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The Economics of Helicopter Money*

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Abstract

An economy plagued by a slump and in a liquidity trap has some options to exit the crisis. We discuss "helicopter money" and other equivalent policies that can reflate the economy and boost consumption. In the framework analysed – where lump-sum transfers may be the only effective fiscal response, like in the current pandemic crisis – the central bank, and only the central bank, is the rescuer of last resort of the economy. Fiscal policy is bounded by solvency constraints unless the central bank backs treasury's debt.

JEL codes: E50.
Keywords: Helicopter money, ZLB, Pandemic Crisis

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1 Introduction

"Let us suppose now that one day a helicopter flies over this community and drops an additional $1,000 in bills from the sky, which is, of course, hastily collected by members of the community. Let us suppose further that everyone is convinced that this is a unique event which will never be repeated." (Friedman, 1969)

Helicopters are now flying over many countries. The US government has just approved a two trillion dollars support to the economy and the Federal Reserve has committed to unlimited quantitative easing among which purchases of treasury's debt. A possible implementation of Friedman's proposal is indeed to have the government doing a transfer to the citizens financed by issuing debt, which is in turn purchased by the central bank through more supply of money or reserves. Time will tell us whether this was true monetisation.

In his writing, Friedman's hypothetical experiment was meant to show the effectiveness of monetary policy on inflation. It is, indeed, odd to think that the central bank cannot control the price level. At the end of the day, Fed's liabilities define exactly what a dollar is. By virtue of this definition, the Fed has the power to print dollars at will without facing any constraint. Since the value of a dollar in terms of goods is the inverse of the price level. The Fed can really throw from the sky as many dollar bills as needed to lower the value of money and reflate the price level. Helicopter money should work!

This suggestive idea has recently received considerable attention in academia and policy circles given that central banks across the globe have lost their conventional ammunitions, having slashed the nominal interest rate down to zero. Helicopter money has been discussed as a viable option to reflate the economy (see among others Bernanke, 2002 and 2003, Galì, 2020, Tuner 2013, 2016).

This paper describes an economy plagued by a slump due to an adverse demand shock in which even cutting the nominal interest rate down to zero does not bring the economy to full capacity, as in the framework of Krugman (1998). Fiscal policy has only access to lump-sum transfers as effective policy tools, like in the current pandemic crisis, where health-policy measures induce a contraction in labor supply that cannot be offset using other tools like spending or changes in tax rates.

We study helicopter money and other alternative, and equivalent, policies that can reflate the economy, boost aggregate demand and bring the economy out of the slump.

To analyse the spectrum of available policies, it is key to understand that central bank's liabilities (money or reserves) are special since they are free of any nominal risk, by definition. These liabilities indeed define what a dollar actually is. Therefore, the central bank can create dollars and reserves at will to pay its liabilities, without being subject to any solvency

requirement. Treasury's liabilities, on the other hand, are like the liabilities of any other agent in the economy. They are a promise to pay a given amount of dollars at maturity. As such, since the treasury cannot create dollars, treasury's liabilities need to satisfy a solvency condition in order to be repaid and be nominally risk free.

The set of tools available to reflate the economy changes depending on whether or not the treasury's liabilities are fully backed by the central bank, i.e. whether or not the special properties of central bank's liabilities extend to the treasury.

In the first case, three options are possible. Helicopter money is one. The treasury can transfer money to the private sector, or cut taxes, and finance these policies by issuing more debt. It does not really matter whether this debt is purchased by the central bank. The reason is that treasury's debt has the same risk-free properties of central bank's liabilities. Moreover, if the central bank purchases treasury's debt, it does not even matter whether it uses money or reserves since the economy is at the zero lower bound. However, key for the success of this combination of policies is that the treasury commit not to withdraw the short-run tax relief with higher taxes in the future.

An alternative, but equivalent approach, is to rely entirely on promises about future policy actions, without any current intervention at all. One way to do this would be for the treasury to commit to a tax relief or a transfer in the future. This policy could be seen as less effective in practice, since it depends entirely on the credibility of future promises. However, also helicopter money is rather frail in this dimension, because it also relies critically on the promises that treasury or central bank will not undo their policies in the future. A third option is for the central bank to reduce future seigniorage revenues, since this is also a transfer of income to the private sector. In this case the central bank should lower its long-run inflation target, if seigniorage is on the upward-sloping side of the Laffer curve. This policy, however, seems also less desirable than helicopter money and the entailed commitment perhaps less credible, because it implies a somewhat schizophrenic behaviour on the part of the central bank, which first tries to reflate the economy and then lowers the long-run inflation target.

The second case, in which the central bank does not back treasury's liabilities, is quite relevant, because it describes well the current situation of the European Monetary Union: the treasuries of the several countries are not different from any other agent in the economy, since they should also satisfy a solvency condition for the debt they issue. Accordingly, treasury's debt is not really wealth for households – when full backing by the central bank is absent and the conditions for Ricardian equivalence hold. A tax relief today should necessarily be offset by future taxes or by default on treasury's debt. With the treasury out of the picture, however, the central bank can still rely on some policy options to reflate the economy, and all those options are equivalent to helicopter money in terms of outcomes.

First, the central bank can reduce its remittances today to raise its net worth. An increase in central bank's net worth corresponds to an increase in the net debt position of consumers. This additional borrowing becomes then unsustainable unless it is inflated. The surge in inflation ends up boosting current consumption through a reduction in the real interest rate. The same outcome can be achieved by either promising to reduce future central bank's remittances or increasing seigniorage revenues through a change in the inflation target. Both these policy actions deteriorate the long-run financial position of the private sector, requiring an increase in the price level to ease the burden.

One shortcoming of the latter policy options, is that they work through a contraction in future aggregate demand that can be offset if prices immediately adjust upward to the new equilibrium level; however, if prices are anything less than perfectly flexible, all these policies can end up making things even worse, and prolong the slump of the economy. On the contrary, helicopter money works through an expansion in long-run aggregate demand, which pushes consumption above potential and reflates the economy even if prices were adjusting only sluggishly.

There is still, however, one option for the central bank to do helicopter money on its own: write a big check to the treasury fully rebated to the private sector. This is indeed a money-financed fiscal transfer. However, there is an important caveat to bear in mind: in order for this policy to work and reflate the economy we need two additional conditions. The first is that the check be so large that central bank's net worth turns negative, with the consequence that the private sector now experiences a positive wealth effect. The second condition is that this large, current transfer be complemented with the commitment to at least partially reverse it in the future through either low remittances or higher seigniorage revenues (and therefore a higher inflation target if seigniorage is on the upward-sloping side of the Laffer curve). Under these two conditions, these helicopter drops can boost aggregate demand even if prices adjust sluggishly.

This paper is related to a recent literature that has studied liquidity trap and policy options. Krugman (1998) is our main inspiration for describing a simple model of a slump at the zero lower bound. With respect to his work, we characterise the long-run equilibrium and therefore the policies that can reflate the economy including helicopter money. Woodford (2000, 2001) is the reference for understanding the special role of the liabilities of the central bank as discussed also in the recent works by Buiter (2014) and Benigno (2020). Del Negro and Sims (2015) and Benigno and Nisticò (2020) analyse the implications of separating treasury and central bank for the control of inflation through central-bank balance sheet policies .

Auerbach and Obstfeld (2005) and Buiter (2014) study experiments of helicopter drops in

various models with different frictions. Along those lines, Galì (2020) compares debt-financed versus money-financed fiscal cuts as well as the role of government purchases. Eggertsson and Woodford (2003) and Woodford (2012) stress the importance of forward guidance as an alternative way to reflate the economy out of a liquidity trap which can be equivalent in its outcome to the proposal of this work.

2 Model

We consider a simple infinite-horizon endowment monetary model in the same spirit as Krugman (1998). Time t_0 has the interpretation of the short run. The economy will be stationary after, and including, period $t_0 + 1$, which is going to be labelled the long run. There are two important features that distinguish the short from the long run: 1) prices are rigid in the short run and flexible in the long run, 2) a preference shock is low in the short run and high in the long run. The short run lasts only one period, for illustrative purposes. But, we can make it longer by extending the duration of price rigidity and/or of the shock.

Let's see the implications of these assumptions. Consider the Euler equation

$$\xi_t U_c(C_t) = \beta(1 + i_t)\frac{P_t}{P_{t+1}}\xi_{t+1}U_c(C_{t+1}) \tag{1}$$

in which $U(\cdot)$ is the utility of consumption and $U_c(\cdot)$ its marginal utility, P_t is the price level at time t and i_t the risk-free nominal interest rate set by the central bank, β is the rate of time preferences; ξ_t is a shock to preferences.

Focus first on the long run, i.e. $t \geq t_0 + 1$: prices are flexible and the preference shock is at the high level $\xi_t = \bar{\xi}$. Since prices are flexible in the long run, from $t_0 + 1$ onwards goods market clears and consumption is equal to output. Assuming a constant endowment, goods market equilibrium implies that $C_t = Y$ for each $t \geq t_0 + 1$. Set an interest rate policy in the long-run to target a positive rate of inflation

$$1 + i_t = \frac{1}{\beta}\Pi$$

for each $t \geq t_0 + 1$. Substituting it into (1) and using $C_t = Y$ and $\xi_t = \bar{\xi}$ we obtain that

$$\frac{P_{t+1}}{P_t} = \Pi$$

for $t \geq t_0 + 1$. Inflation is constant after $t_0 + 1$ at the level targeted by the central bank Π. What is left undetermined is the price level at time $t_0 + 1$. Let's set it at $P_{t_0+1} = \bar{P}$. We will

come back to its determination later.

Consider now the short-run Euler Equation

$$\begin{aligned} U_c(C_{t_0}) &= \beta(1+i_{t_0})\frac{P_{t_0}}{\bar{P}}\frac{\bar{\xi}}{\xi}U_c(Y), \\ &= \beta(1+i_{t_0})\frac{P}{\bar{P}}\frac{\bar{\xi}}{\xi}U_c(Y), \end{aligned} \tag{2}$$

where in the second line we have also used the assumption that short-run prices are sticky at $P_{t_0} = P$. Assume that the distance between $\bar{\xi}$ and ξ is large enough so that, given P and $\bar{P}$, the following inequality holds

$$\beta\frac{P}{\bar{P}}\frac{\bar{\xi}}{\xi} > 1. \tag{3}$$

Using this inequality into (2), it follows that short-run consumption falls below output at any non-negative interest rate: the economy is in a slump.

Figure (1) displays the effect of a current negative demand shock $\xi < \bar{\xi}$ on the interest rate and current consumption. In the space $(C_{t_0}, 1+i_{t_0})$ the Euler equation (2) and the zero-lower bound (ZLB) on the nominal interest rate imply a downward-sloping aggregate demand curve (AD) that dies out at $i_t = 0$. The vertical red line displays the aggregate supply curve (AS), located at the level of the constant endowment Y. Starting from a stationary equilibrium where $C = Y$ and $1 + i = \Pi/\beta$ (point A in the figure), a negative demand shock $\xi < \bar{\xi}$ shifts the AD curve to the left into AD', inducing a downward pressure on current consumption. The central bank can exploit the downward slope of aggregate demand and cut the nominal interest rate to stimulate consumption as much as possible. To restore the equilibrium in the goods market, $C_{t_0} = Y$, the central bank would need to cut the nominal rate down to $1+i_{t_0} = (\xi/\bar{\xi})(\bar{P}/(P\beta))$. However, if the size of the shock satisfies (3), the required cut in the nominal rate would violate the ZLB. As a consequence, the central bank cannot descend the AD' schedule beyond point B, where the economy is in a slump and experiences a shortage of demand:

$$\underline{C} = YU_c^{-1}\left(\beta\frac{P}{\bar{P}}\frac{\bar{\xi}}{\xi}\right) < Y.$$

Equation (2) tells us that the other possibility to restore the equilibrium in the goods market is to act on the future price level, reflating the economy, lowering the real rate and boosting consumption: in Figure (1), indeed, raising $\bar{P}$ shifts the aggregate demand schedule to the right into AD'' and the economy can reach equilibrium E.[1]

[1]We should clarify that, although we analyse the policies to restart the economy once in a liquidity trap, the mechanisms we discuss are at work also for positive values of the nominal interest rates. In that scenario, however, the equivalence results that we are going to discuss are in general weaker.

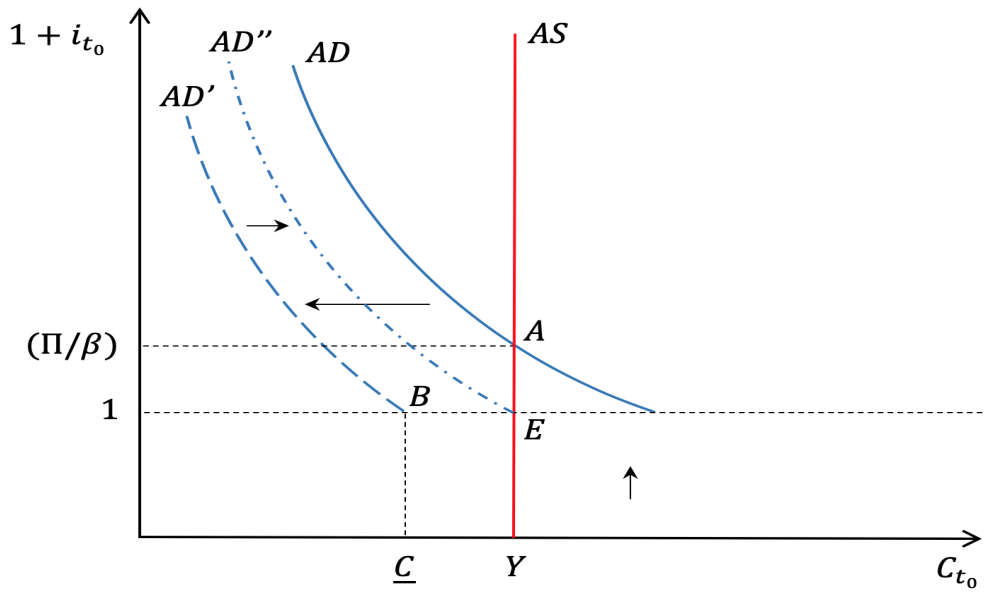

Figure 1: The effects of a negative preference shock $\xi < \bar{\xi}$: AD shifts to the left into AD' and the economy falls in a slump ($\underline{C} < Y$) due to the ZLB, unless the central bank reflates the economy and shifts AD' to the right into AD''.

To understand the policies that can reflate the economy, we now move to study how the long-run price level is determined. Note indeed, that we did say something on the long-run inflation rate but not on the level of prices at time $t_0 + 1$.

At time $t_0 + 1$ the intertemporal budget constraint of the consumer holds with equality

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \left(C_t + \frac{i_t}{1+i_t} \frac{M_t}{P_t} \right) = \frac{W_{t_0+1}}{P_{t_0+1}} + \sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \left(Y_t - \frac{T_t}{P_t} \right) \tag{4}$$

where T_t are lump-sum taxes levied by the treasury and the time $t_0 + 1$ nominal wealth of the household is

$$W_{t_0+1} = B_{t_0} + (1 + \delta Q_{t_0+1}) D_{t_0} + X_{t_0} + M_{t_0}.$$

Four securities are available to households. They can save or borrow in risk-free bonds, B, and hold central bank's reserves, X; both securities pay the risk-free interest rate i. They can also save or borrow using long-term bonds, D, which pay a decaying coupon δ and sell at price Q_t. Finally, they can hold physical money which does not pay any interest rate. For the services that real money balances supply, households need to pay a price, given by the foregone interest rate on bonds. The overall cost of holding real money balances is captured by the second addendum on the left-hand side of (4). Note that in (4), the real interest rate is set at $1/\beta$ as it is implied by long-run equilibrium conditions. We can now add other results from the long-run equilibrium to simplify (4). First, equilibrium in the goods market

implies that $C_t = Y$ for each $t \geq t_0 + 1$. Moreover equilibrium in the money market implies a demand of real money balances of the following form

$$\frac{M_t}{P_t} \geq L(Y, i_t) \tag{5}$$

which holds with equality whenever the interest rate is positive.[2] Real money balances are a negative function of the nominal interest rate and positively related with output. Since in the long run $i = \beta^{-1}\Pi - 1$, then $M_t/P_t = L(Y, \beta^{-1}\Pi - 1)$ for any $t \geq t_0 + 1$. Moreover the price of long-term bond will satisfy the no-arbitrage condition

$$Q_t = \beta \frac{P_t}{P_{t+1}} \frac{\xi_{t+1} U_c(C_{t+1})}{\xi_t U_c(C_t)} (1 + \delta Q_{t+1})$$

and therefore using the Euler equation we get

$$Q_t = \frac{(1 + \delta Q_{t+1})}{1 + i_t}.$$

We can substitute the above restrictions in (4) to obtain

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \left(\frac{T_t}{P_t} \right) + S(\Pi, Y) = \frac{B_{t_0} + X_{t_0} + M_{t_0} + Q_{t_0} D_{t_0}}{P_{t_0+1}}.$$

in which we have defined the present-discounted value of seigniorage as

$$S(\Pi, Y) \equiv \frac{\Pi - \beta}{\Pi(1 - \beta)} L \left(Y, \frac{\Pi}{\beta} - 1 \right).$$

The above equilibrium condition requires the long-run real value of the liabilities of the whole government to be equal to the present discounted value of taxes (first term on the left-hand side) plus seigniorage revenues (the second term on the left-hand side).

Assuming that there is an appropriate tax policy $\{T_t/P_t = \tau_t\}$ consistent with the above constraint and the price level $\bar{P}$ at time $t_0 + 1$, we can finally write:

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \tau_t + \frac{\Pi - \beta}{\Pi(1 - \beta)} L \left(Y, \frac{\Pi}{\beta} - 1 \right) = \frac{B_{t_0} + X_{t_0} + M_{t_0} + Q_{t_0} D_{t_0}}{\bar{P}}. \tag{6}$$

We have now all the ingredients to investigate what are the policy options to reflate the economy and stimulate consumption in the short run.

To proceed we should make an important observation and distinguish two cases. The key

[2] Please refer to the Appendix for a more detailed description of the model.

observation is to note that the central bank has an important and exclusive power in the economy: its liabilities define the unit of account of the monetary system and therefore they are – in nominal terms – risk free by definition. This means that the central bank does not have to satisfy a solvency constraint like all other agents in the economy: its dollar obligations can always be fulfilled just by printing new dollars. In other words, while a treasury bill is redeemable for dollars, a dollar bill is only redeemable for itself.

This peculiar feature of the central bank suggests we should distinguish two cases. In the first case, appropriate institutional arrangements make the properties of central bank's liabilities extend to the treasury's as well, in what we can call a consolidated view of the whole government. In the second case, the two institutions are separate and the treasury is therefore not different from any other agent in the economy and it needs to satisfy a standard solvency condition to determine the market value of its debt.[3]

We start from the first case of a consolidated budget constraint for the government.

3 Central bank and treasury acting together

Consider the case in which the central bank backs the treasury's liabilities and therefore the risk-free property of its liabilities extends to the treasury's. Equation (6) holds and is key to determine the long-run price level

$$\bar{P} = \frac{B_{t_0} + X_{t_0} + M_{t_0} + Q_{t_0} D_{t_0}}{\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \tau_t + S(\Pi, Y)}. \tag{7}$$

To complete the analysis, consider the budget constraint of the government in period t_0

$$B_{t_0} + X_{t_0} + M_{t_0} + Q_{t_0} D_{t_0} = B_{t_0-1} + X_{t_0-1} + M_{t_0-1} + (1 + \delta Q_{t_0}) D_{t_0-1} - T_{t_0}, \tag{8}$$

where on the left-hand side we have used the fact that the nominal interest rate is at the ZLB in the current period $i_{t_0} = 0$.

Equation (7) shows the alternative policy options to reflate the economy.

The first one is to raise the numerator of (7), *ceteribus paribus*, the so called "helicopter money" , where the government (treasury or central bank) increases permanently the long-run nominal liabilities – namely B_{t_0}, X_{t_0}, M_{t_0} or D_{t_0} – to finance a tax cut in the short run.[4] Since the short-run nominal interest rate is zero, all these possibilities are equivalent, as shown in (8). Indeed, given that all government's liabilities have the special properties of central bank's

[3] See Buiter (2014) and Benigno (2020) for a discussion of this point.

[4] Some equivalence results are going to break at positive short-run interest rate, but not the overall argument on the general effectiveness of the policies proposed.

liabilities, it does not really matter whether it is the treasury or the central bank that raises its own liabilities. Moreover, equation (8) clarifies that the increase in government liabilities outstanding at $t_0 + 1$ can be generated by a tax cut at t_0 and therefore a larger current primary deficit. This larger deficit can equivalently be financed issuing either short-term or long-term treasury's debt, which can equivalently be held by either the private sector or the central bank. In the former case B_{t_0} or D_{t_0} increase for given X_{t_0} and M_{t_0}, while in the latter case the opposite occurs, as the central bank raises its liabilities – either money or reserves – to absorb the new issuance of treasury's debt, leaving unchanged the stock of debt held by the private sector (B_{t_0} and D_{t_0}). For this policy option to succeed, equation (7) clarifies that it is important that the denominator does not change (at least not proportionally): the treasury should therefore commit to leave its future tax policy unchanged.[5] In this setup, this is feasible, since there is no solvency constraint required on the treasury once consolidated with the central bank.

It is useful to visualise results using a simple AD–AS logic. We can use (4) to write long-run consumption as

$$\bar{C} = (1-\beta)\left\{\frac{B_{t_0} + X_{t_0} + M_{t_0} + Q_{t_0}D_{t_0}}{\bar{P}} + \sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1}(Y - \tau_t) - S(\Pi, Y)\right\}. \tag{9}$$

Assuming that the private sector is a net creditor with respect to the government (i.e. $B_{t_0} + X_{t_0} + M_{t_0} + Q_{t_0}D_{t_0} > 0$), then equation (9) implies a negative relationship between long-run prices and consumption. This relationship is plotted in Figure 2 as an AD equation together with the AS equation of constant long-run output.

An increase in the long-run government's nominal liabilities stimulates aggregate demand, which shifts to the right into AD', thereby pushing up prices and moving the equilibrium from E to E'.

Equation (7) suggests two alternative policy options to reflate the economy, which work through a reduction in the denominator. The first alternative is a treasury's commitment to lower real taxes in the long run, given an unchanged path of liabilities carried from t_0. The second alternative is a central bank's commitment to lower the present discounted value of seigniorage revenues by changing the inflation target Π. The sign of the required change in Π is ambiguous, and depends on whether seigniorage evaluated at the target rate of inflation, Π, is increasing or decreasing in Π. As equation (9) shows, both policies imply a positive wealth effect on long-run consumption, thus producing upward pressures on nominal spending, shifting aggregate demand to the right into AD' in Figure (2), and thereby reflating

[5] This is therefore an example of "unbacked fiscal expansion", in the words of Jacobson, Leeper and Preston (2019).

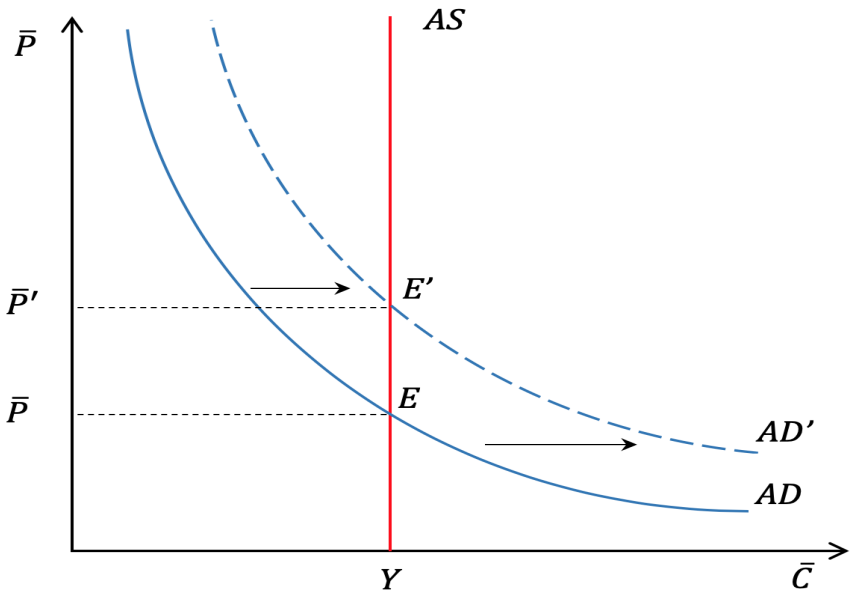

Figure 2: Reflating the economy when the government faces a consolidate budget constraint.

the economy.

4 Central bank acting alone

Consider now the case in which the central bank does not directly back treasury's liabilities. In this case, the treasury should be subject to a standard solvency condition of the following form

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \left(\frac{T_t}{P_t} + \frac{T_t^C}{P_t} \right) = \frac{B_{t_0}^T}{P_{t_0+1}} + \frac{Q_{t_0} D_{t_0}^T}{P_{t_0+1}}, \tag{10}$$

at *any* equilibrium price, in which B^T and D^T is total short and long-term treasury's debt. Given the remittances received from the central bank, T_t^C, the treasury should adjust taxes in a way to back its short and long-term liabilities at any equilibrium prices. If taxes are not adjusted, then treasury should default at least partially on its debt obligation and the above condition will hold at any equilibrium price with the right-hand side adjusting for the recovery rate on debt. This implies that by no means treasury's debt can be considered wealth for the private sector, since any increase in debt should be offset by either a corresponding increase in the present discounted value of future taxes or a (partial) default on it.

Note that in equilibrium the short-term debt issued by the treasury is held by the central bank and by the private sector

$$B^T = B^C + B,$$

while the following condition holds for long-term debt

$$D^T = D^C + D.$$

Using these equilibrium conditions together with (10) into (4), we obtain the relevant equilibrium condition to determine the price level at time $t_0 + 1$:

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \left(\frac{T_t^C}{P_t} \right) = S\left(Y, \Pi\right) + \frac{Q_{t_0} D_{t_0}^C + B_{t_0}^C - X_{t_0} - M_{t_0}}{P_{t_0+1}}.$$

Consider a real value of remittances $T_t^C/P_t = \tau_t^C$ consistent with the price level $\bar{P}$ then we can write

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \tau_t^C = S\left(Y, \Pi\right) + \frac{Q_{t_0} D_{t_0}^C + B_{t_0}^C - X_{t_0} - M_{t_0}}{\bar{P}}$$

and therefore

$$\bar{P} = \frac{N_{t_0}}{\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \tau_t^C - S\left(Y, \Pi\right)} \tag{11}$$

where central bank's net worth is defined as

$$N_t \equiv Q_t D_t^C + \frac{B_t^C - X_t}{1 + i_t} - M_t$$

which at time t_0 is equal to

$$N_{t_0} \equiv Q_{t_0} D_{t_0}^C + B_{t_0}^C - X_{t_0} - M_{t_0},$$

given that the nominal interest rate is zero in the short run.

To complete the analysis, note that the law of motion of net worth is given by

$$N_{t_0} = N_{t_0-1} + \Psi_{t_0} - T_{t_0}^C, \tag{12}$$

where central bank's profits are

$$\Psi_t = i_{t-1}(N_{t-1} + M_t) + (r_t - i_{t-1}) Q_{t-1} D_{t-1}^C,$$

having defined as r_t the return on long term securities, i.e. $1 + r_t = (1 + \delta Q_t^C)/Q_{t-1}^C$. In the short run, at the zero nominal interest rates, profits are just given by the excess return on long-term bonds

$$\Psi_{t_0} = (r_{t_0} - i_{t_0-1}) Q_{t_0-1} D_{t_0-1}^C$$

held from time $t_0 - 1$.[6]

The central bank – and only the central bank – has now several policy options available to reflate the economy, as implied by condition (11). First, it could act on the numerator of (11), by raising its net worth, *ceteribus paribus*. This can be accomplished by reducing short-run transfers to the treasury, as shown by (12), which implies higher current taxes for the private sector.

To understand the intuition behind this apparently counterintuitive mechanism, notice that since the Treasury now must satisfy equation (10) and therefore its debt cannot be private wealth, the net position of the private sector will mirror that of the central bank only: a positive net worth for the central bank corresponds to a net debt position of the private sector. Accordingly, an increase in the net asset position of the central bank implies a larger net debt position for the private sector: the latter therefore borrows more, but for that borrowing to be sustainable at the equilibrium level of consumption, i.e. $\bar{C} = Y$, the price level should increase to reduce the real value of household's debt.

The alternative policy options to achieve the same allocation work through changing the denominator of (11). The central bank could commit to reduce the present-discounted value of real remittances transferred in the long run, which at the end means higher taxes for the households. But the mechanism is similar as above, since the reduction in the present-discounted value of net income for the households makes their debt position unsustainable at the equilibrium level of consumption. Therefore an increase in the price level is required in the new equilibrium to reduce the real value of debt for households. By the same logic, committing to an increase in future seigniorage revenues can now reflate the economy.

Visualising the results through the *AD–AS* graphical analysis proves particularly useful in this case. Consider again the long-run consumption function given by (4). However, equation (10) now holds, saying that treasury's debt cannot be private wealth. Therefore, combining (4) and (10), we get

$$\bar{C} = (1-\beta)\left\{-\frac{Q_{t_0}D^C_{t_0} + B^C_{t_0} - X_{t_0} - M_{t_0}}{\bar{P}} + \sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1}(Y + \tau^C_t) - S(\Pi, Y)\right\}, \qquad (13)$$

which clarifies that the net position of the private sector mirrors that of the central bank only. If central bank's net worth outstanding in the long run is positive ($N_{t_0} \equiv Q_{t_0}D^C_{t_0} + B^C_{t_0} - X_{t_0} - M_{t_0} > 0$) then the private sector becomes net debtor with respect to the wealth position that matters for its consumption, and equation (13) now implies a positive relationship between long run consumption and price level (AD schedule in Figure 3).

[6]Note that r_{t_0} can be different from i_{t_0-1}, because of the surprises in policy and shock that can happen at time t_0.

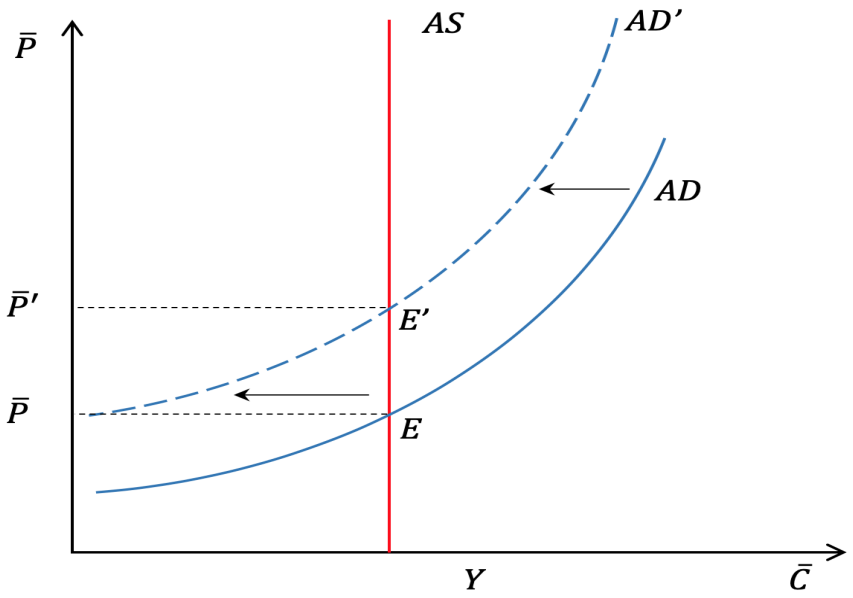

Figure 3: Reflating the economy when the central bank acts alone: the case of positive net worth.

An increase in central bank's net worth (as well as a reduction in future remittances or an increase in seigniorage revenues) then reduces aggregate demand and shifts the AD schedule to the left into AD'. However, this is exactly what it is needed to boost the price level, since the fall in aggregate demand is implied by the deterioration of the net debt position of the private sector, which can be offset by an increase in prices. However, Figure 3 shows an important shortcoming of this policy response, related to the positive slope of the AD schedule: the adjustment mechanism relies critically on the full flexibility of prices in the long run. Indeed, if prices were not flexible enough to fully adjust at the time in which the central bank raises its net worth, then this policy can actually prolong the slump, as consumption falls at any price below the market clearing one. Note the difference with respect to the downward sloping AD schedule of Figure 2, in which consumption instead rises, were prices adjusting sluggishly.

However, equations (11) and (13) suggest that there are still tools available to the central bank, which can work also with prices adjusting sluggishly and relate more directly to policy options discussed in the literature, such as "helicopter money".

Consider again the equilibrium condition

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \tau_t^C = S\left(Y, \Pi\right) + \frac{Q_{t_0} D_{t_0}^C + B_{t_0}^C - X_{t_0} - M_{t_0}}{\bar{P}}.$$

The central bank can make its net worth negative, the numerator of the second addendum on the right-hand side of the above equation. This can be done by making a large transfer to

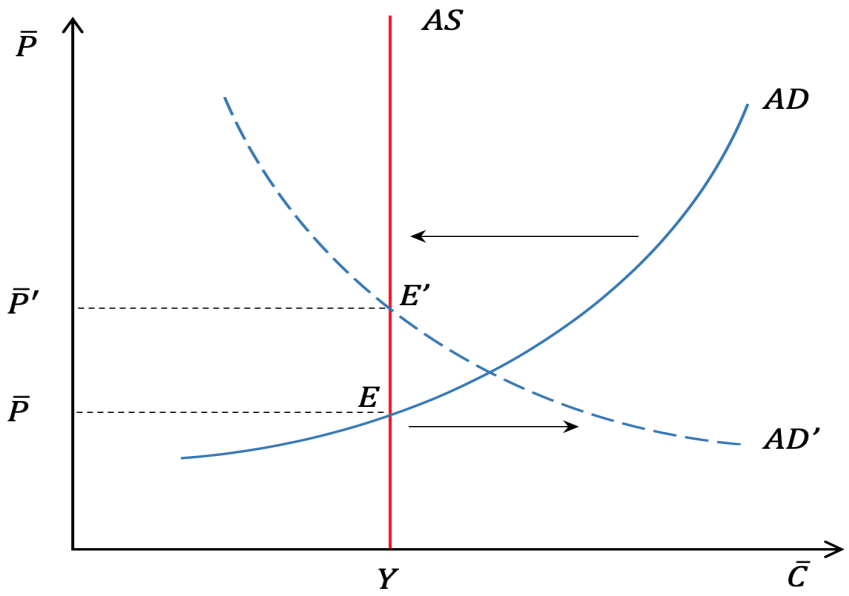

Figure 4: Reflating the economy when the central bank acts alone: "helicopter money" through negative net worth.

the treasury at time t_0, as implied by equation (12), which will be immediately transferred to the private sector by the treasury through a matching tax cut, to satisfy equation (10).[7] This policy therefore involves issuing new central bank's liabilities (or writing off some assets from the central bank's balance sheet, or both) to finance a large transfer to the treasury that translates into a tax cut for the private sector: this is the sense in which this option belongs to the class of policies labelled "helicopter money".

Equation (11), however, shows that this policy should be complemented with further actions in order for the price level to be positive and consistent with an equilibrium. Indeed, if the numerator in (11) turns negative, so should the denominator. Therefore, it should be that

$$\sum_{t=t_0+1}^{\infty} \beta^{t-t_0-1} \tau_t^C < S\left(Y, \Pi\right),$$

which can be obtained by either lowering the present-discounted value of the remittances in the long run or by raising seigniorage revenues through an increase in the inflation target, if seigniorage is on the left side of the Laffer curve.

Figure 3 shows how the way this policy works is similar to the "helicopter money" experiment. In particular, the central bank's transfer at t_0 is reflected in lower taxes to the households in the short run and into an improvement in the net financial position of the private sector in the long run. The latter boosts aggregate demand in $t_0 + 1$ and shifts the

[7] See Benigno and Nisticò (2020) for proof that a simple tax rule satisfying restriction (10) requires the treasury to rebate to the private sector any remittances received by the central bank, period by period.

AD schedule to the right. However, equation (13) implies that if central bank's net worth turns negative, the private sector experiences positive wealth effect. Indeed, the reason why upward pressures on aggregate demand turn out to be inflationary (as opposed to before) is that a current transfer large enough to make central bank's net worth negative not only shifts the AD schedule to the right, but it also flips it into a negatively-sloped curve. It is precisely this switch in the slope of the AD schedule that allows the central bank to reflate the economy through an upward pressures on aggregate demand in the long-run: since the economy is already at full capacity in the long run, the surge in aggregate demand is reflected into higher long-run prices.

5 Conclusion

This paper studies the economics behind policies available to take an economy out of a slump. We consider a simple endowment economy where time is divided into a short-run period and a long-run period. In the short run prices are fixed and the private sector is hit by a large negative demand shock that takes the economy in a slump, because the interest-rate cut required to offset the demand shock cannot be implemented as it would violate the zero-lower-bound constraint. In the long run, prices are perfectly flexible, the demand shock is back at its steady-state value and the economy is at the stationary equilibrium.

We first show that, with short-run price rigidities, the only way to take the economy out of the slump is to induce an increase in the future price level, which then boosts current consumption through the implied reduction in the real interest rate, even when the nominal interest rate is stuck at zero.

We then explore how to reflate the economy depending on specific institutional arrangements between treasury and central bank.

In the case in which the central bank explicitly and directly backs the treasury's liabilities (i.e. when the government faces a consolidated budget constraint), one policy option is the standard specification of "helicopter money": a fiscal transfer to the private sector financed through an increase in monetary liabilities that is not reversed in the future through higher taxes. We show that this option is equivalent to at least three alternatives: i) financing the same fiscal transfer issuing treasury's debt, since in a consolidated view of the government there is really no difference between monetary and non-monetary liabilities; ii) committing to a future tax relief; iii) committing to a future decrease in seigniorage revenues, through a reduction in the long-run inflation target (if seigniorage is on the upward-sloping side of the Laffer curve).

If treasury's liabilities, instead, are not explicitly and fully backed by the central bank

(as in the case of the European Monetary Union) there are still some policy options available to the central bank. It is important in this case to realise that, since treasury's debt is not wealth for the private sector, the relevant net financial position of the latter mirrors that of the central bank alone. The central bank can therefore exploit this to create the necessary pressure on aggregate demand that induce the response on the long-run price level that is needed to boost current consumption.

We have kept our model simple and tractable as possible. Several extensions to avoid the limitations of our analysis can be pursued in future research. First, the model is basically characterised by only two periods. A proper dynamic extension could be helpful to understand the effectiveness of policies even in the medium run. Moreover, a dynamic model can allow to capture the endogenous duration of the zero-lower bound policies depending on the policies used to reflate the economy, along the lines of Eggertsson and Woodford (2003). This extension could interestingly break the equivalence between some of the policies discussed in this paper. An important assumption of our framework is the lump-sum nature of transfers or taxes between government and the private sector. This is motivated by the observation that fiscal policy can also be in a trap under certain shocks that bound the availability of effective tools to just lump-sum transfers.[8] This assumption has diminished the effectiveness of fiscal policy, when the central bank does not fully back its liabilities, because Ricardian equivalence holds. Assuming distortionary taxes or productive public spending can, in general, give more role to fiscal policy to boost the economy out of the slump, as discussed by Eggertsson (2011). It would be interesting to compare the effectiveness of alternative fiscal tools with those proposed in this work.

[8]This class of shocks certainly include the current pandemic crisis, where health-policy measures induce a contraction in labor supply that cannot be offset using other fiscal tools like spending or changes in tax rates.

References

[1] Auerbach, A.J., Obstfeld, M., 2005. The Case for Open-Market Purchases in a Liquidity Trap. American Economic Review 95(1), 110-137.

[2] Bernanke, B., 2002. Making Sure It Does not Happen Here. Speech before the National Economists Club, Washington, D.C.

[3] Bernanke, B., 2003. Some Thoughts on Monetary Policy in Japan. Speech before the Japan Society of Monetary Economics, Tokyo.

[4] Benigno, P., (2020). A Central Bank Theory of Price Level Determination. American Economic Journal Macroeconomics, forthcoming.

[5] Benigno, P., Nisticò, S., 2020. Non-Neutrality of Open-Market Operations. American Economic Journal Macroeconomics, forthcoming.

[6] Buiter, W.H., 2014. The Simple Analytics of Helicopter Money: Why it Works Always. Economics E-Journal 8, 1-51.

[7] Del Negro, M., Sims, C., 2015. When Does a Central Bank's Balance Sheet Require Fiscal Support? Journal of Monetary Economics, 73: 1-19.

[8] Eggertsson, G., 2011. What Fiscal Policy is Effective at Zero Interest Rates? NBER Macroeconomics Annual 2010, pp. 59-112.

[9] Eggertsson, G., Woodford, M., 2003. Zero Bound on Interest Rates and Optimal Monetary Policy. Brookings Papers on Economic Activity 2003(1), 139-233.

[10] Friedman, M., 1969. The Optimum Quantity of Money. In: The Optimum Quantity of Money and Other Essays, Aldine Press (Chicago, IL).

[11] Galí, J., 2020. Helicopter Money: The Time is Now. Vox column, 17 March 2020.

[12] Galí, J., 2020. The Effects of a Money-Financed Fiscal Stimulus. Journal of Monetary Economics, fothcoming.

[13] Jacobson, M., Leeper, E., Preston B., 2019. Recovery of 1933. NBER Working Paper 25269.

[14] Krugman, P., 1998. Its Baaack: Japans Slump and the Return of the Liquidity Trap. Brookings Papers on Economic Activity 1998(2), 137-205.

[15] Turner, A., 2013. Debt, Money, and Mephistopheles: How do we Get Out of this Mess?. Lecture delivered at the Cass Business School.

[16] Turner, A., 2016. Between Debt and the Devil. Money, Credit and Fixing Global Finance. Princeton University Press.

[17] Woodford, M., 1996. Control of the Public Debt: A Requirement for Price Stability. NBER WP#5684.

[18] Woodford, M., 2000. Monetary Policy in a World without Money. International Finance 2(3): 229-260.

[19] Woodford, M., 2001. Monetary Policy in the Information Economy. NBER Working Paper 8674

[20] Woodford, M., 2012. Methods of Policy Accommodatin at the Interest Rate Lower Bound. In: The Changing Policy Landscape, Economic Policy Symposium Proceedings, Federal Reserve Bank of Kansas City, 185-288.

A Appendix

A.1 General Model

In this section, we describe the features of the general model used in the main text.

The representative household has the following objective function

$$\sum_{t=t_0}^{\infty} \beta^{t-t_0} \xi_t \left[U(C_t) + v\left(m_t\right) \right] \tag{A.1}$$

where C is final private consumption, ξ is an inter-temporal preference shock affecting the discount rate, and $m \equiv M/P$ denotes real money balances. Utility from consumption $U(\cdot)$ is increasing and concave, with $U_C(\cdot) > 0$ and $U_{CC}(\cdot) < 0$. Utility from real money balances is also increasing and concave, with $v_m(\cdot) \geq 0$ and $v_{mm}(\cdot) \leq 0$; to account for the zero-lower bound in the nominal interest rate, we assume the existence of a satiation level in real money balances $\bar{m}$, such that $v_m(m_t) = 0$ for $m_t \geq \bar{m}$.

The household's budget constraint is

$$P_t C_t + M_t + \frac{B_t + X_t}{1 + i_t} + Q_t D_t \leq P_t Y + M_{t-1} + B_{t-1} + X_{t-1} + (1 + \delta Q_t) D_{t-1} - T_t, \tag{A.2}$$

where Y is a constant endowment, M is nominal currency, B and X are nominal short-term bonds and central bank's reserves, respectively, both carrying the nominal interest rate i, D is long-term bonds, selling at nominal price Q and paying a geometrically decaying coupon δ, P is the price level and T are taxes levied by the Treasury.

Let λ_t the Lagrange multiplier on the budget constraint at time t, the first-order optimality conditions with respect to consumption and nominal currency are

$$\xi_t U_C(C_t) = \lambda_t P_t \tag{A.3}$$

and

$$\xi_t v_m(m_t)/P_t + \beta \lambda_{t+1} = \lambda_t. \tag{A.4}$$

First-order conditions with respect to B (or X) and D are, respectively

$$\beta(1 + i_t)\lambda_{t+1} = \lambda_t \tag{A.5}$$

and

$$\beta(1 + \delta Q_{t+1})\lambda_{t+1} = \lambda_t Q_t. \tag{A.6}$$

The above optimality conditions imply the Euler equation (1)

$$\xi_t U_c(C_t) = \beta(1+i_t)\frac{P_t}{P_{t+1}}\xi_{t+1}U_c(C_{t+1}) \tag{A.7}$$

the pricing equation for long-term bonds

$$Q_t = \beta\frac{P_t}{P_{t+1}}\frac{\xi_{t+1}U_c(C_{t+1})}{\xi_t U_c(C_t)}(1+\delta Q_{t+1}) \tag{A.8}$$

and the implicit money demand function

$$\frac{v_m(M_t/P_t)}{U_C(C_t)} = \frac{i_t}{1+i_t} \tag{A.9}$$

from which it follows that the liquidity-preference function L in equation (5) is

$$L(Y, i_t) \equiv v_m^{-1}\left(U_C(Y)\frac{i_t}{1+i_t}\right), \tag{A.10}$$

where we used the equilibrium in the goods market $C_t = Y$.