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Stimulus without debt in a severe recession

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Abstract

This paper simulates the impact in a calibrated small macroeconomic model of a policy that attempts to apply sufficient effective stimulus in a severe recession without increasing the government deficit or debt, or inflation. This stimulus- without-debt policy has two components: (1) a large standard fiscal stimulus; (2) a *non-standard* monetary stimulus—a large transfer from the central bank to the treasury of the same magnitude as the fiscal stimulus, offset by an equal cut in the central bank's open market purchases so that the bank's transfer to the treasury is *money-neutral*. According to the simulations, the policy would achieve prompt full recovery from the severe recession without generating any adverse effect on government debt as a percent of GDP or on the inflation rate in either the short run or long run. The difference between the stimulus-without-debt policy and alternative stimulus policies is explained.

Keywords: Stimulus; Recession; Debt

The limits of conventional macroeconomic policies in the 2008 Recession have been pointed out by many economists—for example, by the following participants in a *Journal of Policy Modeling* symposium: Blanchard (2010), Feldstein (2010), Stiglitz (2010), and Salvatore (2010). This paper analyzes and simulates a new policy to combat a future severe recession: "stimulus-without-debt."

In a severe recession, suppose the central bank wrote a large transfer check to the treasury (or to the treasuries of member states in the case of the European Central Bank). Legal authority for this transfer would have to be provided to permit this transfer in a particular jurisdiction. The large transfer would be offset by an equal cut in the central bank's open market purchases so that the bank's transfer to the treasury is *money-neutral*. In turn, suppose the treasury deposited the

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central bank's transfer check and used it to write a small $X cash transfer ("tax rebate") check to each household in the economy. The central bank's check would be a transfer, not a loan, to the treasury, and each $X treasury tax rebate check would be a transfer, not a loan, to each household. The treasury would not owe the central bank any future repayment of the transfer, and each household would not owe the treasury any future repayment of the $X tax rebate. If this were done, what would happen to the economy? By the end of this paper, we will offer an answer to this question. We will begin our paper, however, by analyzing the impact of combined fiscal and monetary stimulus in a severe recession.

1. Fiscal and monetary stimulus without debt

In a mild recession, adequate stimulus can usually be provided by standard monetary policy: the central bank writes checks to sellers of treasury bonds in the open market who deposit the checks in their banks. The banks then reduce interest rates enough to induce sufficient borrowing and spending of the deposited funds to cure the mild recession. In the deep pessimism and anxiety of a severe recession, however, standard monetary policy may be inadequate to achieve a full recovery because not enough borrowing and spending will occur even if interest rates are reduced to zero. But if a large standard fiscal stimulus – a tax cut and/or increase in government spending – is used to complement standard monetary stimulus, there may be a large short-run increase in the government deficit and debt. It is possible that the debt increase will be less than feared (DeLong & Summers, 2012; Seidman & Lewis, 2009). But fear of such an increase in the deficit and debt may limit public and political support for fiscal stimulus.

This paper analyzes the impact of a macroeconomic policy that attempts to apply sufficient effective stimulus in a severe recession without increasing the government deficit or debt. This "stimulus-without-debt" policy consists of two components (Seidman, 2013): (1) a large standard fiscal stimulus – in this paper we will use one example of a standard fiscal stimulus – tax rebates from the treasury to households—but our analysis would apply to any standard fiscal stimulus (cut in taxes or increase in government spending); (2) a non-standard monetary stimulus—a large transfer from the central bank to the treasury of the same magnitude as the fiscal stimulus, offset by an equal cut in the central bank's open market purchases so that the bank's transfer to the treasury is *money-neutral*. The central bank would make the decision about the amount of the transfer to the treasury in the same way that it makes decisions about the amount of bonds to purchase or sell under standard open market operations.

This paper owes a substantial debt to three papers that focus on policies to combat a recession: Seidman and Lewis (2002), and Ball (1999, 2006). Seidman and Lewis (2002) analyzed and simulated fiscal stimulus that generates government debt. By contrast, this paper analyzes and simulates fiscal stimulus that does not generate government debt due to a novel complementary monetary policy. Ball (2006), which extends his model in Ball (1999), also attempts to avoid a rise in government debt when fiscal stimulus is used to combat a severe recession. But our paper has two major differences from Ball's.

First, Ball shows that a money-financed fiscal stimulus would avoid the rise in government debt that occurs under a bond-financed fiscal stimulus *if* treasury bonds held by the central bank are *not* officially counted as government debt. But currently treasury bonds held by the central bank *are* usually counted as government debt, and there may well be significant resistance to excluding them from government debt. Our paper presents a policy that would avoid a rise in debt under fiscal stimulus while still counting treasury bonds held by the central bank as government debt. That policy, which Ball does not consider or discuss, is a non-standard monetary stimulus—a *money-neutral* transfer from the central bank to the treasury ("sterilized" by an equal cut in central bank open market purchases of bonds).

Second, our paper initially places the model in a steady state, providing a useful benchmark for all the simulations; to do this, we assume that the government maintains a *structural* deficit that is a constant percentage of nominal output. All simulations consist of the same one-year large negative shock to output and then an alternative policy response. In this model, along every policy path simulated, the economy returns to the initial steady state in the long run; in the steady-state, the ratio of government debt to nominal output stays constant. By contrast, Ball does not initially place his model in a steady state because he was trying to match the actual position of Japan's economy, so his paper does not provide a steady-state benchmark.

1.1. The stimulus policy

The public and political reaction to the 2008 Recession in economically advanced countries has clearly shown that public and political opposition to a large fiscal stimulus may either prevent enactment of any fiscal stimulus, or prevent enactment of a fiscal stimulus large enough to generate a strong recovery. Much of the opposition is based on concern that large deficits and debt that would be generated by a large fiscal stimulus.

Some of the opposition to a large fiscal stimulus is based on the belief that fiscal stimulus does not actually work—that it does not actually raise real output and employment. We agree with the assessment of Romer (2012) who writes (pp. 58–60):

> We have even stronger evidence that fiscal policy is effective than we did before the crisis. . .Fortunately, the crisis has sparked a great deal of work on the short-run effects of fiscal policy. . .Given this wide range of evidence – not to mention the large body of pre-crisis work on the effects of fiscal policy that I have not touched on – I think we should view the question of whether fiscal stimulus is effective as settled.

This paper, like Ball's (2006), uses one example of fiscal stimulus–cash transfers to households. Such transfers ("tax rebates") were found to be empirically effective in the U.S. by Parker, Souleles, Johnson, and McClelland (2013); claims that the 2008 rebate failed (Feldstein, 2009; Taylor, 2009) are refuted by Lewis and Seidman (2011).

In response to opposition based on concern about deficits and debt, several advocates of fiscal stimulus have recommended that treasury debt held by the central bank should not be officially counted as government debt and should not be viewed as government debt by the public or policy makers (Seidman, 2001, 2003; Ball, 2006). If this recommendation were accepted by policy makers, financial markets, and the public, then the central bank would be able to prevent a large fiscal stimulus from raising official government debt by purchasing, through its standard open market operations, an amount of treasury debt equal to the amount issued by the treasury to finance the fiscal stimulus. In defense of this recommendation, it can be argued that the central bank is an especially lenient creditor to the treasury because, for example, in the U.S. it usually returns to the treasury most of the interest it receives from the treasury on the treasury bonds it holds. By contrast, other holders of treasury debt (domestic and foreign businesses and households) are strict creditors that expect to be paid interest and principal on schedule.

In his paper, Ball (2006) assumes his recommendation that treasury debt held by the central bank should not be officially counted as government debt has been accepted. With this assumption, a "money-financed" fiscal stimulus (in which the central bank buys an amount of treasury bonds equal to the amount issued by the treasury to finance its fiscal stimulus) avoids the rise in debt caused by a “bond-financed” fiscal stimulus (in which the central bank does not buy treasury bonds in response to the fiscal stimulus).

However, policy makers, financial markets, and the public may insist on counting treasury bonds held by the central bank as official government debt, and may worry about the magnitude of this official government debt. After all, the treasury bonds that the central bank buys from the public might in the future be sold by the central bank to the public who would demand full payment on schedule.

This paper therefore presents another approach. In a severe recession, the central bank would give a *money-neutral* transfer to the treasury. *Money-neutral* means the central bank’s transfer would be offset (“sterilized”) by an equal cut in the central bank’s open market purchases so that the bank’s transfer to the treasury is *money-neutral*. The central bank would make the decision about the amount of the transfer to the treasury in the same way that it makes decisions about the amount of bonds to purchase or sell under standard open market operations.

Suppose the central bank decides to give a money-neutral transfer equal to the fiscal stimulus—the combined cut in taxes and/or increase in government spending. Then the treasury would receive revenue from the central bank equal to the fiscal stimulus. This revenue would be added to its tax revenue to give the total revenue received by the treasury. Therefore, the fiscal stimulus would not raise the official government deficit because of the additional revenue the treasury receives from the central bank. For example, in the U.S. note that when a state government receives a transfer from the federal government, the state government adds this transfer revenue to its tax revenue to obtain its total revenue which is compared to its total spending to obtain its official deficit. The same is true when a local government receives a transfer from its state government—the local government adds this transfer revenue to its tax revenue to give its total revenue which is compared to its total spending to obtain its official deficit. Under the policy presented here, it is the federal government – the treasury – that is the recipient of transfer revenue from the central bank.

Under this policy, no treasury bonds would be issued, so it would be clear that there was no increase in government debt. The official government debt would continue to count all treasury bonds held by the central bank, and this number would not increase when the fiscal stimulus is matched by an equal transfer from the central bank to the treasury.

1.2. The model

The model has these equations. The first two equations are the same as in Ball (2006). Eq. (1) is a dynamic IS curve:

$$\frac{\left(Y_t - Y_t^*\right)}{Y_t^*} = \lambda\left[\frac{\left(Y_{t-1} - Y_{t-1}^*\right)}{Y_{t-1}^*}\right] - \beta\left(r_{t-1} - r^*\right) + \delta\left(\frac{G_{t-1}}{Y_{t-1}^*}\right) + s_t, \tag{1}$$

where $(Y - Y^*)/Y^*$ is YGAP, the real output gap, Y is real output, Y^* is potential real output which is assumed to grow at the constant rate g^* per year; $r_t = i_t - \pi_t$; r^* is the “neutral” real interest rate (which we will assume is constant) because if r_{t-1} equals r^*, and if $G_{t-1} = 0$ and $s_t = 0$, then Y_t would equal $Y^*{}_t$ if last year’s Y_{t-1} had equaled $Y^*{}_{t-1}$; s_t is a “shock” to $(Y_t - Y^*{}_t)/Y^*{}_t$, and $\lambda > 0$, $\beta > 0$. Note that r is lagged one year, so that this year’s r_t or i_t has no effect on this year’s Y_t. G is the real (inflation-adjusted) transfer (“tax rebate”) from the treasury to households ($\delta > 0$); the nominal transfer is PG where P is the price level. Eq. (1) explains real output Y, so G, not PG, is the appropriate variable for this equation. Note that G is lagged one year so that this year's G_t has no effect on this year's Y_t.

Seidman and Lewis (2002) proposed and studied an automatic fiscal stimulus policy in which G would be varied every quarter with the output gap according to a formula pre-enacted by Congress. In that paper, the impact of fiscal stimulus in response to a recession shock was simulated using the macro- econometric model of Ray Fair. In this paper, we use a modification of Ball's (2006) transparent calibrated macro model to simulate the impact of the stimulus policy in response to a recession shock, but focus on the impact of a novel monetary component of the stimulus policy: a large transfer from the central bank to the treasury that complements the fiscal stimulus.

Eq. (2) is an accelerationist Phillips curve. The inflation rate π_t is determined by

$$\pi_t = \pi_t^e + \alpha \left[\frac{\left(Y_{t-1} - Y_{t-1}^*\right)}{Y_{t-1}^*} \right] \quad \text{where} \quad a > 0, \tag{2}$$

and $\pi^e{}_t$ equals π_{t-1} except when π_{t-1} is negative—in that case, $\pi^e{}_t$ is 0; thus, we assume that $\pi^e{}_t$ is never negative. Note, however, that π_t can be negative. Also, note that Y is lagged one year, so that this year's Y_t has no effect on this year's π_t. The price level at the end of year t, P_t, is given by

$$P_t = (1 + \pi_t)\, P_{\mathrm{t}-1}. \tag{3}$$

Note the lags: from (2), Y_{t-1} determines π_t which from (3) determines P_t. We assume the central bank chooses a *target* interest rate, $i^T{}_t$, that it will attempt to achieve in the actual economy in year t by adjusting M_t, the money supply in year t. Let potential output Y^* be the central bank's real output target and π^* be the central bank's inflation target. Then the central bank's nominal interest rate target $i^T{}_t$ is given by

$$i_t^T = r^* + \pi_t + a \left(\frac{\left(Y_t - Y_t^*\right)}{Y_t^*} \right) + b\left(\pi_t - \pi^*\right), \qquad a > 0, \quad b > 0, \tag{4}$$

except that if the right side of (4) is negative, then the central bank sets its target $i^T{}_t = 0$. Note that by moving π_t to the left side of (4), the right side of (4) would then give the central bank's real interest rate target. We assume r^* in (4) is the same as r^* in (1). With policy parameters a and b both positive, the central bank reduces its $i^T{}_t$ if Y_t falls below its target $Y^*{}_t$ and raises its $i^T{}_t$ if π_t rises above its target π^*. The central bank must then adjust M_t so that the actual interest rate i_t in the economy equals its target interest rate $i^T{}_t$. We assume the central bank succeeds in doing this each year. The actual interest rate in the economy, i_t, is determined by the supply and demand for money. Let M_t be the high-powered money supply (equivalently, the monetary base), which we will call simply "the money supply." The money supply M_t affects the interest rate i_t, and therefore the real interest rate r_t, which from (1) affects next year's Y_{t+1}, from (2) affects next year's π_{t+1}, and from (3), affects next year's price level P_{t+1}. Thus, due to lags, M_t has no effect on P_t or Y_t.

Like Ball (2006), we assume that money demand $M^D{}_t$ is given by

$$\ln\left(\frac{M_t^D}{P_t Y_t}\right) = k - \gamma i_t, \qquad \text{so} \quad \frac{M_t^D}{P_t Y_t} = \exp\left[k - \gamma\left(i_t\right)\right], \quad \text{where} \quad \gamma > 0 \quad \text{and} \quad i_t \geq 0. \tag{5}$$

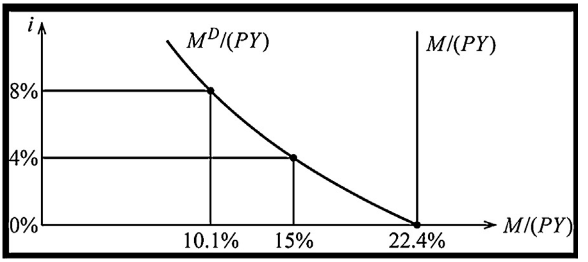

Fig. 1. Money demand and money supply.

In the standard diagram shown in Fig. 1 with i_t plotted vertically and $M^D{}_t/P_tY_t$ plotted horizontally, as i_t gets very large in (5), $M^D{}_t/P_tY_t$ approaches 0. Fig. 1 plots the $M^D{}_t/P_tY_t$ curve for $\gamma = 10$ and $k = -1.49712$: when $i_t = 4\%$, $M^D{}_t/P_tY_t = 15\%$, and when $i_t = 0\%$, $M^D{}_t/P_tY_t = 22.4\%$.

The *actual* interest rate i_t in the economy is determined in Fig. 1 by the intersection of the $M^D{}_t/P_tY_t$ curve and the vertical M_t/P_tY_t line where M_t is the high-powered money supply (the monetary base). Starting at $M_t/P_tY_t = 0$, as the central bank increases M_t/P_tY_t, the vertical M_t/P_tY_t line shifts right in Fig. 1 and the intersection i_t slides down the $M^D{}_t/P_tY_t$ curve. As long as the intersection i_t is still positive or zero, its value is given by

$$i_t = \left[k - \ln\left(\frac{M_t}{P_tY_t}\right)\right]/\gamma, \quad \text{if} \quad i_t \geq 0, \tag{6}$$

and the M_t/P_tY_t required to achieve that $i_t \geq 0$ is given by

$$\frac{M_t}{P_tY_t} = \exp\left[k - \gamma(i_t)\right], \quad \text{if} \quad i_t \geq 0. \tag{7}$$

Setting $i_t = 0$ in (7) yields the M_t/P_tY_t that makes $i_t = 0$: $M_t/P_tY_t = \exp[k]$. For any M_t/P_tY_t greater than this value, i_t will still be 0 because M_t/P_tY_t exceeds $M^D{}_t/P_tY_t$ but lenders will not lend at a negative i_t. We assume that when the central bank wants to achieve $i_t = 0$, it sets M_t/P_tY_t at the minimum value needed to achieve $i_t = 0$: $M_t/P_tY_t = \exp[k]$. For $k = -1.49712$, the central bank sets $M_t/P_tY_t = 22.4\%$ if it wants to achieve $i_t = 0$. Thus, the central bank adjusts the actual money supply M_t by open market operations to make the actual interest rate i_t in (6) equal its target interest rate $i^T{}_t$ in (4).

The high-powered money supply M_t can be increased in two ways (here we ignore the central bank's paying interest on bank reserves to banks which would also increase the high-powered money supply)**.** Let Z_t be the central bank's open market purchase of treasury bonds financed by an injection of high- powered money; and R_t be a transfer from the central bank to the treasury financed by an injection of high-powered money. Then

$$M_t = M_{t-1} + Z_t + R_t. \tag{8}$$

If the central bank follows interest rate rule (4), then (7) shows that it must set a particular M_t to achieve its target interest rate. This means that if it decides to give a transfer R_t to the treasury, then (8) implies that it must simultaneously offset it by an equal cut in central bank open market purchases Z_t so that the bank's transfer to the treasury is *money-neutral* so that it achieve its target M_t and therefore its target i_t (if the central bank pays interest on bank reserves to banks, which would also increase the high-powered money supply, then the central bank would sell more bonds in the open market to achieve its target M_t). Hence, any transfer the central bank gives to the treasury, as long as it adheres to its interest rate rule, would be *money-neutral*—offset ("sterilized") by an equal cut in central bank open market purchases. If necessary, the central bank can make Z_t negative (provided the central bank has a sufficient inventory of treasury bonds) to offset R_t.

Let F be the government budget deficit and B be treasury debt. Then:

$$B_t = B_{t-1} + F_t, \tag{9}$$

where F_t is given by

$$F_t = f_S P_t Y_t + \theta \left(P_t Y_t^* - P_t Y_t \right) + P_t G_t - R_t \tag{10}$$

The structural deficit is $f_S P_t Y_t$, where f_S is a policy parameter assumed to be held constant by policy makers in setting the budget each year so that the structural deficit equals a constant percentage of $P_t Y_t$. Note that in computing the structural deficit, interest payments are included in government expenditures, so it is assumed that policy makers adjust other expenditures and/or revenues in order to keep f_S constant regardless of the expenditure on interest payments.

The cyclical deficit is $\theta(P_t Y_t^* - P_t Y_t)$: when Y_t falls below Y_t^*, tax revenue drops automatically generating a cyclical deficit. The counter-cyclical fiscal stimulus – a transfer to households to combat recession – is $P_t G_t$, and the revenue received by the treasury due to a counter-cyclical transfer from the central bank is R_t. Dividing (10) by $P_t Y_t$ yields

$$\frac{F_t}{P_t Y_t} = f_S + \theta \left[\left(\frac{Y_t^*}{Y_t} \right) - 1 \right] + \frac{(P_t G_t - R_t)}{P_t Y_t}. \tag{11}$$

In any year when $G_t = 0$ and $R_t = 0$, Eq. (11) becomes $F_t/P_t Y_t = f_S + \theta[(Y_t^*/Y_t) - 1]$, so if the model converges to a steady state (after G_t is set at 0 and R_t is set at 0) so that $Y_t = Y_t^*$, then $F_t/P_t Y_t$ will converge to the constant f_S that is maintained by policy makers.

We follow the current official definition of government debt (B) that includes treasury bonds held by the central bank (B^c) as well as treasury bonds held by the public (B^p), so

$$B_t = B_t^c + B_t^p. \tag{12}$$

By contrast, Ball does not count treasury bonds held by the central bank as government debt.

We will compare two cases: "stimulus with debt" and "stimulus without debt." The stimulus is a "tax rebate"—a nominal cash transfer ($P_t G_t$) from the treasury to households. Then:

(1) Stimulus with debt: the central bank sets $R_t = 0$, so the stimulus $P_t G_t$ directly raises the deficit and debt by the amount $P_t G_t$. This generates the G path of the economy.
(2) Stimulus without debt: the central bank sets $R_t = P_t G_t$, so the treasury spends $P_t G_t$ but receives revenue equal to $P_t G_t$ from the central bank so there is no direct increase in the deficit or debt. This generates the GR path of the economy.

2. Simulation results

The numerical calibration of the parameters in each equation is given and discussed in detail in Appendix A. We choose reasonable numerical values of parameters based on the empirical literature and other studies that reference empirical literature. Our numerical parameter values are given in Table 1.

Table 1
Numerical values of parameters.

Eq. (1): $\beta = 0.33$, $\lambda = 0.8$, $\delta = 1.20$, $r^* = 2\%$. Y^* grows at rate $g^* = 2\%$
Eq. (2): $\alpha = 0.25$
Eq. (4): $a = 0.5$, $b = 0.5$, $r^* = 2\%$, $\pi^* = 2\%$
Eq. (5): $\gamma = 10$, $k = -1.49712$
Eq. (10): $\theta = 0.33$, $f_S = 3\%$

We simulate four paths of the economy. Under all four paths, in each year the central bank adjusts the money supply to achieve the nominal interest rate target prescribed by the Taylor rule given by (4) with $a = 0.5$, $b = 0.5$, $r^* = 2\%$, and $\pi^* = 2\%$ (Y^* grows at the constant rate $g^* = 2\%$). On all four paths the economy is in its steady state in year 1. A large negative real output shock occurs in year 2.

Base steady state (SS): there is no output shock.

Shock: a large negative output shock occurs in year 2.

Shock plus fiscal stimulus (G): a large negative output shock occurs in year 2 and fiscal stimulus is injected in year 2.

Shock plus fiscal stimulus plus central bank transfer (GR): a large negative output shock occurs in year 2, fiscal stimulus is injected in year 2, and the central bank provides a transfer to the treasury in year 2.

In Eq. (1), for the Shock, *G*, and GR paths, $s_2 = -7.5\%$ so the shock causes real output (Y_2) to be 7.5% below potential real output (Y^*_2) in year 2; at the trough of the 2008 Recession, actual real output was roughly 7.5% below potential real output. Then s_t is 0% for all t starting in year 3.

For all four paths we set these values for the following exogenous variables: g^*(growth rate of potential output Y^*) = 2%; r^*(neutral real interest rate) = 2%; π^*(central bank's target inflation rate) = 2%; $YGAP^*$ (central bank's target output gap) = 0%.

Fig. 2 contains the simulation results. In Fig. 2, there are 8 charts, one for each of the following eight variables: *YGAP*, *F/PY*, *B/PY*, *i*, π, *r*, *M/PY*, and *Z/PY*. Each chart shows the four simulation paths (SS, Shock, *G*, GR) of a single variable for 16 years.

Although the charts do not show paths beyond 16 years, in the long run every variable returns to its initial steady state value—the horizontal line in its chart.

2.1. Base path steady state

The numerical values of variables on the base path steady state are given in Table 2 (discussed further in Appendix A). In the absence of a shock, the model simulations maintain an initial steady state where the values of eight endogenous variables shown in the charts in Fig. 2 remain constant over time (horizontal lines in the chart).

2.2. Shock vs steady state

In year 1 the economy is in its steady state. The shock occurs only in year 2. In year 2, $s_2 = -7.5\%$ in Eq. (1) so the shock causes an output gap of −7.5%. In year 3, $s_3 = 0\%$, but because the lagged output gap term in Eq. (1) has a coefficient $\lambda = 0.8$, this term would cause an output gap of −6%. The output gap in year 3 is −5% rather than −6% because in year 2 the central bank, following the Taylor rule, sharply increases high-powered money M_t through a large jump in open

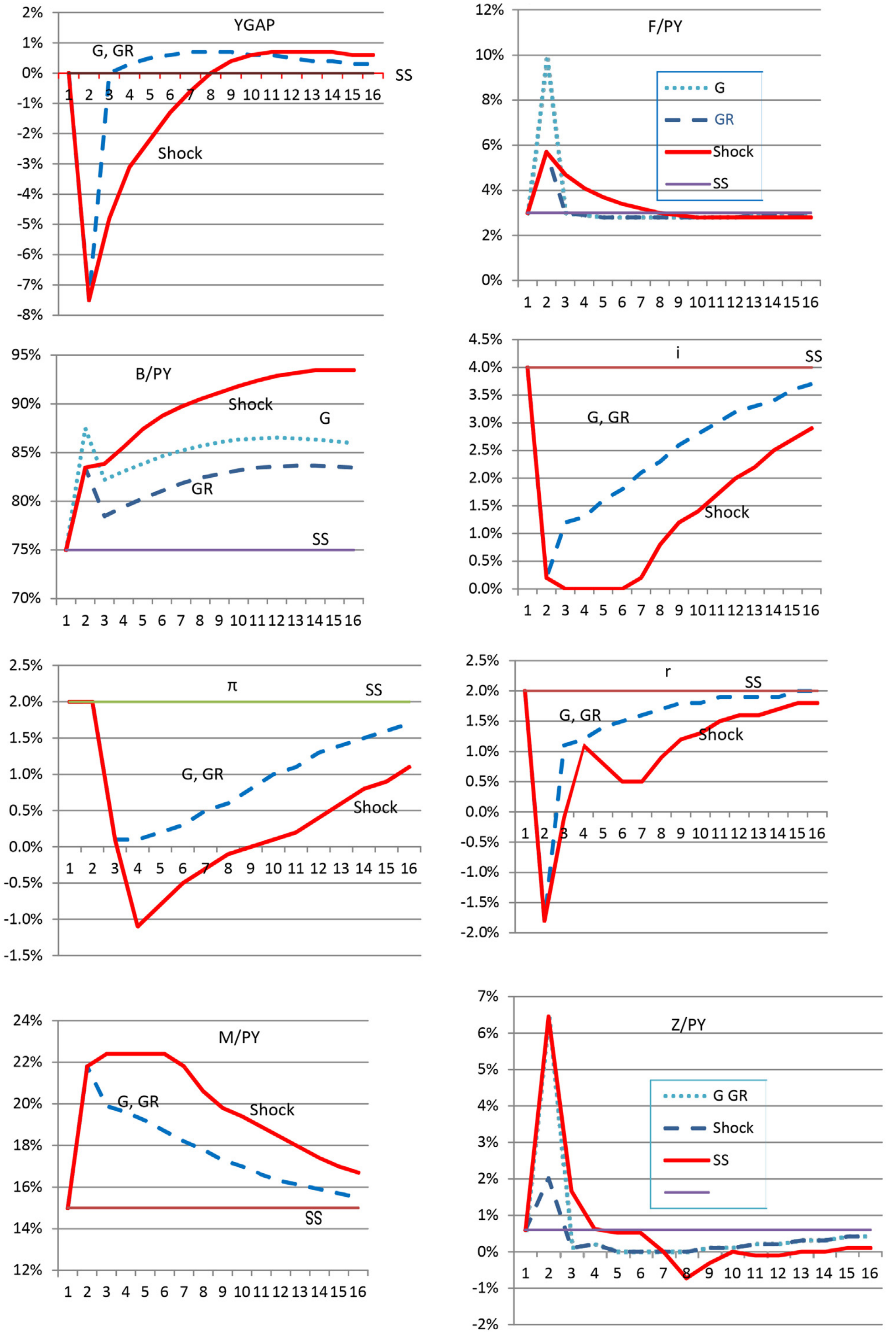

Fig. 2. Simulation results.

Table 2
Steady-state numerical values.

Steady-state values on base path (%)		Growth rate on base path (%)	
YGAP	0	*Y*	2
B/PY	75	*P*	2
F/PY	3	*PY*	4
F/B	4	*B*	4
i	4	*F*	4
π	2	*M*	4
r	2	*Z*	4
M/PY	15		
Z/PY	0.6		
Z/M	4		

YGAP is the output gap, *B/PY* is the debt as a percent of nominal output *F/PY* is the deficit as a percent of nominal output *F/B* is the deficit as a percent of the debt, *i* is the nominal interest rate, π is the inflation rate, *r* is the real interest rate, *M/PY* is money as a percent of nominal output, *Z/PY* is central bank open market bond purchases as a percent of nominal output, *Z/M* is central bank purchases of treasury bonds as a percent of the monetary base.

market purchases Z_t so that $i_2 = 0\%$ and $r_2 = -2\%$. Though the Taylor rule keeps the interest rate at 0% in years 3 and 4, the output gap is still −3% in year 4 and −2% in year 5. It is important to emphasize that when there is no fiscal stimulus, the Taylor rule requires the central bank to generate a large increase in the money supply through a large open market purchase of treasury bonds to achieve a sharp drop in the nominal interest rate to 0%.

The shock causes *F/PY* to jump from 3% to nearly 6% in year 2 due to the automatic drop in tax revenue reflected in the cyclical term in Eq. (10); consequently, *B/PY* jumps from 75% to 83%. Then *F/PY* slowly declines to its steady-state value while *B/PY* rises steadily over the next decade to a peak of 93% before gradually declining to its steady-state value.

2.3. *Fiscal stimulus vs shock*

The fiscal stimulus is injected only in year 2. Once again, following the Taylor rule, the central bank sharply increases high-powered money to reduce the interest rate to 0%. The magnitude of fiscal stimulus in year 2 is set so that it succeeds in making the output gap 0% in year 3; it turns out that *G* must be set about 4% of *Y* in year 2 to make the output gap 0% in year 3. Even though the fiscal stimulus occurs only in year 2 with a direct effect on the economy only in year 3, the strong effect of last year's output on this year's output in Eq. (1) keeps the output gap slightly above 0% for the next decade. Without fiscal stimulus, relying on Taylor's monetary policy, the output gap takes five years to decline gradually to 0%.

But in year 2, this fiscal stimulus *G* causes *F/PY* to jump to 10% from just under 6% under the shock itself. At the end of year 2, *B/PY* jumps to 88% with fiscal stimulus compared to 83% without it, so the deficit and debt are significantly higher (roughly 4 or 5 percentage points higher) in year 2 due to fiscal stimulus. Thus, fiscal stimulus would make the deficit and debt significantly higher in year 2, possibly inviting significant opposition to its implementation.

2.4. *Fiscal stimulus plus central bank transfer vs fiscal stimulus*

Suppose the same fiscal stimulus is implemented in year 2 but the central bank gives the treasury a transfer *R* of about 4% of *PY*, equal to the fiscal stimulus in year 2. Once again, following the

Taylor rule, the central bank wants to sharply increase high-powered money just enough to reduce the interest rate to 0%; but with money now injected into the economy through the transfer to the treasury, the central bank must cut its open market purchases of treasury bonds so that the money injected into the economy is exactly the same as it would have been without the transfer to the treasury. The transfer to the treasury substitutes for open market purchases in achieving the same target increase in high-powered money. As can be seen in the *Z*/*PY* chart, a cut of open market purchases in year 2 from slightly above 6% of PY on the *G* path to 2% of *PY* on the GR path would offset the transfer *R* of 4% of *PY* and keep *M*/*PY* the same on the *G* and GR paths.

Once again, the fiscal stimulus eliminates the output gap in year 3. But because the central bank transfer is revenue for the treasury, in year 2 *F*/*PY* is the same as with no fiscal stimulus – just under 6% – instead of 10% without the central bank transfer; and *B*/*PY* in year 2 is the same as with no fiscal stimulus – 83% – instead of 88% without the central bank transfer. As shown in the charts for *F*/*PY* and B/PY, the central bank transfer in year 2 avoids the sharp rise in *F*/*PY* and *B*/*PY* in year 2 that would otherwise result from fiscal stimulus in year 2. Moreover, for many years after year 2, *B*/*PY* remains lower along the GR path than along the *G* path.

What must be emphasized, as shown in the chart for *M*/*PY*, is that the path of money is *exactly the same* on the GR path (fiscal stimulus with the central bank transfer) as on the *G* path (fiscal stimulus without the central bank transfer). The reason is that on both paths the central bank adjusts the money supply to achieve the interest rate target prescribed by the Taylor rule, so when it injects money into the economy by giving a transfer to the treasury on the GR path it cuts its open market purchases by the same amount in order to keep its total injection of money the same—hence, the transfer is "money-neutral." As the π chart shows, inflation is also the same on the GR path as on the *G* path. In addition, *YGAP*, *i*, and *r*, are also the same on the GR and *G* paths.

Along the GR path, the central bank has more than enough treasury bonds in case it needs to sell bonds in the open market in order to raise the interest rate back toward its steady-state value as prescribed by the Taylor rule. As can be seen in the *Z*/*PY* chart, along the GR path, *Z*/*PY* never goes below 0% (actually, the printout shows that *Z*/*PY* is very slightly below 0% in two years, not visible in the chart, so tiny sales do occur in two years). As can be seen in the *B*/*PY* chart, treasury debt is initially 75% of *PY* (see Appendix A). Most treasury bonds are held by the public, but a portion are held by the central bank so if necessary, the central bank could easily handle the tiny sales in the simulation.

2.5. *Overall comparison of paths*

Compare the three paths (Shock, *G*, and GR) for each variable by looking at the chart for each variable. *YGAP* is promptly returned to 0% with *G* or GR in contrast to the Shock path on which monetary policy follows the Taylor rule without assistance from fiscal stimulus. The rise in year 2 in *F*/*PY* is no greater along the GR path than along the Shock path, while the rise in year 2 along the *G* path is much (about 4 percentage points) higher. Starting in year 3, *B*/*PY* is lowest along the GR path. Inflation (π) falls further below its target ($\pi^* = 2\%$) along the Shock path than along the identical *G* or GR path; in fact, there is some actual deflation ($\pi < 0$) for several years along the Shock path with the Taylor rule monetary stimulus but there is no deflation along the path with *G* or GR.

M/*PY* is higher along the Shock path than the *G* or GR path because more monetary stimulus is prescribed by the Taylor rule when output stays far below potential than when output returns quickly to potential due to fiscal stimulus. Under the Taylor rule policy, more money must be injected into the economy to try to reduce the output gap without help from fiscal stimulus, and more money must eventually be removed from the economy once the recovery gradually takes hold.

In the long run (not shown in the charts which show only through year 16) all three paths return to the same steady state values for all variables.

3. Policy discussion: Stimulus without debt vs alternative stimulus policies

We contrast the stimulus-without-debt plan with the following alternative stimulus plans: (1) Helicopter money; (2) Monetizing the debt; (3) Quantitative easing by the central bank; (4) Transfers from the central bank to households. Each will be considered in turn.

3.1. Helicopter money

The stimulus-without-debt plan should not be called "helicopter money." First, the central bank's check to the treasury is offset by a cut in the central bank's open market purchases of bonds or other assets below what the purchases otherwise would have been, so the central bank's check to the treasury has no effect on the money supply. The phrase "helicopter money" implies that the plan would cause the money supply to increase by more than it would have without the plan which is false.

Second, a crucial aspect of any practical stimulus plan is the exact details of how money is actually obtained by particular households. For example, in the U.S., the first component of the stimulus-without-debt plan proposed in this article is the enactment of a tax rebate by Congress instructing the U.S. Treasury, using its IRS data base of household taxpayers, to send tax rebate checks in dollar amounts specified by Congress through regular mail to households (as it actually did in 1975, 2001, and 2008). The second component of the plan is a transfer check from the Federal Reserve to the U.S. Treasury. Both components are practical, and analysis of the effects of the plan can focus on how the public would actually respond to the practical implementation of the two components.

In a discussion of practical stimulus plans, it is unhelpful to call any particular plan "helicopter money" because that phrase ignores whether there will be checks and balances between actual institutions in the practical implementation of the plan.

3.2. Monetizing the debt

The stimulus-without-debt plan proposed in this article does not involve "monetizing the debt" because it creates no debt to monetize: the treasury sells no bonds, and no additional treasury bonds are held by either the public or the central bank; the official government debt stays constant. By contrast, standard fiscal- monetary stimulus involves "monetizing the debt": the treasury sells bonds to the public, the central bank buys treasury bonds from the public, and official government debt increases.

3.3. Quantitative easing by the central bank

Under quantitative easing by the central bank, the central bank buys bonds in the open market and pays bond sellers with checks that the sellers deposit in their banks, thereby increasing bank reserves, which is expected to lead to a reduction in the interest rates that banks offer borrowers, thereby raising borrowing and spending by households and business firms, resulting in more production and employment. To work, quantitative easing must therefore induce households and businesses to incur more debt.

The stimulus-without-debt plan proposed here has the treasury mail cash transfers to households in order to raises households' ability to spend more without incurring more household debt. It is expected that households will use some of their rebate to pay down debt, some for saving, and some to increase their spending. Prior to the 2008 Recession, many households accumulated excessive debt, and the recession generated a deleveraging process in which many households gradually reduced their debt to normal—a process that was healthy for individual households and the economy. Quantitative easing tries to halt prematurely this deleveraging process and induce households to start accumulating debt. Such a premature accumulation of debt would not be healthy for households or the economy and is unlikely to succeed with many households who are determined to reduce their debt to normal. By contrast, cash transfers enable households to continue reducing their debt while increasing their spending.

3.4. Transfers from the central bank to households

Under central bank transfers to households, the central bank would give each household a transfer of a specific amount. Legal authority would have to be provided to permit the central bank to do this in a particular jurisdiction. The central bank would have to obtain the addresses of households – presumably from the tax collection agency – and would have to specify the dollar amount that would be sent to each household. Under the stimulus-without-debt plan, the central bank does not need to do this.

4. Conclusion

This paper simulated the impact in a calibrated small macroeconomic model of a policy that attempts to apply sufficient effective stimulus in a severe recession without increasing the government deficit or debt. In a severe recession, standard monetary policy may be inadequate to achieve a full recovery because of the zero bound on the nominal interest rate. But if a large standard fiscal stimulus – a tax cut and/or increase in government spending – is used to complement standard monetary stimulus, there may be a large short-run increase in the government deficit and debt, and fear of such an increase may limit public and political support for a sufficiently large fiscal stimulus. The stimulus-without-debt policy simulated in this paper consists of two components: (1) a large standard fiscal stimulus – in this paper we use one example of a standard fiscal stimulus – cash transfers ("tax rebates") from the treasury to households—but our analysis would apply to any standard fiscal stimulus (cut in taxes or increase in government spending); (2) a *non-standard* monetary stimulus—a large transfer from the central bank to the treasury of the same magnitude as the fiscal stimulus (legal authority would have to be provided to permit this transfer in a particular jurisdiction), offset by an equal cut in the central bank's open market purchases so that the bank's transfer to the treasury is *money-neutral*. The central bank would *not* be "monetizing debt" for two reasons: there would be no debt to monetize, and the money supply would not increase. According to the simulations, the policy would achieve prompt full recovery from the severe recession without generating any adverse effect on government debt as a percent of GDP or on the inflation rate in either the short run or long run. The difference between the stimulus-without-debt policy and several alternative stimulus policies is explained.

Appendix A.

A.1. Calibration of numerical parameter values

The time period for the model is a year. This Appendix A explains the numerical values assigned to parameters in each equation. We choose reasonable numerical values of parameters based on the empirical literature and other studies that reference empirical literature. Our numerical values for our parameters are given in Table 1 of the text.

Equation 1. Potential real output Y^* grows at the constant rate $g^* = 2$. The "neutral" real interest rate $r^* = 2\%$ (Ball assumed a steady-state value for r^* of 2%); if r_{t-1} equals r^*, then Y_t would equal Y^*_t if last year's Y_{t-1} had equaled Y^*_{t-1} (assuming $G_{t-1} = 0$ and $s_t = 0$). $\beta = 0.33$: Ball (1999, 2006) sets $\beta = 1.0$, based on regressions by Rudebusch (1995) with U.S. data for years when the economy was generally not in recession; we set a smaller β because we are focusing on the response of real output (Y) to the real interest rate (r) in a severe recession. $\lambda = 0.8$: Ball (1999) sets $\lambda = 0.8$ for the U.S. based on regressions by DeLong and Summers (1988), and Ball (2006) sets $\lambda = 0.6$ for Japan based on regressions with Japanese data by Kuttner and Posen (2001). $\delta = 1.20$: Ball (2006) sets $\delta = 1.25$ for Japan based on regressions by Kuttner and Posen (2001); Ball says Blanchard and Perotti (2002) find a value higher than 1.25 for the U.S.; for European countries during the Great Recession, the International Monetary Fund World Economic Outlook (2012, p. 41, Box 1.1) has a box that states, "So actual multiplier may be higher, in the range of 0.9 to 1.7," and Blanchard and Leigh (2013, p. 19) write: "If we put this together, and use the range of coefficients reported in our tables, this suggests that actual multipliers were substantially above 1 early in the crisis."

Equation 2. $\alpha = 0.25$: Ball (1999) sets $\alpha = 0.40$ for the U.S. based on regressions in Ball (1994, 2006) sets $\alpha = 0.20$ for Japan based on studies at the Bank of Japan such as Hirose and Kamada (2002).

Equation 4. $a = 0.5$, $b = 0.5$, $r^* = 2$, the target inflation rate $\pi^* = 2\%$, the target real output Y^* grows at rate $g^* = 2\%$ per year. These are the values of the parameters that Taylor originally (1993) recommended and recently (2013) recommended. We want to simulate what would happen if the central bank's interest rate rule follows the numerical values recommended by Taylor. Thus, we use Taylor's, not Ball's, numerical values.

Equation 5. $\gamma = 10$, $k = -1.49712$: Ball cites Fujiki, Hsiao, and Shen (2002), and Miyao (2002), in defending this functional form for money demand and the value of 10 for γ. Ball chose a value of k to fit Japanese data; he noted that "when the interest rate reached zero in 1998 the ratio of the monetary base to GDP was about 0.1. This implies $k = \ln(0.1)$ so that $k = -2.30259$. We set k to fit U.S. data. U.S. Council of Economic Advisers (2013), *Economic Report of President* data tables indicate that from 2008 to 2012 the ratio of high-powered money (monetary base) to nominal GDP (M/PY) in the U.S. averaged 15%, the yield on 30-year treasury bonds averaged 3.9%, and the yield on corporate bonds (Moody's Aaa) averaged 4.8%; with $\gamma = 10$, we computed the value of k that would make $M/PY = 15\%$ when $i = 4\%$; we obtained $k = -1.49712$.

Equation 9. Based on U.S. experience, we set these steady state values: $B/PY = 75\%$ and $F/PY = 3\%$.

Equation 10. $\theta = 0.33$: Ball (2006) used the cyclical deficit term $\theta(P_tY_t^* - P_tY_t)$ in his deficit equation. Based on Kuttner and Posen (2001), Ball set $\theta = 0.25$. According to a report from the U.S. Congressional Budget Office (2013), in 2009 at the trough of the Great Recession the real GDP gap was −6.8%, the federal deficit was 9.4% of GDP, and 2.3% of this 9.4% was due to automatic stabilizers so the ratio of the automatic-stabilizers deficit to the output gap was 2.3%/6.8% = 0.34 implying $\theta = 0.34$. We set $f_S = 3\%$ as a plausible, politically feasible target for the structural federal deficit as a percent of GDP.

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