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An Assessment of Inflation Targeting in a Quantitative Monetary Business Cycle Framework

Dooyeon Cho and Dong-Eun Rhee

KIEP Korea Institute for International Economic Policy

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Wook Chae
President

Korea Institute for International Economic Policy
246 Yangjaedaero, Seocho-Gu, Seoul 137-747, Korea
Tel: 02) 3460-1114 / FAX: 02) 3460-1144,1199
URL: http//www.kiep.go.kr

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Tel: (822) 3460-1251   Fax: (822) 3460-1144
URL: http://www.kiep.go.kr

Wook Chae, *President*

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Executive Summary

This paper examines the effectiveness of inflation targeting to stabilize the real economy of the advanced countries where inflation targeting was adopted in the early 1990s. This paper employs the monetary business cycle accounting methodology recently developed by Šustek (2011) which is an extended version of Chari, Kehoe, and McGrattan (2007) to monetary models in order to quantitatively assess inflation targeting. Our main finding is that the monetary policy wedge, which captures economic fluctuations caused by monetary policy, has significantly declined since the implementation of inflation targeting in the early 1990s. The results suggest that advanced economies such as Australia, Canada, Sweden, and the UK, that adopted inflation targeting in the early 1990s have been successful in stabilizing business cycle fluctuations.

Keywords: Monetary Business Cycle Accounting; Inflation Targeting; Taylor Rule

JEL Classification: E31; E32; E52

Dooyeon Cho is a research fellow at Korea Institute for International Economic Policy (KIEP). He received his Ph.D. in Economics from Michigan State University. His fields of specialization include international finance, macroeconomics, and applied econometrics.

Dong-Eun Rhee is Head of International Macroeconomics Team at Korea Institute for International Economic Policy (KIEP). His fields of research are monetary economics, macroeconomics, and international finance. He received his B.A. and M.A. degree in Economics from Korea University and his Ph.D. degree in Economics from the Indiana University-Bloomington.

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An Assessment of Inflation Targeting in a Quantitative Monetary Business Cycle Framework

Dooyeon Cho* and Dong-Eun Rhee**

I. Introduction

Inflation Targeting (IT) has become one of the common monetary policy strategies used since New Zealand first adopted it in April 1990. While approximately thirty central banks all over the world have publicly announced IT, many other central banks such as European Central Bank (ECB), have *implicitly* adopted the basic idea of IT.[1] However, although it is broadly believed that the performance of IT has largely been a success, there is no strong empirical evidence that

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* Department of International Economy, Korea Institute for International Economic Policy (KIEP), Seoul 137-747, Korea; Tel: +82 2 3460 1109, Fax: +82 2 3460 1212, Email: dycho@kiep.go.kr

** Corresponding author. Department of International Economy, Korea Institute for International Economic Policy (KIEP), Seoul 137-747, Korea; Tel: +82 2 3460 1151, Fax: +82 2 3460 1212, Email: derhee@kiep.go.kr

[1] Those countries that have *implicitly* adopted IT are referred to as 'inflation targeting lite' countries in the literature.

is supportive of such successful IT, especially in developed countries. For example, Lin and Ye (2007) find no empirical evidence that IT has significant effects on the level and volatility of the inflation rate for seven industrialized countries that adopted the policy in the 1990s; while Lin and Ye (2009) find some empirical evidence that IT played a role in lowering both the inflation rate and inflation variability significantly for thirteen developing countries that adopted the policy by the end of 2004. Similarly, Walsh (2009) also finds no evidence that IT affected, on average, output growth or volatility for industrialized economies. Moreover, there exists some concern that IT may cause larger real output volatility, since inflation is supposed to be the only target of monetary policy for IT countries (See Kohn 2003).

This paper aims to evaluate the role which IT plays in helping stabilize the real economy during the so-called period of the Great Moderation. As noted by Walsh (2009), IT has been a candidate to promote stable growth in the Great Moderation period, but the hypothesis has not yet been rigorously tested. This paper investigates whether economic fluctuations caused by monetary policies have been stabilized for four developed economies–Australia, Canada, Sweden, and the United Kingdom–which adopted IT in the early 1990s in the 'Monetary Business Cycle Accounting' framework.

The standard Business Cycle Accounting (BCA) methodology was first introduced by Chari, Kehoe and McGrattan (2007) (CKM henceforth). BCA decomposes output fluctuations into fluctuations due to changes in the efficiency wedge, labor wedge, investment wedge, and government consumption wedge. In their paper, CKM decompose the U.S. business cycle components into the four different types of wedges, and find that the efficiency and labor wedges are the most important factors in explaining output fluctuations in the U.S. There have been many studies that employ the standard BCA model with various countries and different periods being analyzed. Among others, Cociuba *et al.* (2008) use the standard BCA methodology to study the Canadian economy during the post 1960 period, and find that the efficiency and labor wedges are the key driving factors in explaining output fluctuations, as in CKM. Lama (2011) develops an open economy version of the standard BCA methodology to analyze output drops in Latin America, and finds that the efficiency and labor wedges were the most promising factors. For all of these studies, the efficiency and labor wedges are found to be very important, but the investment wedge plays a tertiary role. However, Chakraborty (2009) finds the efficiency and investment wedges to be the most important in the analysis of the Japanese economy by applying the standard BCA methodology. Cho and Doblas-Madrid (2013) also apply the standard BCA methodology to a sample of 23 financial crises, and conclude that output drops in the aftermath of East Asian financial crises are mostly driven by the efficiency and investment wedges. These two studies find that the investment wedge plays an important role in East Asia as opposed to other BCA studies that analyze Western countries.

Šustek (2011) extends the standard BCA model to monetary models. More specifically, he adds two key nominal variables, which are the short-term nominal interest rate and inflation, to the standard BCA model to study the roles of the asset market and monetary policy wedges in the business cycle, and the specific methodology is referred to as 'Monetary Business Cycle Accounting'. He finds two stylized facts in the U.S. nominal business cycle: the lead–lag relationship between output and inflation, and between output and the short-term nominal interest rate using the quarterly data for the period 1959.Q1–2004.Q4. This paper employs the monetary BCA methodology to explore effects of IT on the business cycle. The methodology enables us to decompose aggregate business cycle fluctuations in order to isolate the marginal effects of the six wedges in the underlying theoretical framework. Among the six wedges, the monetary policy wedge is our main interest, and it is tested to determine whether the monetary policy wedge has significantly declined after the implementation of IT. Our study is similar to Kersting (2008) in that he focuses on the labor wedge to study the effects of the new labor market policies under Margaret Thatcher on union density and collective bargaining. In his paper, he employs the standard BCA methodology to study the U.K. economy in the 1980s, and concludes that Margaret Thatcher's labor market reforms lowered the labor wedge, and thus contributed to the improvement in economic performance. Akin to his study, our paper focuses on the monetary policy wedge to study the effectiveness of IT for those countries that adopted it in the early 1990s.

We find evidence that both output volatility and the monetary policy wedge have significantly declined in the years following the implementation of IT. Moreover, in the same period, the monetary policy wedge is the only factor which has significantly decreased for all four countries. This finding suggests that IT is at least one of the factors contributing to the stabilization of output volatility. In terms of the six factors of business cycle fluctuations, it appears that IT which is evaluated by the monetary policy wedge is the only factor which contributed in a consistent way to the stabilization of the aggregate output volatility during the Great Moderation period. It is the first to show the effectiveness of IT in stabilizing developed economies' business cycles in the quantitative monetary business cycle framework.

The rest of this paper is organized as follows. In Section 2, we provide a brief discussion on the relationship between IT and business cycle fluctuations. In Section 3, we introduce the model and describe the measurement and accounting procedure. In Section 4, we describe our data. In Section 5 we present and interpret the quantitative results, and also provide some robustness checks for the Taylor rule. In Section 6, we conclude.

II. Inflation Targeting and the Business Cycle

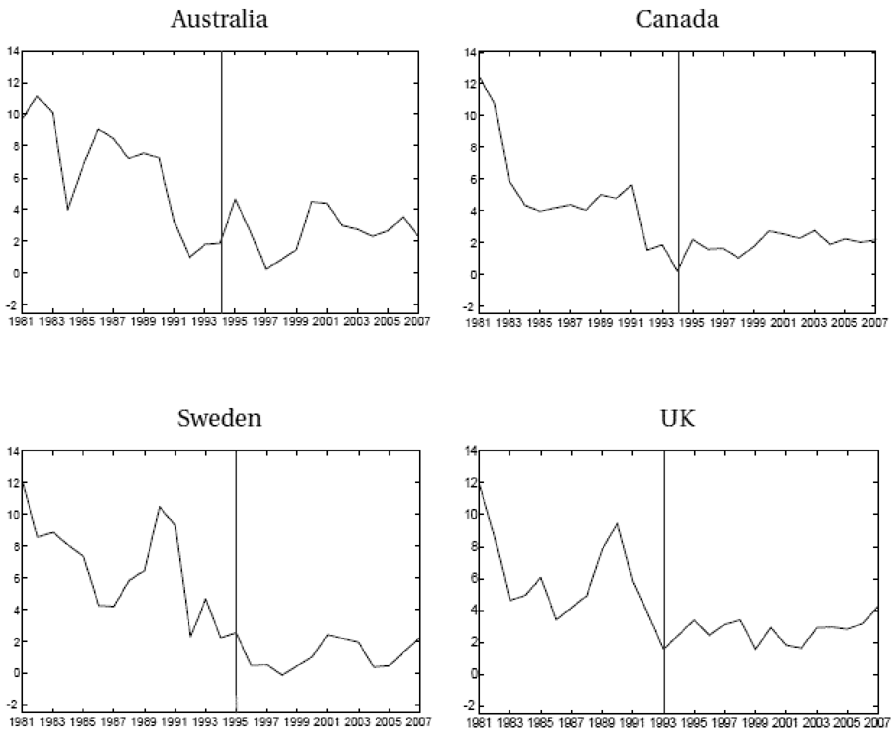
The implications of the New Keynesian Phillips Curve (NKPC), based on rational expectations are that discretionary monetary policy has only temporary effects on the real economy, and that repeated unexpected monetary shocks reduce policy credibility. In the spirit of NKPC, discretionary monetary policy causes fluctuations in the real economy in the long-run, and thus such a policy rule is superior to discretion. Since IT is a very simple and special case of those rules, it will reduce business cycle fluctuations.

Although there is no long-run relationship between inflation and output since NKPC is vertical in the long-run, there might be a long-run trade-off between fluctuations in output and fluctuations in inflation as in the so-called Taylor curve (Taylor 1979). In his empirical research, Taylor (1979) finds that a reduction in the variability of output can come at the expense of more variability in the inflation rate. If the Taylor curve actually matters, the country with IT policy will have more volatile business cycle, since the main goal of IT is to stabilize both the level and volatility of the inflation rate.

However, the macroeconomic data in the period of the Great Moderation suggest a somewhat different story from Taylor (1979). In the Great Moderation period, both inflation volatility and output volatility in advanced countries have significantly declined. Moreover, the starting point of the period coincides with the early stage of IT in advanced economies. Both Figures 1 and 2 clearly confirm this story. Figure 1 represents the inflation rate for each country. It shows that the inflation rates in Canada, Sweden, and the U.K. were approximately 12

Figure 1. Inflation Rate

(Unit: percentage)

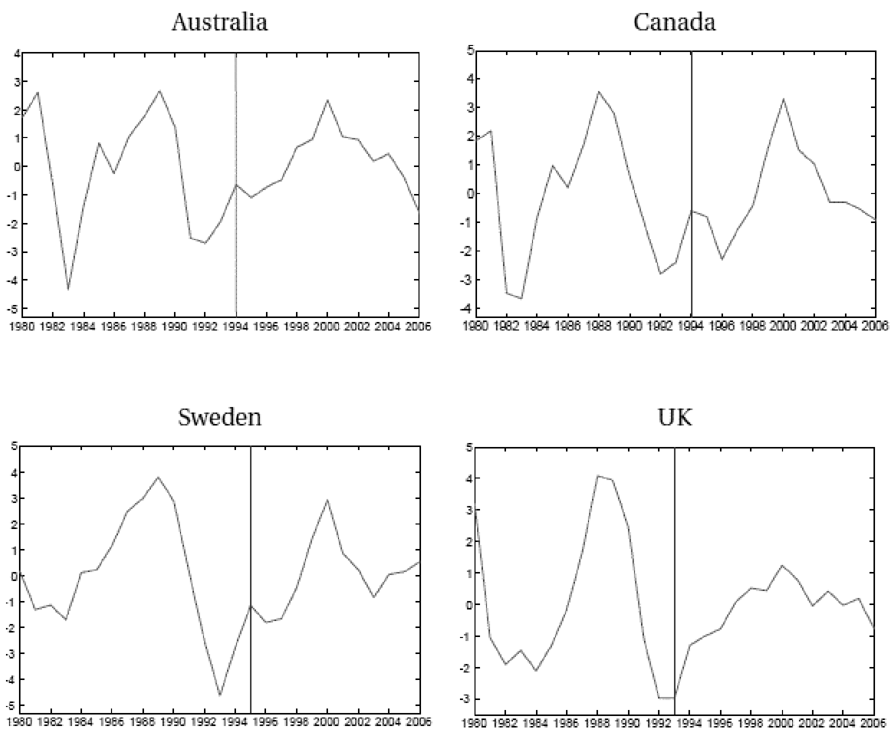


Note: The vertical line denotes the starting date of the constant inflation targeting for each country.

percent in 1981 (in Australia, it was about 10 percent), and the variability of the inflation rates was high. However, the variability of the inflation rates has significantly declined varying between 0 and 4 percent after the starting dates of constant IT. In Figure 2, the series for real GDP per working age population in percentage deviation from steady state are depicted. It clearly shows that the volatility of per capita real output in each country has declined after the implementation

Figure 2. Real GDP per Working Age Population in Deviation from Steady State

(Unit: percentage)



Note: The vertical line denotes the starting date of the constant inflation targeting for each country.

of constant IT in the early 1990s. Specifically, the difference in means of volatilities between before- and after-constant IT shows a statistically significant decrease for Australia, Canada, and Sweden at the 5 percent level, and for the U.K., at the 1 percent level. Flood and Rose (2010)'s empirical findings are also supportive of the idea that IT might affect the business cycle. They find that the coupling of the business cycles became stronger, and IT policy might contribute to the business cycle synchronization.

Therefore, the two facts that we mainly consider in this paper are that in the Great Moderation period, both output volatility and inflation volatility have reduced, and that IT has been adopted in some advanced economies in the same period. To investigate whether specific monetary policy caused a decrease in output volatility, we need a rigorous theoretical framework instead of running reduced form regressions. We employ the monetary BCA model to combine the theoretical monetary policy transmission mechanism with the macroeconomic data.

III. Monetary Business Cycle Accounting

1. The Prototype Model

Following CKM and Šustek (2011), we introduce the model and accounting procedure. Šustek (2011) extends the standard BCA model in CKM by adding two nominal variables, inflation and the short-term nominal interest rate into the model. To be more specific, the model described in Šustek (2011) is a prototype monetary economy, which is based on a standard neoclassical growth model augmented to include nominal bonds and monetary policy which differs from the original model in CKM. A government imposes a tax to consumers, and sets the rate of return on a one-period bond. In period *t*, the economy is hit by one of a finite number of events s_t. The history of realized events up to and including period *t* is denoted by $s^t = (s_0, \ldots, s_t)$, and the initial realization of the event denoted by s_0 is exogenously given. The probability of any particular history s^t is denoted by $\Pi_t(s^t)$ as of period 0. In this economy, there are six exogenous stochastic variables which depend on s^t: the efficiency wedge $A_t(s^t)$, which acts like time-varying productivity; the labor wedge $\tau_{lt}(s^t)$, which resembles a time-varying tax on labor income; the investment wedge $\tau_{xt}(s^t)$, which acts like a time-varying tax on investment; the government consumption wedge $g_t(s^t)$, which acts like government expenditure; the asset market wedge $\tau_{bt}(s^t)$, which has the same effect as a time-varying tax on nominal bonds; and the monetary policy wedge $\tilde{R}_t$, which distorts the Taylor rule. In Šustek (2011), among the six wedges listed above, the first four wedges are referred to as 'CKM wedges' since they are essentially the same as those in the CKM economy. The last two wedges are newly added nominal wedges in addition to the aforementioned four real wedges in the monetary BCA model.

The population, which is denoted by N_t, is assumed to grow at a constant rate of γ_n. The representative consumer chooses per capita consumption $c_t(s^t)$ and per capita labor $l_t(s^t)$ to solve the following maximization problem:

$$max \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \Pi_t(s^t) U(c_t(s^t), 1 - l_t(s^t))(1 + \gamma_n)^t,$$

where $\beta \in (0,1)$ is a discount factor. The representative consumer's utility maximization is subject to the following budget constraint:

$$\begin{aligned} & c_t(s^t) + [1 + \tau_{xt}(s^t)][(1 + \gamma_n)k_{t+1}(s^t) - (1 - \delta)k_t(s^{t-1})] \\ & \quad +[1 + \tau_{bt}(s^t)]\left[(1 + \gamma_n)\frac{b_t(s^t)}{(1 + R_t(s^t))p_t(s^t)} - \frac{b_{t-1}(s^{t-1})}{p_t(s^t)}\right] \\ & \quad\quad =[1 - \tau_{lt}(s^t)]w_t(s^t)l_t(s^t) + r_t(s^t)k_t(s^{t-1}) + T_t(s^t), \end{aligned} \tag{1}$$

where $k_t(s^{t-1})$, $[(1 + \gamma_n)k_{t+1}(s^t) - (1 - \delta)k_t(s^{t-1})]$, and $T_t(s^t)$ are respectively, per capita capital, per capita investment, and per capita lump-sum taxes/transfers. $p_t(s^t)$ is a nominal price of goods in terms of a unit of account, and $b_t(s^t)$ is holdings of a bond paying a net nominal rate of return $R_t(s^t)$ in all states of the world in period *t*+1 and is in net zero supply. The real wage rate and real rental rate on capital are denoted respectively, by $w_t(s^t)$ and $r_t(s^t)$, and δ is the depreciation rate of capital.

In period *t*, firms choose per capita capital $k_t(s^{t-1})$ and per capita labor

$l_t(s^t)$ to maximize profits

$$A_t(s^t)F\big(k_t(s^{t-1}),(1+\gamma)^t l_t(s^t)\big) - r_t(s^t)k_t(s^{t-1}) - w_t(s^t)l_t(s^t), \tag{2}$$

where γ denotes the constant growth rate of labor-augmenting technological progress.

In this economy, equilibrium is described entirely by the following equations:

$$c_t(s^t) + [(1+\gamma_n)k_{t+1}(s^t) - (1-\delta)k_t(s^{t-1})] + g_t(s^t) = y_t(s^t), \tag{3}$$

$$y_t(s^t) = A_t(s^t)F\big(k_t(s^{t-1}),(1+\gamma)^t l_t(s^t)\big), \tag{4}$$

$$R_t(s^t) = (1-\rho_R)\big[R + \omega_y(\ln y_t(s^t) - \ln y) + \omega_\pi(\pi_t(s^t) - \pi)\big] + \rho_R R_{t-1}(s^{t-1}) + \tilde{R}_t, \tag{5}$$

$$\frac{U_{lt}(s^t)}{U_{ct}(s^t)} = [1-\tau_{lt}(s^t)]A_t(s^t)(1+\gamma)^t F_{lt}(s^t), \tag{6}$$

$$\begin{aligned} U_{ct}(s^t)[1+\tau_{xt}(s^t)] = {} & \beta \textstyle\sum_{s^{t+1}} \pi_t(s^{t+1}|s^t)\, U_{c,t+1}(s^{t+1}) \\ & \mathrm{X}\, \{A_{t+1}(s^{t+1})F_{k,t+1}(s^{t+1}) + (1-\delta)\big[1+\tau_{x,t+1}(s^{t+1})\big]\} \end{aligned} \tag{7}$$

and

$$\begin{aligned} U_{ct}(s^t)[1+\tau_{bt}(s^t)]p_{t+1}(s^{t+1}) = {} & \beta \textstyle\sum_{s^{t+1}} \pi_t(s^{t+1}|s^t)\, U_{c,t+1}(s^{t+1}) \\ & \mathrm{X}\, \{\big[1+\tau_{b,t+1}(s^{t+1})\big]p_t(s^t)[1+R_t(s^t)]\} \end{aligned} \tag{8}$$

where $\rho_R \in [0,1)$, $\pi_t(s^t)$ ($\equiv \ln p_t(s^t) - \ln p_{t-1}(s^{t-1})$) denotes the inflation rate, and a variable's symbol without a time subscript denotes the variable's steady state (or balanced growth path) value. U_{ct} and U_{lt} denote the first derivatives of the utility function with respect to consumption and labor. Similarly, F_{lt} and F_{ct}

denote the first derivatives of the production function with respect to labor and capital. These six equations (1)–(6) above determine equilibrium $(c_t(s^t), x_t(s^t), y_t(s^t), l_t(s^t), p_t(s^t), R_t(s^t))$. Equation (1) is the feasibility condition in this economy, and equation (2) is the production function. Equation (3) is the monetary policy rule, distorted by the monetary policy wedge or Taylor rule wedge $\tilde{R}_t$. Equation (4) states that in equilibrium, the marginal rate of substitution between consumption and leisure is equal to the marginal product of labor, distorted by the labor wedge $\tau_{lt}(s^t)$. Equation (5) is an intertemporal Euler equation, distorted by the investment wedge $\tau_{xt}(s^t)$, and $\tau_{lt+1}(s^{t+1})$. Lastly, equation (6) is an intertemporal optimality condition for bonds, distorted by the asset market wedge $\tau_{bt}(s^t)$ and $\tau_{bt+1}(s^{t+1})$.

Monetary authority is assumed to follow a version of the Taylor (1993) rule as given in equation (5). ρ_R represents the degree of interest rate smoothing, ω_y is a response to output gap, and ω_π is a response of monetary authority to the deviation of current inflation from the target inflation rate. If $\omega_\pi > 1$, the central bank moves the nominal interest rate enough to adjust the real interest rate to stabilize inflation. If $\omega_\pi < 1$, the central bank accommodates changes in inflation. In the baseline parameterization, we assume $\omega_\pi > 1$ and $\omega_y = 0.5$ to describe a version of IT. Specifically, we assume that $\rho_R = 0$, $\omega_y = 0.5$, and $\omega_\pi = 1.5$, and conduct robustness checks for the parameter value changes in equation (5) in Section 5. In the context of discussions between rule and discretion in monetary policy, IT policy is a very special case of policy rule, which imposes a heavy weight on inflation stabilization. Equation (5) implies a kind of rules, and thus the error term $\tilde{R}_t$ captures discretionary monetary policy which is not explained by the rule. If monetary authority actually follows the rule, instead of discretionary monetary policy, it may have a smaller monetary policy wedge.

Since we assumed a version of IT rule, a smaller monetary policy wedge implies that the country actually implemented IT.

The equilibrium conditions given by equations (1), (2), (4), and (5) are the same as those in the CKM economy. What are new in this economy are equations (3) and (6). Besides four CKM wedges, the asset market wedge distorts the intertemporal optimality condition for bonds as in equation (6), and the monetary policy wedge distorts the Taylor rule as in equation (3). As Šustek (2011) explains, this economy is block recursive in the sense that equations (1), (2), (4), and (5) first determine the equilibrium allocations $(c_t(s^t), x_t(s^t), y_t(s^t), l_t(s^t))$, and then the monetary policy rule (3) and the optimality condition for bonds (6) determine equilibrium $p_t(s^t)$ and $R_t(s^t)$, respectively. While the four CKM wedges affect both real and nominal variables as a result of this recursive structure, the asset market and monetary policy wedges affect only two nominal variables which are $p_t(s^t)$ and $R_t(s^t)$.

As CKM stress, the wedges or frictions represent all possible kinds of distortions that can enter the first order conditions. For example, a labor wedge may arise due to a labor income tax. Frictions may arise from a variety of sources, such as taxes, monopoly power by unions or firms, sticky wages or sticky prices. CKM and Šustek (2011) generalize these results by illustrating the mapping, and showing that explicitly modeled frictions map into wedges in this prototype economy. For example, in CKM, input-financing frictions map into efficiency wedges, investment-financing frictions into investment wedges, and fluctuations in net exports in an open economy map into government consumption wedges. Šustek (2011) provides three examples of mappings from detailed economies with frictions to the prototype economy. For example, sticky prices map into labor and investment wedges, limited participation in asset markets into asset market wedges, and all aspects of monetary policy beyond the responses of the monetary authority to output and inflation into monetary policy wedges.

As a consequence, by construction, the model exactly reproduces the data on output, labor, investment, consumption, inflation rate, and nominal interest rate when all six wedges are jointly fed into the model.

2. The Business Cycle Accounting Procedure

2.1. Measuring the Wedges

Following CKM and Šustek (2011), it is assumed that the mapping from the event $p_t(s^t)$ and $R_t(s^t)$ to all the wedges is one-to-one and onto. The accounting procedure is to conduct experiments isolating the marginal effect of each wedge as well as the marginal effects of combinations of the wedges on aggregate variables. For example, in conducting the experiment which isolates the marginal effect of the labor wedge, we hold all other wedges fixed at some constant levels in all periods.

To implement the accounting procedure, the production function is assumed to have the Cobb-Douglas form:

$$F(k,l) = k^{\alpha} l^{1-\alpha}$$

where α is the capital share and the utility function is given by

$$U(c,l) = \lambda \log c + (1-\lambda)\log(1-l)$$

where λ denotes the time allocation parameter. In Table 1, we describe the benchmark model parameter values and their sources for each country in our sample. To derive the steady state value of the wedges, we make use of these values along with the data.

As in CKM and Šustek (2011), the government consumption wedge g_t is directly measured from the data by summing government expenditure and net exports.

To estimate the stochastic process for the state, we follow CKM and Šustek (2011) and specify a vector autoregressive process of order 1 (AR(1)) for the six dimensional state $s_t = (\log A_t, \tau_{lt}, \tau_{xt}, \log g_t, \tau_{bt}, \tilde{R}_t)$. The process has the form

$$s_{t+1} = P_0 + \mathrm{P} s_t + Q\varepsilon_{t+1}$$

where the shock is independent and identically distributed over time and is distributed normally with mean zero and covariance matrix V. The estimate of V is positive semi-definite, because we estimate the lower triangular matrix Q, where

Table 1. Benchmark Model Parameter Values

Parameter Values	Australia	Canada	Sweden	United Kingdom
Technological progress rate (γ)	0.016	0.018	0.016	0.015
Population growth rate (γ_n)	0.011	0.011	0.004	0.003
Discount factor (β)	0.995	0.995	0.995	0.995
Depreciation rate of capital (δ)	0.040	0.040	0.042	0.040
Time allocation parameter (λ)	0.310	0.360	0.215	0.320
Capital share (α)	0.350	0.350	0.350	0.350

Note: The benchmark model parameter values were obtained from the business cycle literature: Sweden - Brinca (2012). The parameter values for the remaining countries were obtained by calibration for the corresponding data.

$V = QQ'$.[2] We use the log-linear decision rules of the prototype economy along with data on c_t, x_t, y_t, l_t, p_t and R_t. We use a standard maximum likelihood procedure to estimate the parameters P_0, P and V of the VAR(1) process for the wedges.

As in Šustek (2011), we use the equilibrium decision rules and pricing functions of the prototype economy to back out the realized wedges from the data. Since the state space is large as it contains nine state variables in the model ($\log A_t, \tau_{lt}, \tau_{xt}, \log g_t, \tau_{bt}, \tilde{R}_t, \log p_t, R_t,$ and $\log k_t$), the prototype economy is further approximated by a linear-quadratic economy and the equilibrium is computed using the method described in Hansen and Prescott (1995). Before computing the equilibrium, the model is transformed so the price level is stationary. The output of this solution method is a set of decision rules and pricing functions that expresses the deviations of the vector ($\log y_t, \log l_t, \log x_t, \log c_t, \log p_t, R_t$) from steady state as linear functions of the deviations of the state vector ($\log A_t, \tau_{lt}, \tau_{xt}, \log g_t, \tau_{bt}, \tilde{R}_t, \log p_t, R_t,$ and $\log k_t$) and from steady state.

Following CKM and Šustek (2011), for the results reported, we fix parameters of preferences, production, and growth and estimate the processes for the wedges. The parameters to be estimated are elements of P_0, P, and Q, and are estimated by the standard maximum likelihood estimation. As in Šustek (2011), the search for the maximum is implemented using simulated annealing with a conservative temperature reduction factor of 0.95 (Goffe *et al.* (1994)) to thoroughly explore the surface of the likelihood function. Once we have estimated P_0, P and V, we can then find the realized values of the wedges (For more technical details, see Appendices of Chari *et al.* 2006, and Šustek 2011).

[2] As in Šustek (2011), we impose no additional restrictions on the stochastic process beyond stationarity, and particularly, the off-diagonal elements of P and Q are allowed to be non-zero.

IV. Data

To construct the sample used in this paper, we first looked at the list of countries that implemented IT in the early 1990s, displayed in Svenssen (2011). After dropping some cases due to the start of the European Union (EU) and data limitations, we were left with the following four countries: Australia, Canada, Sweden, and the U.K.[3] In Table 2, we display the dates of inflation targeting and constant inflation targeting along with some rationale for the choice of the starting dates from Ball and Sheridan (2004). In what follows, we use the dates of constant inflation targeting.

The data are mainly from the *International Financial Statistics* (*IFS*) database. The series that are not from the *IFS* are as follows: working-age population (i.e., population aged 15-64), total employment, and hours worked, which are from the *International Labour Office* (*ILO*) *LABORSTA* database. For all countries analyzed in this paper, the annual data start from 1980 and end in 2007. This sample period includes the Great Moderation period.

We construct the series for per capita output (y), per capita investment (x), per capita labor input (l), per capita government consumption (g) and per capita consumption (c) as follows. Per capita output (y) is the sum of nominal GDP, deflated by the GDP deflator, and divided by population aged 15-64. We subtract sales taxes which are collected from the *OECD Economic Outlook*, from

[3] We excluded Finland in our analysis since it adopted European Central Bank (ECB)'s monetary policy after the starting date of the European Union (EU). We excluded, New Zealand, because most of data available are from only after the year 1986.

Table 2. Dates Of Inflation Targeting and Constant Inflation Targeting

Country	Inflation Targeting	Constant Inflation Targeting[Rate]	Rationale for Choice of Starting Dates
Australia	1994	1994 [2-3%]	In September 1994, the Governor of the Reserve Bank of Australia announced that "underlying inflation of 2 to 3 percent is a reasonable goal for monetary policy." See Bernanke *et al.* (1999, 218–220) for further discussion.
Canada	1992	1994 [2-3%]	The first target range was announced by the Bank of Canada in February 1991: 2 to 4 percent over 1992 (i.e. December 1991 to December 1992). In December 1993, a range of 1 to 3 percent was established for 1994, and the range has remained constant since then.
Sweden	1995	1995 [2%]	The Riksbank announced in January 1993 that it aimed "to limit the annual increase in the consu- mer price index from 1995 onwards to 2 percent." This target ap- plied to inflation over all of 1995, not to year-over-year inflation at the start of 1995 (Svensson 1995).
United Kingdom	1993	1993 [2.5%]	In October 1992, the Bank of England announced a 2.5 percent target, beginning immediately.

Source: Ball and Sheridan (2004).

the original GDP as in CKM and Šustek (2011). The series for per capita investment (x) is obtained by getting gross fixed investment, deflated using the GDP deflator and divided by population aged 15-64. To construct the series for the per capita labor input (l), we multiply annual hours worked per employed person by total employment, and divide the result by population aged 15-64. Since the value itself is total hours worked per year, we divide it by the number of weeks per year (50) and the endowment of total hours per week (100). As stated above, the series for per capita government consumption (g) is simply the sum of government expenditure and net exports of goods and services, which is deflated using the GDP deflator and divided by working-age population 15-64. By equation (1), the series for per capita consumption (c) is obtained by subtracting per capita investment (x) and per capita government consumption (g) from per capita output (y). Regarding the series for the price level (CPI) and nominal interest rate, which are the two additional nominal variables in the model, the data are also collected from the *IFS*.

V. Results

In this section, we first present and interpret quantitative results from the monetary BCA model, and then provide some robustness checks for the alternative specifications of the Taylor rule. The quantitative results overall suggest that the monetary policy wedge has significantly dropped after the implementation of the constant IT in our sample, which is in line with a reduction in output volatility. It appears that a decrease in output volatility may be attributed to a drop in the volatility of the monetary policy wedge, which is evidenced by the fact that the monetary policy wedge was the only common factor that reduced at 5 percent conventional level of statistical significance across the four countries.

1. Quantitative Results

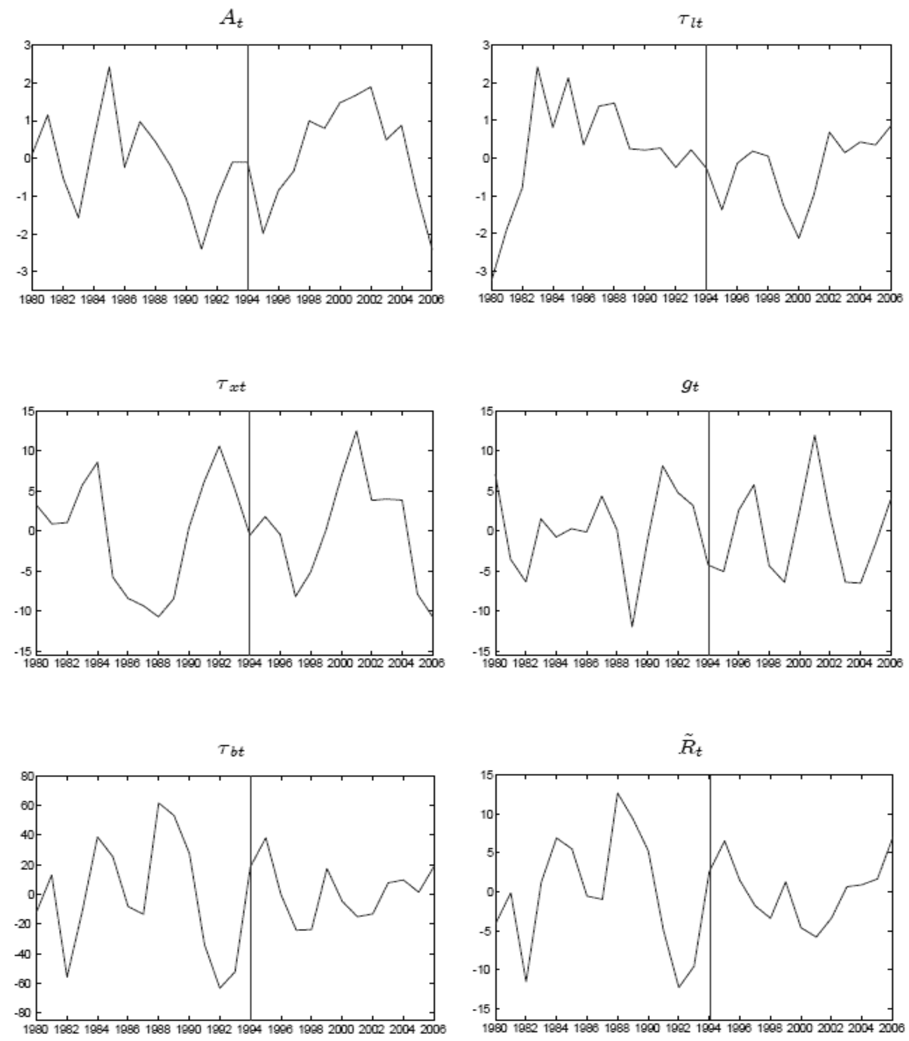
The measured wedges in deviation (percentage) from steady state for the efficiency, labor, investment, government consumption, asset market, and monetary policy wedges for all countries are depicted in Figure 3. As shown in Figure 2 and evidenced by subsequent statistical tests, we observed that output volatilities are statistically declined after implementing IT for all four economies. Since we can decompose the output volatilities into the six wedges, we are searching for the factor(s) which causes this change in output volatilities among the six wedges.

Most of all, Figure 3 shows that the volatilities of the monetary policy wedges for all four countries are reduced dramatically after the implementation of constant IT (Dates are given in Table 2). For all four countries, the difference in means

Figure 3. Measured Wedges in Deviation from Steady State.

(Unit: percentage)

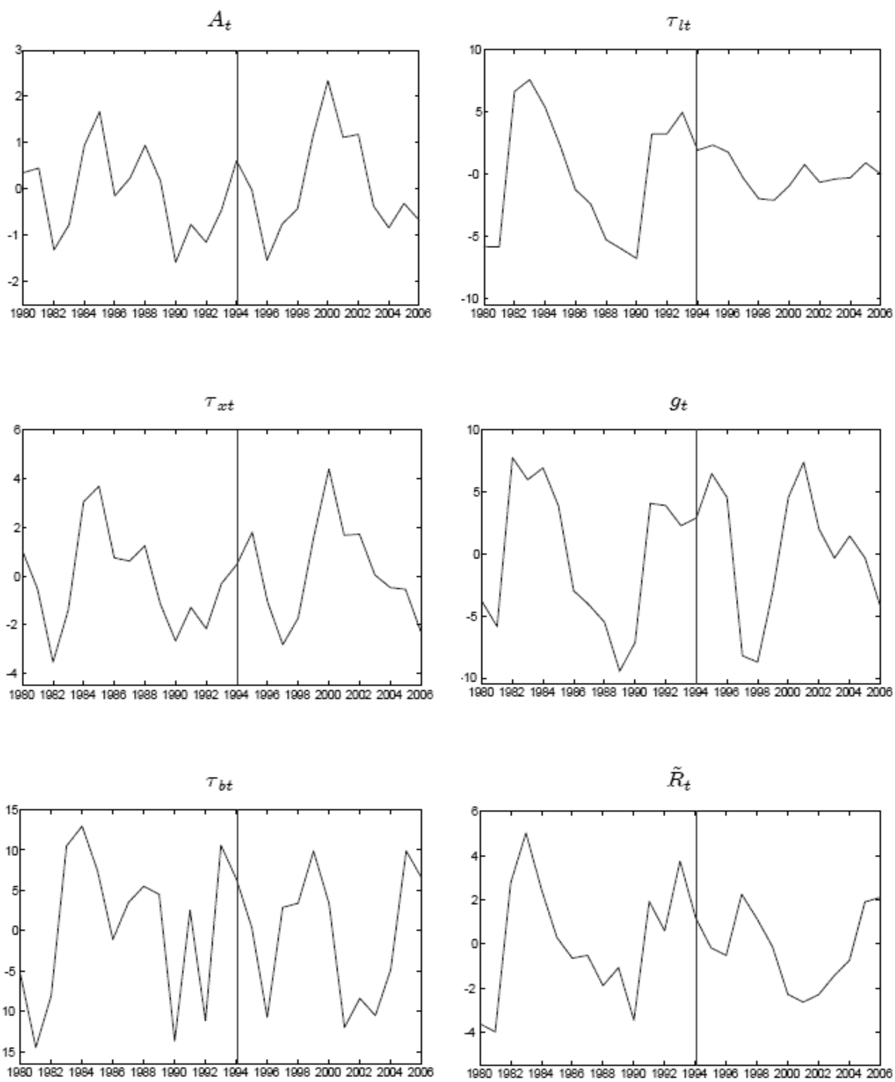
(a) Australia



Note: The vertical line denotes the starting date of the constant inflation targeting.

Figure 3. Continued

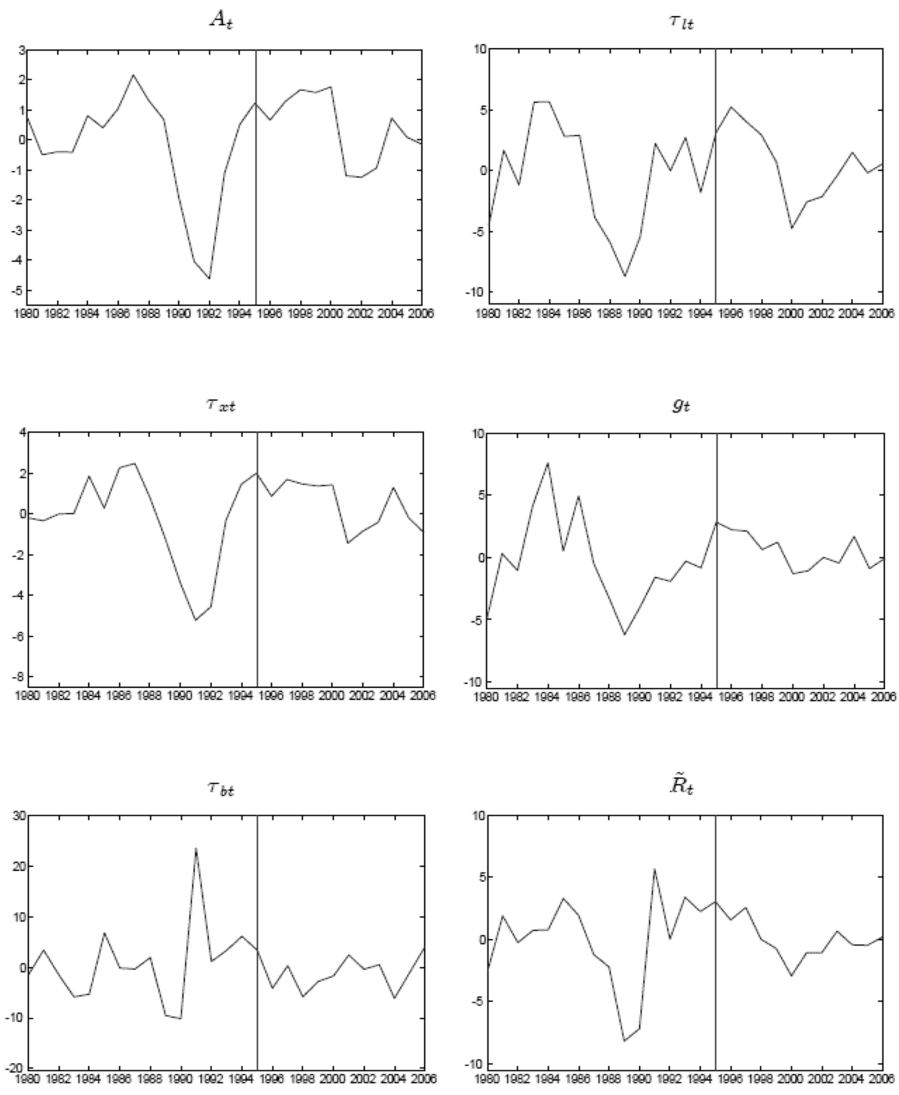
(b) Canada



Note: The vertical line denotes the starting date of the constant inflation targeting (cont'd).

Figure 3. Continued

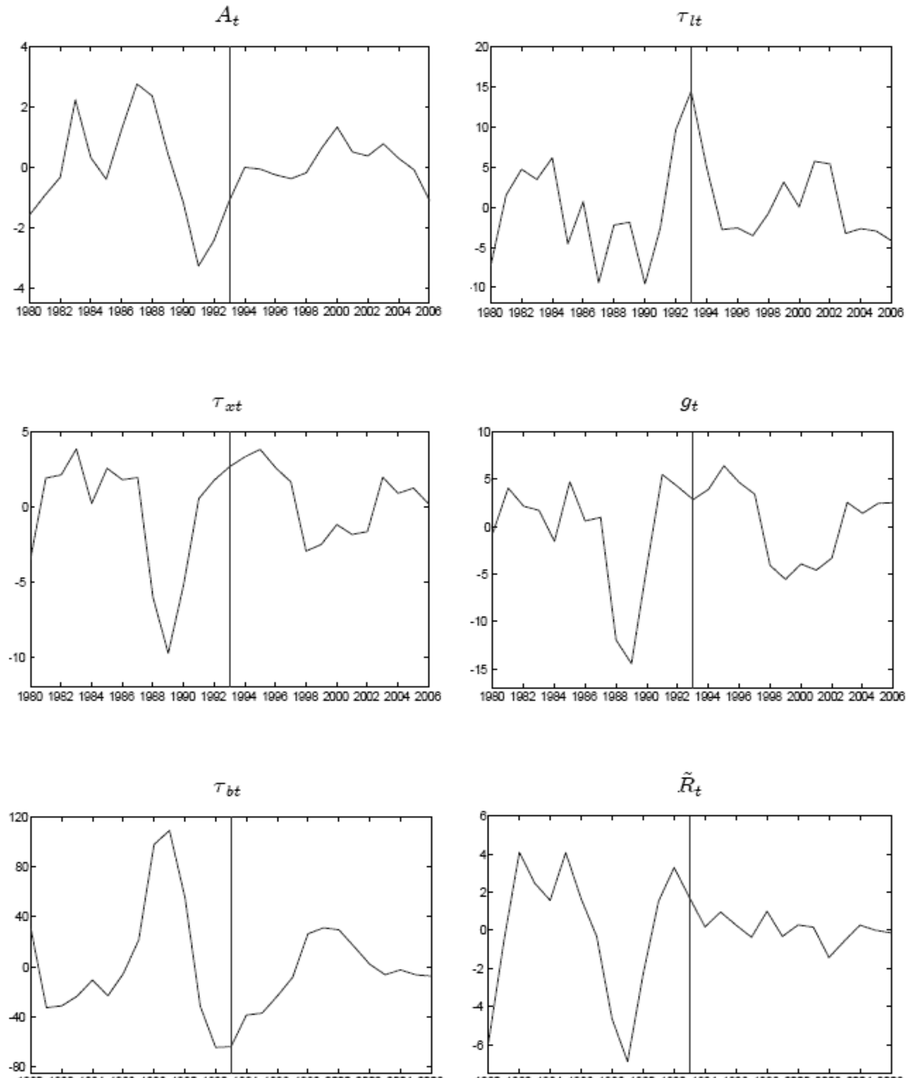
(c) Sweden



Note: The vertical line denotes the starting date of the constant inflation targeting (cont'd).

Figure 3. Continued

(d) U.K.



Note: The vertical line denotes the starting date of the constant inflation targeting (cont'd).

of volatilities is statistically significant for Australia, Canada, and Sweden at the 5 percent level, and for the U.K., at the 1 percent level. This leads to a rejection of the null hypothesis of the difference of volatility after the implementation of constant IT being greater than that before the implementation of constant IT in means. Since the baseline parameterization for the Taylor Rule (equation (5)) implies a version of IT, and the wedge has a form of error term of the equation, the reduced volatilities of the wedge implies that those countries actually follow a kind of IT policy rule. In other words, the rule-based monetary policy successfully reduced uncertainty of the economies. The result, in turn, implies that business cycle fluctuations from the monetary policy showed a statistically significant decline after implementing IT for all four economies.

A more interesting finding is that, among the six wedges, the monetary policy wedge is the only factor which has been consistently contributing to a reduction in the real economy's output volatility for all four countries after implementing IT. We report the test results of the significance regarding the other five wedges as follows. For the significance test, we use the conventional level of the 5 percent. For Australia, the volatility of the asset market wedge decreased at the 1 percent level. For Canada, the volatility of the labor wedge declined at the 1 percent level, and for Sweden, the volatilities of the labor and government consumption wedges declined at the 5 percent level. For the U.K., the volatility of the efficiency wedge dropped at the 1 percent level. It is interesting to note that the volatilities of both output and the monetary policy wedge have declined, and at the same time only the monetary policy wedge appears to be a common factor that showed a statistically significant decrease after the implementation of constant IT for four countries.

These results are suggestive of the fact that the monetary policy wedge played a role in stabilizing business cycle fluctuations. Overall, it appears that the advanced economies that adopted constant IT in the early 1990s have been successful in stabilizing business cycle fluctuations.

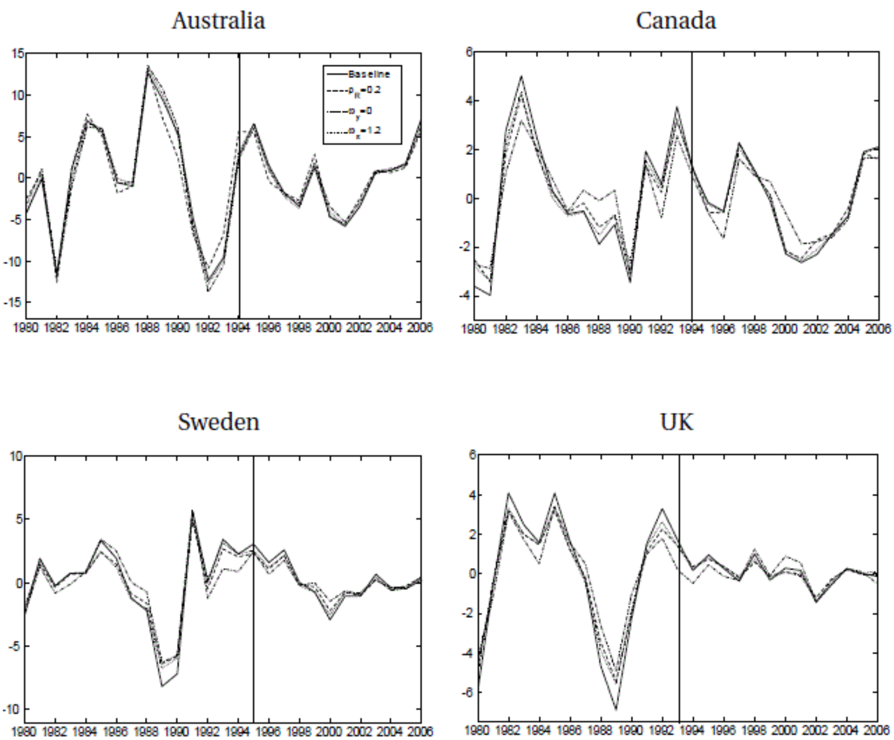
2. Robustness Checks

In this section, we conduct robustness checks for the alternative specifications of the Taylor rule in equation (2). In the baseline case, we assume that $\rho_R = 0$, $\omega_y = 0.5$, and $\omega_\pi = 1.5$. To check whether our main findings are robust to parameter value changes in the Taylor rule, we alter the parameter value one at a time as follows: i) $\rho_R = 0.2$, ii) $\omega_y = 0$, and iii) $\omega_\pi = 1.2$, and report the results in Figure 4. For example, $\rho_R = 0.2$ means that two other parameter values are the same as in the baseline case: $\omega_y = 0.5$ and $\omega_\pi = 1.5$. In Figure 4, we report only the results for the monetary policy wedge for reasons of conserving space.[4] As the Figure clearly indicates, the measured monetary policy wedge does not change dramatically when one of the parameter values alters, implying that the statistical significance of the wedge for four countries remains unaffected by the alternative specifications of the Taylor rule.

[4] The other realized wedges resulting from changing the parameter values in the Taylor rule do not affect the statistical significance of our main findings at all.

Figure 4. Robustness Checks: Measured Monetary Policy Wedges in Deviation from Steady State

(Unit: percentage)



VI. Conclusion

This paper investigates the effects of IT on business cycles in the quantitative monetary business cycle framework. We apply the monetary BCA methodology developed by Šustek (2011) to four advanced countries–Australia, Canada, Sweden and the U.K.–that started IT in the early 1990s. The main finding is that the monetary policy wedge which captures economic fluctuations caused by monetary policy has significantly decreased for all four advanced economies since the implementation of constant IT in the early 1990s. Since we observed that output volatilities have also declined after implementing IT and the monetary policy wedge is the only factor which consistently contributes to the stabilization of the aggregate output volatility for the four countries during the Great Moderation period, we conclude that these results are at least partial evidence that IT played a role in stabilizing real economic fluctuations in advanced economies.

After two decades of monetary policy experiments, IT is still on the test bed. Although it is widely accepted that IT has been successful in stabilizing inflation for developing countries, there seems to be a lack of consensus on the effectiveness of IT in stabilizing the real economy especially for developed economies. This paper sheds new light on this issue, and finds some supporting evidence that IT has been contributing to the real economy stabilization for advanced economies during the Great Moderation period.

References

Ball, L., Sheridan, N. 2004. "Does Inflation Targeting Matter?" In B.S. Bernanke and M. Woodford ed. *The Inflation-Targeting Debate*. Chicago, IL: University of Chicago Press.

Bernanke, B.S., Laubach, T., Mishkin, F.S., Posen, A.S. 1999. "Inflation Targeting: Lessons from the International Experience." Princeton, NJ: Princeton University Press.

Brinca, P. 2012. "Monetary Business Cycle Accounting for Sweden." Working Paper.

Chakraborty, S. 2009. "The Boom and the Bust of the Japanese Economy: A quantitative look at the period 1980-2000." *Japan and the World Economy*, 21, pp. 116–131.

Chari, V.V., Kehoe, P.J., McGrattan, E.R. 2006. *Appendices: Business Cycle Accounting*. Federal Reserve Bank of Minneapolis Research Department Staff Report 362, pp. 1–53.

______. 2007. "Business Cycle Accounting." *Econometrica,* 75, pp. 781–836.

Cho, D., Doblas-Madrid, A. 2013. "Business Cycle Accounting East and West: Asian Finance and the Investment Wedge." *Review of Economic Dynamics*, forthcoming.

Cociuba, S.E., Ueberfeldt, A. 2008. "Driving Forces of the Canadian Economy: An Accounting Exercise." Manuscript. Bank of Canada.

Flood, R.P., Rose, A.K. 2010. "Inflation Targeting And Business Cycle Synchronization." *Journal of International Money and Finance,* 29, pp. 704-727.

Goffe, W.L., Ferrier, G.D., Rogers, J. 1994. "Global Optimization of Statistical Functions with Simulated Annealing." *Journal of Econometrics*, 60, pp. 65–99.

Hansen, G.D., Prescott, E.C. 1995. "Recursive Methods for Computing Equilibria of Business Cycle Models." In T.F. Cooley. ed. *Frontiers of Business Cycle Research*. Princeton, NJ: Princeton University Press.

Kersting, E.K. 2008. "The 1980s Recession in the UK: A Business Cycle Accounting Perspective." *Review of Economic Dynamics*, 11, pp. 179–191.

Kohn, D. 2003. *Commentary, In Evolution and Procedures in Central Banking*. D.E. Altig and B.D. Smith. ed. Cambridge: Cambridge University Press, 82–88.

Lama, R. 2011. "Accounting for Output Drops in Latin America." *Review of Economic Dynamics,* 14, pp. 295–316.

Lin, S., Ye. H. 2007. "Does Inflation Targeting Really Make a Difference? Evaluating the Treatment Effect of Inflation Targeting in Seven Industrial Countries." *Journal of Monetary Economics,* 54, pp. 2521–2533.

_____. 2009. "Does Inflation Targeting Make a Difference in Developing Countries?" *Journal of Development Economics,* 89, pp. 118–123.

Šustek, R. 2011. "Monetary Business Cycle Accounting." *Review of Economic Dynamics,* 14, pp. 592–612.

Svensson, L.E.O. 1995. "The Swedish Experience of an Inflation Target." In L. Leiderman and L.E.O. Svensson. eds. *Inflation Targets*, 69–89. London: Centre for Economic Policy Research.

_____. 2011. *Inflation Targeting. In Handbook of Monetary Economics*, Vol. 3, pp. 1237–1302. In B. Friedman and M. Woodford. ed.

Taylor, J.B. 1979. "Estimation and Control of a Macroeconomic Model with Rational Expectations." *Econometrica,* 47, pp. 1267–1286.

_____. 1993. "Discretion Versus Policy Rules in Practice." Carnegie–Rochester Conference Series on Public Policy, 39, pp. 195–204.

Walsh, C.E. 2009. "Inflation Targeting: What Have We Learned?" *International Finance,* 12, pp. 195–233.

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국문요약

본 연구는 인플레이션 타기팅(Inflation Targeting) 정책이 호주, 캐나다, 스웨덴, 영국 등의 선진국 실물 경기변동에 미친 영향을 화폐적 경기변동회계(Monetary Business Cycle Accounting) 기법을 이용하여 분석하고 있다. 화폐적 경기변동회계 분석은 Šustek(2011)에 의해 처음 개발되어 사용된 분석 방법으로, Chari, Kehoe, and McGrattan(2007)의 경기변동회계(Business Cycle Accounting) 분석 방법에서 사용된 실물적 경기변동 요인에 통화정책 경기변동 요인(monetary policy wedge)과 자산시장 경기변동 요인(asset market wedge) 등의 명목적 경기변동 요인을 추가한 것이다. 본 연구의 주요 결론은 1990년대 초반 인플레이션 타기팅 정책을 시행한 선진국들의 경우, 통화정책 경기변동 요인이 인플레이션 타기팅 정책의 시행 시점 이후에 통계적으로 유의미하게 감소하였다는 것이다. 이러한 연구 결과는 본 연구의 분석 대상인 선진국의 경우 인플레이션 타기팅 정책이 실물 경기변동 안정화에 기여하였다는 점을 시사하고 있다.

핵심용어: 화폐적 경기변동회계, 인플레이션 타기팅, 테일러 준칙

조두연(趙鋀衍)

연세대학교 경제학과 졸업
미국 Michigan State University 경제학 박사
대외경제정책연구원 국제경제실 국제거시팀 부연구위원
(現, E-mail: dycho@kiep.go.kr)

저서 및 논문

"When Carry Trades in Currency Markets Are Not Profitable" (Co-authors, 2012)
"Business Cycle Accounting East and West: Asian Finance and the Investment Wedge" (Co-authors, *Review of Economic Dynamics*, 2013, Forthcoming) 외

이동은(李東垠)

고려대학교 경제학과 졸업
미국 Indiana University-Bloomington 경제학 박사
대외경제정책연구원 국제경제실 국제거시팀 팀장
(現, E-mail: derhee@kiep.go.kr)

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An Assessment of Inflation Targeting in a Quantitative Monetary Business Cycle Framework

Dooyeon Cho and Dong-Eun Rhee

This paper examines the effectiveness of inflation targeting to stabilize the real economy of the advanced countries where inflation targeting was adopted in the early 1990s. This paper employs the monetary business cycle accounting methodology recently developed by Šustek (2011) which is an extended version of Chari, Kehoe, and McGrattan (2007) to monetary models in order to quantitatively assess inflation targeting. Our main finding is that the monetary policy wedge, which captures economic fluctuations caused by monetary policy, has significantly declined since the implementation of inflation targeting in the early 1990s. The results suggest that advanced economies such as Australia, Canada, Sweden, and the UK, that adopted inflation targeting in the early 1990s have been successful in stabilizing business cycle fluctuations.

KIEP Korea Institute for International Economic Policy

246 Yangjaedaero, Seocho-gu, Seoul 137-747, Korea
P.O.Box 235, Seocho, Seoul 137-602, Korea
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