in disequilibrium. Specifically, at $r = r_0$, there is excess demand in the market for loanable funds equal to the distance CD. The interest rate clears the money market but not the loanable funds market.

Consider, now, the case in which the interest rate adjusts to clear the market for loanable funds. This is illustrated in Figure 4. Once again, assume the Fed increases the nominal money supply from M_1^s to M_2^s. As before, the money supply curve shifts right to M_2^s/P_1, and the loanable funds supply curve shifts right to LF_2^s. If r now clears the loanable funds market, the interest rate will fall only from r_2 to r_1, restoring the loanable funds market to equilibrium at point E in panel (b). It is obvious that the decline in r that clears the market for loanable funds is smaller than the decline needed to clear the money market. Indeed, we see in panel (a) that there is an excess supply of money equal to the distance FG at the interest rate r_1. The interest rate that clears the loanable funds market does not clear the money market.[9]

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[8] If LF_2^S did not go through point C, that would indicate a spillover from the money market. However, there can be no spillover from the money market at the interest rate r_0 because the money market is in equilibrium. Hence, LF_2^S must go through point C.

[9] At first blush, it may appear that our results stem from allowing an excess supply of money to spill over to the market for loanable funds. This is not the case. If no spillover from the money market to the loanable funds market were allowed, it still would be true that r cannot simultaneously clear the two markets. The reason is that if spillover from the money market to the loanable funds market is disallowed, the equilibrium conditions for the loanable funds market and the *goods* market are one and the same [See Fields and Hart (2003)]. It is obvious that the interest rate cannot always clear the money market and the goods market simultaneously (consider, for example, the IS and LM curves).

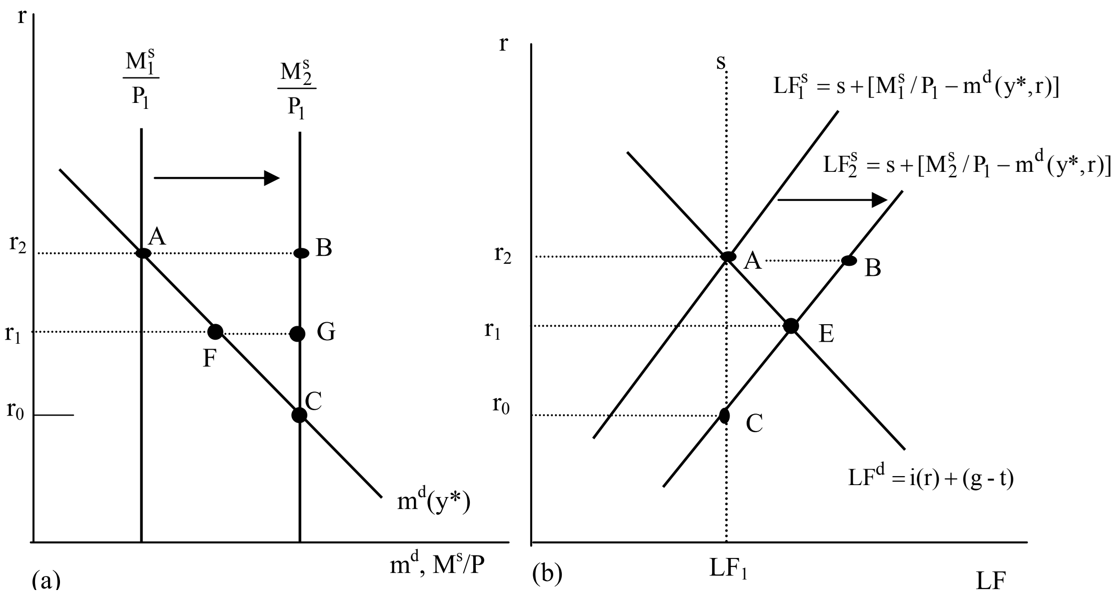

Figure 4

How can this be when, following the rise in M, the excess supply of money at the initial interest rate, r_2, equals the excess supply of loanable funds? The answer is simple. In the money market, only the demand for money is affected by the interest rate. Consequently, as r falls in response to the rise in M, it must decline until the quantity demanded of money balances rises by the increase in M. In the market for loanable funds, however, *both* quantity demanded and quantity supplied are affected by the interest rate. Thus, when r falls in response to the excess supply in the loanable funds market, the quantity of loanable funds supplied decreases (because of the rise in money balances demanded) while the quantity demanded increases (because of the increased flow supply of private bonds required to finance the interest-induced rise in investment demand). This has the effect of dampening the decline in r required to clear the loanable funds market relative to the decline required to clear the money market.

Are the results presented above dependent in any way on the interest responsiveness of money demand? Would a flatter money demand curve, for example, be sufficient for the two approaches to yield the same interest rate response to a rise in M? Except for the case of a liquidity trap, the answer is no.[10]

To demonstrate, consider Figure 5. As before, the money market is initially in equilibrium at point A given by the intersection of the real money supply curve with the money demand curve, $m^d(y^*)$. Equilibrium in the loanable funds market is at point A given by the intersection of LF^d with LF_1^s. Now let the interest responsiveness of money demand increase (in absolute value). For any given rise (decline) in the interest rate, there will now be a larger decrease (increase) in the real quantity of money balances demanded, and a larger excess supply (demand) of money. In panel (a), this shows up as a counterclockwise rotation in the money demand function to $m_3^d(y^*)$ from $m^d(y^*)$.[11] At the same time, the loanable funds supply curve rotates clockwise (through point A) to $LF_3^s = s + [M_1^s/P_1 - m_3^d(y^*,r)]$ from LF_1^s because a *ceteris paribus* rise in r now causes a greater excess supply of money balances to spill over to the loanable funds market. It should be obvious that the rotation in the loanable funds supply curve is exactly the same (except in opposite direction) as the rotation in the money demand curve. Put differently,

[10] We thank an anonymous referee for bringing this issue to our attention.

[11] We rotate the money demand function through point A so as to maintain the general equilibrium in both the money and loanable funds markets at the initial interest rate r_2.

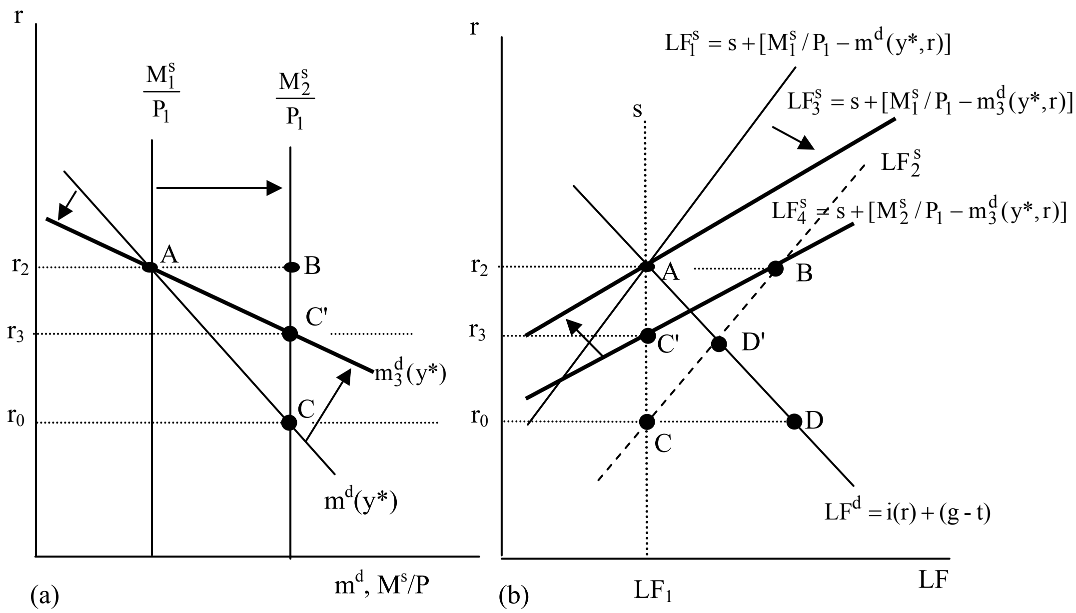

Figure 5

any change in the interest responsiveness of money demand is mirrored by an equal change in the interest responsiveness of loanable funds supplied.

Now let the Fed increase the nominal money supply from M_1^s to M_2^s. Again, the real money supply curve shifts right from M_1^s/P_1 to M_2^s/P_1 in panel (a). At the initial interest rate, r_2, this creates an excess supply of money, equal to the distance AB, that spills over to the loanable funds market in panel (b), shifting the original LF^s curve, LF_1^s, and the new flatter LF^s curve, LF_3^s, through point B to LF_2^s and $LF_4^s = s + [M_2^s/P_1 - m_3^d(y^*,r)]$, respectively.

Given the flatter money demand curve, $m_3^d(y^*)$, the interest rate need only fall from r_0 to r_3 at point C' in panel (a) to clear the money market. This decline in r will drive the excess supply of money to zero and return the quantity of loanable funds supplied to its initial level (i.e., to LF_1) as well. Accordingly, LF_4^s must pass through point C' in panel (b) which means, as before, that the interest rate that clears the money market (r_3) does not clear the market for loanable funds. The opposite conclusion holds if the interest rate is assumed to clear the loanable funds market.

The one exception is a liquidity trap in which the interest responsiveness of money demand is infinite (i.e., $\partial m^d/\partial r = -\infty$). In this case, the impact of an increase in the nominal money supply on the equilibrium interest rate will the same--namely, zero--in both the money market and the market for loanable funds. That a liquidity trap implies no change in the equilibrium interest rate following a change in the nominal supply is well known. In a liquidity trap, economic agents are indifferent between holding money and bonds. As such, any increase in the nominal money supply will be immediately absorbed into private-sector portfolios with no change in the interest rate. Because the excess supply of money is always zero in a liquidity trap, there is no spillover from the money market to the market for loanable funds. Thus, the LF^s will be a vertical line at the fixed level of household saving and will not shift following an increase in the nominal money supply. Accordingly, an increase in the nominal money supply will have no effect in the loanable funds market. The (unchanged) interest rate that equilibrates the money market also clears the market for loanable funds.[12]

[12] What about other 'extreme' parameter values? Will the response of r to a change in the nominal money supply be the same in the LP and LF approaches if the interest responsiveness of money demand or the interest responsiveness of investment is zero or if the interest responsiveness of investment is infinite? The answer is no. When the interest responsiveness of money demand is zero, the money demand curve, like the real money supply curve, will be a vertical line. In this case, r cannot be determined in the money

There is another important result that stems from recognition that r cannot simultaneously clear the money market and the loanable funds market. It turns out that the *slope* of aggregate demand (AD) curve depends on whether the interest rate clears the money market or the loanable funds market. We address this issue in the next section.

Implications for the Aggregate Demand Curve

The AD curve that results when the interest rate clears the money market is more elastic than the AD curve that results when the interest rate clears the loanable funds market. This is illustrated in Figure 6. As before, assume that the economy begins in a general equilibrium in which the interest rate is r_2. The money and loanable funds markets are in equilibrium at the points labeled A in panels (a) and (b). Now consider panel (c). Given M_1^s and the other exogenous variables, at the initial price level of P_1 the quantity of goods and services demanded equals y_1 at point A.[13] Thus, A represents one point on the AD curve. Moreover, since this is the starting point for deriving the AD curve, the curve must go through point A regardless of whether the interest rate clears the money market or the loanable funds market.

Now suppose that P decreases to P_0, so that the real money supply increases to M_1^s/P_0. If the interest rate clears the money market, then r falls to r_0 at point C in panel (a). If, however, the interest rate clears the market for loanable funds, then r falls to r_1 at point E in panel (b). Since the decline in the interest rate is larger when r clears the money market, it follows that the increase in the number of investment goods demanded must be larger as well. More specifically, in panel (b) we see that the quantity of loanable funds demanded rises from LF_1 to LF_3 when r falls to r_0 (i.e., when r clears the money market), but only from LF_1 to LF_2 when r falls to r_1 (i.e., when r clears the loanable funds market). And since the government budget deficit is the same in either case, this increase in the quantity of loanable funds demanded must be the result of a rise in the number of investment goods demanded. In panel (c), this corresponds to the movement from point A to point D if the interest rate clears the money market (i.e., $y_3 - y_1 = LF_3 - LF_1$) and from point A to point E if the interest rate clears the loanable funds market (i.e., $y_2 - y_1 = LF_2 - LF_1$). Points A and D in panel (c) represent two of an infinite number of points which, taken together, map out the AD curve (labeled AD_{MM}) when r clears the money market. Similarly, points A and E map out the more steeply sloped AD curve (labeled AD_{LFM}) when r clears the market for loanable funds.[14]

The fact that the slope of the AD curve depends on whether the interest rate clears the money market or the loanable funds market has no effect whatsoever on the long-run general equilibrium properties of the model. Consider, for example, a doubling of the nominal money supply. This rise in M will cause a larger decrease in the interest rate and a larger increase in aggregate demand when r clears the money market than when r clears the loanable funds market. However, the rise in price that eventually results from the increase in M will cause a larger rise in r and a larger reduction in the aggregate quantity of goods demanded when r clears the money market. Consequently, in final general equilibrium the economy's response to the change in M will be the same for both AD_{MM} and AD_{LFM}. In both cases the price level will double leaving the real variables unchanged.

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market. Instead, the interest rate is a real phenomenon determined exclusively in the real sector (i.e., the market for loanable funds). By contrast, when the interest responsiveness of investment is zero, the demand curve for loanable funds will be a vertical line. r cannot be determined in the market for loanable funds. Why? Because once the money market is in equilibrium, and there is no spillover to the market for loanable funds, the supply curve of loanable funds is a vertical line too. In this case, the interest rate is a monetary phenomenon determined exclusively in the money market. In these two 'extreme' cases then there is nothing to compare. Finally, if the interest responsiveness of investment is infinite, the demand curve for loanable funds will be horizontal. Following an increase in the nominal money supply, the interest rate that clears the money market will be lower, but the interest rate required to equilibrate the market for loanable funds will be unchanged.

[13] Notice that $y_1 = y^*$ because, by assumption, the economy is initially in a general equilibrium.

[14] For two reasons, we ignore the multiplier effects that normally characterize the derivation of the AD curve. First, incorporating the multiplier complicates the analysis but in no way alters the result that the slope of the AD curve depends on whether the interest rate adjusts to clear the money market or the loanable funds market. Second, and more importantly, our framework of analysis is the Classical model in which output is constant at y*. Given that output, and hence income, is equal to y* at every price, it's not at all clear that multiplier effects are germane to the analysis. For further discussion of this issue, see Fields & Hart [1990, 1998].

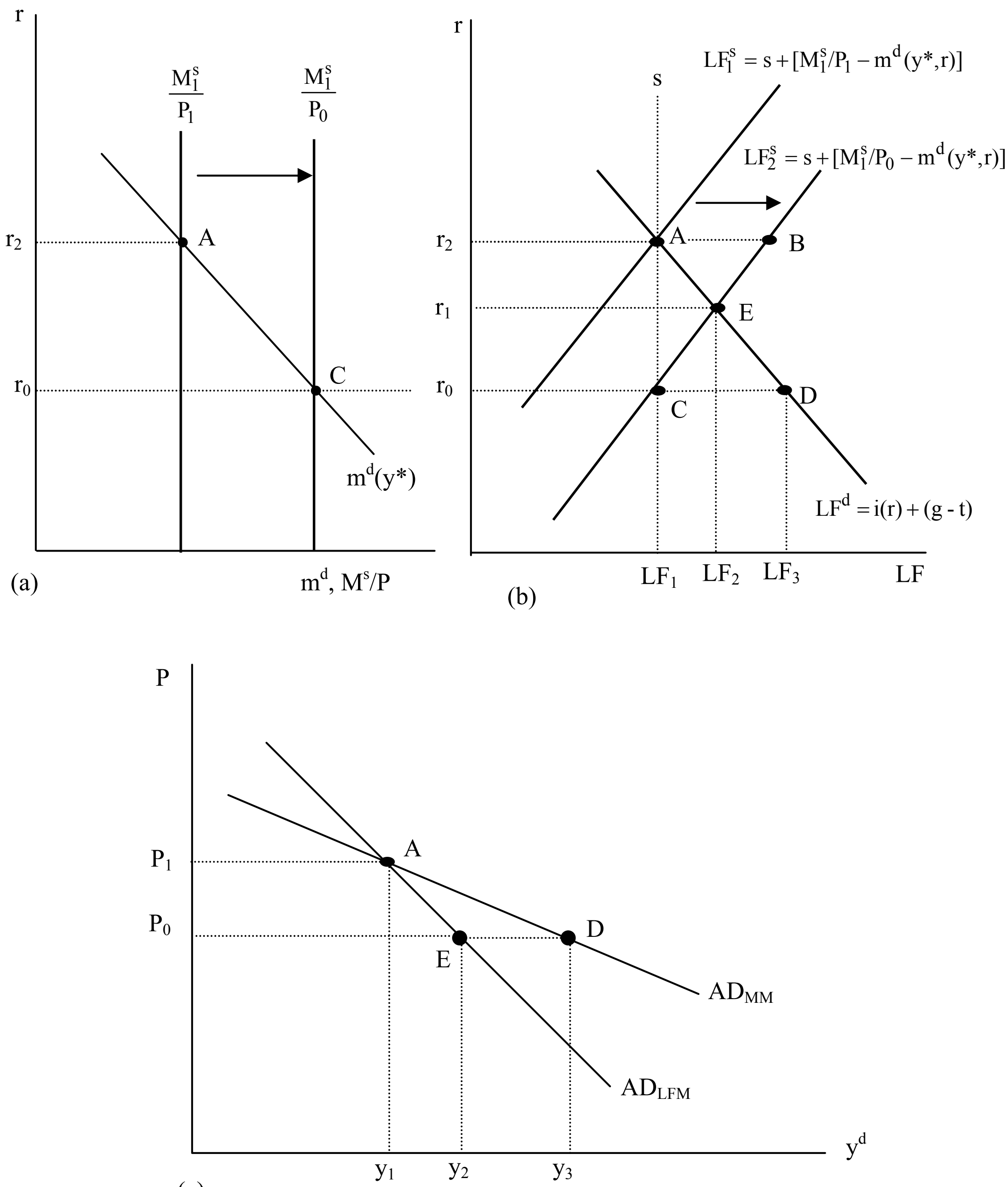

Figure 6

Conclusion

The interest rate can clear the money market or the loanable funds market, but it cannot simultaneously clear both markets when the economy is out of general equilibrium. Any claim to the contrary involves a logical inconsistency. The implication for macroeconomic modeling is that one has to make a choice. One can assume that the interest rate clears either the money market or the loanable funds market; but making the choice then commits one to a specific story about the dynamics of macroeconomic adjustment. Textbook authors have attempted, either explicitly or implicitly, to have it both ways. We have shown, however, that this simply isn't possible. Accordingly, it is our contention that textbook authors need to start paying more attention to the modeling of interest rate determination. It is not sufficient to develop the liquidity preference and loanable funds approaches separately and then leave students with the impression that these two approaches are somehow equivalent. Our preference is to assume that the interest rate clears the loanable funds market. But whatever one assumes, making that assumption explicit is surely better than pretending that the LP and LF models are the same.

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