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Optimal discretionary monetary policy in a micro-founded model with a zero lower bound on nominal interest rate

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ABSTRACT

This paper investigates optimal discretionary monetary policy under the zero lower bound on the nominal interest rate (ZLB) in the case of a distorted steady state due to monopoly and taxation. Solving a fully nonlinear micro-founded (FNL) model using a global method, I find that the central bank in a more distorted economy would cut the interest rate less aggressively under a particularly adverse demand shock. This occurs because inflation and nominal interest rates are higher on average, making the ZLB less likely to bind and causing the economy to escape from the ZLB sooner. However, the social planner would choose the optimal inflation rate of approximately zero. The result emerges because the unconditional benefit of avoiding the ZLB is not big enough to offset the cost of higher relative price dispersion when inflation is significantly positive. In addition, I show that the conventional linear-quadratic (LQ) method is inaccurate in the case of a sufficiently distorted steady state.

1. Introduction

The focus of researchers concerned with optimal monetary policy under the ZLB has been the case of a non-distorted steady state, where the overall economic distortion due to monopoly and taxation is assumed to be zero. Specifically, government subsidies exist to fully offset monopolistic distortion so that the steady state output is not distorted from its socially efficient level. Hence, we can simplify a fully nonlinear micro-founded problem of optimal discretionary monetary policy using the LQ approach developed by Woodford (2001), Woodford (2003) and can avoid computational difficulty.

This paper aims at filling the hole in the ZLB literature by investigating optimal discretionary monetary policy under the ZLB in the case of a distorted steady state due to positive overall economic distortion. To this end, I solve a FNL micro-founded model using a global method. Also, I use the LQ method to simplify the FNL model, which I solve using the same method. I then provide a comparison between the FNL and LQ models.

Studying the case of a distorted steady state brings the ZLB literature closer to reality. McGrattan (1994) reports that labor income taxes range from 10% to 40%, while Diewert and Fox (2008) estimate that monopolistic markups in some main

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industries range from 11% to 44%. As a result, the overall economic distortion ranges from 20% to 60%. This information might influence private expectations, which, in turn, would affect optimal policy before, during and after the ZLB period.[1]

Solving FNL models also helps us to answer the question stated in Adam and Billi (2007): to what extent does the full nonlinearity affect the optimal monetary policy under discretion in the presence of the ZLB? In addition, we can study the role of relative price dispersion as an endogenous state variable, which is eliminated in the LQ framework due to the linear approximation.[2]

I obtain four sets of main findings. First, under a particularly adverse shock driving the economy near the ZLB, the central bank in an economy with a larger economic distortion would cut the interest rate less aggressively. The intuition is simply that, in this economy, inflation and nominal interest rate are higher on average. When the nominal interest rate is near the ZLB, a particularly adverse demand shock might have occurred. Given the mean-reverting nature of shocks, the conditional probability that another adverse shock occurs and pushes the economy into the liquidity trap with binding ZLB is very small. Furthermore, even when this shock occurs and the ZLB binds, the output losses and reduction in inflation are smaller than they would be in an economy with a smaller economic distortion. Therefore, downward pressure on the conditional expected inflation is smaller and the central bank cuts the nominal interest rate less aggressively.

Second, with a larger overall economic distortion, inflation and interest rates are higher on average, resulting in a smaller probability of reaching the ZLB. However, the social planner would choose the optimal inflation rate of approximately zero, corresponding to very small overall economic distortion. This occurs because the unconditional benefit from avoiding the ZLB is not big enough to offset the cost of higher relative price dispersion when inflation is high. In sum, the unconditional expected welfare is maximal when the average long-run inflation is around zero.

Third, when the initial relative price distortion is greater than the steady state value, the central bank tends to pursue a higher nominal interest rate, making the ZLB less likely to bind. The intuition is that the relative price dispersion is an inefficiency wedge: when the relative price dispersion is high, the central bank would like to reduce it by tightening the monetary policy and, as a result, lowers the front-loading behavior by firms in setting their prices, leading to a smaller current relative price dispersion. This result is interesting and cannot be found using the LQ method because the change in relative price dispersion is always zero.

Finally, the FNL model and the LQ model produce different results if there is a particularly adverse shock that makes the ZLB binding. When the ZLB binds, the central bank cannot stabilize output and the price level, making the relative price dispersion distant from the steady state. While the impact of the relative price dispersion as an endogenous state variable in the FNL model is significant, it is always zero and has no role in the LQ model due to the first order approximation. However, the difference between the FNL and LQ models is not significant in the case of a non-distorted steady state.

When the overall economic distortion is large, the two methods produce very different results, especially when the ZLB binds. The approximated inflation and interest rate in the LQ model are substantially smaller than the true values derived using the FNL model. Consequently, given the ZLB binds in both models, the output losses in the FNL model are significantly smaller than those in the LQ model. In addition, the interest rate cut in the FNL model is less aggressive under a shock driving the interest rate near the ZLB.

The related literature on optimal monetary policy under the ZLB was inspired by seminal work by Krugman (1998), which extensively discusses causes and consequences of the ZLB in a series of simple two-period perfect-foresight models. Since then, extensive research related to the ZLB has been implemented, including Eggertsson and Woodford (2003), Jung et al. (2005), Adam and Billi (2006), Nakov (2008), Levin et al. (2010), Bodenstein et al. (2010), Eggertsson and Krugman (2012), and Werning (2011). The common feature of these papers is that they focus on the case of non-distorted steady state and use the LQ method.

The papers closest to mine are Adam and Billi (2007), and Anderson et al. (2010). Like my paper, Adam and Billi (2007) use a global method to solve an optimal discretionary monetary policy problem that allows for an occasionally binding ZLB. However, because they use the LQ approach, the only nonlinearity in their paper is the ZLB. This paper extends the work of Adam and Billi (2007) by considering a fully nonlinear model. In addition, this paper studies the implications of positive overall economic distortion on discretionary policy and optimal inflation rate in the presence of the ZLB.

Anderson et al. (2010) investigate the size of inflationary biases under discretion in the presence of overall economic distortion using nonlinear methods. However, in their model, the nominal interest rate can be adjusted freely because the ZLB is not imposed. Hence, the average long-run inflation is the same as the deterministic steady state inflation. This paper extends their work by considering the ZLB, a very important constraint faced by policymakers.

There are three recent working papers studying the ZLB using fully nonlinear methods. Nakata (2011) studies optimal fiscal and monetary policy in a nonlinear sticky price model of the Rotemberg-type instead of the Calvo-type as in my model. I choose to use the Calvo-type price adjustments so that I can examine relative price dispersion as an endogenous variable and compare my results directly to the results in the previous literature. I study the role of economic distortion, while Nakata (2011) focuses on fiscal policy. Fernandez-Villaverde et al. (2012) study the ZLB in a fully nonlinear model

[1] It is well-known in the literature of inflation bias that the greater the overall economic distortion, the higher the average inflation under discretion and, as a result, the higher the nominal interest rate, see Woodford (2003). Whether in reality we observe the kind of inflation bias that emerges in the model under discretionary policy in the case of a distorted steady state is still debatable and beyond the scope of this paper.

[2] Alvarez et al. (2011) find that relative price variance is significantly positive when inflation is high, while Zandweghe and Wolman (2010) show that initial relative price dispersion could affect monetary policy. So studying the role of relative price dispersion is interesting.