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Non-Stationary Inflation and Panel Estimates of the New Keynesian Phillips Curve for Australia

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Abstract

This paper uses a recent panel method of Russell and Banerjee (2008) to estimate the new Keynesian Phillips curve for Australia. Our estimates show that while the hybrid new Keynesian Phillips curve and backward looking conventional Phillips curve are well determined, estimates of the Phillips curve with the pure forward looking expectations are unsatisfactory.

Keywords: Panel data estimates, new Keynesian Phillips curve, Australia and Unit roots in the rate of inflation.

JEL: C2, C12, E3.

1. Introduction

One branch of the Phillips curve (PC) literature recognizes that a stationary inflation rate is inconsistent with the theoretical and empirical properties of the inflation for the past fifty years; see Henry and Shiedls (2003) and Russell and Banerjee (2008). Therefore, four methods are used to overcome non-stationarity in inflation. Following Gali and Gertler (1999), many have used the difference between inflation and its sample mean as the dependent variable. King and Watson (1994), Stock and Watson (2007), and Ireland (2007) have differenced the data. Cogley and Sbordone (2008) have used the gap between inflation and its smooth time varying mean. Russell and Banerjee (2008) take the view that inflation could be nonstationary because monetary authorities respond to shocks by making discrete changes to inflation targets. Therefore, inflation may be stationary with structural breaks for shifting means.

These alternative approaches may give different results on the relative importance of the forward and backward looking expectations of inflation and the trade off in the long run. This has policy implications because if backward looking expectations are more important, deflationary policies to reduce inflation will be costly. In a Monte Carlo study Russell et. al., (2010) found that the Gali and Gertler and Cogley and Sbordone methods overestimate the coefficient of forward looking expectations, but such biases are less in their shifting means approach. Therefore, this paper uses their panel data method, with shifting means, to estimate three formulations of PC for Australia: Backward looking PC, forward looking PC, and hybrid PC.

Section 2 presents specifications and describes the Russell and Banerjee method. Section 3 uses the Bai and Perron (2003) break tests to identify inflation regimes. Section 4 presents empirical results and Section 5 concludes.

2. Specification and Estimation

2.1 Specification

The specifications can be presented in terms of restrictions to the hybrid PC (Gali and Gertler (1999)):

$$\pi_t = \gamma_b \pi_{t-1} + \gamma_f E_t \pi_{t+1} + \gamma_y y_t + \varepsilon_t \qquad (1)$$

$$\varepsilon_t \sim N(0, \delta^2)$$

where $\pi =$ rate of inflation (measured as year-on-year percentage change), $E_t =$ expected rate of inflation based on information in period t and $y =$ a measure of the forcing variable, e.g., real marginal cost and output gap etc. Although US empirical studies use alternative measures for y, in Australian works unemployment rate or its deviation from the natural rate $(u - u^*)$ is popular.

The purely backward looking adaptive expectations PC model of Friedman and Phelps (F-P) assumes $\gamma_f = 0$ and $\gamma_b = 1$. The New Keynesian (NK) PC is based on the microeconomic foundations and implies that optimizing firms use rational and purely forward looking expectations of inflation in their product pricing decisions. Therefore, NKPC implies that $\gamma_f = 1$ and $\gamma_b = 0$. Finally, the hybrid PC of Gali and Gertler assumes that $\gamma_f + \gamma_b = 1$.

2.2 Estimation Method

Unit root tests show that the rate of inflation is an integrated variable and unemployment rate too[1]. Following the influential work by Gali and Gertler (1999) many studies have used the deviation of the rate of inflation from its sample mean as their inflation measure, believing that this is a stationary variable. This relationship is then estimated with a classical instrumental variable method. However, de-trending inflation with its sample mean may not make it stationary. Therefore, estimation with any classical method would give spurious results.

In the introduction we discussed various alternatives to transform inflation rate into a stationary variable. Since the scope of this paper is limited, we explain only the Russell and Banerjee (2008) method because it is promising. They assume that inflation is stationary with shifting means. Based on this assumption, they use the Bai and Perron (2003) break tests to identify breaks in the mean rate of inflation so that the mean rate of inflation is constant in each inflation regime. If these tests show five structural breaks there will be six regimes to form six cross section units. Finally, Russell and Banerjee use the fixed effects panel data method to estimate the three versions of PC viz., F-P, hybrid, NK.

[1] The results are available upon request by authors.

3. Empirical Results

Our data are from 1967Q1 to 2010Q3. Definitions and sources of data are in the appendix.[2] The natural rate of unemployment (u^*) is estimated by smoothing the unemployment rate with Hodrick-Prescott filter. Following Gali and Gertler (1999) the actual rate of inflation, one period ahead, is used for the expected rate of inflation.

3.1 Bai-Perron Breakpoint Test

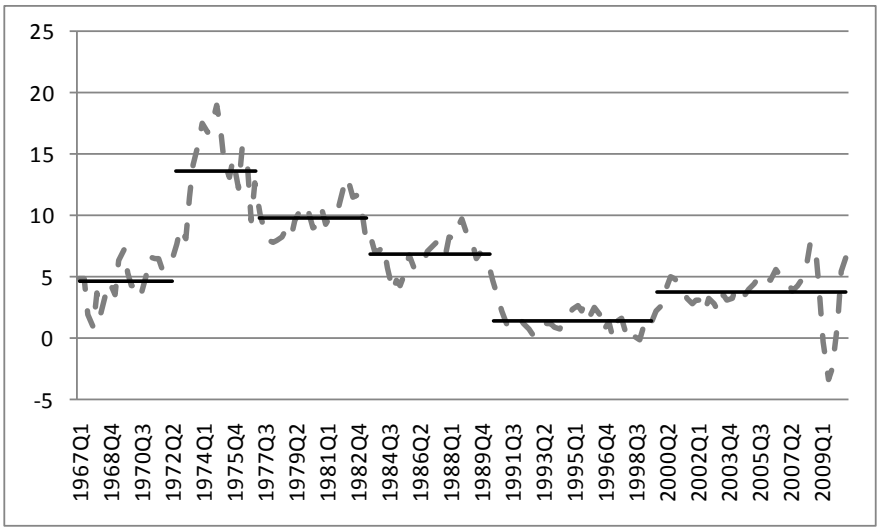
The estimated model is:

(2) $$\pi_t = \gamma_{k+1} + \zeta_t$$

where π is the inflation rate and γ_{k+1} is a series of *k+1* constants that estimate the mean rate of inflation in each of *k+1* inflation regimes and ζ_t is a random error. The model uses a trimming rate of 10 per cent of the sample and is estimated using quarterly data for the period 1967Q1 to 2010Q3. The graph and the table of estimated regimes are reported below.

Figure 1

Inflation Rate and the Regime Specific Mean Inflation



---- Actual rate of inflation and ____ mean rate of inflation.

[2] This period is selected on the ready availability of reliable data on the unemployment rate.

Table 1 Estimated Inflation Regimes with the Bai-Perron Break Tests			
Regime	Dates of Regimes	Mean inflation	Mean Natural unemployment Rate
1	1967Q1 – 1972Q2	4.7	1.9
2	1972Q3 – 1977Q1	13.7	3.7
3	1977Q2 – 1983Q2	9.8	6.6
4	1983Q3 – 1990Q2	6.9	7.9
5	1990Q3 – 1999Q3	1.4	8.6
6	1999Q4 – 2010Q3	3.7	5.5

3.2 Empirical Results

The three specifications of the PC are estimated with fixed effects and the results are in Table 2. In F-P all the coefficients have the expected signs and are statistically significant. The Wald test on γ_b rejects the null that $\gamma_b = 1$. Estimates of the hybrid PC are good. All the coefficients have the expected signs and are statistically significant. The Wald test confirms the hypothesis that $\gamma_f + \gamma_b = 1$. The NK PC performs poorly. The coefficient of the forcing variable has the wrong positive sign and the coefficient of forward expectations is significantly higher than an expected value of unity.

Table 2
Fixed Effects Estimates of the PC for Australia (GMM)

$$\pi_t = \alpha + \gamma_b \pi_{t-1} + \gamma_f E_t \pi_{t+1} + \gamma_u (u_t - u_t^*)$$

	(1) F-P	(2) Hybrid	(3) NK
α	1.507*** [0.465]	0.469 [0.539]	-2.462* [1.287]
γ_b	0.715*** [0.073]	0.516*** [0.077]	-
γ_f	-	0.381*** [0.116]	1.488*** [0.254]
γ_u	-0.527*** [0.154]	-0.281* [0.162]	0.483 [0.340]
Centered R^2	0.92	0.96	0.83
Hansen test	2.80	3.30	3.37
Under ID test	27.00***	10.37*	11.54***
Weak ID test	56.86***	3.56*	5.34**
AR(1)	0.44	0.14	0.49
AR(2)	0.45	0.24	0.96
Wald test (p-value)	$0.10E^{-3}$	0.23	-

* Significant at 10%; ** significant at 5%; *** significant at 1%. AR(1) and AR(2) are the p-values from the Arellano and Bond test for serial correlation. Hansen is the test for over-identifying restrictions, Weak ID and Under ID are the weak identification and under-identification tests (Kleibergen-Paap rk test LM and Wald statistic).

Instruments used: F-P = lags 2 and 3 of inflation, lags 1 and 2 of unemployment, lags 1 and 2 of the cyclical component of oil price;

Instruments used: Hybrid = lags 2 and 3 of inflation, lags 1 and 2 of unemployment, lags from 1 to 3 of the cyclical component of oil price;

Instruments used: NK= lags 2 of inflation, lags 1 and 2 of unemployment, lags from 1 to 3 of the cyclical component of oil price.

4. Conclusions

In this paper we applied the Russell and Banerjee (2008) panel data method of estimating three specifications of the PC for Australia. The cross section units are based on the breaks in the mean rate of inflation. We found that estimates of the pure backward looking and hybrid versions give good results and the micro-founded NKPC performs poorly. In the hybrid model the restriction that the coefficient of backward and forward looking expectations sum to one is accepted. Therefore, the long run Phillips curve is vertical in Australia. The hybrid PC also indicates that backward looking expectations are relatively more important than forward looking expectations for product pricing decisions. Therefore, deflationary policies to reduce inflation are costly. However, these conclusions have the usual limitations and need further analysis with improved methods of estimation.

Data Appendix

Data Source. Sample 1967Q1 – 2010Q3

Variable	Definition	Source
π	GDP deflator Inflation (year-on-year percentage changes).	OECD Statistical database.
u	Unemployment rate.	OECD Statistical database.
u^*	Natural unemployment rate obtained through a Hodrick-Prescott filter technique of *u*.	Our calculation.
oil	Cyclical component of natural log of oil price (US$/barrel) obtained with Hodrick-Prescott filter.	Dow Jones & Company.

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