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A More Detailed IS-LM Story

Martin Hiermeyer

German Federal Ministry of Finance

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A More Detailed IS-LM Story

By MARTIN HIERMEYER*

Textbooks tell a fairly short IS-LM story. This paper offers a more detailed IS-LM story. Based on a nearly unchanged IS-LM framework (so that model complexity remains low), the more detailed story covers the money multiplier, quantitative easing and central bank interest rate targeting (increasing explanatory power). Comparable explanatory power is usually only achieved by highly complex models, which, however, are beyond the scope of most undergraduates and the wider public.

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

Today, complex DSGE models dominate macroeconomic research. At the same time, simpler models preserve niches such as undergraduate teaching or policy advice.

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

As of 2017, it still features in such widely used undergraduate macro textbooks 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” with more complex models playing no role. It can be assumed that the IS-LM model continues to wield such influence, in the White House as well as 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, one, that distinguishes between high-powered money on the one hand and M1 money on the other hand.

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

Customarily, the IS-LM model is 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 “money”.

Figure 1 shows a fiscal expansion and a monetary expansion for the IS-LM model from equations (1) and (2). It is assumed that C’(Y) equals zero and that L’(Y) equals 0.25.

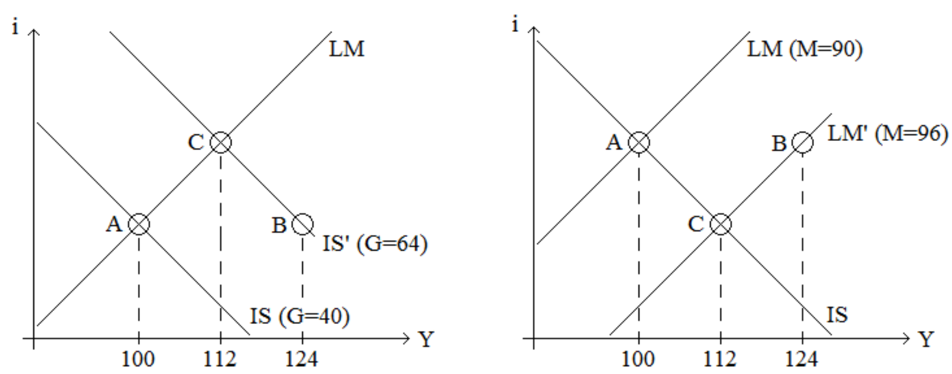

FIGURE 1. FISCAL EXPANSION (LEFT) AND MONETARY EXPANSION (RIGHT) IN THE IS-LM MODEL

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

The usual IS-LM textbook story for Figure 1's fiscal expansion is:

Increase in Government Spending (24 Units).—The economy is at point A when the government increases spending by 24 units (from 40 units to 64 units). Given C'(Y) equal to zero, the IS curve shifts to the right by those 24 units, crossing through point B.

Increase in Output (12 Units).—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 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.

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

The usual IS-LM textbook story for Figure 1's monetary expansion is:

Increase in Money (6 Units).—The economy is at point A when the central bank increases money by 6 units (from 90 units to 96 units). Given L'(Y) equal to 0.25, the LM curve shifts to the right by 24 units, crossing through point B. The increase in money drives down the interest rate i.

Increase in Output (12 Units).—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 goods and services (and thus additional transactions for which money is needed). Here, the higher money demand uses up 12 units of the central bank's additional money, 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*

In the usual IS-LM textbook story, money is both described as controlled by the central bank, and as 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 can be controlled by the central bank. However, from the second description one has to 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 has to say that "money" cannot mean M1 money as M1 money cannot be 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 (One That Includes High-Powered Money and M1 Money)

Equation (2) – the LM curve – includes money M. Its supply is controlled by the central bank. It therefore makes sense to assume that M reflects high-powered money (HPM) as the central bank can control the supply of high-powered money.

$$M = HPM \tag{3}$$

Today, central banks usually do not control high-powered money, but rather control ("target") a policy rate, pr. High-powered money and the policy rate are linked, though, since the policy rate is the interest rate which banks charge one another for overnight loans of high-powered money.

In practice, the central bank's policy makers decide on the policy rate, and the central bank's traders then lend more or less high-powered money to banks so that the policy rate is met. High powered money and the policy rate are negatively related as banks' demand for high-powered money is lower if the interest rate on it is higher.

$$\text{(4)} \qquad \mathrm{HPM} = \mathrm{HPM(pr)} \text{ with } \mathrm{HPM'(pr)} < 0$$

Equation (1) – the IS curve – includes consumption spending C, investment spending I and government spending G. Spending implies transactions. Transactions imply money. M1 money, which consists of currency held by the public and demand deposits, is used for such transactions. It therefore makes sense to state Fisher's (1911) equation of exchange – the quantity equation of money – with respect to M1 money:

$$\text{(5)} \qquad M1V1 \equiv PY$$

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.

$$\text{(6)} \qquad P = 1$$

This is a standard assumption of the IS-LM model. It can be dropped anytime by adding an aggregate supply curve to the IS-LM model that 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.

$$V1 = 1 \tag{7}$$

This 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 one. For example, in the US from 1959 to 2016, yearly V1 rather varied between 3.6 and 10.7 (Federal Reserve 2017a).

Like the assumption on the price level, the assumption of V1 being equal to one is, however, a convenient simplification. It can be dropped anytime as we will see in section VIII. For the time being, without dropping it, we can write equation (5) conveniently as:

$$M1 \equiv Y \tag{8}$$

Equation (8) is similar to a "cash-in-advance constraint" (Clower 1967), even though equation (8) refers to M1 money and not just to "cash" (cash, also called "currency held by the public", is one of two components of M1 money, with demand deposits being the other). Requiring that buyers have M1 money in advance 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 can also take place on credit. However, even there M1 money is needed in advance – this time by the seller. We can see this from the fact that if a business sells a good on credit, its "accounts receivable" balance sheet item goes up. Accounts receivable is an asset which firms, if higher, have to match with an additional liability, that is, with a ceteris paribus higher borrowing of M1 money.

If we combine equations (3), (4) and (8) with equations (1) and (2), an adjusted IS-LM model results:

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

(2') adjusted LM curve: HPM(pr) = L(M1, i), with M1 ≡ Y

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

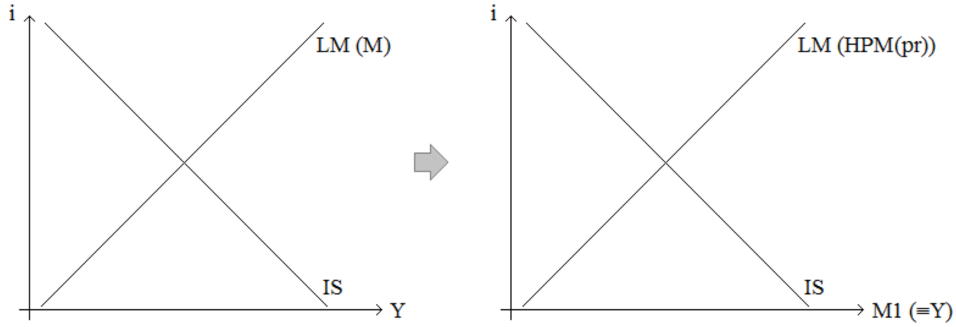

FIGURE 2. USUAL IS-LM MODEL (LEFT) AND ADJUSTED IS-LM MODEL (RIGHT)

IV. Interpreting the IS and LM Curves As Demand for and Supply of M1 Money

The adjusted IS-LM model in the right-hand panel of Figure 2 consists of an interest rate-output (i-Y) space and an interest rate-M1 money (i-M1) space. The interest rate-M1 money space can be interpreted as the "market for M1 money". Since M1 money is usually either borrowed from banks or from the bond market, we can think of the market for M1 money as consisting of the bank lending market and the bond market.

In this interpretation, the IS curve reflects demand for M1 money and the LM curve reflects supply of M1 money. The interest rate i equates both.

The IS curve is downward sloping as firms plan more spending, and therefore require more M1 money, if the interest rate decreases.

The LM curve is upward sloping as banks want to make additional loans if the interest rate increases. In the process, based on a given level of high-powered money, they create additional M1 money.

Interpreting the IS and LM curves as demand for and supply of M1 money means to deviate from the traditional interpretation of the IS and LM curve. The traditional interpretation holds that the IS curve reflects goods market equilibrium and that the LM curve reflects money market equilibrium.

This interpretation is frequently criticized as there is only a single interest rate in the IS-LM model. A single interest rate, however, cannot clear both the goods market and the money market as the two markets have in fact different interest rates (Romer 2000).

This criticism cannot be leveled against the "market for M1 money"-interpretation, as this interpretation has only one market for the one interest rate – the market for M1 money.

The next section makes maximum use of the "market for M1 money"-interpretation in order to give a more detailed IS-LM story.

V. A More Detailed IS-LM Story

Figure 3 shows a fiscal expansion and a monetary expansion for the adjusted IS-LM model from equations (1') and (2'). It is assumed that C'(Y) equals zero, that HPM'(pr) equals -6 and that L'(Y) equals 0.25.

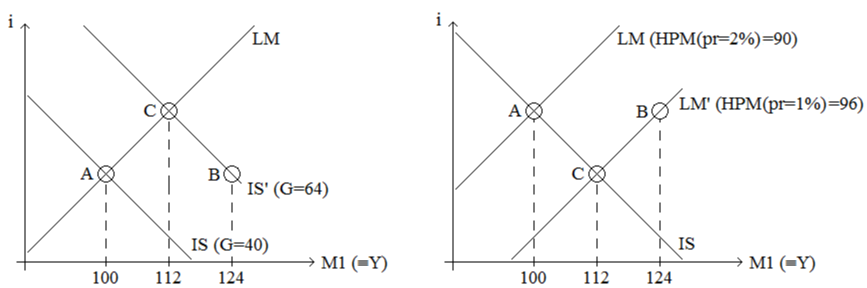

FIGURE 3. FISCAL EXPANSION (LEFT) AND MONETARY EXPANSION (RIGHT) IN THE ADJUSTED IS-LM MODEL

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

A more detailed IS-LM story for Figure 3's fiscal expansion is:

Increase in Government Spending (24 Units).—The economy is at point A when the government increases spending by 24 units (from 40 units to 64 units). To do so, the government needs 24 additional units of M1 money which it borrows at the market for M1 money (as discussed, this market consists of the bank lending market and the bond market). Given

C’(Y) equal to zero, the IS curve shifts to the right by those 24 units, crossing through point B.

*Excess Demand for M1 Money at Point B (24 Units).—*At point B, there is excess demand of 24 units at the market for M1 money. In turn, the interest rate i increases as the economy moves to point C. There, equilibrium is restored, partly through lower demand for M1 money by firms (12 units) and partly through higher supply of M1 money by banks (12 units).

*Lower Demand for M1 Money (12 Units).—*Demand for M1 money decreases as firms borrow less M1 money if the interest rate is higher. In Figure 3, firms borrow 12 units of M1 money less, as can be seen from the horizontal distance between point B and point C.

*Higher Supply of M1 Money (12 Units).—*Supply of M1 money increases as banks create additional M1 money if the interest rate is higher. In Figure 3, banks create 12 additional units of M1 money, as can be seen from the horizontal distance between point A and point C. Banks do so by making 12 additional units of loans. The exact process is illustrated below – see subsection “Illustration of the Interest Rate-Induced 12-Unit Increase in M1 Money”.

*Increase in Output (12 Units).—*Output increases by the increase in government spending (24 units) minus the crowded out borrowing by firms (12 units). The intuition is that those 24 units of M1 money, which the government additionally spends, have to come from somewhere. Here, 12 of the 24 units come from higher supply of M1 money as banks create 12 additional units of M1 money by making 12 additional units of loans. This is good for output. The other 12 units come from lower demand for M1 money as firms borrow 12 units of M1 money less. This is not so good for output. After all, firms that borrow 12 units less also spend 12 units less as borrowing and spending go hand in hand (there is, after all, no point in borrowing if there is no intention of spending).

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 bank lending market and the bond market are linked anyway, forming together the market for M1 money. (Here, things may play out as follows: Firms borrow 12 additional units of M1 money from banks, and 24 units of M1 money less from the bond market, while the government borrows 24 additional units of M1 money from the bond market.)

Illustration of the Interest Rate-Induced 12-Unit Increase in M1 Money.— The story holds that banks create 12 additional units of M1 money by making 12 additional units of loans. Table 1 illustrates how this works.

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

		(1)	(2)
Currency held by the public (CHP)		80	80
Excess reserves (ER)		5	2
Required reserves (RR)		5	8
High-powered money (HPM)	[HPM = CHP + ER + RR]	90	90
Reserve ratio (rr)		0.25	0.25
Additional bank loans		.	+12
Demand deposits (D)	[D = RR / rr]	20	32
M1 money (M1)	[M1 = CHP + D]	100	112

Column (1) shows the economy at Figure 3's point A (left-hand panel). Currency held by the public is 80 units and excess reserves and required reserves are 5 units each. High-powered money is 90 units. The reserve ratio is 25%, meaning that the economy has a fractional-reserve banking system as opposed to a full-reserve banking system. Demand deposits are 20 units. M1 money is 100 units (like in Figure 3 at point A).

In column (2), given the higher interest rate, banks use 3 units of excess reserves to make loans totaling 12 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 why demand deposits increase by 12 units to 32 units. Together with demand deposits, M1 money increases by 12 units.

Creation of M1 Money Not Necessarily Dependent on Banks Decreasing Excess Reserves.—On first sight, the just-described creation of additional M1 money seems to depend critically on the desire of banks to reduce their excess reserves in response to the higher interest rate. However, this is not true. One can construct a case where banks maintain a constant level of excess reserves, but still create 12 additional units of M1 money. For this to happen, households have to pay currency into their savings accounts, thus handing extra excess reserves to banks which those can lend out. This case is actually very realistic, given that the higher interest rate drives up households' opportunity cost of holding currency.

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

A more detailed IS-LM story for Figure 3's monetary expansion is:

Cut in the Central Bank Policy Rate (1 Percentage Point).—The economy is at point A when the central bank cuts its policy rate pr by one percentage point from 2% to 1%.
Given HPM'(pr) equal to -6, to meet the lower policy rate, the traders of the central bank must lend 6 additional units of high-powered money to banks (96 units, instead of 90 units). Given L'(Y) equal to 0.25, banks then use the 6 additional units of high-powered money to create 24 additional units of M1 money. They do so by making 24 additional units of loans at the market for M1 money (as discussed, this market consists of the bank lending market and the bond market). The exact process is illustrated below – see subsection "Illustration of the High-Powered Money-Induced 24-Unit Increase in M1 Money". The LM curve shifts to the right by those 24 units, crossing through point B.

Excess Supply of M1 Money at Point B (24 Units).—At point B, there is excess supply of 24 units at the market for M1 money. In turn, the interest rate i decreases as the economy moves to point C. There, equilibrium is restored, partly through higher demand for M1 money by firms (12 units) and partly through lower supply of M1 money by banks (12 units).

Higher Demand for M1 Money (12 Units).—Demand for M1 money increases as firms borrow more M1 money if the interest rate is lower. In Figure 3, firms borrow 12 additional units of M1 money, as can be seen from the horizontal distance between point A and point C.

Lower Supply of M1 Money (12 Units).—Supply of M1 money decreases as banks destroy M1 money if the interest rate is lower. In Figure 3, banks destroy 12 units of M1 money, as can be seen from the horizontal distance between point B and point C. Banks do so by making 12 units of loans less. The exact process is illustrated below – see subsection "Illustration of the Interest Rate-Induced 12-Unit Decrease in M1 Money".

Increase in Output (12 Units).—In sum, banks create 12 additional units of M1 money (plus 24 units because of the additional high-powered money, and minus 12 units because of the lower interest rate). While monetary policy is thus partly self-defeating, there is still a 12-unit net increase in M1 money. The net increase is borrowed by firms and spent (there is, after all, no point in borrowing if there is no intention of spending).

Illustration of the High-Powered Money-Induced 24-Unit Increase in M1 Money.—The story holds that banks create 24 additional units of M1 money by making 24 additional units of loans. Table 2 illustrates how this works.

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
Additional bank loans		.	.	+24
Demand deposits (D)	[D = RR / rr]	20	20	44
M1 money (M1)	[M1 = CHP + D]	100	100	124

Column (1) shows the economy at Figure 3's point A (right-hand panel). Currency held by the public is 80 units and excess reserves and required reserves are 5 units each. High-powered money is 90 units. The reserve ratio is 25%, meaning that the economy has a fractional-reserve banking system as opposed to a full-reserve banking system. Demand deposits are 20 units. M1 money is 100 units (like in Figure 3 at point A).

In column (2), the central bank's traders implement the lower policy rate. Banks' excess reserves and high-powered money increase by 6 units.

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 why demand deposits increase by 24 units to 44 units. Together with demand deposits, M1 money increases by 24 units.

Illustration of the Interest Rate-Induced 12-Unit Decrease in M1 Money.—The story holds that banks destroy 12 units of M1 money by making 12 units of loans less. Table 3 illustrates how this works.

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

		(1)	(2)
Currency held by the public (CHP)		80	80
Excess reserves (ER)		5	8
Required reserves (RR)		11	8
High-powered money (HPM)	[HPM = CHP + ER + RR]	96	96
Reserve ratio (rr)		0.25	0.25
Additional bank loans		.	-12
Demand deposits (D)	[D = RR / rr]	44	32
M1 money (M1)	[M1 = CHP + D]	124	112

Column (1) of Table 3 takes over where column (3) of Table 2 left of. M1 money stands at 124 units.

In column (2), given the lower interest rate, banks make 12 units of loans less, thus bolstering excess reserves by 3 units. Demand deposits decrease by 12 units, and so does M1 money.

Destruction of M1 Money Not Necessarily Dependent on Banks Increasing Excess Reserves.—On first sight, the just-described destruction of M1 money seems to depend critically on the desire of banks to increase their excess reserves in response to the lower interest rate. However, this is not true. One can construct a case where banks maintain a constant level of excess reserves, but still destroy 12 units of M1 money. For this to happen, households have to withdraw currency from their savings accounts, thus taking up the excess reserves which banks inevitably free up when lending less. This case is actually very realistic, given that the lower interest rate makes it less costly for households to hold currency.

VI. Different Parameter Values

Figure 3 assumed that C'(Y) equals zero, that HPM'(pr) equals -6 and that L'(Y) equals 0.25. This section looks at three different parameter values to give a feel for the difference.

A Different Parameter Value for C'(Y).—For C'(Y) equal to, say, 0.5 instead of equal to 0, the IS curve shifts to the right by more than the increase in government spending as second-round effects along the lines of the Keynesian cross appear.

A Different Parameter Value for HPM'(pr).—For HPM'(pr) equal to, say, -3 instead of equal to -6, the central bank's traders have to lend only three, instead of six, additional units of high-powered money to banks to produce the desired one percentage point decrease in the policy rate. The reason is that banks are less keen to take on additional high-powered money. Thus, already three additional units of high-powered money make the policy rate drop by one percentage point.

A Different Parameter Value for L'(Y).—For L'(Y) equal to, say, 2 instead of equal to 0.25, a 6-unit increase in high-powered money shifts the LM curve to the right by only 3 units, instead of by 24 units. As Table 2 shows, higher reserve requirements, higher currency drain and higher excess reserves all have the potential to reduce the rate at which high-powered money is turned into M1 money (lower "M1 money multiplier").

Of those, higher excess reserves seem particularly relevant. Banks may choose to build them up because of competitive pressure, cyclical over-pessimism, or strict capital requirements (Goodhart et al. 2004, McLeay et al. 2014, Stein 2013).

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 monetary policy measures ("quantitative easing") in order to still get M1 money into the economy.

VII. 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 comprehend.

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 this criticism may be overdone. Once a distinction is made between high-powered money and M1 money, the IS-LM model is actually extraordinarily well suited to describe monetary policy as it 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, it 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 shows why central banks reverted in recent years to 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 important concept. In contrast to 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, showing immediately how both frameworks relate.

E. Advantage 5

Equations (1) and (2) above specify that $0 \leq C'(Y) < 1$ holds and that $L'(Y)$ is greater than zero.

For $C'(Y)$ equal to zero, the IS curve shifts to the right by the increase in government spending; for $C'(Y)$ between zero and one, the IS curve shifts to the right by more than the increase in government spending. Textbooks provide an intuition for the comparatively strong shift in the latter case – the Keynesian cross.

For $L'(Y)$ between zero and one, the LM curve shifts to the right by more than the increase in money; for $L'(Y)$ equal to one, the LM curve shifts to the right by the increase in money; and for $L'(Y)$ greater than one, the LM curve shifts to the right by less than the increase in money. Textbooks do not provide an intuition for the comparatively strong shift in the first case. Nor do they provide an intuition for the comparatively weak shift in the third case.

In contrast, the more detailed IS-LM story provides such an intuition, showing that desired excess reserves, currency drain, and required reserves determine whether the LM curve shifts by much or by 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 i. The more detailed IS-LM story, in contrast, is precise: The IS-LM model's interest rate i is the interest rate which clears the market for M1 money. This market, in turn, consists of the bank lending market and 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 one and dropped from the IS-LM model. Because of the quantity equation of money ($MV \equiv PY$), the IS-LM model thus implicitly includes 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 defined. In contrast, the more detailed story defines money clearly, distinguishing between high-powered money on the one hand and M1 money on the other hand. 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 which 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 (e.g. 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 by distinguishing between high-powered money and M1 money. While high-powered money is assumed to be constant, M1 money increases with output in response to a fiscal expansion, thus providing the additional money.

J. Advantage 10

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.

VIII. Velocity of M1 Money

In section III, we assumed that velocity of M1 money, V1, equals one. We can drop this assumption anytime. In this case, equation (8) becomes:

$$M1V1 \equiv Y \tag{9}$$

For V1 greater than one, equation (9) 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 (9) 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 at all during the period under consideration.

Apart from those "accelerating" or "decelerating" effects, the more detailed IS-LM story is unchanged for V1 being unequal to one.

IX. 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.

From those two adjustments, an adjusted IS-LM model results which includes both high-powered money and M1 money. For it, we can tell a more detailed IS-LM story. As listed in section VII, this story has ten advantages vis-à-vis the usual story.

Each of the ten advantages gives the IS-LM model additional explanatory power (up to the level achieved by complex DSGE models). At the same time, model complexity is largely unchanged, with equations (1') and (2') not noticeably more difficult than equations (1) and (2).

Combined, this means that the more detailed IS-LM story improves the IS-LM model's explanatory-power-to-model-complexity ratio. This ratio, which is sometimes also called the “bang for the buck” ratio (McAfee 2014), is the metric against which any model should be judged.

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