行政院國家科學委員會專題研究計畫成果報告
探究就美國聯邦準備銀行之貨幣政策形成

計畫編號：NSC 90-2415-H-035-010
執行期限：90 年 8 月 1 日至 91 年 7 月 31 日
主持人：黃鏡如　交通大學管理科學系
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1、中文摘要

本文探討美國聯邦準備銀行貨幣政策的不對稱性。它提出，並估計一隨著時間而變動的央行反應函數。此函數能表現央行的政策不僅關注當前的經濟條件，且期望能維持經濟長期穩定的特性。本文採用失業率、通貨膨脹、與產出的總體經濟變數間的共整合關係來代表經濟長期的均衡。央行的短期反應函數係利用 logistic 平滑轉換模型來捕捉貨幣政策的不對稱性。利用 1959:01 到 2001:01 的月資料，實證結果，支持央行反應函數是一隨時間而變動與不對稱的假說。

關鍵詞：聯邦準備、不對稱反應函數、平滑轉換誤差修正、Logistic 函數

Abstract

The paper investigates the asymmetric nature of the Federal Reserve monetary policy objectives. It proposes and estimates a time-varying Fed's response function that characterizes the Fed's policy as being motivated by a concern for current economic conditions and also a desire to maintain the long-run stability of the economy. Specifically, the model uses a cointegrating relationship between unemployment, output, and inflation to represent the economy's long-run equilibrium; asymmetries in the Fed's response function are formulated as a smooth transition error correction model where the transition function is of logistic type. Empirical results obtained from the monthly data series, 1959:01 to 2001:01, support the asymmetry hypothesis of the time-varying Fed's response function.

Keywords: Federal Reserve, asymmetric response function, smooth transition, error-correction, logistic function.

2、Introduction and Purpose

There is a large empirical literature directed towards estimating the Federal Re-serve's response function. Most of the contributions to this literature estimate the relationship between a particular monetary policy indicator and a relatively small set of economic variables to which the Federal Reserve can be expected to respond. However, the results appear to be extremely sensitive to the specifications in lag structure, variable selection, and the estimation technique employed. Consequently, Khoury (1990), who surveys forty-two estimated Federal Reserve reaction functions, is forced to conclude that, relative to the amount of work that has been done, very little has been learned about how the Fed responds to economic conditions.

There are a variety of potential explanations for the instability exhibited by estimated Federal Reserve reaction functions. From an econometric point of view, the most obvious problem is that Federal Reserve reaction functions are most often fixed-coefficient estimates and, as such, necessarily assume that the Fed's policy objectives and the effectiveness of policy initiatives are time-invariant. Using a nonlinear Kalman filter to model the time paths of the coefficients in the Fed's reaction function, Shen, Hakes, and Brown (1999) recently find that there are significant asymmetries in the Fed's response to changes in economic conditions. Their results show that over the period 1956 to 1994, the Fed's policy stance had a systematic cyclical component in that the Fed responded more strongly to increases in unemployment during recessions than in non-recessionary times. Conversely, the Fed's response to increases in the price level was stronger in non-recessionary periods.

In this paper, we employ an extended series of the dichotomous monetary policy indicator used by Potts and Luckett (1978), and Shen, Hakes, and Brown (1999). Following Shen, Hakes, and Brown, we allow for asymmetry in the Fed 's response function. However, we choose not to use a Kalman filter, which provides very little economic insight into the source of the asymmetric response, to model variations in the response coefficients over time. Instead, we use a logistic smooth transition error correction model (LSTECM) to allow for asymmetries in the Fed's policy response function. In our model, the Fed's short-run policy response is a function of (1) observed changes in unemployment, output, and inflation, and (2) the desire to achieve (and maintain) long-run economic stability. Specifically, we use a cointegrating relationship between unemployment, output, and inflation to represent the economy's long-run equilibrium; asymmetries in the Fed's response function are modeled as a non-linear function of short-run (monthly) deviations from the cointegrating vector.

3、Results and Discussion

In order to develop an explicit relationship between short-run policy decisions and long-run policy objectives, we assume that, for practical purposes, long-run economic stability can be interpreted as the achievement of a stable relationship between unemployment, inflation, and economic growth. We therefore model long-run stability as a cointegrating relationship between the unemployment rate (U), the producer price index (PPI), and the industrial production index (IP). Applying Johansen's (1995) maximum likelihood test to the variables confirms the existence of a cointegrating relation between U_t, PPI_t, and IP_t. This estimated long-run cointegrating equation is given by

$$U_t - 10.93496 \log(PPI_t) + 13.85107 \log(IP_t) - 15.63994 = \varepsilon_t \qquad (1)$$

where ε_t measures the period-by-period deviation of the economy from the economy's long-run equilibrium. We specify the Fed's short-run policy response function as a probit function, which includes short-run (monthly) changes in economic variables and the long-run deviation ε_t as explanatory variables. Formally, the Fed's short-run policy response function is given by

$$\begin{aligned} \mathrm{Prob}(P_t = 1) &= \Phi[\, \beta_0 + \beta_1 \Delta U_{t-1} + \beta_2 \Delta U_{t-2} + \beta_3 \Delta \log(PPI_{t-1}) + \beta_4 \Delta \log(PPI_{t-2}) + \\ &\quad \beta_5 \Delta \log(IP_{t-1}) + \beta_6 \varepsilon_{t-1} + \\ &\quad F(\varepsilon_{t-d}) \{\delta_1 \Delta U_{t-2} + \delta_2 \Delta \log(PPI_{t-1}) \\ &\quad + \delta_3 \varepsilon_{t-1}\}] \qquad (2) \end{aligned}$$

where P_t is a dichotomous monetary policy indicator which takes on a value of 0 when monetary policy is tight and a value of 1 in when monetary policy is easy. The function $F(\varepsilon_{t-d})$ is a smooth transition function that is bounded between zero and one. The parameter d is a delay coefficient.

The formulation given in equation (2) allows us to consider a number of alternative models of the Fed's policy response function. When $F(\varepsilon_{t-d}) = 0$, equation (2) is simply an Error Correction Model; when $F(\varepsilon_{t-d}) \neq 0$, equation (2) is an example of the Smooth Transition Error Correction Model (STECM) formulated by Granger and Terasvirta (1993) and Terasvirta (1994). The function $F(\varepsilon_{t-d})$ provides for a wide variety of non-linear models. In this paper, we consider two specifications of STECM, an exponential STECM (ESTECM) and a logistic STECM (LSTECM). The ESTECM assumes that the transition function is an exponential function of the form

$$F(\varepsilon_{t-d}; \gamma, c) = 1 - \exp[- \gamma (\varepsilon_{t-d} - c)^2] \qquad (3)$$

Since the transition function $F(\varepsilon_{t-d}; \gamma, c)$ given in (3) is symmetric about c, the

ESTECM generates similar short-run dynamics in recessions and expansions. An alternative formulation of the function $F(\varepsilon_{t-d})$ is a logistic function that allows for policy asymmetries that depend on the sign as well as the magnitude of the deviation from long-run equilibrium. The particular logistic transition function we employ is of the form

$$F(\varepsilon_{t-d};\gamma,c)=\{1+\exp[-\gamma(\varepsilon_{t-d}-c)]\}^{-1}-0.5 \qquad (4)$$

When the smoothness parameter γ approaches 0, the ESTECM and LSTECM both reduce to a linear ECM. To determine which model best fits the data, we begin by testing for the linearity of ECM specification. The results from the Lagrange multiplier (LM) test reject the linear ECM model, and the STECM model is of logistic type; in other words, it is a LSTECM model.

The following table shows the estimates of the ECM and LSTECM models. The transition coefficient γ = 6.061776 is statistically significant at the 10% level, which reconfirms a nonlinear STECM model for the Fed's response function.

Variable	Coefficient	ECM Estimate		LSTECM Estimate	
Constant	β_0	-0.625179	(0.165056)	-1.865089	(0.469720)
ΔU_{t-1}	β_1	0.840252	(0.367505)	0.847789	(0.386715)
ΔU_{t-2}	β_2	1.020395	(0.346058)	0.575027	(0.523223)
$\Delta\log(PPI_{t-1})$	β_3	-20.75193	(9.028941)	-41.40127	(16.82467)
$\Delta\log(PPI_{t-2})$	β_4	-21.39284	(9.007555)	-18.13281	(8.025793)
$\Delta\log(IP_{t-1})$	β_5	-16.50618	(8.468782)	-19.49188	(9.601989)
ε_{t-1}	β_7	0.161570	(0.040658)	0.697740	(0.212359)
ΔU_{t-2}	ä $_1$			1.090642	(0.869335)
$\Delta\ln PPI_{t-1}$	ä $_2$			31.05251	(20.35088)
ε_{t-1}	ä $_3$			-0.342963	(0.141580)
$F(\varepsilon_{t-d};r,c)$	r			6.061776	(4.160267)
	c			3.684944	(0.183878)
AIC		1.293862		1.273607	

4、Contribution of the Project

Following the stated objective in the original proposal submitted to the National Science Council, the paper develops a Fed's policy response function, which is empirically testable on the hypothesis of asymmetric monetary policy. It is expected that upon revision, the paper will be published and shall make contribution in the literature of monetary policy.

5、References

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附件：封面格式

行政院國家科學委員會補助專題研究計畫成果報告

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□國際合作研究計畫國外研究報告書一份

執行單位：交通大學管理科學系

中 華 民 國 91 年 7 月 30 日