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Inflation expectations formation in the presence of policy shifts and structural breaks: An experimental analysis☆

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ABSTRACT

In this paper we study how inflation expectations are formed and whether these change due to the occurrence of policy shifts or structural breaks. We conduct 4 experiments with 75 inexperienced subjects, in which we ask them to predict future home inflation and report confidence intervals. At three points in time during our experiments, we also ask our participants to provide additional information regarding the uncertainty about their expectations. Our design allowed us to gather 6750 home inflation point forecasts and confidence intervals. We find that: (1) inflation expectations are seldom rational, (2) our subjects generally ignore valuable information and, instead, tend to pay close attention to past trends, (3) the adoption of inflation targeting increases the amount of subjects that forecast in a rational fashion and reduces the uncertainty about future inflation, and (4) a recession reduces rationality among forecasters, yet induces them to expect inflation to revert to its mean.

1. Introduction

The current workhorse of macroeconomics – New Keynesian models – posits that the paths of macro variables depend on the expectations that subjects hold about future realizations. In this context, understanding the processes by which inflation expectations are formed is fundamental to the conduction of optimal monetary and fiscal policies. Additionally, policy design needs to take into account the fact that policy shifts and structural breaks may change the way subjects assess the occurrence of future uncertain events. In this paper, we conduct experiments with both undergraduate- and graduate- economics students from Pontificia Universidad Católica del Perú (PUCP) to shed light on their expectations formation processes and whether these change when an economy experiences a policy shift or structural break.

Since their introduction in the early sixties, rational expectations (RE) have been the predominant paradigm for modeling expectations in macroeconomics and finance. This hypothesis asserts that "...expectations of firms (or, more generally, the subjective probability distribution of outcomes) tend to be distributed, for the same information set, about the prediction of the theory (or the "objective" probability distribution of outcomes)." (Muth, 1961: 316). It implies that economic agents generally do not waste information, that expectations formation depends on the structure of the economy, and that any differences between the expectations of the relevant theory and those held by them will be eliminated by arbitrage (Muth, 1961). This hypothesis does not specify a particular expectations formation process, yet most models that incorporate RE become operable by assuming that subjects know the underlying structure of the economy, the values of the parameters, and the nature of the shocks (Evans and Honkapohja, 2001). Consequently, subjects are thought to exploit all the available information and make no systematic forecast errors.

Although there is no consensus on what the best test for rationality is, several papers (Adam, 2007; Branch, 2007; Curtin, 2005; Hey, 1994; Mankiw et al., 2004; Pfajfar and Zakelj, 2009, among others) have relied on different tests – usually analyzing forecasting bias and efficiency – to examine whether inflation expectations behave rationally. The results have been mixed. Adam (2007), Branch (2007), Curtin (2005), and Mankiw et al. (2004) find evidence indicating departures from rationality. On the other hand,

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Pfajfar and Zakelj (2009) find, in their experimental analysis, that about 40% of their participants use predominately a rational forecasting rule; while Hey (1994), in another experiment, concludes that the expectations formation processes have characteristics of both rational and adaptative behavior.

The development of the bounded rationality literature and the concomitant permeation of cognitive psychology and evolutionary biology in economics have resulted in the creation of forecasting models based on heuristics and disciplined by evolutionary selection. In these models, at every point in time, subjects choose between a finite number of heuristics (or a combination of heuristics and sophisticated rules) in order to make their forecasts. These decisions are disciplined by evolutionary selection, meaning that subjects are specified to choose among forecasting rules based upon their past performance.[1]

In addition to point forecasting, the literatures on economic and psychological prediction have also developed theories on how people predict confidence intervals. Tversky and Kahneman (1974) assert that when subjects make use of the anchoring and adjustment heuristic to make predictions in the form of confidence intervals they think first of their best prediction and then adjust this value upwards and downwards to complete the task. Yet, the use of this heuristic impedes sufficient adjustment which results in the prediction of overly narrow confidence intervals. Additionally, Kahneman and Tversky (1973) show that subjects fail to expect mean-reversion even when it is bound to happen. The authors confirm this hypothesis by conducting an experiment in which they ask graduate students to report confidence intervals about an outlier observation. They observe that the majority of students reported symmetric confidence intervals, as opposed to intervals skewed toward the mean. Nevertheless, in the context of asset pricing, De Bondt (1993) finds the exact opposite. His experiment reveals that when prices are rising, people predict left skewed confidence intervals and, when prices are going down, they predict right skewed ones. De Bondt (1993) calls this phenomenon the hedging theory of confidence intervals.

The question of whether the processes by which subjects form their expectations are stable, or whether these are sensitive to exogenous events has been addressed by the literature on decision making under uncertainty. The available experimental evidence tends to favor the latter hypothesis: "At times when they [subjects] view the world as stable or static, they place too much weight on past events in prediction; but when they perceive large structural changes taking place in the environment, they underestimate the significance of past experience for predicting the future." (Simon, 1997: 285) Additionally, both theoretical and empirical evidence support the hypothesis that ambiguity[2] conditions the way people assess uncertainty (Einhorn and Hogarth, 1987). In particular, one could expect that the occurrence of an exogenous event would induce greater ambiguity among subjects and, consequently, alter the way they assess the occurrence of future events.

In this paper we design experiments aimed at studying the following: (1) how subjects form their expectations about future inflation, (2) how subjects assess the uncertainty about their inflation expectations, and (3) whether the previous two processes are sensitive to exogenous events. In particular, we explore whether a policy shift, such as the adoption of inflation targeting (IT), and a structural break in the form of a recession alter the way subjects assess future inflation. Our work follows a long line of experimental research on expectations formation (Adam, 2007; De Bondt, 1993; Dominitz and Manski, 1994; Heemeijer et al., 2009; Hey, 1994; Kahneman and Tversky, 1973; Schmalensee, 1976; Smith et al., 1988; Tversky and Kahneman, 1974, among others). In particular, the design of our experiment is similar to that of Pfajfar and Zakelj (2009); we expand their design by opening the experimental economy, introducing exogenous events to test for stability in the inflation forecasting processes, and allowing for an in depth analysis of inflation expectations uncertainty. We choose to work with a small open economy setup as external dynamics could play a primary role in the prediction of inflation.

The paper is organized as follow. Section 2 presents the model and Section 3 describes the experimental design. In Section 4, we present the results which include analysis of rationality, model selection, mean-reversion analysis and uncertainty. Section 5 concludes.

2. The model

In this paper we consider a small open economy new Keynesian model with price rigidities, as presented by Galí and Monacelli (2005). The model can be described by a forward-looking dynamic IS curve (Eq. (1)), a new Keynesian Phillip's curve (Eq. (2)), and two equations: one describing the uncovered interest rate parity (Eq. (3)) and another specifying the composition of CPI inflation (Eq. (4)). Additionally, we close the model by introducing a Taylor rule (Eq. (5)) that only considers lagged data. We do this in order to broaden the parameters space that allows for a determinate RE equilibrium (Baask, 2006).

This model requires subjects to hold expectations about the future exchange rate, home inflation, and output gap; yet, we consider that asking our experimental subjects to forecast all three variables and provide confidence intervals would be a task too taxing. Accordingly, we make our first departure from the standard model by specifying that output and exchange rate expectations are naïve, that is, $E_t[X_{t+1}|\Psi_{t-1}] = X_{t-1}$, where Ψ_t is the set of all the available information at time t.

Our second and final departure from the standard model is that the exchange rate adjusts only partially to the domestic and foreign interest rate spread. We do this to match a well documented stylized fact that, even though some central banks claim to have floating exchange rates, many of these do utilize their policy instruments to reduce the exchange rate volatility (Reinhart, 2002).

Therefore, the model we utilize in our experiment is characterized by the following equations:

$$x_t = x_{t-1} - \frac{1}{\sigma_\alpha}(r_t - E_t^{AM}[\pi_{H,t+1}] - \overline{rr}) + \varepsilon_t^x, \tag{1}$$

$$\pi_{H,t} = \beta E_t^{AM}[\pi_{H,t+1}] + k_\alpha x_t + \varepsilon_t^{\pi_H}, \tag{2}$$

$$e_t = e_{t-1} + \lambda(r_{t-1} - r^*) + \varepsilon_t^e, \tag{3}$$

$$\pi_t = (1-\alpha)\pi_{H,t} + \alpha(\Delta e_t + \pi^*), \tag{4}$$

$$r_t = \varphi_r r_{t-1} + (1-\varphi_r)[\varphi_\pi \pi_{t-1} + \varphi_x x_{t-1}], \tag{5}$$

where x_t is the output gap, $\pi_{H,t}$ is the home inflation, π_t is the CPI inflation, e_t is the log exchange rate, r_t is the nominal interest rate, $\overline{rr}$ is the natural interest rate, π^* is the imported inflation, and r^* is the foreign nominal interest rate. $\varepsilon_t^{\pi_H}$, ε_t^x, and ε_t^e are serially autocorrelated home inflation, output gap, and exchange rate shocks, respectively. Additionally, Δ is the difference operator and $E_t^{AM}[\pi_{H,t+1}]$ indicates the arithmetic mean of the one-quarter-ahead home inflation expectations (Table 1).[3]

[1] See Hommes (2006) for a theoretical survey on this class of models and Simon (1997) for an introduction to the concept of satisficing.

[2] "...ambiguity results from the uncertainty associated with specifying which of a set of distributions is appropriate in a given situation." (Einhorn and Hogarth, 1987: 45).

[3] $E_t^{AM}[\pi_{H,t+1}] = \frac{\sum_{i=1}^{N} E_{i,t}[\pi_{H,t+1}|\Psi_{t-1}]}{N}$.