
Munich Personal RePEc Archive

A More Detailed IS-LM Story

Hiermeyer, Martin

German Federal Ministry of Finance

25 August 2017

Online at https://mpra.ub.uni-muenchen.de/81004/
MPRA Paper No. 81004, posted 26 Aug 2017 08:19 UTC

A More Detailed IS-LM Story

By MARTIN HIERMEYER*

Textbooks give a fairly short IS-LM story. This paper offers a more detailed one. This story has several advantages vis-à-vis the usual textbook story, including: (a) it is clear about what it means by "money"; (b) it describes the central bank as targeting an interest rate; and (c) it covers the money multiplier and quantitative easing. To unfold, the more detailed story requires only minor adjustments to the IS-LM model, mostly the addition of the quantity equation of money – a mere identity.

* German Ministry of Finance, Wilhelmstr. 97, 10117 Berlin (e-mail: m.hiermeyer@gmx.de).

I. Introduction

Today, complex models dominate macroeconomic research. At the same time, simple models have preserved niches such as undergraduate teaching or policy advice.

A prime example for such a simple model is the IS-LM model of John Hicks (Hicks 1937) and Alvin Hansen (Hansen 1953).

As of 2017, it still features in many introductory macroeconomics textbooks such as Abel, Bernanke and Croushore (2017), Blanchard (2017), Dwivedi (2015), Froyen (2013), Gordon (2012), Heijdra (2017) or Mankiw (2016).

Moreover, it still influences policy decisions. Cohen-Setton and Kessler (2011) report that according to Lawrence Summers, the White House policy response to the financial crisis was "all IS-LM augmented by a liquidity trap". It can be assumed that such influence continues to this day, in the White House and in other corridors of power.

The thesis of this paper is that the IS-LM model might be even more successful – both in undergraduate teaching and in policy advice – if only textbooks would tell a more detailed IS-LM story. To see the potential of such a story, consider first the usual IS-LM textbook story and its main limitation.

II. The Usual IS-LM Textbook Story and Its Main Limitation

The IS-LM model is customarily given by the following equations.

(1) IS curve: $Y = C(Y) + I(i) + G$, where $0 \leq C'(Y) < 1$ and $I'(i) < 0$

(2) LM curve: $M = L(Y, i)$, where $L'(Y) > 0$ and $L'(i) < 0$

In the equations, Y denotes output, C consumption spending, I investment spending, i the interest rate, G government spending and M the money stock.

For the IS-LM model from equations (1) and (2), Figure 1 shows a fiscal expansion (left-hand panel) and a monetary expansion (right-hand panel). In terms of parameters, Figure 1 is within the wide limits set by equations (1) and (2).

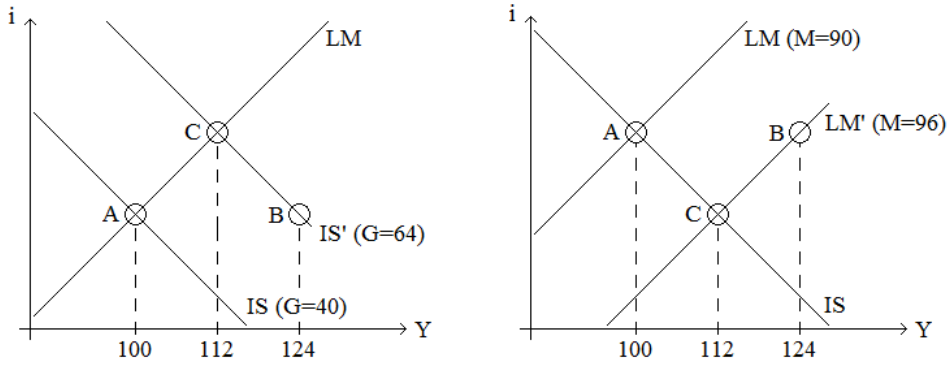

FIGURE 1. FISCAL EXPANSION (LEFT) AND MONETARY EXPANSION (RIGHT) IN THE IS-LM MODEL

A. The Usual IS-LM Textbook Story for a Fiscal Expansion

For the fiscal expansion shown in the left-hand panel of Figure 1, the usual IS-LM textbook story is:

"The economy is at point A when the government decides to increase its spending by 24 units from 40 units to 64 units. The IS curve shifts to the right by those 24 units, crossing through point B. Output increases, although not by the full 24 units.

This is because higher output comes with higher money demand as higher output means additional purchases of final goods and services (and thus additional transactions for which money is needed). The higher money demand drives up the interest rate i. This reduces investment spending by 12 units. Equilibrium is reached in point C, with government spending up by 24 units and investment spending down by 12 units, for an overall increase in output of 12 units."

In the example, the IS curve shifts to the right by 24 units while the increase in government spending is also 24 units. Mathematically, this means that C'(Y) equals zero. Economically, this means that there are no second-round effects along the lines of the Keynesian cross. In contrast, if C'(Y) would be between zero and one, such second-round effects would exist as the IS curve would shift to the right by more than the increase in government spending.

B. The Usual IS-LM Textbook Story for a Monetary Expansion

For the monetary expansion shown in the right-hand panel of Figure 1, the usual IS-LM textbook story is:

"The economy is at point A when the central bank decides to increase money by 6 units from 90 units to 96 units. The LM curve shifts to the right by 24 units, crossing through point B. The increase in money drives down the interest rate i. In response, investment spending and output increase, although not by the full 24 units.

This is because higher output comes with higher money demand as higher output means additional purchases of final goods and services (and thus additional transactions for which money is needed). In the figure, the higher money demand uses up 12 units of the additional money provided by the central bank, dampening the decreases in the interest rate. Equilibrium is reached in point C, with investment and output up by 12 units."

C. Imprecise Use of the Term "Money" as the Main Limitation of the Usual IS-LM Textbook Story

The usual IS-LM textbook story describes money as being controlled by the central bank, and as being used for transactions (for the first description, see the first part of section II B; for the second description, see section II A or the second part of section II B).

Based on the first description one would say that "money" must mean high-powered money as high-powered money is controlled by the central bank. However, from the second description one would say that "money" cannot mean high-powered money as high-powered money is not meant for transactions.

Vice versa, based on the second description one would say that "money" must mean M1 money as M1 money is meant for transactions. However, from the first description one would say that "money" cannot mean M1 money as M1 money is not controlled by the central bank.

The root of the problem is that there is only one money measure in the model ("M"), yet there are two mutually exclusive descriptions of its main characteristic.

Since both descriptions have their place, the dilemma can only be solved if both money measures (high-powered money and M1 money) are introduced into the model. The next section adjusts the IS-LM model accordingly. Based on that, a more detailed IS-LM story unfolds.

III. Adjusting the IS-LM Model to Allow for a More Detailed IS-LM Story

The "M" in equation (2) is controlled by the central bank. It therefore makes sense to assume that the "M" is high-powered money (HPM) as high-powered money can indeed be controlled by the central bank.

(3) $$M = HPM$$

Next to that, the IS-LM model also covers spending on final goods and services. Spending implies transactions. Transactions involve some form of money. M1 money, which consists of currency held by the public and demand deposits, is the appropriate money measure here. It therefore makes sense to state Fisher's (1911) equation of exchange – the quantity equation of money – with respect to M1 money:

(4) $$M1V1 \equiv PY$$

In the equation, M1 denotes M1 money, V1 denotes the velocity of M1 money, P denotes the price level and Y denotes output.

Let's assume that the price level is constant and can be set to one.

(5) $$P = 1$$

This is a standard assumption of the IS-LM model. The assumption can be dropped anytime by adding an aggregate supply curve to the IS-LM model which distributes changes in aggregate demand between changes in the price level P and changes in output Y (IS-LM-AS model). However, doing so adds an additional layer of complexity to the IS-LM model which is not always necessary or helpful.

Let's also assume that the velocity of M1 money, V1, is constant and can be set to one.

(6) $$V1 = 1$$

Equation (6) means that, within a period, every unit of M1 money is spent exactly once on a final good or service. In reality, (yearly) V1 is usually not close to 1. For example, in the US from 1959 to 2016, yearly V1 varied between 3.6 and 10.7 (Federal Reserve 2017a).

Like the assumption on the price level, the assumption of V1 being equal to 1 is, however, a convenient simplification. We can drop it anytime as we will see in section VI. For the time being, without dropping it, we can write equation (4) conveniently as:

$$M1 \equiv Y \tag{7}$$

Equation (7) is similar to a "cash-in-advance constraint" (Clower 1967), even though equation (7) refers to M1 money and not just to cash (cash, also called "currency held by the public", is only one of two components of M1 money, with demand deposits being the other). Requiring that buyers have M1 money in advance when carrying out a transaction makes sense as payment with M1 money is generally the only accepted method of payment. "Payment with M1 money" includes the use of currency, check, direct debit and bank wire transfer. Of course, purchases might also take place on credit. However, even there M1 money is needed in advance – this time by the creditor. This can be seen from the fact that if, for example, a business sells a good on credit, this drives up its accounts receivable balance sheet item. "Accounts receivable" is an asset which, if higher, has to be matched by an additional liability, that is, by a ceteris paribus higher borrowing of M1 money by the business.

If we combine equations (3) and (7) with equations (1) and (2), an "augmented" IS-LM model results:

(1') augmented IS curve: $M1 = C(M1) + I(i) + G$, with $M1 \equiv Y$

(2') augmented LM curve: $HPM = L(M1, i)$, with $M1 \equiv Y$

Figure 2 graphically compares the usual IS-LM model to the augmented IS-LM model.

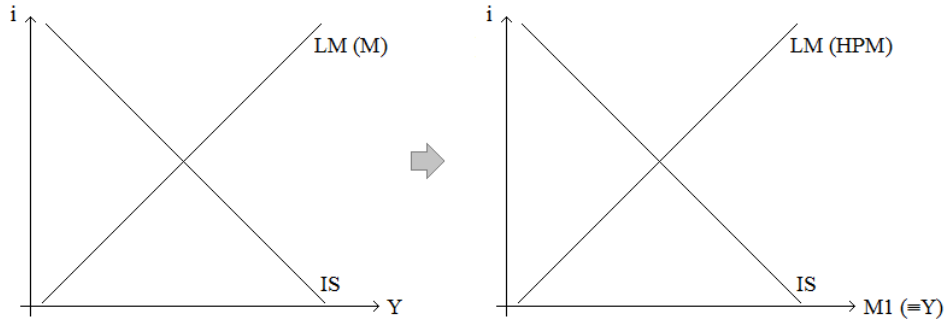

FIGURE 2. USUAL IS-LM MODEL (LEFT) AND AUGMENTED IS-LM MODEL (RIGHT)

From the augmented IS-LM model, a more detailed IS- LM story unfolds.

IV. A More Detailed IS-LM Story

Figure 3 shows a fiscal expansion (left-hand panel) and a monetary expansion (right-hand panel) for the augmented IS-LM model from equations (1') and (2'). In terms of parameters, Figure 3 is within the wide limits set by equations (1) and (2) and, by extension, (1') and (2').

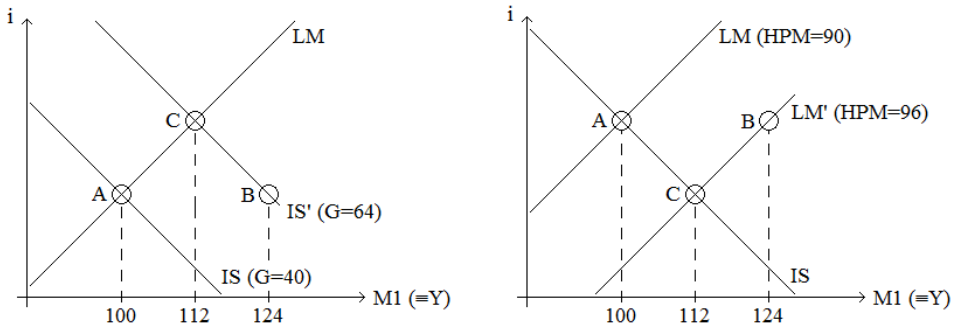

FIGURE 3. FISCAL EXPANSION (LEFT) AND MONETARY EXPANSION (RIGHT) IN THE AUGMENTED IS-LM MODEL

A. More Detailed IS-LM Story for a Fiscal Expansion

For the fiscal expansion shown in the left-hand panel of Figure 3, a more detailed IS-LM story is:

"The economy is at point A when the government decides to increase its spending by 24 units from 40 units to 64 units. In order to do so, the government needs 24 more units of M1 money. The government acquires

the M1 money by issuing bonds. It then spends the money. The IS curve shifts to the right by those 24 units, crossing through point B.

Excess demand.—At the market for M1 money, which consists of the market for bank-issued loans and of the bond market, excess demand of 24 units results. In turn, the interest rate, i, increases as the economy moves toward point C. At this point, equilibrium is restored, partly through lower demand for M1 money (12 units) and partly through higher supply of M1 money (12 units).

Lower demand.—The IS curve reflects demand for M1 money. Demand for M1 money decreases with the interest rate as firms want to borrow less M1 money if financing costs are higher. In the figure, firms borrow 12 units of M1 money less than otherwise as can be seen from the horizontal distance between point B and point C.

If firms borrow 12 units less, they also spend 12 units less. This is because borrowing and spending go hand in hand as there is no point in borrowing (at a cost) if there is no intention of spending.

Higher supply.—The LM curve reflects supply of M1 money. Supply of M1 money increases with the interest rate as banks create more M1 money if the interest rate is higher. In the figure, banks increase M1 money by 12 units as can be seen from the horizontal distance between point A and point C. The 12-unit increase in M1 money is explained in Table 1.

TABLE 1—INTEREST RATE-INDUCED 12-UNIT INCREASE IN M1 MONEY

		(1)	(2)	(3)
Currency held by the public (CHP)		80	76	76
Excess reserves (ER)		5	9	5
Required reserves (RR)		5	5	9
High-powered money (HPM)	[HPM = CHP + ER + RR]	90	90	90
Reserve ratio (rr)		0.25	0.25	0.25
Demand deposits (D)	[D = RR / rr]	20	20	36
M1 money (M1)	[M1 = CHP + D]	100	100	112

There, column (1) shows the economy before the increase in the interest rate. It is assumed that currency held by the public equals 80 units, that excess reserves equal 5 units, that required reserves equal 5 units, that high-powered money equals 90 units, that demand deposits equal 20 units

and that M1 money equals, as in the figure, 100 units. The reserve ratio is assumed to equal 25%. This means that the economy has a fractional-reserve banking system (as opposed to a full-reserve banking system with a 100% reserve ratio). A reserve ratio of 25% means that banks have to hold one unit of required reserves for every four units of demand deposits.

In column (2), the higher interest rate makes the public (in particular households but maybe also firms) pay 4 units of currency into their savings accounts as the higher interest rate increases the opportunity cost of holding non-interest bearing currency. Currency held by the public thus decreases to 76 units while banks' excess reserves increase to 9 units.

In column (3), banks use the additional 4 units of excess reserves to make loans totaling 16 units. When banks make such loans, they credit the demand deposits account of the borrower with a demand deposit of the size of the loan (so that the borrower can use the money). This is the reason why demand deposits increase by 16 units from 20 units in column (2) to 36 units in column (3). In line with that, required reserves increase from 5 units in column (2) to 9 units in column (3).

In a fractional-reserve banking system, the amount of loans made can exceed the amount of excess reserves that are dissolved in return ("money multiplier"). This is the case here: Loans increase by 16 units while only 4 units of excess reserves are dissolved.

M1 money now stands at 112 units, in line with the figure's point C.

Effect on output.—Output increases by the increase in government spending (24 units) minus the crowded out spending by firms (12 units). We could also say: Output increases by those 12 units of M1 money that banks additionally create and lend out because of the higher interest rate."

In the easiest case, the government borrows the additional bank loans (12 units) and takes over the crowded out lending of firms (12 units) for its needed total of 24 units. In reality, things may be somewhat more complicated given that the government generally borrows at the bond

market rather than from banks. This is, however, not a problem as the market for bank-issued loans and the bond market are linked anyway, forming together the market for M1 money. In effect, some firms, which before bond financed, may now bank finance, thus absorbing bank lending and freeing up bond demand for purchases of government bonds.

In the example, the IS curve shifts to the right by 24 units while the increase in government spending is also 24 units. Mathematically, this means that C'(Y) equals zero. Economically, this means that there are no second-round effects along the lines of the Keynesian cross. In contrast, if C'(Y) would be between zero and one, such second-round effects would exist as the IS curve would shift to the right by more than the increase in government spending.

B. A More Detailed IS-LM Story for a Monetary Expansion

For the monetary expansion shown in the right-hand panel of Figure 3, a more detailed IS-LM story is:

"The economy is at point A when the central bank decides to cut its policy rate, which is the interest rate which banks charge one another for overnight loans of high-powered money. (Although an interest rate, too, this is not the interest rate i from the equations or the figures.) In order to meet the lower policy rate, the central bank's traders lend more high-powered money to banks. In Figure 3, it is assumed that they increase high-powered money by 6 units (from 90 units to 96 units). The 6-unit increase in high-powered money can also be seen in Table 2.

TABLE 2—HIGH-POWERED MONEY-INDUCED 24-UNIT INCREASE IN M1 MONEY

		(1)	(2)	(3)
Currency held by the public (CHP)		80	80	80
Excess reserves (ER)		5	11	5
Required reserves (RR)		5	5	11
High-powered money (HPM)	[HPM = CHP + ER + RR]	90	96	96
Reserve ratio (rr)		0.25	0.25	0.25
Demand deposits (D)	[D = RR / rr]	20	20	44
M1 money (M1)	[M1 = CHP + D]	100	100	124

There, column (1) shows the economy before the injection of high-powered money. It is assumed that currency held by the public equals 80

units, that excess reserves equal 5 units, that required reserves equal 5 units, and that demand deposits equal 20 units. As in the figure, high-powered money and M1 money are assumed to equal 90 units and 100 units, respectively. The reserve ratio is assumed to equal 25%. This means that the economy has a fractional-reserve banking system (as opposed to a full-reserve banking system with a 100% reserve ratio). A reserve ratio of 25% means that banks have to hold one unit of required reserves for every four units of demand deposits.

High-powered money increases from 90 units in column (1) to 96 units in column (2). In line with that, excess reserves increase from 5 units in column (1) to 11 units in column (2) as banks are the recipient of the central bank's additional high-powered money.

In column (3), banks use the additional 6 units of excess reserves to make loans totaling 24 units. When banks make such loans, they credit the demand deposits account of the borrower with a demand deposit of the size of the loan (so that the borrower can use the money). This is the reason why demand deposits increase by 24 units from 20 units in column (2) to 44 units in column (3). In line with that, required reserves increase from 5 units in column (2) to 11 units in column (3).

In a fractional-reserve banking system, the amount of loans made can exceed the amount of excess reserves that are dissolved in return ("money multiplier"). This is the case here: Loans increase by 24 units while only 6 units of excess reserves are dissolved.

M1 money increases from 100 units in column (2) to 124 units in column 3. This 24-unit increase in M1 money can also be seen in Figure 3 where the LM curve shifts to the right by those 24 units, crossing through point B.

Excess supply.—At the market for M1 money, which consists of the market for bank-issued loans and of the bond market, excess supply of 24 units results. In turn, the interest rate, i, decreases as the economy moves toward point C. At this point, equilibrium is restored, partly through high-

er demand for M1 money (12 units) and partly through lower supply of M1 money (12 units).

Higher demand.—The IS curve reflects demand for M1 money. Demand for M1 money increases for a lower interest rate as firms want to borrow more M1 money if financing costs are lower. In the figure, firms increase borrowing of M1 money by 12 units as can be seen from the horizontal distance between point A and point C.

If firms borrow 12 units more, they also spend 12 units more. This is because borrowing and spending go hand in hand as there is no point in borrowing (at a cost) if there is no intention of spending.

Lower supply.—The LM curve reflects supply of M1 money. Supply of M1 money decreases for a lower interest rate as banks create less M1 money if the interest rate is lower. In the figure, banks decrease M1 money by 12 units as can be seen from the horizontal distance between point B and point C. The 12-unit decrease in M1 money is explained in Table 3.

TABLE 3—INTEREST RATE-INDUCED 12-UNIT DECREASE IN M1 MONEY

		(1)	(2)	(3)
Currency held by the public (CHP)		80	84	84
Excess reserves (ER)		5	1	5
Required reserves (RR)		11	11	7
High-powered money (HPM)	[HPM = CHP + ER + RR]	96	96	96
Reserve ratio (rr)		0.25	0.25	0.25
Demand deposits (D)	[D = RR / rr]	44	44	28
M1 money (M1)	[M1 = CHP + D]	124	124	112

There, column (1) takes over where column (3) of Table 2 left of, with M1 money standing at 124 units. In column (2), the lower interest rate makes the public (in particular households but maybe also firms) hold 4 units of currency more than they would do otherwise. Currency held by the public thus increases to 84 units while banks' excess reserves decrease to 1 unit.

In column (3), banks restore their initial level of excess reserves by making 16 units of loans less than they would otherwise do.

M1 money now stands at 112 units, in line with the figure's point C.

Effect on output.— Output increases by the high-powered money-induced increase in M1 money (24 units) minus the interest rate-induced decrease in M1 money (12 units). We could also say: Output increases by those 12 units of M1 money that firms additionally borrow and spend because of the lower interest rate."

In the example, the LM curve shifts to the right by 24 units while the increase in high-powered money is only 6 units. Mathematically, this means that L'(Y) equals 0.25. In contrast, if L'(Y) would equal one, the LM curve would shift to the right by the increase in high-powered money. And if L'(Y) would be greater than one, the LM curve would shift to the right by less than the increase in high-powered money.

From Table 2, we can see why there might be such a relatively small rightward shift in the LM curve. The table shows that for a given increase in high-powered money, M1 money creation is the lower the higher currency drain, the higher excess reserves and the higher the reserve ratio. For example, if in column (3) excess reserves would be 10 units instead of 5 units, M1 money would increase only by 4 units instead of by 24.

Monetary policy would thus be comparatively less effective. This is not merely a theoretical point. A massive increase in excess reserves took place in many countries in recent years, forcing central banks all over the world into unprecedented unconventional monetary policy measures (quantitative easing) in order to still get M1 money into the economy.

V. Advantages of the More Detailed IS-LM Story

Vis-à-vis the usual IS-LM textbook story, the more detailed IS-LM story has ten advantages.

A. Advantage 1

While the usual IS-LM textbook story does mention "money", it does not say which money measure it actually means. At times it seems to refer to high-powered money, at other times to M1 money. The more detailed

IS-LM story removes any ambiguity, clearly distinguishing between high-powered money on the one hand and M1 money on the other hand. This makes the IS-LM model more "tangible" and thus easier to understand.

B. Advantage 2

Based on the usual IS-LM textbook story, the IS-LM model is often criticized for describing a central bank that targets money. This is considered a weakness since most central banks today target an interest rate rather than money. The criticism has led to attempts to replace the LM curve with an interest rate rule (e.g. Romer 2000 in his IS-MP model).

The more detailed IS-LM story shows that the criticism may be overdone. Once a distinction is made between high-powered money and M1 money, the IS-LM model is extraordinarily well suited to describe monetary policy as it actually takes place (i.e.: central bank sets a policy rate and adjusts high-powered money so that the policy rate is met).

C. Advantage 3

In 2016, excess reserves in the US were about 1,600 times above their 1987-2007 average (2,204 vs. 1.36 billion USD, Federal Reserve 2017b). This is a remarkable increase. Together with quantitative easing, this is probably the main macro phenomenon of our times. Yet, the usual IS-LM textbook story is silent on excess reserves and quantitative easing.

The more detailed IS-LM story, in contrast, introduces excess reserves by distinguishing between high-powered money (which includes excess reserves) and M1 money. It shows that the efficiency of conventional monetary policy suffers if banks accumulate excess reserves. By this, it describes what prompted central banks in recent years to employ quantitative easing as a way of bypassing the clogged bank lending channel.

D. Advantage 4

Fractional-reserve banking is common today. This makes the money multiplier, which relates high-powered money and M1 money, an im-

portant concept. Unlike the usual IS-LM textbook story, the more detailed IS-LM story contains the money multiplier as it distinguishes between high-powered money and M1 money. It thus offers the chance to teach the money multiplier within the IS-LM model. This has the advantage that it becomes immediately apparent how both frameworks relate.

E. Advantage 5

For C'(Y) between zero and one, the IS curve shifts to the right by more than the increase in government spending. Likewise, for L'(Y) between zero and one, the LM curve shifts to the right by more than the increase in money. For the IS curve, textbooks provide an intuition for why this is the case (Keynesian cross). In contrast, they do not provide a comparable intuition for the LM curve. The more detailed IS-LM story addresses this imbalance by showing that it is the money multiplier which makes the LM curve shift very much (or possibly also very little).

F. Advantage 6

The IS-LM diagram depicts a quantity on the x-axis, a price (an interest rate) on the y-axis and a downward and an upward sloping curve. Thus, it appears like a market diagram. Yet, with the usual IS-LM textbook story, the analogy does not go through. This is because the usual IS-LM textbook story does not contain a "commodity" that is demanded and supplied subject to market forces. In contrast, the more detailed IS-LM story introduces just such a commodity (M1 money), allowing for a market diagram interpretation of the IS-LM model. Thus, students can put to good use prior knowledge of the market diagrams which they likely have.

G. Advantage 7

From the usual IS-LM textbook story, there is considerable uncertainty about the nature of the IS-LM model's interest rate. In contrast, the more detailed IS-LM story is precise: The IS-LM model's interest rate is the

interest rate which clears the market for M1 money (which in turn consists of the market for bank-issued loans and of the bond market).

H. Advantage 8

The IS-LM model includes money M and output Y. It also includes the price level P, although P is usually set equal to 1 and dropped from the IS-LM model. Because of the quantity equation of money ($MV \equiv PY$), the IS-LM model implicitly includes also velocity of money, V. From the usual IS-LM textbook story it is, however, unclear which "velocity of money" might be meant as "money" itself is not clearly defined. In contrast, the more detailed story defines money precisely, distinguishing between high-powered money and M1 money. Thus, velocity of money is also clearly defined.

I. Advantage 9

The usual IS-LM textbook story can be confusing for students as expansionary fiscal policy is said to increase output while "money" is assumed to be constant. Some students argue that, by closer inspection, output may thus actually not increase. After all, they say, the money that the government additionally spends has to come from somewhere. And if the money is by assumption not printed, it has to be taxed, or borrowed, out of the economy. Given that whoever gives up the money might have spent it as well, it is not obvious why output should increase.

This argument is sometimes called the "Treasury view" as it was advanced by staff of the UK Treasury in the 1930ies (Peden 2004). The argument is frequently "rediscovered" as Bridel (2014) notes. The usual IS-LM textbook story provokes such rediscoveries as it indeed leaves open the question where the government's additional money comes from.

The more detailed IS-LM story resolves the issue. It distinguishes between high-powered money on the one hand and M1 money on the other hand. While high-powered money is assumed to be constant, M1 money increases with output in response to a fiscal expansion.

Full-reserve banking is a relevant concept. More than one notable economist has advocated it over the years (Benes and Kumhof 2012). Switzerland is on the brink of a referendum regarding its possible introduction. Yet, from the usual IS-LM textbook story it appears as if the IS-LM model does not touch full-reserve banking. After all, required reserves do not seem to play a role. In contrast, the more detailed IS-LM story creates a link between the IS-LM model and full-reserve banking as it distinguishes between high-powered money (which includes required reserves) and M1 money.

VI. Velocity of M1 Money

In section III, we assumed that velocity of M1 money, V1, equals one. This assumption can be dropped anytime. In this case, equation (7) becomes:

$$M1V1 \equiv Y \tag{8}$$

For V1 greater than one, equation (8) means: For a given increase in M1 money, output increases by more than the increase in M1 money. This is because the newly created M1 money is spent on average more than once during the period under consideration. This "re-spending" brings about second-round effects which drive up output.

For V1 less than one, equation (8) means: For a given increase in M1 money, output increases by less than the increase in M1 money. This is because some of the newly created M1 money is not spent. This case seems, however, unlikely given that the newly created M1 money is borrowed. After all, there is no point in borrowing (at a cost) if there is no intention of spending.

Apart from those "accelerating" or "decelerating" effects, the story from section IV is unchanged for V1 being unequal to 1.

VII. Conclusion

If “simplicity is the ultimate sophistication”, as Leonardo da Vinci is alleged to have said, then simple models such as the IS-LM model have a place next to more complex models.

This paper aims to further improve the IS-LM model by being specific about its money measure(s). It does so in two steps.

Firstly, it assumes that the “M” of the LM equation reflects high-powered money.

Secondly, it adds the quantity equation of money with respect to M1 money ($M1V1 \equiv PY$). This is permissible as the quantity equation of money, as an identity, always holds true anyway.

From those two adjustments, an “augmented” IS-LM model results which includes both high-powered money and M1 money. For it, a more detailed IS-LM story can be told.

Vis-à-vis the usual IS-LM textbook story, the more detailed IS-LM story has ten advantages.

1. There is no ambiguity about what is meant by “money”;
2. Monetary policy is described as it actually takes place (central bank sets a policy rate and adjusts high-powered money so that the policy rate is met);
3. Quantitative easing is brought into the picture;
4. The M1 money multiplier is integrated into the IS-LM story;
5. An intuition is given for why the LM curve might shift to the right by more or less than the increase in money;
6. A market diagram interpretation of the IS-LM model opens up;
7. There is no ambiguity about the IS-LM model's interest rate;
8. There is no ambiguity about what is meant by “velocity of money”;
9. It guards against the “Treasury view” fallacy;
10. Full-reserve banking is brought into the picture.

REFERENCES

Abel, Andrew B., Ben S. Bernanke, and Dean Croushore. 2017. “Macroeconomics”, 9th ed. Boston: Pearson Education, Inc.

Benes, Jaromir, and Kumhof, Michael. 2012. “The Chicago Plan Revisited”. IMF Working Paper WP/12/202.

Blanchard, Olivier. 2017. “Macroeconomics”, 7th ed. Upper Saddle River, New Jersey: Pearson Education, Inc.

Bridel, Pascal. 2014. “The ‘Treasury View’: An (un-)expected return?” In The European Journal of the History of Economic Thought 21 (5). 920-942.

Cohen-Setton, Jérémie and Martin Kessler. 2011. “Traditional vs. Modern Macro”. http://bruegel.org/2011/10/traditional-vs-modern-macro/

Clower, Robert, 1967. “A reconsideration of the microfoundations of monetary theory.” In Economic Inquiry, 6. 1-8.

Dwivedi, D.N.. 2015. “Macroeconomics – Theory and Policy”, 4th ed. New York: McGraw-Hill Irwin.

Fisher, Irving. 1911. “The Purchasing Power of Money: Its Determination and Relation to Credit, Interest and Crises”, Macmillan, New York.

Federal Reserve. 2017a. “Velocity of M1 Money Stock [M1V]”, retrieved from FRED, Federal Reserve Bank of St. Louis.

Federal Reserve. 2017b. “Excess Reserves of Depository Institutions (EXCSRESNS)”, retrieved from FRED, Federal Reserve Bank of St. Louis.

Froyen, Richard T.. 2013. “Macroeconomics”, 10th ed. Upper Saddle River, New Jersey: Pearson Education, Inc.

Gordon, Robert J.. 2012. “Macroeconomics”, 12th ed. Boston: Pearson Addison Wesley.

Hansen, Alvin H.. 1953. “A Guide to Keynes”. New York: McGraw Hill.

Heijdra, Ben J.. 2017. “Foundations of Modern Macroeconomics”, 3rd ed. Oxford University Press.

Hicks, John R. 1937. “Mr. Keynes and the 'Classics': A Suggested Interpretation”. In Econometrica 5 (2). 147-159.

Mankiw, N. Gregory. 2016. “Macroeconomics”, 9th ed. New York: Worth Publishers.

Peden George C.. 2004. “Keynes and His Critics: Treasury Responses to the Keynesian Revolution, 1925-1946”. Records of Social and Economic History, New Series 36. New York: Oxford University Press.

Romer, David, H.. 2000. “Keynesian Macroeconomics without the LM Curve.” In Journal of Economic Perspectives, 14(2): 149-169.