A comment on Casey Mulligan's test of the Paradox of Toil

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– preliminary –

Abstract

This note studies Casey Mulligan's empirical test of the paradox of toil. Mulligan proposes that one can test it by checking if an increase in labor supply, due to seasonal factors, reduced output in 2009. This note shows that in the context of the standard New Keynesian model this test is invalid. The note also discusses two other tests proposed by Mulligan and suggests that they do not resolve the controversy.

Recently I proposed a new paradox in macroeconomics called the "Paradox of Toil" (Eggertsson 2010a). The paradox is as follows: Suppose everybody suddenly starts working more. Then, under some special conditions, this leads aggregate employment to fall. Thus while the old Keynesian paradox of thrift was that if everybody started saving more, there will be less savings in the aggregate, the paradox of toil is that if everybody tries to work more, there will be less work in the aggregate.

The conditions under which the paradox applies are quite special. In particular one needs the sudden increase in people's willingness to work to be "in response" to an "intertemporal disturbance" which leads the nominal interest rate to collapse to zero (e.g. due to a banking crisis). This would perhaps just be a theoretical curiosity, except for that this is precisely the economic circumstance of the crisis of 2008 (when interest rate collapse to zero in the US, triggered by a financial crisis). Furthermore, the main goal of many "stimulus plan proposals" was to create incentives for people work more in response to this shock (see Eggertsson (2010b) for references). The paper I wrote on the Paradox of Toil, and related work, clarifies that the shock "suppose everybody want's to work more in response to intertemporal shock" shows up in just the same way as a pay-roll tax cuts and other policies aimed at increasing factor supply. The key point of the paradox (and this, of course, was also Keynes' point by proposing the paradox of thrift) is that economic policy – once the nominal interest rate hits zero – should aim at increasing aggregate demand. Increasing aggregate supply is at best irrelevant, but can even have subtle counterintuitive effects. Higher short-run supply may create deflationary expectations and increase the real interest rate. This lowers aggregate demand, since aggregate demand depends on the real interest rate.

Recently Casey Mulligan (2010) proposes some interesting indirect tests of the paradox of toil (he also suggests that these tests cast doubt on recent papers by Woodford (2010) and Christiano, Eichenbaum and Rebelo (2009)). Mulligan suggests that one simply needs to check how the economy reacts to exogenous variations in labor supply during the crisis of 2008 when the interest rate hit zero. Many teenagers, for example, storm into the labor market when schools close at the end of May, while returning back to school in September. Shouldn't the paradox of toil predict, then, that employment falls during the summertime due to this increase in aggregate supply? Mulligan shows data suggesting otherwise, i.e., employment actually increased during the summer months of 2009 when people wanted to work more. His interpretation of this data is that it says that the paradox of toil is not really a paradox. Indeed, it's probably just an artifact of a misspecified model.

As I suggest in the original paper (Eggertsson (2010a)), one of the purposes of posing the paradox of toil, was indeed to establish a counterintuitive result from New Keynesian theory that could be refuted by the data. Any good theory needs to be refutable. While the model I illustrated in the original paper is quite special, I suggested in the discussion that the paradox is likely to arise in pretty much *any* model that features nominal rigidities, i.e. models that rely on staggered *nominal* price setting (in line with a vast body of empirical evidence).

The paradox relies on only two basic premises: 1) that aggregate demand depends on the real interest rate (i.e. the difference between the nominal interest rate, which is constrained at zero, and *expected* inflation) and 2) that inflation depends on current and future *marginal costs*. Marginal costs, in turn depend on aggregate supply in most reasonable environments. A shift in aggregate supply reduces current and future marginal costs, and thus *reduces expected inflation*. This raises the real rate and contracts demand. Mulligan's proposed test may thus be an important test for New Keynesian models *in general* and requires careful study.

This note illustrates that Mulligan's empirical test is not a test of the paradox of toil, and therefore, unlikely to pose a challenge to New Keynesian theory in general, or the paradox in particular. New Keynesian theory does not predict that static changes is the labor supply, which are reversed in the next quarter (e.g. such as seasonal variations in the labor force) have a contractionary effect, even at zero interest rates. Instead, at worst, one time short-run supply shifts are predicted to be irrelevant. What the theory suggests, however, is that a policy is contractionary if it is aimed at increasing labor supply in the *short-run*, that is, in all states of he world in which there is a negative "banking" crisis. What is missing in Mulligan's proposed static one time change in the labor supply, is that is has no effect *on expectations of future marginal costs*. Because demand depends on the difference between the nominal interest rate an *expected inflation*, and static one-time variations in supply have no effect on expected future marginal costs, this means that they do not change inflation expectations, and thus by implication, do not change the real interest rate or aggregate demand.

Here I extend the model in Eggertsson (2010a,b) to incorporate a one-time change in labor supply. The model consists of an AD equation (derived from the consumption Euler equation together with the resource constraint), and the AS equation (derived from the firms pricing problem), see the work cited above for derivation,

$$\hat{Y}_t = E_t\hat{Y}_{t+1} - \sigma(i_t - E_t\pi_{t+1} - r_t^e) \tag{1}$$

$$\pi_t = \kappa\hat{Y}_t + \beta E_t\pi_{t+1} + \psi\tau_t \tag{2}$$

$$i_t = \max(0, r_t^e + \phi_\pi\pi_t) \tag{3}$$

where $\hat{Y}_t$ is output in log-deviation from steady state, π_t is inflation, i_t is the nominal interest rate, r_t^e is an exogenous disturbance and $\sigma, \kappa, \beta, \phi_\pi$ are coefficients such that $\sigma, \kappa > 0$, $0 < \beta < 1$ and $\phi_\pi > 1$. In Eggertsson (2010a,b) I studied a shock $r_t^e = r_S^e < 0$ that goes to some negative level in period 0 and then reverts back to steady state, r_L^e, with probability $1 - \mu$ in each period. Once it goes back to steady state, it stays there forever. Lets call the stochastic date it returns to steady state T^e. Then I define, as in Eggertsson (2010a,b), $t < T^e$ as the short run and $t \geq T^e$ as the long run. It is easy to show (see e.g. the propositions in the papers cited above) that in the long run

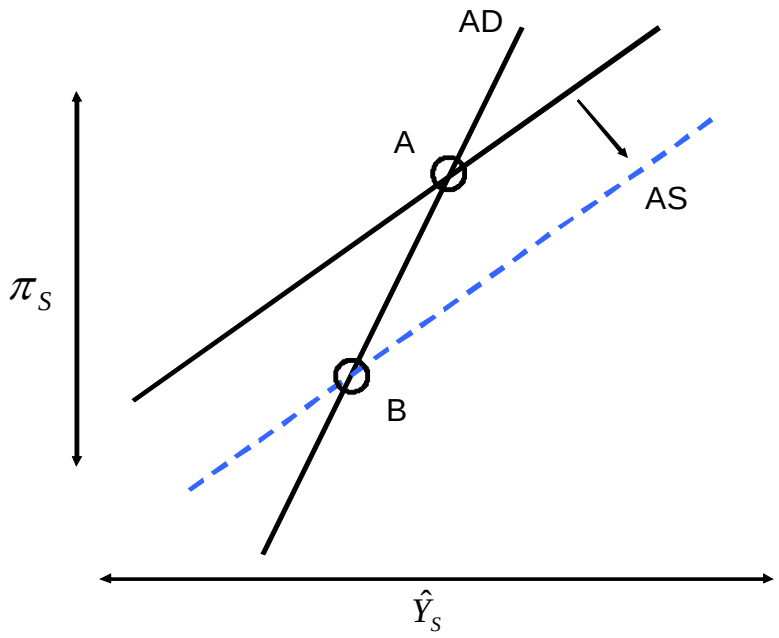

Figure 1: The Paradox of Toil

$\pi_t = \hat{Y}_t = 0$ and $i_t = r_L^e$. Then, conditional on the parameter restriction that $(1-\mu)(1-\mu\beta)-\mu\sigma\kappa > 0$, it can be shown that in the short run the numbers π_S and $\hat{Y}_S$ are the intersection of the following two curves, derived from equation (1)-(3)

$$AD \qquad (1-\mu)\hat{Y}_S = \sigma\pi_S + \sigma r_S^e \tag{4}$$

$$AS \qquad (1-\mu\beta)\pi_S = \kappa\hat{Y}_S + \psi\tau_S \tag{5}$$

These two curves are plotted up in Figure 1. As we can see, they imply that at zero interest rates, then cutting short run payroll taxes (or alternatively increasing short run labor supply somehow), reduces output. In other word increasing factor supply in the short run, reduces aggregate output in the short run in general equilibrium. This is the paradox of toil: If everybody wants to work more, there will be less work in the aggregate. The intuition for this result is discussed in detail in Eggertsson (2010a,b).

Mulligan (2010) asks a very sensible question: But how did the economy in 2008 and 2009 respond to seasonal variations in the labor supply? This is clearly a case in which the nominal interest rate collapsed to zero. Isn't a

straight forward interpretation of the figure above that this temporary increase in labor supply should temporarily reduce output and employment?

This would be an incorrect interpretation of the model, however. The key simplification in the example above is that all periods in which $t < T^e$ *are the same*. This means that the thought experiment in the paper (Eggertsson (2010a,b)) corresponds to: Increasing/reducing labor supply in *short run*, that is, *in all states of the world in which* $t < T^e$. This is clearly not the thought experiment involved in seasonal variation in the labor supply, since that is not a "stimulus package" that increases labor supply in all recessionary states of the world. Instead it is a one-off *temporary* increase in labor supply in one specific quarter that is reversed with probability one the next quarter.

A more reasonable way of analyzing a temporary one-off increase in labor supply is to imagine a shock in period 0, which is expected to revert back in period 0 with probability 1. What is the consequence of this shock?

Lets assume that in period 0 then $r_t^e = r_S^0 < 0$ and there is as before a μ probability that it stays there. Now, however, we assume that variations in τ_0 will be completely reverted in period 1, regardless of whether or not the shock is over. Hence we can think of this as a being due to a "seasonal" change in $\hat{\tau}_t$.[1] The short run is then divided into two, period 0 when there is the policy intervention (or increase in labor supply) and then $0 < t < T^e$ when the shock is still negative but there is no policy intervention. In period 0, then, the equilibrium must satisfy

$$AD_0 \qquad \hat{Y}_0 = \mu \hat{Y}_S + \sigma \pi_S + r_0^e$$

$$AS_0 \qquad \pi_0 = \kappa \hat{Y}_0 + \beta \mu \pi_S + \psi \tau_0$$

where the variables $\hat{Y}_S$ and π_S are determined as before (by equation 4-5) but $\hat{Y}_0$ and π_0 are determined by the equations above. The equilibrium allocation in period 0 is shown in Figure 2.

The first thing to observe in this figure is that the aggregate demand is vertical in inflation determined at time zero, i.e. π_0. The implication of this is that an increase in supply, i.e. a negative $\hat{\tau}_0$, is not contractionary. We can think of $\hat{\tau}_0$, for example, as stand in for a sudden increase in labor supply due to seasonal variations. This suggest that Mulligan suggested test for the paradox of toil is not valid.

The reason why output is not increasing in π_0, as it was in our prior figure, is that what is important for demand is not actual inflation in period 0, but instead *expectations about future inflation*. Those, in turn, depends on expectations about future marginal costs, which in turn, depends on expectations about

[1] Altough let me be clear that this is somewhat of a stretch. The model as it stands is not written to incorporate seasonal variations which may in principle have non-trivial effect on the price setting of the firms. I think the illustration above, however, is sufficient to make clear that a one time change in the labor supply that is reversed the next quarter should not give rise to the paradox of toil, and hence seasonal variations cannot be considered a legitimate test of the paradox.

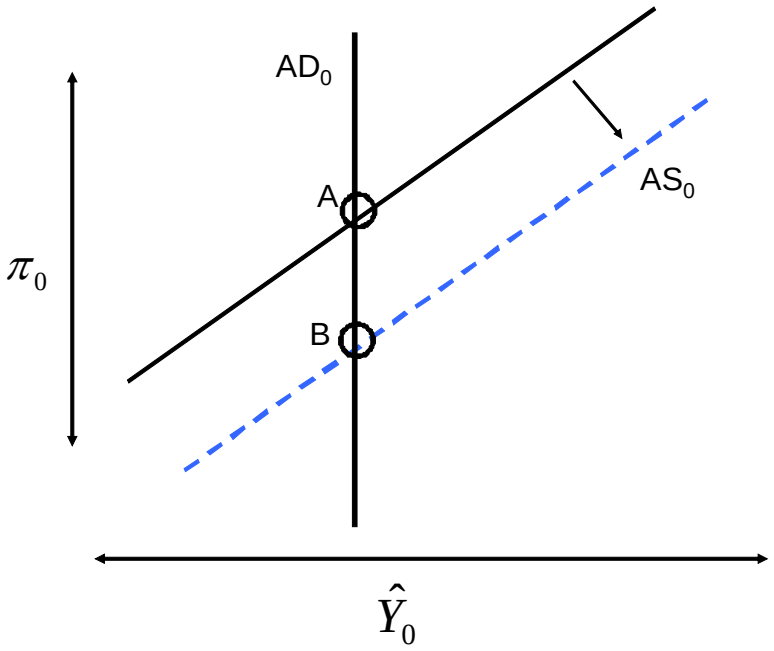

Figure 2: The effect of static changes in factor supply does not generate the Paradox of Toil.

future aggregate supply. Hence, static variations in factor supply is not a valid test of the paradox of toil.

Mulligan (2010) proposed two other tests of the paradox of toil. Let me comment briefly on each in turn.

Mulligans second test focuses on the increase in minimum wage in June 2009. The increase in the minimum wage is also not a direct test of the paradox of toil. This policy, most plausibly, involves a *permanent* increase in the policy distortion, not a policy which only shifts the AS equation in the short-run (instead it affects τ both in the *short* and the *long run*, thereby also *affecting long run output*). As stressed in Eggertsson (2010a,b), see e.g. Proposition 3 in the latter paper, the general equilibrium effect of a *permanent change* in policy in ambiguous and depends on the parameter values. In any event the evidence Mulligan (2010) presents is about the composition of the labor force (between part time and full time employment). The theory only makes a prediction about *aggregate employment*, not composition, because of the way in which minimum wages can interact with expectations about the aggregate price level. Finally Mulligan only shows raw data from what actually happened, while the relevant benchmark is what would have happen relative to if there was no policy. It would be a non-trivial extension of the model to explain the joint dynamics of full and part-time employment and one that is undoubtedly an exciting avenue for further research.

Mulligan's third test is to consider what the effect of the housing collapse was on non-residential investment. He suggests that a flexible price model suggests that it increases, while a sticky price model says it declines. He provides some suggestive evidence to support the former. This is an interesting hypothesis. Mulligan does not, however, provide a calibrated intertemporal general equilibrium model which incorporates different sectors and staggered price setting. This could be done, and would no doubt provide an interesting test of the theory. For what it is worth, an inspection of the two sector model proposed in Woodford (2003)[2], does not necessarily lead to the testable implication of New Keynesian theory at zero interest rate proposed by Mulligan (although this is not a model that explicitly incorporates a housing sector). I think that all that can be said at the moment is that it is too early to tell whether or not a modeling exercise along the lines suggested by Mulligan will provide testable implication for the New Keynesian model in general (which abstracts from sectoral heterogeneity of this sort) or of the paradox of toil in particular. That remains an important topic for future research.

1 References

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[2] See in particular the model on page 203 in proposition 3.9.

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