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INTERNATIONAL SYMPOSIA IN ECONOMIC THEORY
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ENVIRONMENTAL, SOCIAL, AND GOVERNANCE PERSPECTIVES ON ECONOMIC DEVELOPMENT IN ASIA

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CHAPTER 1

THE NEO-FISHERIANISM TO ESCAPE ZERO LOWER BOUND

Siddhartha Chattopadhyay

ABSTRACT

Sufficiently persistent rise in nominal interest increases inflation rate in short-run. This short-run comovement of nominal interest rate and inflation rate is known as Neo-Fisherianism. This chapter proposes a policy based on Neo-Fisherianism to escape Zero Lower Bound (ZLB) using a textbook Forward Looking New Keynesian Model*. I have shown that proposed policy with properly chosen inflation target and persistence can stimulate economy and escape ZLB by raising nominal interest rate. I have also shown that the proposed policy is robust to varying degrees of price stickiness.*

Keywords: New Keynesian Model; Neo-Fisherianism; Zero Lower Bound; Inflation Target; Taylor Rule; Optimal Policy

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1. INTRODUCTION

Conventional wisdom says rise in nominal interest rate is contractionary; it reduces inflation and depresses economic activity in the short-run. On the other hand, Fisher Effect suggests a positive relationship between inflation and nominal interest rate in the long-run. However, recent data of low inflation rate with near zero nominal interest rate of the United States, Europe and Japan indicates a positive relationship of nominal interest rate and inflation even in short-run. This

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short-run comovement of nominal interest rate and inflation is known as Neo-Fisherianism (see Garín, Lester, & Sims, 2018, Cochrane, 2016, 2017, Schmitt-Grohé & Uribe, 2014, 2017, Uribe, 2018 for detail). This chapter proposes a policy based on Neo-Fisherianism to escape Zero Lower Bound (ZLB) or liquidity trap.[1]

Large adverse demand shock sends nominal interest rate to ZLB, where conventional monetary policy looses its ability to stimulate economy by reducing it further. After worldwide financial crisis started from 2007 to 2008 and economic slum of Japan during last two decades, ZLB is no longer a mere theoretical curiosity. A large body of literature devoted to analyze monetary policy suggest a major role to expected inflation to stimulate economy activity when nominal interest rate is near zero. While Krugman (1998) suggests to increase expected inflation through a permanent rise in money growth,[2] Svensson and others (2003) argues for currency depreciation to achieve a higher price level target for stimulating economic activity at ZLB.[3]

Beside these, a large body of literature have also been devoted to analyze optimal conduct of monetary policy at ZLB. Papers analyzing the optimal monetary policy at ZLB include Eggertsson and Woodford (2003), Jung et al. (2005), Adam and Billi (2006, 2007), Nakov (2008), Werning (2012), and Cochrane (2017). Using a textbook *Forward Looking New Keynesian Model*, these papers suggest a "forward guidance" policy where monetary authority retains its ability to stimulate economy by promising a path of future interest rates which can stimulate expected inflation. The optimal policy at ZLB is divided into two parts, for example, optimal discretionary policy and optimal policy under commitment. Since monetary authority cannot influence individual expectations, nominal interest rate under discretion remains zero as long as adverse demand shock is strong enough to keep natural rate of interest negative. However, economy exits ZLB under discretion as soon as natural rate of interest becomes positive.

While optimal discretionary policy is credible, it involves higher welfare loss than policy under optimal commitment. Optimal policy under commitment can influence individual expectations optimally and produces lower welfare loss than discretion by delaying exit from ZLB. Such promises even if non-credible, allow optimal commitment to generate extra stimulus to produce lower welfare loss than discretion. Moreover, the extent of recession and deflation under commitment is also lower than discretion. Note that optimal policies both under discretion and commitment discussed above do not escape ZLB and associated recession. In fact, they allow economy to fall into recession initially and choose the date of exit according to the requirement of stimulus needed by optimal monetary policy.

This chapter on the other hand stands at another extreme. Unlike optimal policy at ZLB, this chapter proposes policy to escape ZLB when economy gets hit by a large adverse demand shock. The proposed policy is based on the textbook *Forward Looking New Keynesian Model and Its Property of Neo-Fisherianism*. The textbook *New Keynesian Model* produces short-run comovement between nominal interest rate and inflation rate when change in inflation target is sufficiently persistent. Garín et al. (2018) shows that a persistent rise in inflation target increases both output and expected inflation through New Keynesian Phillips curve (NKPC) and the rise in output is consequently matched by a sufficient

reduction in real interest rate through expectational IS equation. Note that when expected inflation rises sufficiently due to a persistent increase in inflation target, real interest rate may fall and nominal interest rate can rise, yielding a comovement between nominal interest rate and inflation rate in short-run, known as Neo-Fisherianism in the literature.[4] Garín et al. (2018) further shows that the textbook *New Keynesian Model* follows Neo-Fisherianism due to its forward looking nature and the same model may ceases to follow Neo-Fisherianism under hybrid Phillips curve with both forward and backward looking inflation rate) due to the presence "rule of thumb" price setters in Phillips curve (Gali & Gertler, 1999).[5]

The theory of Neo-Fisherianism as noted by Garín et al. (2018) is advanced in several theoretical writings of John Cochrane and Steven Williamson.[6] Uribe (2018) is the first to find empirical evidence of Neo-Fisherianism while estimating a Bayesian structural vector autoregression (SVAR) model for postwar United States and Japan. He shows while a rise in nominal interest rate expected to be transitory is both contractionary and deflationary, it is inflationary when expected to be permanent. Moreover, the chapter also shows that the rise in nominal interest rate, which is expected to be permanent, is expansionary too as it keeps real interest rate remains low throughout the transition. Uribe (2018) also argues that proper identification of permanent and temporary shock can provide answer to the issue of price puzzle (see Eichenbaum, 1992).

Schmitt-Grohé and Uribe (2014) has proposed a policy to avoid liquidity trap using a model of endowment economy. They have used a Taylor rule for their analysis that depends only on inflation rate (not on output) with an exit strategy (from liquidity trap) where monetary authority promptly switches to set a deterministic nominal interest rate as soon as inflation rate goes below a pre-determined threshold level. Authors show that such a truncated Taylor rule is able to avoid liquidity trap by raising inflationary expectation. However, the model used by them is not only based on endowment economy but also assumes complete price flexibility. The counterfactual assumption of complete price flexibility held deflation costless, which is not true in reality as correctly identified by the author themselves.

Schmitt-Grohé and Uribe (2017) on the other hand use the full blown dynamic stochastic general equilibrium (DSGE) model with downward nominal wage rigidity to show (i) standard dynamic optimization model can produce jobless growth recovery observed in the United States, Japan, and Europe in recent times and (ii) an appropriate policy prescription to avoid liquidity trap entails proper identification of the characteristics of the shock pushing economy into liquidity trap. They show if economy falls into liquidity trap due to negative confidence shock, raising nominal interest rate to its intended target for an extended period of time boosts inflationary expectations and foster employment. The chapter also argues that a proper policy to combat liquidity trap in this context should of Neo-Fisher in nature.

Using the property of Neo-Fisherianism of the textbook *Forward Looking New Keynesian Model*, this chapter proposes policy that can escape ZLB through a persistent rise in inflation target when economy gets hit by adverse demand shock, large enough to send the economy to ZLB. I have shown that the policy proposed by me where inflation target follows a first order autoregressive process

with half-life 2.40 quarters not only escapes ZLB but also robust to various degrees of price stickiness. I have also shown that my proposed policy is characterized completely by the persistence and value of inflation target at initial period, chosen by the monetary authority so that economy gets enough stimulus to escape ZLB with positive nominal interest rate.

It is worth remembering here that the effectiveness of a policy depends heavily on its communication and credible implementation. Therefore, it is important to discuss these properties for the policy based on Neo-Fisherianism too. While analyzing the communication of optimal forward guidance policy using standard Taylor rule with time-varying inflation target, Chattopadhyay and Daniel (2018) show that (i) we can replicate discretionary policy by choosing zero inflation target and (ii) we can replicate optimal policy under commitment by choosing appropriate non-zero inflation target whose persistence is determined by the stable root of the system post-exit. As a result, the optimal policy under discretion and commitment can be communicated successfully using inflation target and its persistence as it can be described using the time path of nominal interest rate. Now, since policy based on Neo-Fisherianism is also characterized by inflation target and its persistence, it can similarly be communicated completely by them. Nevertheless, in sharp contrast with the standard forward guidance policy that keeps nominal interest rate low longer, the policy based on Neo-Fisherianism can be communicated as a policy that increases nominal interest rate instantaneously and allows it to converge to its long-run value gradually through an appropriate choice of a sufficiently persistent inflation target.

Policy based on Neo-Fisherianism requires increasing nominal interest rate at ZLB to stimulate economy, contradicting the conventional wisdom. Moreover, the policy based on Neo-Fisherianism is dynamically inconsistent and hence non-credible too as it requires to keep inflation target positive even if ZLB on nominal interest rate is no longer binding. Therefore, implementation and effectiveness of such policies requires re-education of general public through effective, transparent, and periodic communication of the monetary authority about their policy stance and future course of action. Literature do have evidence that timely effective communications about monetary policy helps shaping individual expectations and has significant impact on the economy. While Bernanke, Reinhart, and Sack (2004) have shown that central bank statement and other types of financial and economic news do have significant effect on asset prices, Davis and Wynne (2016) have shown that the extent of monetary policy shocks of the United States increases with volume of Federal Open Market Committee (FOMC) report. Blinder, Ehrmann, Fratzscher, Hann, and Jansen (2008) have a nice survey of literature on the importance and strategies of central bank communication to influence financial market and achieve macroeconomic stability. Beside these, the growing literature of Epidemiology has shown news about inflation/prices published in newspapers, magazines, etc. has significant impact on household inflation expectation formation. Lei, Zhe, and Chengsi (2015) have shown news published in leading Chinese newspaper and magazine has impact on household inflation expectations of China. Using the same theory of epidemiology, Saakshi, Sahu, and Chattopadhyay (2018) have shown that information of inflation/prices obtained from Google Trend helps

Indian households to form their expectations on inflation.[7] Moreover, Schmitt-Grohé and Uribe (2014) argue that the policy based on Neo-Fisherianism can be implemented credibly as general public, having observed low inflation rate with near zero nominal interest rate will gradually internalize the possibility raising inflation expectations by increasing nominal interest rate at ZLB.

However, the policy based on Neo-Fisherianism has its own cost and benefit. In this chapter, I have shown that the welfare loss of the proposed policy is close but higher than optimal discretionary policy and hence higher than policy under optimal commitment too. On the other hand, policy based on Neo-Fisherianism can escape ZLB and associated recession and deflation completely. We know recession is "bad" and it has negative impact on the economy both in short-run and long-run. Moreover, recession has its own dynamics which is generally very persistent and often goes out of control once sets in. Along with this, Schmitt-Grohé and Uribe (2017) show that, due to the presence of financial frictions and downward nominal wage rigidity, macroeconomic adjustment in the context of deflation becomes costly as it yields more distressed financial market condition. Beside this, I also feel that communicating policy based on Neo-Fisherianism which is associated output expansion at the cost of a bit more welfare loss than optimal forward guidance policies is far more easier to communicate than the optimal forward guidance policy producing temporary recession but smaller overall welfare loss. This is because general people can observe recession and feel the pain of unemployment easily but cannot observe the implicit welfare loss incurred by the monetary authority. Given this backdrop, policy that escapes ZLB and associated recession and deflation seems more desirable to me even if it comes with a little more welfare loss.[8]

2. MONETARY POLICY IN THE SIMPLE NEW KEYNESIAN DSGE MODEL

2.1. Simple New Keynesian Model

Following Walsh (2017) and Woodford (2003), I represent the textbook *Forward Looking New Keynesian Model* through an IS curve derived from the log-linearized Euler Equation of the representative agent and representing the aggregate demand of the economy (Equation (1)) and a New Keynesian Phillips Curve (NKPC) derived from a model of Calvo pricing (Calvo, 1983) and log-linearized around zero long-run inflation rate (Equation (2)).[9] NKPC represents the aggregate supply of the economy.

$$y_t = E_t\left(y_{t+1}\right) - \sigma\left[i_t - r_t^n - E_t\pi_{t+1}\right] \tag{1}$$

$$\pi_t = \beta E_t\left(\pi_{t+1}\right) + \kappa y_t. \tag{2}$$

In these equations, y_t denotes the output gap; inflation (π_t) is the deviation about a long-run value of zero; i_t denotes the nominal interest rate, σ represents

the intertemporal elasticity of substitution with $\sigma \geq 0$; κ represents the degree of price stickiness;[10] $\beta \in (0,1)$ denotes the discount factor. The natural rate of interest embodies the combination of the long-run natural rate together with demand shocks associated with preferences, technology, fiscal policy, etc. Following Schmitt-Grohé and Uribe (2017), the demand shock, u_t also captures the shock in confidence in the simple New Keynesian model discussed here. I assume demand shock follows an AR(1) process as given below,

$$u_t = \rho_u u_{t-1} + \epsilon_t, 0 < \rho_u < 1 \tag{3}$$

and natural rate of interest is defined as,

$$r_t^n = r^n - \sigma^{-1} u_t \tag{4}$$

where $r^n = \beta^{-1} - 1$ is the long-run natural rate of interest. Following Woodford (2003, Chapter 4), we do not add an independent shock to inflation in the Phillips Curve.[11] This restricts the analysis to the case where monetary policy faces no tradeoff between inflation and the output gap.

2.2. Taylor Rule

The method, typically employed in New Keynesian models for determining the nominal interest rate is to assume that the monetary authority follows a Taylor rule (Taylor, 1993). In Taylor's original rule, the nominal interest rate is set to equal a fixed real rate plus a fixed inflation target and to respond positively to deviations of inflation and output from fixed target values. The Taylor rule, log-linearized about long-run equilibrium values of zero, can be expressed as

$$i_t = r_t^n + E_t\left(\pi_{t+1}^*\right) + \phi_\pi\left(\pi_t - \pi_t^*\right) + \phi_y\left(y_t - y_t^*\right),\ \phi_\pi > 1,\ 0 < \phi_y < 1, \tag{5}$$

Liquidity trap is defined as a situation of a big enough demand shock causing $r_t^n < 0$. I assume inflation target to follow a deterministic AR(1) process as given below.

$$\pi_t^* = \xi \pi_{t-1}^*, 0 < \xi < 1 \tag{6}$$

I allow the monetary authority to choose a target value for inflation $\left(\pi_t^*\right)$ greater than the long-run value of zero with persistence ξ.[12] Both inflation target and its persistence is determined by monetary authority.

When the inflation target is positive, solution of Equation (2) implies that the output gap target is given by $y_t^* = \dfrac{1-\beta\xi}{\kappa}\pi_t^*$. Substituting the value of output gap target to Equation (5) and collecting terms gives,

$$i_t = r_t^n + \phi_\pi \pi_t + \phi_y y_t - z\pi_t^* \tag{7}$$

where

$$z = \phi_\pi + \phi_y \left(\frac{1-\xi\beta}{\kappa} \right) - \xi$$

Taylor rule given in Equation (5) follows Taylor principle where nominal interest rate responds strongly enough to endogenous variables that solves the problem of indeterminacy. Specifically, Bullard and Mitra (2002) demonstrate that if ϕ_π and ϕ_y are large enough such that Equations (1) and (2), with Equation (5) substituted for the interest rate, yields a dynamic system with two unstable roots, corresponding to the two forward-looking variables, then the equilibrium is unique. We get $z > 0$ when Taylor Principle is satisfied with $\phi_\pi > 1, 0 < \phi_y < 1$.

Using Equations (1), (2), and (7), and denoting the unstable roots of the system as λ_1 and λ_2,[13] the rational expectations solutions for the output gap and inflation are given by[14]

$$y_t = \frac{1-\xi\beta}{\beta(\lambda_1 - \xi)(\lambda_2 - \xi)} \sigma z \pi_t^*, \tag{8}$$

and

$$\pi_t = \frac{\kappa}{\beta(\lambda_1 - \xi)(\lambda_2 - \xi)} \sigma z \pi_t^*. \tag{9}$$

Both the output gap and inflation respond positively to the inflation target. This is because an increase in the inflation target raises inflationary expectations, reducing the real interest rate, stimulating current spending. Note that the Taylor Rule, with a time-varying intercept dependent on the natural rate of interest, eliminates any effect of u_t, which does not operate through π_t^*. Substituting equilibrium values for π_t and y_t from Equations (8) and (9) into Equation (5) yields an equilibrium value for the nominal interest rate as,

$$i_t = r_t^n + qz\pi_t^* \text{ where } q = \left[\frac{\phi_\pi \kappa + \phi_y (1-\xi\beta)}{\beta(\lambda_1 - \xi)(\lambda_2 - \xi)} \sigma - 1 \right] \tag{10}$$

q captures both direct and indirect effect of inflation target on nominal interest rate. The indirect effect of inflation target on nominal interest rate, captured by the first term of the square bract in the expression of q above, rises with the persistence of inflation target, ξ. For ξ high enough the indirect effect dominates the direct effect and we observe the short-run comovement of nominal interest rate and inflation rate and our model would follow the Neo-Fisherianism.

2.3. The Loss Function

The model is completed with determination of the nominal interest rate. We consider two alternative methods to specify the nominal interest rate. The first follows Woodford (2003) and chooses values for the time paths of inflation and the output gap to minimize the loss function,

$$L_1 = \frac{1}{2} E_1 \sum_{t=1}^{\infty} \beta^{t-1} \left(\pi_t^2 + \lambda y_t^2 \right), \ \lambda \in [0, \infty). \tag{11}$$

Woodford derives Equation (11) as a linear approximation to the utility function of the representative agent when equilibrium inflation is zero and the flexible-price value for output is efficient.[15]

To explain first optimal policy, define a threshold value for u_t as $\hat{u} = \sigma \bar{\imath}$. When demand shock is small $(u_t < \hat{u})$ so that $r_t^n > 0$, the optimal policy is $i_t = r_t^n$ with $\pi_t^* = \pi_t = y_t = 0$, yielding $L_1 = 0$. However, if demand shock is large $(u_t \geq \hat{u})$ so that $r_t^n < 0$, optimal policy is no longer $\pi_t^* = 0$. This is because $\pi_t^* = 0$ yields $i_t = r_t^n < 0$ which is not possible since nominal interest has ZLB.

A large body of literature have analyzed the optimal policy under ZLB and its implementation as discussed above. Chattopadhyay and Daniel (2018) have analyzed optimal policy at ZLB with uncertainty in the persistence of the shock. To keep their analysis analytically tractable, the chapter assumes that individuals are uncertain about the persistence of adverse demand shock initially, which can take three different values, for example, 0.85, 0.9, and 0.95 with probability 0.25, 0.50 and 0.25, respectively. As a result, there can be three different time paths of natural rate of interest depending on the realized persistence of the shock, which individuals get to know after a year. Such a specification of natural rate of interest yields three different time paths for optimal output gap, inflation, and nominal interest rate both under discretion and commitment. I have used the algorithm of Chattopadhyay and Daniel (2018) to calculate welfare loss under discretion and commitment when the realized persistence of the shock is 0.9. In the analysis of Chattopadhyay and Daniel (2018), economy never reverts back to ZLB once exits. This is true for my analysis as well. The policy based on Neo-Fisherianism proposed by me is based on a model which assumes nonoccurrence of ZLB once economy exits out of it. Hence, I have used welfare losses obtained by Chattopadhyay and Daniel (2018) as benchmark to compare the same produced by the policy based on Neo-Fisherianism.

3. THE POLICY BASED ON NEO-FISHERIANISM

The issue in a liquidity trap is how to stimulate output and inflation without reducing the nominal interest rate. The Neo-Fisherianism does the same. To understand the intuition of Neo-Fisherianism and how it escapes ZLB, note that Equations (8) and (9) reveal that stimulating output and inflation requires raising the inflation target. Also note that the coefficient on π_t^* in Equation (10) is