COMMENT BY

GAUTI B. EGGERTSSON I like this paper by Gregory Mankiw and Matthew Weinzierl, and not only for presenting a simple and elegant model that is easy to follow. I also like the topic, which is optimal stabilization policy—in the classic "aggregate demand management" sense—using both monetary and fiscal policy instruments, with special consideration of what happens once the short-term nominal interest rate has fallen to zero. This is certainly a topic close to my heart: the very first paper I wrote in my career as an economist (Eggertsson 2001) was on this topic and relates quite closely to some of the results presented here.[1] That paper was written within what has now become known as the standard New Keynesian framework. Here I will contrast the results from that unpublished paper with those of this paper. Although this may seem a somewhat self-indulgent distraction, I hope to show that this exercise provides some additional insights, not only by underlining the generality of the current paper's results, which I think extend much beyond the two-period model the authors propose, but also by highlighting some important limitations.

Although the authors touch on many issues, I will focus on their suggested four lines of defense against large shocks, which I summarize below. To anticipate my conclusions: broadly speaking, I agree with the authors' characterization. What I will show is that the principles they lay out also generalize naturally to a standard New Keynesian framework, building on the earlier work cited above. In the process I want to emphasize various nuances that may appear a little less obvious in the authors' two-period model. What I take from these nuances is this: stabilization policy can be very difficult when the shock is large enough to lower the short-term interest rate to zero. In fact, my sense is that all four lines of defense have been penetrated in recent years in the United States, at the very least in the sense that the economy now looks far from its first-best state despite some recovery measures. My takeaway is that a better understanding is needed of both the political and the economic constraints imposed on stabilization policy.

To summarize the paper: Mankiw and Weinzierl articulate four lines of defense available to a policymaker in response to a shock to demand, and they arrange these in what they call a hierarchy of policy alternatives. The first line of defense is cutting the short-term nominal interest rate. The fact that the short-term nominal interest rate cannot be negative brings the authors

1. Somewhat embarrassingly, I never got around to submitting that paper anywhere, so it remains unpublished.

to the second line of defense, which is to cut long-term interest rates. If this path, too, is infeasible, then the authors suggest, as the third line of defense, variations in taxes to increase private spending. Finally, if all else fails, the authors propose government spending as a stimulus of last resort.

Mankiw and Weinzierl sketch out the basic battle plan within the context of a two-period model with perfect competition but where prices have been exogenously fixed in the first period. Before discussing the four lines of defense, I shall outline a simple alternative environment, where I want to put the results in context.

Consider an economy in which households live over an infinite horizon instead of only two periods. Assume that firms in this economy employ the members of these households and produce differentiated goods, which are then sold to the households. Finally, as the main twist in this environment, assume that prices are set at staggered intervals and that firms satisfy whatever demand prevails at these prices, thus bringing monetary nonneutrality into the model. Whereas Mankiw and Weinzierl assume rigid prices in the first period and fully flexible prices in the second, I follow here the more recent New Keynesian tradition in assuming, as does Guillermo Calvo (1983), that each firm sets a price for its output that is fixed for a stochastic number of periods. I will not go into the details of the model here (see, for example, Eggertsson 2001) but instead summarize the model in its linearized-quadratic form.

Let π_t denote inflation, $\hat{Y}_t$ the deviation of output as a fraction of its steady state, $\hat{G}_t$ the deviation of government spending from its steady state as a fraction of steady-state output, i_t the logarithm of 1 plus the short-term nominal interest rate, E_t an expectations operator, and r_t^e an exogenous disturbance term. The model can be summarized by the following two linear equations (the first from the household's optimal consumption decision and the second from the firm's pricing decision) and the zero bound on the short-term nominal interest rate:

$$\hat{Y}_t = \mathrm{E}_t\hat{Y}_{t+1} - \sigma\left(i_t - \mathrm{E}_t\pi_{t+1} - r_t^e\right) + \hat{G}_t - \mathrm{E}_t\hat{G}_{t+1} \tag{1}$$

$$\pi_t = \kappa\hat{Y}_t - \delta\kappa\hat{G}_t + \beta\mathrm{E}_t\pi_{t+1} \tag{2}$$

$$i \geq 0, \tag{3}$$

where the coefficients β and δ are between 0 and 1 and the coefficients κ and σ are positive.

Although I will not go into the details of the underlying microfoundations, I do want to highlight the underlying utility function of the representative household, and especially a second-order approximation of it. This will be helpful for understanding the results and deriving optimal policy. The household's utility is

$$E_t \sum_{t=0}^{\infty} \beta^t \psi_t \left[u(C_t) - w(G_t) - \int_0^1 v(h_t(i)) di \right],$$

where C_t is private consumption (a Dixit-Stiglitz aggregator of differentiated goods), G_t is public consumption, $h_t(i)$ is hours worked, β is a discount factor, and ψ_t is a shock that leads to variations in r_t^e (all functions satisfy standard properties). Eggertsson (2001) shows that a second-order expansion of this utility function gives[2]

$$-E_t \sum_{t=0}^{\infty} \beta^t \left[\pi_t^2 + \lambda_y \hat{Y}_t^2 + \lambda_G \hat{G}_t^2 \right], \tag{4}$$

where the coefficients λ_y and λ_G are greater than zero. Without further ado, let me now move to the first line of defense in the presence of a large adverse shock.

THE FIRST LINE OF DEFENSE: CUTTING SHORT-TERM INTEREST RATES. Consider the response of the government to a negative shock, $r_t^e < \bar{r}$ (where $\bar{r}$ is the steady-state value for r_t^e), which for simplicity is assumed to be independent and identically distributed (i.i.d.). One could interpret this exogenous disturbance term as the real interest rate in the first-best equilibrium (but with $\hat{G}_t = 0$, price rigidities can cause the equilibrium to move away from the first-best state). For simplicity, hold the future fixed at steady state so that $E_t \pi_{t+1} = E_t \hat{Y}_{t+1} = 0$. If the interest rate is held constant, this negative shock reduces $\hat{Y}_t$ by equation 1 and triggers deflation by equation 2. A quick review of equations 1 through 3 suggests, however, that the shock can be offset by cutting the nominal interest rate one for one; that is, $i_t = r_t^e$. Given this response, and moving to $\hat{G}_t$, the objective (expression 4) can then be maximized simply by setting $\hat{G}_t = 0$. In other words, the first line of defense should be one-for-one interest rate cuts to offset the shock, with government spending set at its optimal steady-state level (determined

2. For simplicity I expand the model around a first-best steady state. To achieve this steady state, one needs to achieve the first best by introducing subsidies that do away with monopoly distortions of the goods-producing firms.

by the steady relationship $\overline{u}_c = \overline{w}_G$; that is, fiscal policy is set according to what Mankiw and Weinzierl call "classical principles," where the marginal utility of public spending is equated to the marginal utility of private spending). By setting the instruments in this way, the government achieves the first-best allocation where $\hat{G}_t = \hat{Y}_t = \pi_t = 0$.

Some special conditions are required for this result to hold. But I think the gist of it is correct and that it applies quite broadly.[3] It seems rather natural to me to respond to temporary variations in the "efficient rate of interest" by varying the nominal interest rate, rather than by changing the size of the government over the business cycle. In the model above, this result holds for a variety of shocks, be they shocks to preferences or productivity shocks. It is also irrelevant here that r_t^e was assumed to be i.i.d. in the example above; the result extends to a general stochastic process for r_t^e. Clearly, however, the first line of defense fails when the shock is large enough so that $r_t^e < 0$, as this would violate the zero bound on the short-term nominal interest rate.

THE SECOND LINE OF DEFENSE: CUTTING LONG-TERM INTEREST RATES. Although the first line of defense is identical in the standard New Keynesian model and in the current paper, some differences start to emerge when the second line of defense is considered, and this is one reason why it is worth contrasting these two models. Mankiw and Weinzierl argue that once the zero bound on the short-term interest rate is binding, the natural thing to do next is to reduce long-term rates in both models. As stressed in Eggertsson and Michael Woodford (2003), this policy is identical to making a commitment about lowering future short-term rates, since long-term rates in the model are equal to the average of current and future short-term rates. Within the context of the model the authors present, there is no reason to doubt that the government can—and should—do this. In the New Keynesian model, however, the limitations of this approach become a bit clearer. Why? Because there is an inherent credibility problem with the government committing to low future short-term rates in the model above. This credibility problem results from the fact that prices are set at staggered intervals, as opposed to just once, one period in advance, as in Mankiw and Weinzierl's paper, and this implies that the welfare function (expression 4) penalizes actual inflation.

Consider a policy that maximizes the objective in expression 4 subject to the constraints laid out in equations 1 through 3. Consider now a shock

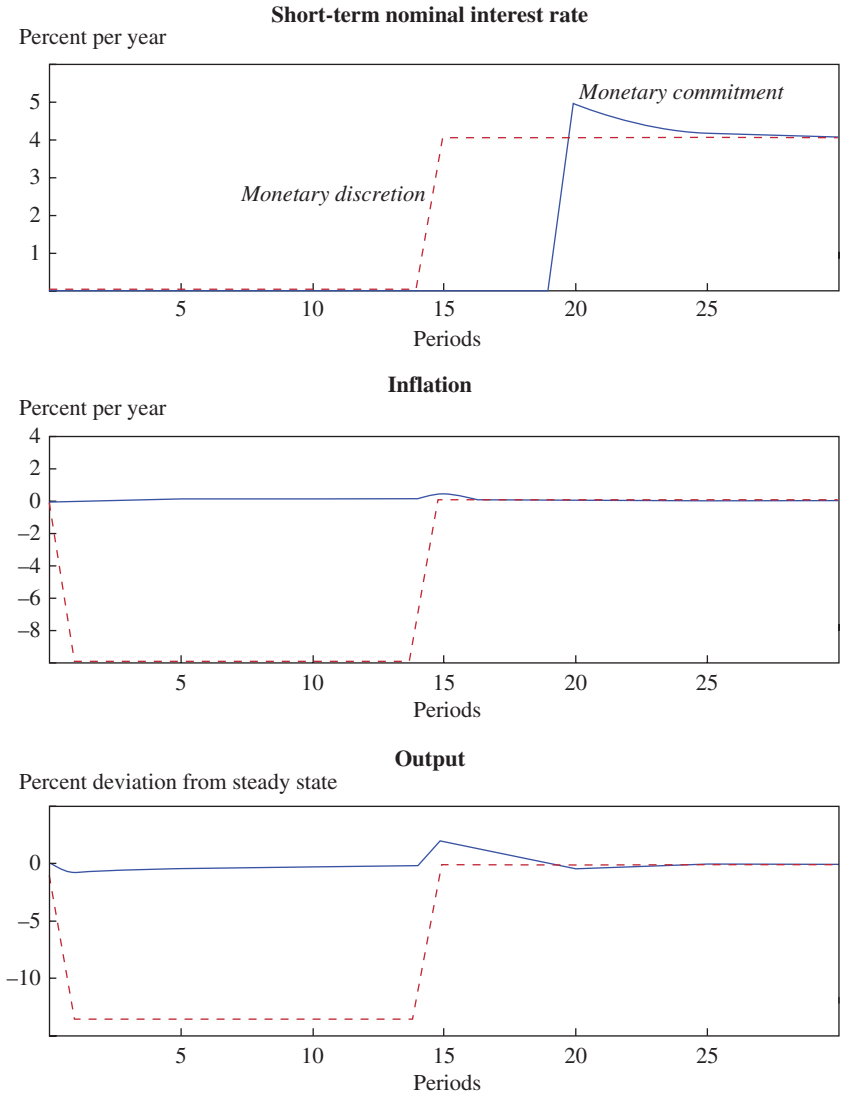
3. Most importantly here, I have assumed steady-state subsidies that do away with the distortions associated with monopoly. If those were kept in place, we would be in the world of second-best, with an inefficient steady state, and the logic would be a bit more complicated.

$r_t^e = r_L^e < 0$ in period 0 that reverts to a steady state of $r_t^e = \overline{r} > 0$ with probability μ in every period. This is the problem studied in Eggertsson (2001) and in Eggertsson and Woodford (2003). My figure 1 illustrates the optimal commitment by showing the behavior of the endogenous variables for one particular realization of r_t^e, namely, when it reverts to steady state in period 15, taken from Eggertsson and Woodford (2003). As can be seen, the optimal commitment in the New Keynesian model is to commit to a future output boom and inflation once the shock is over, in order to reduce the output contraction and deflation at the time of the shock. The central bank achieves this, as can be seen in the top panel, by committing to keeping the short-term nominal interest rate at zero for several periods after the economy has reverted to steady state. If the government is a discretionary policymaker, however, this is not credible. Why? Simply because the government has an incentive to renege on its promise to allow inflation and an output boom once the shock is over. At that time it can achieve zero inflation and a zero output gap going forward, and thus achieve the first-best state from that time on, whereas the commitment equilibrium implies a welfare loss at that time (which the government is willing to incur in order to get a better outcome while trapped). The dashed line in figure 1 shows the optimal policy under discretion, where the government is unable to make any commitments about future nominal short-term rates, and as the figure reveals, this outcome is highly suboptimal.

When I first studied this credibility problem as a graduate student, I liked to refer to it as an application of "the fable of the fox and the lion." A lion falls into a deep trap and cannot get out. A fox passes by, and the lion promises the fox that it will hunt any other animal in the forest and give it to the fox for dinner, if the fox will help it out of the trap. The fox, however, understands that once it has saved the lion, the lion has no incentive to fulfill its promise and instead, being quite hungry after sitting for so long in the trap, will eat the fox for dinner. The result, then, is that the fox walks on its merry way, while the lion starves to death, unable to credibly commit to the future action that would save it. In this example, as with the central bank in the liquidity trap, the problem is attenuated by the fact that getting oneself in a trap is a relatively rare event, so that it is difficult to establish a reputation for dealing with it as promised. Moreover, the solution involves promising things in the future that are not consistent with how the lion (or the central bank) has behaved in the past, and at the time the promise is made, no particular action is required, only words.

In summary, the New Keynesian model confirms the second line of defense proposed by Mankiw and Weinzierl but adds the wrinkle that it

Figure 1. Optimal Monetary Policy under Commitment and under Discretion in the New Keynesian Model



Source: Eggertsson and Woodford (2003), p. 180.

involves a relatively serious credibility problem for policymakers. This leads to the third line of defense.

THE THIRD LINE OF DEFENSE: CHANGING SPENDING INCENTIVES THROUGH TAXES. The third line of defense is to use tax incentives to increase private spending. The authors here mostly discuss how tax changes can affect private investment. It might be useful to clarify this logic within the context of the framework presented above, where I have in fact abstracted from investment altogether. In principle, there is nothing special here about investment. The problem in a liquidity trap is a collapse in private spending, and thus any component of spending—investment or consumption—can in principle be increased to offset it.

Let us add to the model above a tax on consumption τ^c (which is levied exclusive of the posted sticky price) and a tax on labor τ^w. In this case equations 1 and 2 become

$$\hat{Y}_t = \mathrm{E}_t \hat{Y}_{t+1} - \sigma\left(i_t - \mathrm{E}_t \pi_{t+1} - r_t^e\right) - \mathrm{E}_t\left(\hat{\tau}_t^c - \mathrm{E}_t \hat{\tau}_{t+1}^c\right) \tag{5}$$

$$\pi_t = \kappa \hat{Y}_t + \beta \mathrm{E}_t \pi_{t+1} + \kappa\left(\hat{\tau}_t^c + \hat{\tau}_t^w\right) \tag{6}$$

Interestingly, as discussed in Eggertsson and Woodford (2006), this extension does not change the second-order approximation of utility in expression 4. What this extension shows is that the first-best solution can now be implemented by cutting sales taxes in response to the shock, while simultaneously increasing labor taxes. In particular, as pointed out by Eggertsson and Woodford (2006), if the tax instruments above are available to the government, the first-best equilibrium can be replicated by setting taxes as follows:

$$\hat{\tau}_t^s = \sum_{T=t}^{\infty} \mathrm{E}_t\left[r_T^e - \bar{r}\right].$$

$$\hat{\tau}_t^w = -\hat{\tau}_t^s$$

The intuition for this result is simple. The problem once the zero bound is binding is that there is not enough private spending. It is exactly for that reason that nominal interest rate cuts are helpful: they make spending today cheaper relative to spending tomorrow. When interest rate cuts are no longer feasible, the incentive to spend today rather than in the future can instead be created by reducing the sales tax. This, however, has an additional effect: it gives people the incentive to work more today, thus triggering deflationary pressures by reducing real wages and so reducing the marginal costs faced by firms. It is to offset this deflationary effect that

an increase in labor taxes is also called for: this works in an inflationary direction, thus replicating the first-best state. As a side benefit, the policy is deficit neutral. The result that Mankiw and Weinzierl derive is similar to this one, except that they focus on how the government can affect another component of private spending, namely, investment.[4]

The first point I want to emphasize in this context is that using tax incentives in this way is perfectly consistent with old-style Keynesian economics: it was, for example, a theme in an early Brookings Paper by Franco Modigliani and Charles Steindel (1977). In this respect there is nothing unconventional about this policy. Tax incentives here work mainly by increasing aggregate spending. The more substantive issue, I suspect, is that some important limitations on variations in taxes are likely to make this third line of defense insufficient.

With respect to the simple example from Eggertsson and Woodford (2006), for example, the political and physical constraints are somewhat obvious in the U.S. context. Sales taxes are levied at the state level, and hence a coordinated temporary cut would be challenging. Moreover, as a practical matter, there may also be a zero bound on sales taxes: it is difficult to imagine a negative sales tax (that is, a subsidy on consumption goods), since people could then profit from buying and selling the same items over and over. Are there any limits on investment tax credits as a solution to an economy-wide demand contraction? My conjecture is that the answer is yes. To start with, these credits are most commonly implemented by allowing firms to deduct investment expenditures from taxes paid on profits. In a deep recession, however, profits may be low or nonexistent, thus blunting the impact of the credit. In theory, of course, one can imagine many ways to get around this, but as a practical matter it may not be so simple. Moreover, investment spending is usually financed with money borrowed from banks. The collapse in investment during a crisis is usually due in part to the fact that the interest rate at which firms can borrow becomes very high, even if the risk-free interest rate falls to zero. This increase in spreads may be prohibitively large, because of both default risk and a liquidity premium, and thus even a very aggressive tax credit may not stimulate investment enough to stabilize the economy.

Yet another limitation of investment tax credits is worth mentioning. In the authors' model, the economy is depressed in the first period but is assumed to return to full employment in the second. Investment in the first

4. Correia and others (2011) show how the result above extends to the fully nonlinear model and how it applies once investment is introduced in the model.

period is then useful in the second period, when the economy is operating at capacity. In a depression, however, the investment decisions facing firms may be quite different from those in normal times. In particular, one can imagine that in many cases the firms making the investments anticipate that the recession will still be in full swing by the time the invested capital can be used for production. In an economy that is expected to be operating below capacity for some time, then, it might be difficult to give firms strong enough incentives to invest.[5]

To sum up, it seems far from clear at the moment that the U.S. tax system is flexible enough to eliminate a large contraction in demand. This leads to the fourth and last line of defense.

THE FOURTH LINE OF DEFENSE: GOVERNMENT SPENDING. In discussing this last line of defense, rather than study isolated experiments, it might be interesting to explain what the fully optimal government spending profile looks like when no other fiscal instruments are available for stabilization apart from the nominal interest rate (hence taxes are lump sum). I find this helpful to give further insight into how this policy might work in this class of models. I think it also clarifies some important advantages of fiscal policy over monetary policy, in that it is less subject to the dynamic inconsistency problem illustrated in the fable about the fox and the lion.

The optimal fiscal policy under commitment can be found by maximizing expression 4 subject to equations 1 through 3. This gives rise to the following first-order conditions:

$$\pi_t + \psi_{2t} - \psi_{2t} - \beta^{-1}\sigma\psi_{1t-1} = 0 \tag{7}$$

$$\lambda_Y \hat{Y}_t + \psi_{1t} - \beta^{-1}\psi_{1t-1} - \kappa\psi_{2t} = 0 \tag{8}$$

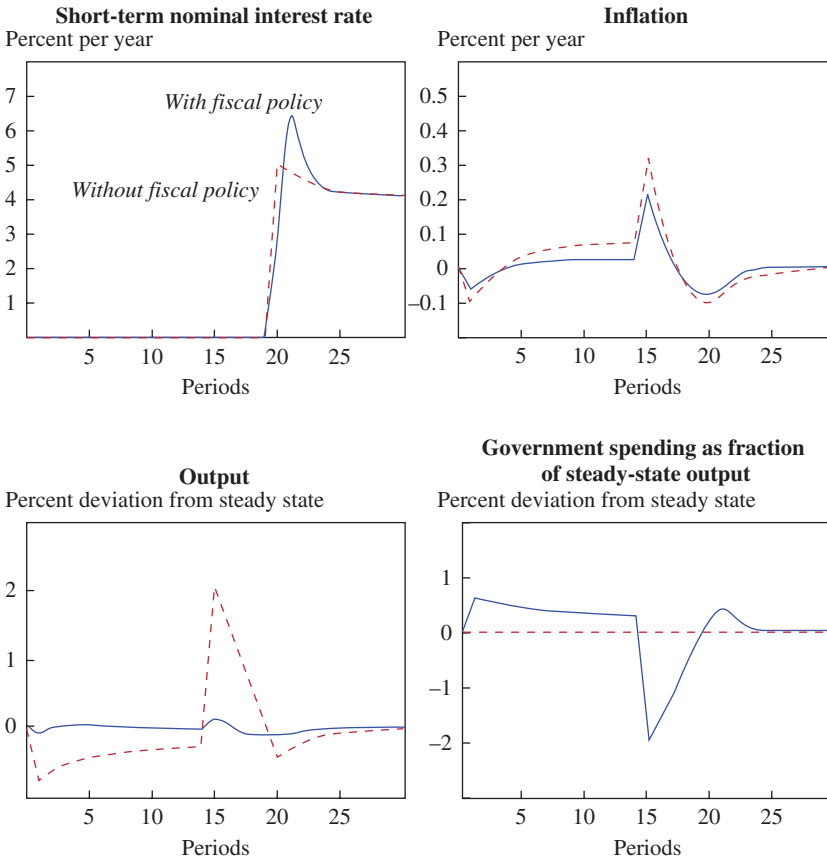
$$\lambda_G \hat{G}_t - \psi_{1t} + \beta^{-1}\psi_{1t-1} - \psi_{2t}\delta\kappa = 0 \tag{9}$$

$$\psi_{1t} \geq 0, i \geq 0, \psi_{1t} i_t = 0, \tag{10}$$

where ψ_1 and ψ_2 are the Lagrange multipliers associated with each constraint as in Eggertsson and Woodford (2003), and the last set of conditions are the complementary slackness conditions. This is a natural generalization of that paper, extended to include government spending, but spending is determined by the first-order condition in equation 9.

5. Eggertsson (2011) studies the effect of investment credits in an economy where the zero bound is binding for several periods. The result suggests that, despite the possibility of multiple-period recessions, this policy can still be quite effective at increasing demand.

Figure 2. Optimal Monetary and Fiscal Policy under Commitment Compared with Use of Monetary Policy Only



Source: Author's model described in the text.

Figure 2 shows the optimal commitment when the government can use both interest rates and government spending to stabilize output in response to a negative shock $r_L^e < 0$ that reverts to steady state with 10 percent probability in each period. The figure shows the contingency in the case where the shock reverts to steady state in period 15. The calibration is the same as in Eggertsson and Woodford (2003), except that it allows for government spending corresponding to 20 percent of output in steady state.[6]

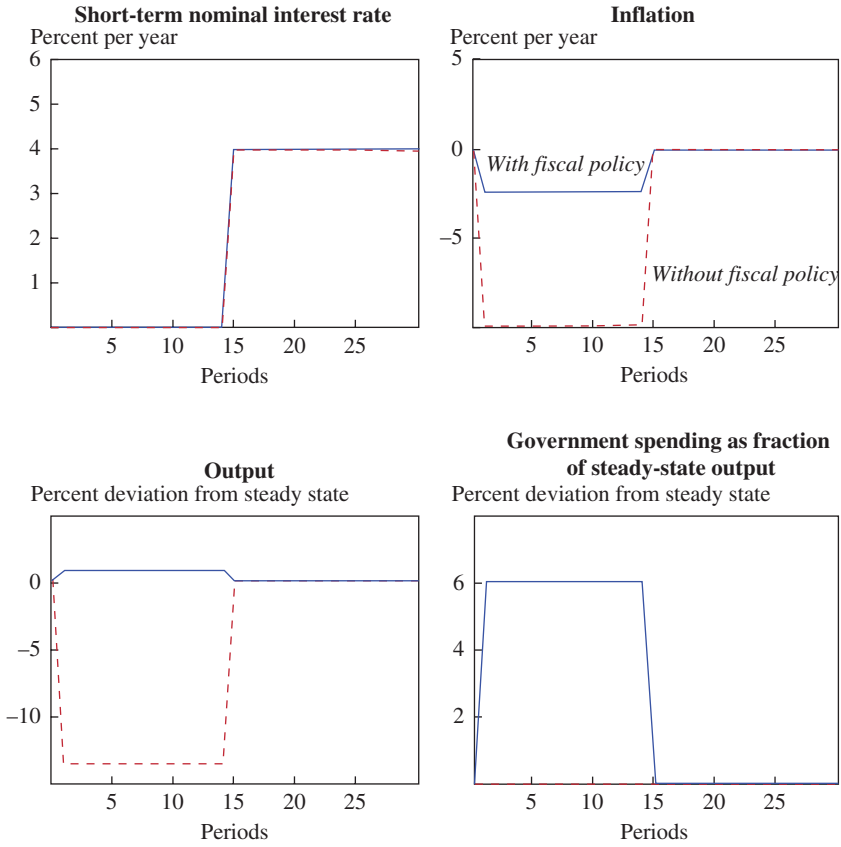
6. Here $\kappa = 0.02$, $\sigma = 0.5$, $\beta = 0.99$, $r_L^e = -0.02/4$, $\delta = 2/3$, $\mu = 0.1$, $\lambda_y = 0.0025$, $\lambda_G = 0.000329$, and $\bar{G}/\bar{Y} = 0.2$.

As the figure reveals, optimal government spending policy in this case is to not only increase spending during the period of the shock, but also to commit to contracting spending once the economy has recovered. The intuition for this result is as follows. As equation 1 shows, demand can be increased either by increasing government consumption today or by committing to reduce the size of the government in the future. The increase in government spending today increases aggregate demand today directly through the aggregate resource constraint ($Y = C + G$). The commitment to reduce the size of the government in the future, however, works somewhat differently. It stimulates aggregate spending today by stimulating private consumption today. Why does cutting future government spending increase consumption today? Because the anticipation of a smaller government in the future leaves more room for private consumption in the future; that is, it increases future income and consumption. This, in turn, works to increase current consumption, as consumers try to smooth consumption over time, and the higher future income and consumption thus stimulate current consumption according to the consumption Euler equation. The figure suggests, perhaps somewhat surprisingly, that this second effect is the more important of the two under the optimal commitment in this numerical example.[7]

Committing to a smaller government in the future once the shocks have subsided suffers from the same problem as the optimal monetary commitment: it is not credible. The government has an incentive to promise a future retrenchment and then renege on the promise, setting the size of government at its first-best level as soon as the adverse shock has subsided. This is shown in figure 3, which illustrates the optimal policy under discretion. As the figure reveals, as soon as the shock is over, the government will keep spending at its steady-state optimal level. Meanwhile, government spending is not subject to any zero bound during the period of the shock. This makes all the difference. We see that because of this, government spending increases quite dramatically, thus eliminating the disastrous outcome that occurs if the government uses monetary policy alone. The government increases its spending by about 6 percent and as a result eliminates the drop in output (which was about 14 percent), suggesting a "multiplier" of more than 2: every dollar

7. There is a bit of a difference between the standard New Keynesian model and Mankiw and Weinzierl's paper here, as in their case a permanent increase in government spending is also expansionary. I will not dwell on this difference since I suspect it is a relatively special feature of their model, which has only capital as a factor of production.

Figure 3. Optimal Monetary and Fiscal Policy under Discretion Compared with Use of Monetary Policy Only



Source: Author's model described in the text.

spent in the recessionary state creates more than 2 dollars of output in that state.

CONCLUSION. The way I think of multipliers is as a comparative statistic. A multiplier indicates what happens to y if x is increased, holding everything else constant. This can make sense only within the context of specific examples where such comparisons are meaningful. The authors argue that those statistics can be misleading if one wants to make welfare comparisons. A policy with a low multiplier is not necessarily better than one with a high multiplier. This is certainly correct, as Mankiw and Weinzierl's numerical examples illustrate. Nevertheless, I think the best that policy

can do at the moment is, first, to identify clearly what the problem is, and second, to identify in broad-brush terms what can be done about it. With respect to certain policies, I think the best one can do at the moment is to simply identify the basic directions of their effects. Does increasing government spending in the short run help? What about increasing government spending in the long run? What about a variety of tax cuts? What should be the role of a balanced budget in the short, medium, and long run? Unfortunately, I think the economy is still so far from its first-best state, and our understanding of policy is so weak, that we need to be content with finding these basic signs. And here I think multipliers can be helpful summary statistics that can get quite close to the heart of the matter. After all, as the authors (citing Arthur Okun) remind us, it takes a lot of Harberger triangles to fill an Okun's gap.

My overall impression about the policy debate during this episode is that it has not been so much about whether to use tax credits or government spending to increase demand, or whether committing to some degree of inflation would have helped. Instead, it seems to me, the debate has been about whether "aggregate demand management" is a useful concept in the first place. Hence, perhaps the debate has not been as focused as it should have been on how exactly aggregate demand should be increased. This paper is a step in that direction, and I think it is the right step. At this stage, I think it is of considerable value to illuminate the basic forces at work. Much remains to be learned about the details of the tax code before we can claim to fully understand demand management.

REFERENCES FOR THE EGGERTSSON COMMENT

Calvo, Guillermo A. 1983. "Staggered Prices in a Utility-Maximizing Framework." *Journal of Monetary Economics* 12, no. 3: 383–98.

Eggertsson, Gauti. 2001. "Real Government Spending in a Liquidity Trap." Princeton University. www.newyorkfed.org/research/economists/eggertsson/JMP2.pdf.

———. 2011. "What Fiscal Policy is Effective at Zero Interest Rates?" In *NBER Macroeconomic Annual.* MIT Press.

Eggertsson, Gauti B., and Michael Woodford. 2003. "The Zero Bound on Interest Rates and Optimal Monetary Policy." *BPEA,* no. 1: 139–211.

———. 2006. "Optimal Monetary and Fiscal Policy in a Liquidity Trap." In *NBER International Seminar on Macroeconomics 2004,* edited by Richard H. Clarida, Jeffrey Frankel, Francesco Giavazzi, and Kenneth D. West. MIT Press.

Modigliani, Franco, and Charles Steindel. 1977. "Is a Tax Rebate an Effective Tool for Stabilization Policy?" *BPEA,* no. 1: 175–203.