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A Visual Model of Fiscal Policy

By MARTIN HIERMEYER*

Undergraduate textbooks present the *IS-LM* model in a way that leaves open three questions. (1) How does the government fund a fiscal stimulus in the *IS-LM* model? (2) Given the unchanged money supply: What money do economic actors use to buy the extra output that a fiscal stimulus brings? (3) What is the appropriate money measure and interest rate for the *IS-LM* model? To help with those questions, the paper suggests a visual model of fiscal policy that can be seen as a long-form version of the *IS-LM* model – a long-form version that still contains answers to the three questions.

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I. Introduction

The *IS-LM* model is part of most undergraduate textbooks (e.g. Abel et al. 2020, Acemoglu et al. 2021, Arnold 2019, Blanchard 2020, Boyes & Melvin 2016, Burda & Wyplosz 2022, Colander 2020, Dornbusch et al. 2018, Dullien et al. 2018, Frank et al. 2022, Gordon 2014, Gärtner 2016, Gottfries 2016, Gwartney et al. 2020, Hubbard & O'Brien 2021, Jones 2020, Karlan & Morduch 2021, Krugman & Wells 2021, Mankiw 2022, McConnell et al. 2021, McEachern 2016, Mishkin 2015, O'Sullivan et al. 2017, Parkin 2019, Richards et al. 2018, or Slavin 2020).

The model consists of an *IS* equation and an *LM* equation:

$$(IS) \qquad Y = C(Y) + I(r) + G + NX$$

$$(LM) \qquad M/P = L(Y, r)$$

In the equations, Y denotes output, C personal consumption expenditures, I gross private domestic investment, G government purchases of

final goods and services, *NX* net exports of final goods and services, *r* the interest rate, *M* the money stock, and *P* the price level.

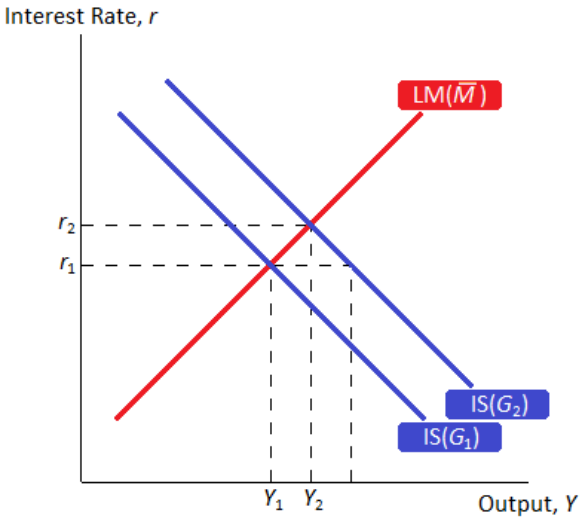

FIGURE 1. FISCAL STIMULUS IN THE *IS-LM* MODEL.

Usually, textbook authors provide a diagram such as Figure 1 and tell the following story about a fiscal stimulus:

"When the government increases its purchases from G_1 to G_2, the *IS* curve shifts to the right by $\Delta G(1–C'(Y))$. Output Y increases, although by less than $\Delta G(1–C'(Y))$. This is because the demand for money, M^D, increases when output Y increases. At the same time, the supply of money, M^S, is unchanged. To restore equilibrium in the money market, the *IS-LM* model's interest rate r rises. The higher interest rate makes firms cut back on their investment spending I. The fall in I partially offsets the expansionary effect of the increase in G (partial crowding out)."

With that, textbook authors leave open three questions.

Question 1. How does the government fund a fiscal stimulus in the *IS-LM* model?

Clearly, a government must somehow fund a fiscal stimulus. If the government has excess operating funds, it can use those; otherwise, it must issue bonds or increase taxes to fund the fiscal stimulus. Yet, textbook authors mention neither operating funds, nor bonds, nor taxes – understandably, as the variables are not part of the *IS-LM* model.

Question 2. Given the unchanged money supply: What money do economic actors use to buy the extra output that the fiscal stimulus brings?

Above, textbook authors said that *"the demand for money, M^D, increases when output increases"*. That is presumably because extra output comes with extra transactions; to pay for the extra transactions, economic actors need some extra money. Despite that, textbook authors do not say where the economic actors get the necessary extra money from. Clearly, the money does not come from a higher money supply as textbook authors explicitly state that *"the supply of money, M^S, is unchanged"*.

Textbook authors do say that the interest rate r rises to restore equilibrium in the money market, and that firms cut back on their investment spending because of the higher interest rate. However, that does not answer the question at hand. It makes the problem smaller – output increases by less than it would otherwise – but it does not make the problem go away. There is still a net increase in output (of Y_2 minus Y_1 in Figure 1) that *must* be underpinned monetarily somehow.

Implicitly, the *IS-LM* model includes an answer to the question. To see this note that the *IS-LM* model includes money M, prices P and output Y. Because of the quantity equation $MV \equiv PY$, it thus also includes velocity of money V. With M and P exogenously fixed, it follows from $MV \equiv PY$ that in the *IS-LM* model any increase in output Y is *necessarily* accompanied by an increase in velocity of money V. It is *that* increase in velocity of money that provides the needed extra money. Like an airline that can get extra flights per day out of a plane by cutting the time that the plane is idle on the ground, economic actors can get extra spending out of a given money stock by cutting the amount of money that lies idle in their pockets or in their accounts.

Textbook authors mention none of that – understandably, as the *IS-LM* model includes velocity of money only implicitly, and economic actors or idle money not at all.

Question 3. What is the appropriate money measure and interest rate for the *IS-LM* model?

Many different money measures and interest rates exist (M0, M1, bond yields, bank rates, etc.). Above, textbook authors remain vague – understandably, as the *IS-LM* model gives them no hints at all.

To help with those questions, the next chapter suggests a visual model of fiscal policy that can be seen as a long-form version of the *IS-LM* model – a long-form version that still contains answers to the three questions from above.

II. Visual Model of Fiscal Policy

The visual model is structurally and outcome-wise similar to the *IS-LM* model.

A. Baseline Case of the Model

Figure 2 gives the baseline case of the model.

There are four *economic actors*. The US government is the federal, state, and local government in the US, as represented by President Joe Biden. Households and firms are households and firms worldwide that hold US coins or notes or have checkable deposits at US banks. The Fed is the US Federal Reserve System, as represented by Chairman Jerome Powell. Banks are US depository institutions, as represented by Jamie Dimon, the CEO of JP Morgan Chase, the biggest bank.

Three of the economic actors have *money*. The US government has operating funds O, consisting of checkable deposits held in its Treasury General Account at the Fed, and of coins and notes. Households and firms have M1 money $M1$, consisting of checkable deposits held in their checking accounts at banks, and of coins and notes. Banks have reserves R, consisting of checkable deposits held in their Federal Reserve Accounts at the Fed, and of coins and notes ("vault cash").

Figure 2 gives numbers for an average day in 2021 (source Federal Reserve 2022a through f). The numbers, in particular those for reserves R and operating funds O, are much higher than they were 15 years earlier (66-fold and 145-fold increase, respectively, vis-à-vis 2006).

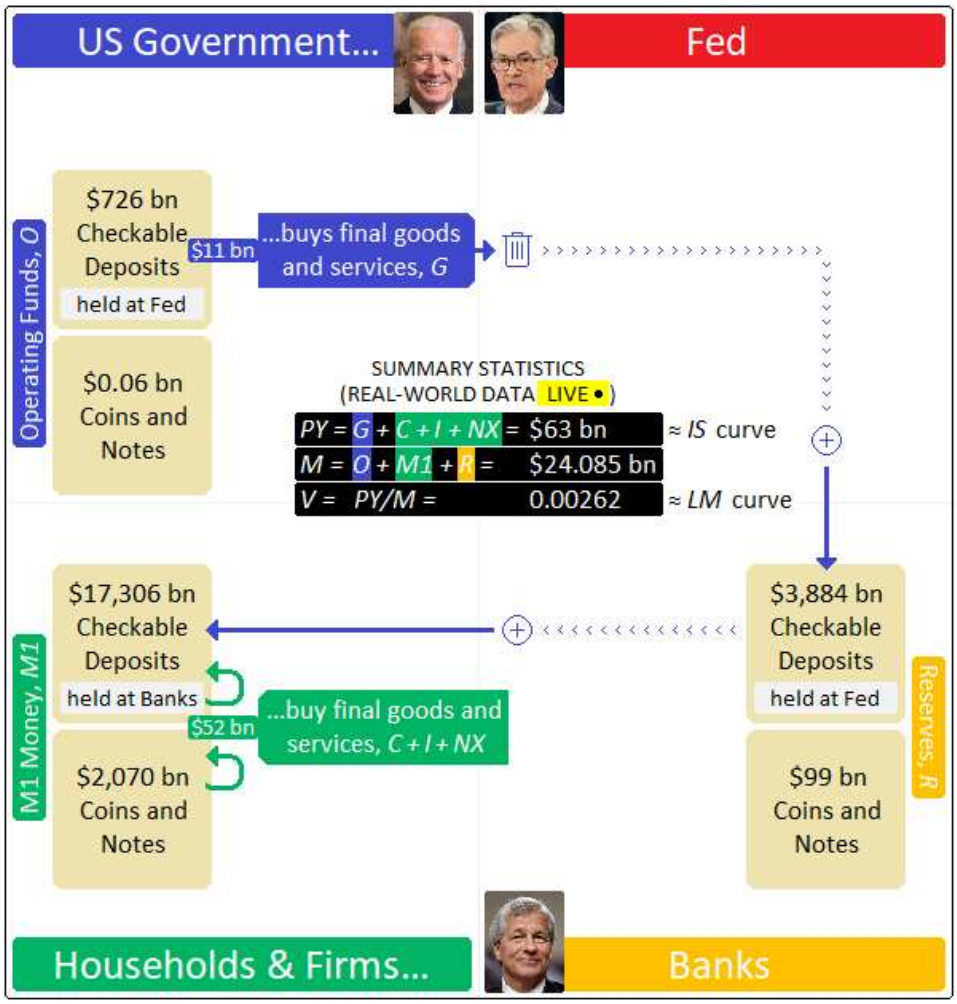

FIGURE 2. THE BASELINE CASE OF THE MODEL SHOWS THE US ECONOMY ON AN AVERAGE DAY IN 2021. IT SHOWS "LIVE FOOTAGE" IN THE SENSE THAT IT GIVES DAILY PURCHASES WHILST THE SETTLEMENT OF THE RELATED PAYMENTS ALSO TAKES ABOUT A DAY.

Two out of the four economic actors make *purchases*. The US government buys final goods and services G from households and firms, while households and firms buy final goods and services $C + I + NX$ from (other) households and firms.

Because the US government bought final goods and services, G, for 4.1 trillion dollars in 2021 (Bureau of Economic Analysis 2022), Figure 2 assumes that 11 billion dollars of checkable deposits (4.16 trillion dollars divided by 365 days) traveled from the US government to households and

firms on an average day (blue money flow). In a first step, the Fed destroys 11 billion dollars of operating funds by debiting the US government's Treasury General Account (blue trash bin symbol). In a second step, the Fed creates 11 billion dollars of reserves by crediting the Federal Reserve Accounts of the banks whose customers sell final goods and services to the US government (upper right blue plus symbol). In a third step, the involved banks create 11 billion dollars M1 money by crediting the checking accounts of the households and firms that sell to the US government (lower left blue plus symbol).

Because households and firms bought final goods and services, $C + I + NX$, for 19.1 trillion dollars in 2021 (Bureau of Economic Analysis 2022), Figure 2 assumes that 52 billion dollars (19.1 trillion dollars divided by 365 days) travel from households and firms to other households and firms on an average day. A part of the money travels as non-cash payments (upper circular green money flow) while another part travels as cash payments (lower circular green money flow).

Figure 2 includes three summary statistics.

Firstly, it gives aggregate demand PY. Aggregate demand PY is output Y multiplied with the current price level P. The current price level P could be set to 1 and dropped, however, it can just as well be retained. Aggregate demand PY consists of G and $C + I + NX$ and thus totals 63 billion dollars on an average day in 2021. This is also the real-world figure. The equation $PY = G + C + I + NX$ is structurally similar to the IS equation from above given that both equations give GDP and its components.

Secondly, Figure 2 gives the US economy's money stock M which consists of O, $M1$ and R and thus totals 24,085 billion dollars on an average day in 2021.

Thirdly, Figure 2 gives velocity of money V which is defined through the quantity equation $MV \equiv PY$ and thus totals 0.00262 (63 billion dollars divided by 24,085 billion dollars) on an average day in 2021. The equation $V = PY/M$ is structurally similar to the LM equation from above given that both equations relate a flow (output) to a stock (money).

In the next three sections, the US government engages in a hypothetical one-day, one-off fiscal stimulus that it funds in three different ways.

In all cases, the US government buys final goods and services for an extra 10 billion dollars vis-à-vis the baseline case of Figure 2. The fiscal stimulus is cleared through the Fed and banks (blue money flow in Figures 3, 4, 5 and 6).

B. Government Operating Funds-Funded Fiscal Stimulus

In Figure 3, the US government uses idle operating funds to fund the hypothetical fiscal stimulus. 10 billion dollars of operating funds that lay idle in Figure 2 now travel from the US government to households and firms (blue money flow in Figure 3).

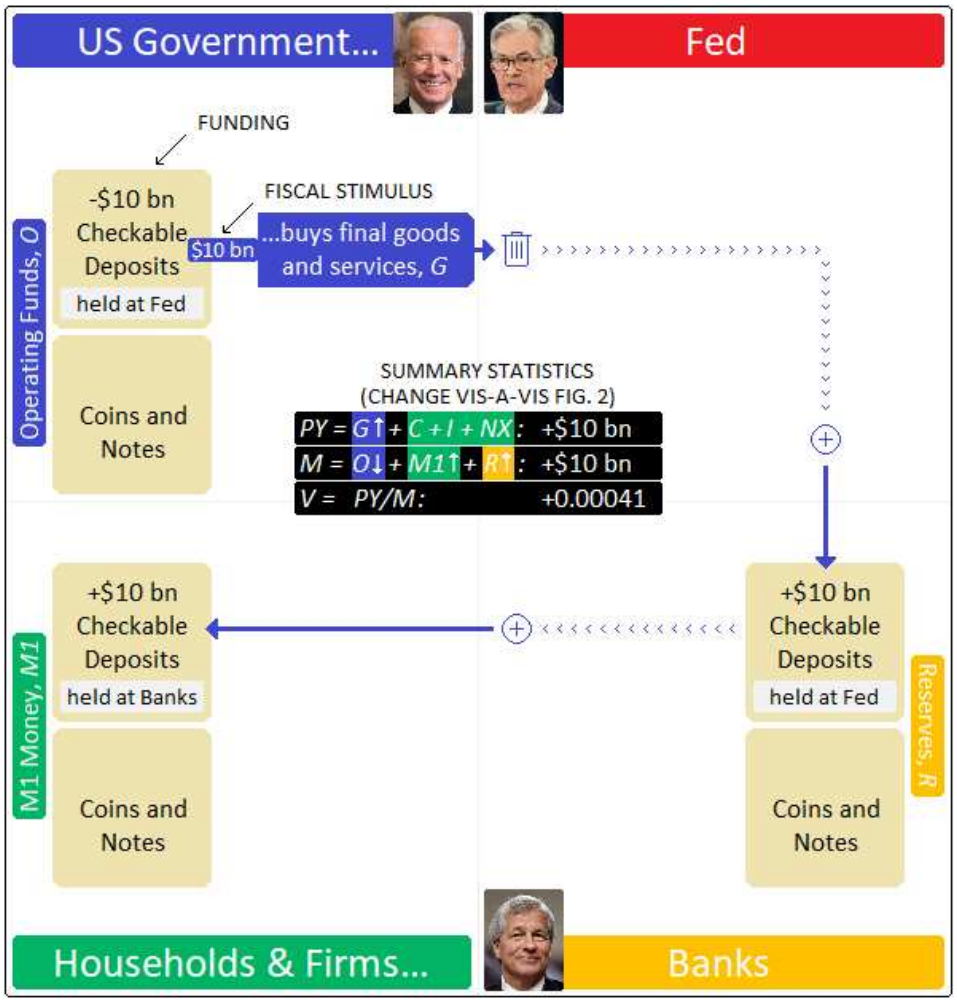

FIGURE 3. A $10 BN-FISCAL STIMULUS INCREASES AGGREGATE DEMAND BY $10 BN IF THE US GOVERNMENT FUNDS THE FISCAL STIMULUS WITH IDLE OPERATING FUNDS ("NO CROWDING OUT").

Aggregate demand PY increases by 10 billion dollars because of the extra government purchases G of 10 billion dollars. There is no crowding out as there is no reason why households and firms should cut their purchases of $C + I + NX$ just because the US government spends idle operating funds.

Whether the increase in PY reflects an increase in the price level P, an increase in output Y, or a combination of both, depends on the price-elasticity of the final goods or services that the US government chases with its extra purchases. For a fixed price level P, output Y increases by 10 billion dollars as producers are willing to supply extra output at unchanged prices ("horizontal aggregate supply curve"). If there is an increase in output, second-round effects along the lines of the Keynesian cross may result. I leave out such second-round effects as they do not change the result qualitatively yet threaten to overload Figure 3.

The money stock M is up by 10 billion dollars, given operating funds that are down by 10 billion dollars, and reserves and M1 money that are up by 10 billion dollars each.

Velocity of money V is also up. Economic actors use a slightly higher money stock M of 24,095 billion dollars (Figure 2: 24,085 billion dollars) to buy final goods and services for 73 billion dollars (Figure 2: 63 billion dollars), increasing velocity of money by 0.00041 from 0.00262 (63/24,085) in Figure 2 to 0.00303 (73/24,095).

C. Bond-Funded Fiscal Stimulus

If the US government wants to spare its idle operating funds or does not have any to begin with, it may obtain the 10 billion dollars for the fiscal stimulus by selling 10 billion dollars of extra US Treasuries.

If the buyer – either households and firms, or banks – demands a higher interest rate in return for absorbing the extra US Treasuries, the nominal interest rate on newly issued US Treasuries increases.

Households and Firms Buy The Extra US Treasuries.—In Figure 4, households and firms buy the extra 10 billion dollars of US Treasuries.

To pay, households and firms use 5 billion dollars of idle M1 money and cut their purchases of $C + I + NX$ by 5 billion dollars (black-and-green money flow).

Thus, 5 billion dollars of M1 money that lay idle in Figure 2 now travel to the US government. In addition, another 5 billion dollars of M1 money that in Figure 2 traveled to households and firms as payment for $C + I + NX$ now also travel to the US government.

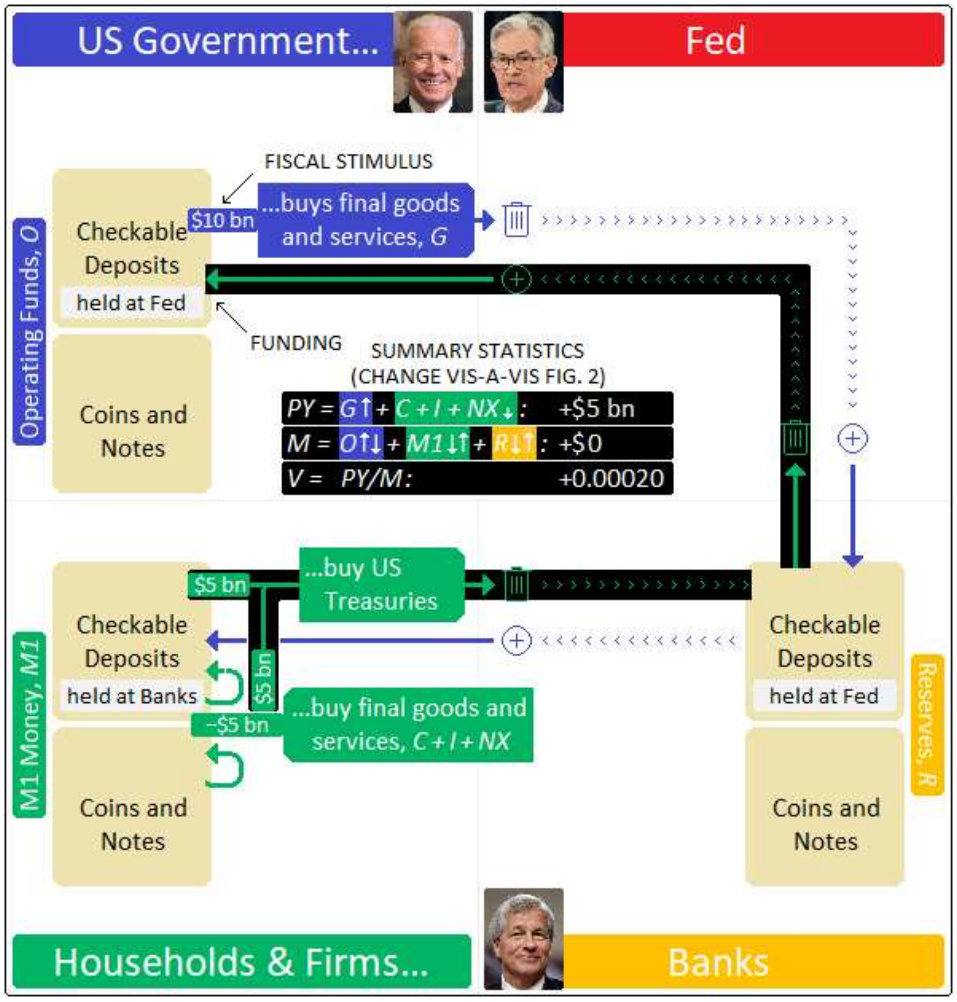

FIGURE 4. A $10 BN-BOND FUNDED-FISCAL STIMULUS INCREASES AGGREGATE DEMAND BY $5 BN IF HOUSEHOLDS AND FIRMS PAY FOR HALF OF THE EXTRA BONDS WITH IDLE M1 MONEY AND FOR THE OTHER HALF BY CUTTING THEIR PURCHASES OF $C + I + NX$ ("PARTIAL CROWDING OUT")

Aggregate demand PY increases by 5 billion dollars given that G is up by 10 billion dollars while $C + I + NX$ is down by 5 billion dollars ("partial crowding out").

The money stock *M* is unchanged. Any money that is destroyed by the fiscal stimulus is created again later, and vice versa, as made clear by the three trash bin symbols and the three plus symbols in Figure 4.

Velocity of money *V* is up. Economic actors use an unchanged money stock *M* to buy final goods and services for 68 billion dollars (Figure 2: 63 billion dollars), increasing velocity of money by 0.00020 from 0.00262 (63/24,085) to 0.00282 (68/24,085).

Banks Buy The Extra US Treasuries.—In Figure 5, banks buy the 10 billion dollars of extra US Treasuries, paying with reserves. 10 billion dollars of reserves, that were idle in Figure 2, now travel from the US government to households and firms (black-and-orange money flow).

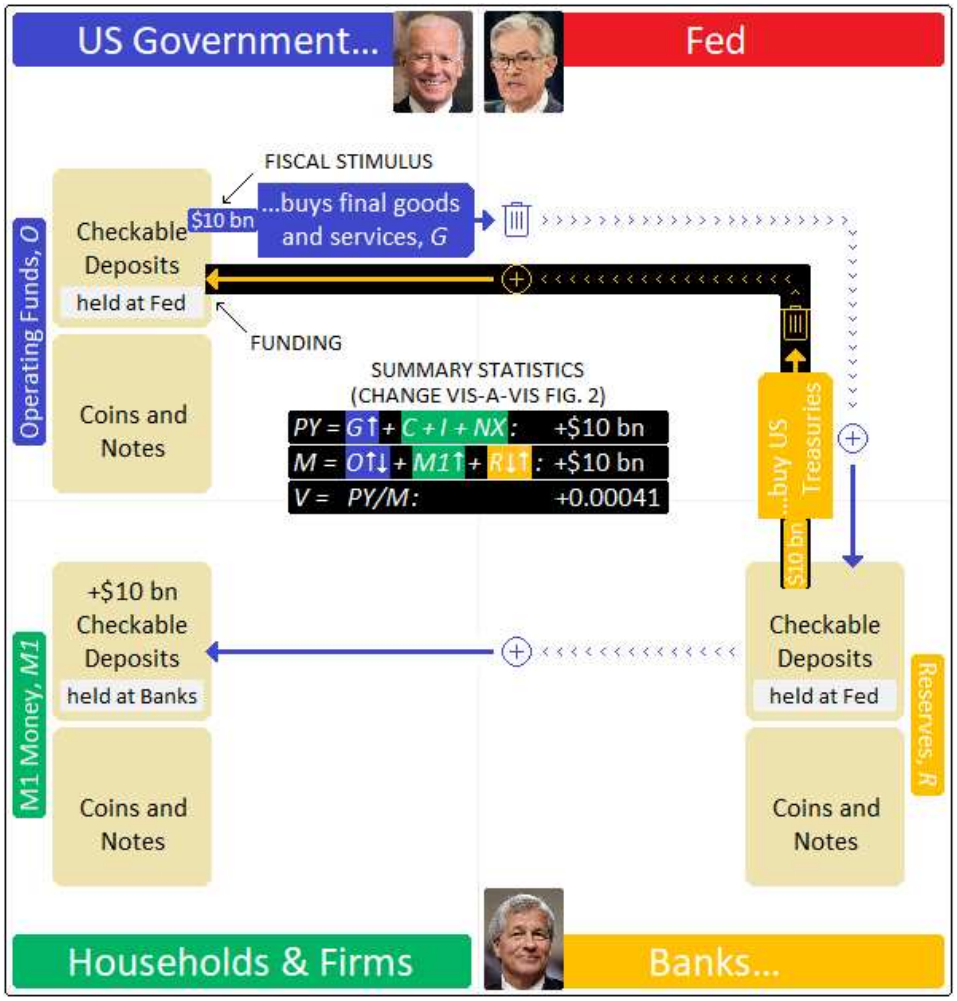

FIGURE 5. A $10 BN-BOND FUNDED-FISCAL STIMULUS INCREASES AGGREGATE DEMAND BY $10 BN IF BANKS BUY THE EXTRA BONDS WITH RESERVES ("NO CROWDING OUT").

Aggregate demand PY increases by 10 billion dollars given that G is up by 10 billion dollars. The fiscal stimulus does not crowd out private spending as there is no reason why households and firms should cut their purchases of $C + I + NX$ just because banks reduce their reserves. Households and firms probably do not even notice.

Also, households and firms likely still receive the same dividends and loans from banks. Dividends are likely unchanged because banks simply exchange one interest-bearing asset (reserves) against another interest-bearing asset (US Treasuries). With that, their profit-and-loss statement is unaffected, and they can still distribute the same dividends to households and firms who own their shares. Bank loans are likely also unchanged. The fiscal stimulus comes with a temporary 10 billion dollar decline in reserves (see Figure 5). A lack of reserves restricts bank lending if a minimum reserve requirement exists and if reserves are scarce. In 2021, however, none of the conditions applied. There was no minimum reserve requirement and reserves were ample after years of quantitative easing.

The money stock M is up by 10 billion dollars with M1 money up by 10 billion dollars and operating funds and reserves unchanged.

Velocity of money V is up by 0.00041 (73/24,095 vs. 63/24,085).

D. Tax-Funded Fiscal Stimulus

The US government may also increase taxes to fund the 10 billion dollar-stimulus from above. It does not make a difference whether households and firms or banks have to pay the extra tax. Even if banks have to pay the extra tax, the burden of the tax ends up with households and firms. This is because banks lose one asset (reserves) without getting another one in return. Their profit-and-loss statement is therefore affected ant they are forced to distribute a lower dividend to households and firms who hold their shares. Thus, in both cases households and firms are forced to come up with 10 billion dollars in M1 money – either because the US government levies the tax directly on them, or because the lower

dividend leaves a 10 billion dollar-gap in their usual inflow of M1 money from banks for which they have to compensate.

The effect of the tax-funded fiscal stimulus on aggregate demand PY depends on whether households and firms draw on idle M1 money or cut their purchases of $C + I + NX$ to come up with the needed M1 money. Like Figure 4, Figure 6 assumes that households and firms use both options to an equal extent. With that, Figure 6 is identical to Figure 4 except that it says "pay taxes" instead of "buy US Treasuries". As in Figure 4, aggregate demand is up by 5 billion dollars, the money stock M is unchanged, and velocity of money V is up by 0.00020.

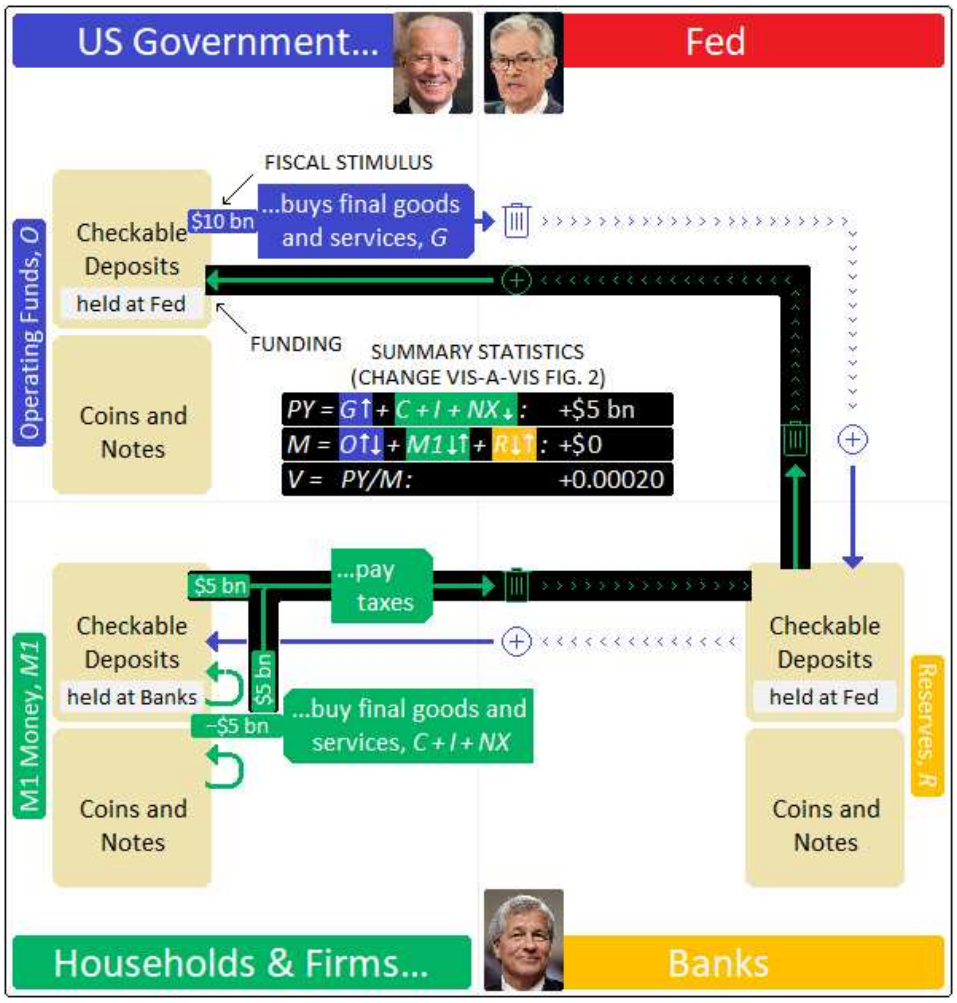

FIGURE 6. A $10 BN-TAX FUNDED-FISCAL STIMULUS INCREASES AGGREGATE DEMAND BY $5 BN IF HOUSEHOLDS AND FIRMS PAY FOR HALF OF THE TAX WITH IDLE M1 MONEY AND FOR THE OTHER HALF BY CUTTING THEIR PURCHASES OF $C + I + NX$ ("PARTIAL CROWDING OUT").

E. Fiscal Stance

In 2021, US total federal spending was 6.9 trillion dollars (US Treasury 2022a). The spending consisted of purchases of final goods and services, as well as of other expenditures such as transfer payments.

The US government funded 1.5 trillion dollars of the 6.9 trillion dollars (22%) with idle operating funds, running down its stock of operating funds from 1.7 trillion dollars at the beginning of the year to 0.2 trillion dollars at the end of the year (Federal Reserve 2022a). Another 2.6 trillion dollars (38%), it funded with US Treasuries as it issued 5.1 trillion dollars of US Treasuries during the year while repaying 2.5 trillion dollars of matured US Treasuries (US Treasury 2022b). Finally, it funded 2.8 trillion dollars of the spending (40%) with taxes and tax-like receipts (US Treasury 2022a).

The 2021 federal budget deficit corresponds to the US government's net issuance of US Treasuries and was therefore 38% of total spending.

Figure 7 summarizes the information and adds that according to the previous sections the US government does not crowd out private spending if it funds spending with idle operating funds (Figure 3) or with US Treasuries that banks buy (Figure 5). By contrast, it crowds out private spending if it funds its spending with US Treasuries that households and firms buy (Figure 4) or with taxes (Figure 6).

The previous section studied crowding out with respect to a fiscal stimulus. However, what is true for extra spending is also true for the spending itself.

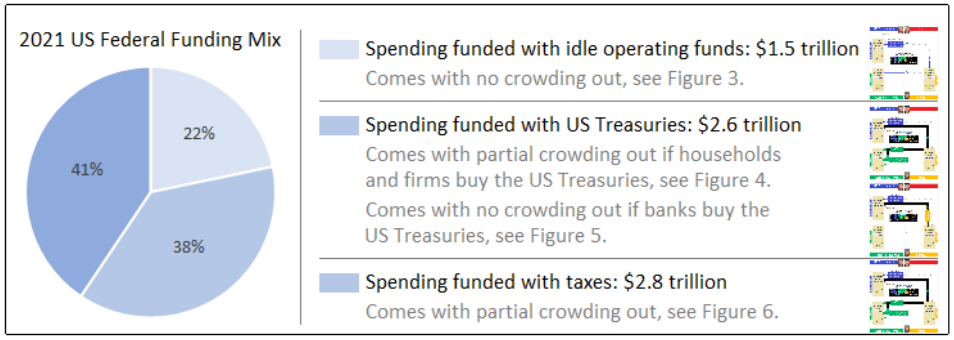

FIGURE 7. THE FIGURE SHOWS HOW THE US GOVERNMENT FUNDED ITS 2021 SPENDING OF $6.9 TRILLION.

It follows that "fiscal stance" is more than just the level of government spending or the budget deficit.

In 2021, the US government sold its US Treasuries partly directly to banks and partly to households and firms (US Treasury 2022b). Had it sold more of them to banks and correspondingly less to households and firms, it would have crowded out less private spending. The same level of government spending and the same budget deficit would have been more "expansionary" (would have generated a higher aggregate demand). The same is true if the US government would have funded more of its spending with idle operating funds and correspondingly less through taxes.

The IMF (1995) has long maintained that the fiscal stance of an economy depends not only on the level of spending or on the budget deficit but also "on the range of items that comprise government operations – importantly, the way the deficit is funded". The visual model drives the point home.

III. Answers Lost And Found

The visual model can be seen as a long-form version of the *IS-LM* model. Vice versa, the *IS-LM* model can be seen as a short-form version of the visual model that collapses the visual model into two equations.

Table 1 compares both models, showing that the *IS-LM* model keeps seven of the ten features of the visual model, making both models structurally (features 1-3) and outcome-wise (features 4-7) similar.

TABLE 1—THE VISUAL MODEL CAN BE SEEN AS A LONG-FORM VERSION OF THE *IS-LM* MODEL

	Model Feature	Visual Model	*IS-LM* Model	
1	Model has an equation that gives GDP and its components?	✓	✓	STRUCTURALLY SIMILAR
2	Model has an equation that relates a flow (output) to a stock (money)?	✓	✓	
3	Model has an explicit, or at least implicit, role for velocity of money V?	✓	✓	
4	A fiscal stimulus increases aggregate demand PY and/or output Y?	✓	✓	OUTCOME-WISE SIMILAR
5	Second-round effects along the lines of the Keynesian cross may result?	✓	✓	
6	A fiscal stimulus may crowd out private purchases $C + I + NX$ or I?	✓	✓	
7	A fiscal stimulus may increase the interest rate?	✓	✓	
8	Model discusses how a fiscal stimulus is funded?	✓	×	
9	Model has an explicit role for velocity of money V?	✓	×	
10	Model clearly defines its money measure and interest rate?	✓	×	

The visual model has three features that the *IS-LM* model lacks (features 8-10). The features allow the visual model to answer the questions from above. It goes systematically through the ways in which a government can fund a fiscal stimulus (idle operating funds in Figure 3; bonds in Figures 4 and 5; taxes in Figure 6), thus answering question 1. It shows how economic actors pay for any extra spending, thus answering question 2. And it is clear about its money measure – the sum of operating funds, M1 money and reserves – and about its interest rate – the nominal interest rate on newly issued US Treasuries, thus answering question 3.

IV. Conclusion

The visual model plots economic actors, selected purchases, and money stocks to track the various ways in which a government can fund a fiscal stimulus. The model makes it possible to "see" how velocity of money goes up if some economic actor puts otherwise idle money into circulation.

Velocity of money plays a key role for fiscal policy. Unlike monetary policy, fiscal policy cannot simply create extra money. At the same time, successful fiscal policy *needs* extra money as payment for the extra purchases of final goods and services that a fiscal stimulus hopes to induce.

Velocity of money V is implicitly included in the *IS-LM* model but is easy to overlook there.

To give students a fuller picture of fiscal policy in general, and of the *IS-LM* model in specific, textbook authors may want to present the visual model alongside the *IS-LM* model as a companion guide.

Adding the model would make textbooks longer, something that textbook authors rightly dread (Mankiw 2019). The problem is, however, alleviated by the fact that textbook authors present four of the visual model's concepts – stocks vs. flows; bank reserves; M1 money; aggregate supply and aggregate demand – elsewhere in textbooks and could drop them there.

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