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Mario Jovanović

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Abstract

During financial crises central banks usually decrease interest rates in order to reduce financial uncertainty. This behavior increases inflation risk. The trade-off between inflation and uncertainty stabilization can be modeled by the generalized Taylor rule, which describes inflation sensitivity as a function of financial uncertainty instead of a constant parameter. Based on the GMM-estimation of the generalized approach I confirm the suggested uncertainty-dependent inflation sensitivity of the Fed. Prolonged deviations from the Taylor principle are not evident. This implies that the Fed does not deemphasize inflation stabilization in favor of uncertainty stabilization – especially during the peak of the latest sub-prime crisis.

JEL Classification: E44, E58

Keywords: Financial instability; time-varying inflation sensitivity

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1 Introduction

Monetary policymaking is a complex business and depends on a large amount of data and supposed dependencies. Taylor (1993) proposed the most popular - and in the long-run extraordinary useful - simplification of monetary policy. A weakness - caused by the simplification - of the Taylor rule is the constant-parameter assumption, which implies constant inflation sensitivity of a central bank over time. Contrary, real world observations show monetary policy shifts - dependent on the state of financial instability - from price stability focus to financial stability focus. Thus, from a counterfactual perspective the inflation sensitivity of a central bank varies over time and is a function of financial instability.

During financial crisis central banks usually decrease interest rates in order to tame financial excess. On the contrary, decreased interest rates may induce significant inflation. Hence, interest rate adjustments have an inverse effect on inflation and financial stability and cause a conflict of these political objectives. Concerning the Fed behavior - especially during the peak of the latest financial crisis - this fact poses the following question: Did the Fed excessively deemphasize inflation stabilization in favor of financial stabilization? Usually, the compliance with the Taylor principle guarantees reasonable inflation stabilization. Therefore, monetary policy is adequate with respect to inflation stabilization, if the Taylor principle is not violated over a prolonged period. The present paper shows that the Fed did not systematically neglect the objective of inflation stabilization in favor of financial stabilization over a prolonged period - especially during the peak of the latest financial crisis.

2 Existing studies

The current state of research provides theoretical and simulation based studies concerning time-varying Taylor coefficients. Dotsey (1990), Kaminsky (1993), Ruge-Murcia (1995), Andolfatto and Gomme (2003), Leeper and Zha (2003) and Davig (2004) investigate the coefficient sensitivity accounting for diverse exogenous processes like e.g. a tax rate, money growth rate, or government expenditures. Davig and Leeper (2007) generalize Taylor's rule by allowing for regime changes in which the parameters vary stochastically over time. Furthermore, this study underlines that price stability is deemphasized periodically in favor of financial stability and is intended to compensate fundamental shocks. Contrary to existing literature, I estimate a concrete generalized Taylor rule by allowing for time-varying inflation sensitivity of the Fed upon stock market uncertainty.

3 Empirical results

In order to estimate the standard and generalized Taylor rule for the US, the conventional methodology according to Clarida, Galí, and Gertler (1998, 2000) is applied. Relevant monthly data are obtained from Thompson Reuters Datastream for the period 1990:1 to 2010:12. r_t symbolizes the nominal interest rate during the month t in terms of the mean value of the Federal Funds Rate. The proxies for the expected inflation $\pi_{12,t} = \log(cpi_{t+12}/cpi_t) \cdot 100$ and the current inflation $\pi_{1,t} = \log(cpi_t/cpi_{t-1}) \cdot 100$ rely on the seasonally adjusted consumer price index *cpi* (1982-84=100). Furthermore, $o_t = \Delta \log o_t^\star$ stands for logarithmic growth rates of the commodity spot price index $o_t^\star$ (1967=100) and vix_t (monthly average of daily *vix* closing prices) denotes in period t expected stock market variability of the S&P 500 during the next month $t+1$. The *vix* values are calculated by the Chicago Board Options Exchange and rely on implied volatilities of S&P 500 options. Usually, this volatility index serves as a proxy for financial uncertainty (see e.g. Bloom (2009)). Similarly to Bernanke and Gertler (1999), the seasonally adjusted industrial production index y_t (2007=100) is detrended by a linear and quadratic trend based on the OLS estimation from 1990:1 to 2008:6 and leads to the output gap $x_t = y_t - \widehat{\beta}_0 - \widehat{\beta}_1 t - \widehat{\beta}_2 t^2$.[1] The approximated potential output $\widehat{\beta}_0 + \widehat{\beta}_1 t + \widehat{\beta}_2 t^2$ for the remaining period 2008:7-2010:12 corresponds to the projection of the OLS estimates of the short sample. Figure 1 illustrates the distortive effect of the recent financial crisis on the estimated potential output, where the biased potential output is calculated using the OLS estimates for β_0, β_1 and β_2 over the entire sample. It is unlikely to expect that the recent financial crisis shifts the overall potential production in the illustrated way. The more realistic scenario seems to be the convergence of the actual production to the projected pre-crisis path of potential production. This more likely development implies a recovery of the economy and not a permanent negative evolution of the potential output.

In the following the standard Taylor rule[2]

$$r_t = (1-\rho)(\beta \pi_{12,t} + \gamma x_t) + \rho r_{t-1} + u_t \tag{1}$$

with constant inflation sensitivity expressed by β and the generalized Taylor rule

$$\begin{aligned} r_t &= (1-\rho)(\beta_t \pi_{12,t} + \gamma x_t) + \rho r_{t-1} + e_t & (2) \\ \beta_t &= \alpha_1 + \alpha_2 vix_t & (3) \end{aligned}$$

[1] The appropriate Datastream times series codes are:
r = usfdfund, *cpi* = usconprce, $o^\star$ = crbspot, *vix* = cboevix, y = usiptot.g

[2] The constant - which turns out to be statistically insignificant - is neglected, due to large nominal interest rate fluctuations during the observed sample.

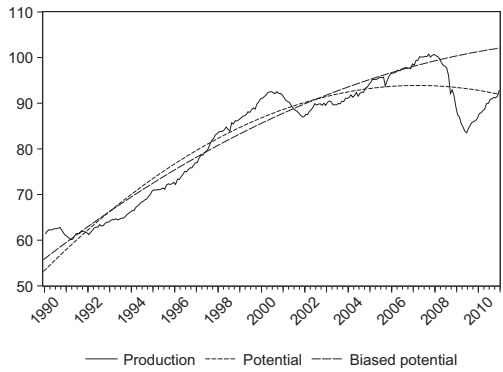

Figure 1: Industrial (potential) production.

with variable inflation sensitivity expressed by β_t are estimated using the GMM methodology. Here u_t and e_t indicate the error terms. Table 1 shows the estimation results. All estimates are significantly different from zero on

Table 1: GMM-estimated Taylor rules

α_1	α_2	β	γ	ρ
Standard Taylor rule				
-	-	1.73	0.28	0.96
-	-	(0.18)	(0.06)	(0.01)
Generalized Taylor rule				
3.01	-0.07	-	0.29	0.97
(0.44)	(0.02)	-	(0.10)	(0.01)

Standard errors in parenthesis; adjusted sample: 1990:1-2009:12; instruments: x_{t-i}, $\pi_{1,t-i}$, o_{t-i}, r_{t-i}, vix_{t-i} with $i = 1, \ldots, 6, 9, 12$

every plausible level of significance. It is possible to compute $\widehat{\beta}_t$ according to equation (3) using the estimates $\widehat{\alpha}_1$, $\widehat{\alpha}_2$ and the values for vix_t. If $\widehat{\beta}_t < 1$ holds, the Taylor principle is violated for the observation t. In order to detect a prolonged deviation from the Taylor principle of the Fed, the term ,,prolonged" has to be specified in more detail. To abstract from short-term fluctuations of $\widehat{\beta}_t$ it is reasonable to extract its local trend, which will be interpreted as the ,,average" or ,,prolonged" behavior at time t. A popular nonlinear trend extraction method in macroeconomics is the HP-filter.

Therefore, I will use the HP-trend of $\widehat{\beta}_t$ as a proxy for the prolonged inflation sensitivity behavior of the Fed. The estimated inflation sensitivity $\widehat{\beta}_t$, its HP-trend and mean are illustrated in Figure 2, whereas the shaded

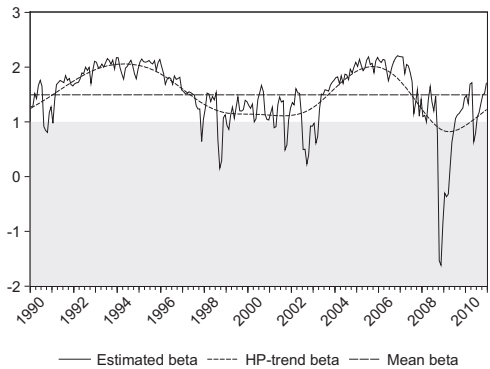

Figure 2: Variable inflation stabilization.

area is connected to inconsistency according to the Taylor principle. It is interesting to note that the mean value (= 1.5) of $\widehat{\beta}_t$ matches the parameter setting of Taylor (see Taylor (1999)) and, therefore, bares empirical evidence

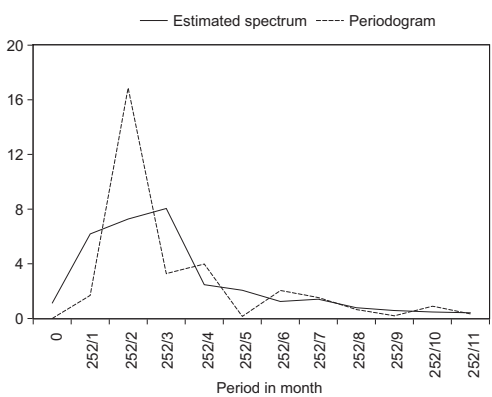

Figure 3: Periodogram and the estimated Daniell spectrum of $\widehat{\beta}_t$ (window width = 3).

of the long-run consistency of the estimated generalized Taylor rule with the extraordinary useful standard Taylor rule.

The interesting domain of the periodogram and the consistently estimated Daniell spectrum (window width = 3) of $\widehat{\beta}_t$ for the sample 1990:1 to 2010:12 ($N = 252$ months) at Fourier frequencies $\lambda = k/N$, $k = 0, 1, 2, \ldots$, is illustrated in Figure 3. A wide peak of the estimated spectrum is observable in the frequency band [1/252;3/252]. The clear periodogram peak at $\lambda = 2/252$ allows for the identification of the dominant period of $1/\lambda = 126$ months. Therefore, inflation sensitivity of the Fed shows empirically - as postulated by Davig and Leeper (2007) - a cyclical pattern. To be more precise, the cycle lasts approximately 10 years.

4 Conclusions

In this paper the standard Taylor rule and the generalized Taylor rule - which allows for time-varying inflation sensitivity - are estimated by GMM for the Fed. The variable evolution of inflation sensitivity over time is determined by financial instability. Increasing financial instability by means of *vix* values leads to decreasing inflation stabilization. Based on the precise coefficient estimates of the generalized Taylor rule, stock market uncertainty approximated by *vix* values larger than $(1 - \widehat{\alpha}_1)/\widehat{\alpha}_2 = 27$ leads to a conflict - in the Taylor sense - between financial and inflation stabilization (i.e. $\widehat{\beta}_t < 1$). Therefore, from the Fed's perspective it is reasonable to avoid regimes which correspond to the critical *vix* band. Temporary deviations from the Taylor principle are evident during the past 20 years and reflect the important effect of financial uncertainty on inflation sensitivity of the Fed. Prolonged deviations from the Taylor principle in terms of the HP-trend of the time-varying inflation parameter are not evident. Although, the Fed's focus on price stability at the end of the year 2008 seems to be close to the Taylor limit of 1, it is empirically not evident that the Fed disregarded price stabilization over a prolonged period during the latest financial crisis. Even during the peak of the crisis at the end of the year 2008 (Lehman Brother bankruptcy on Sep. 15, 2008) the Fed reacted resolutely, but still controlling for inflation.

Additionally, the supposed periodical shifts (see Davig and Leeper (2007)) of the Fed's focus from price to financial stabilization is evident and formally confirmed by the periodogram and the consistently estimated spectrum. A periodical inflation stabilization cycle lasts approximately 10 years.

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