

Lecture 6: The Empirical Stability of the Phillips Curve

I. OVERVIEW

- In the last lecture we looked at the Phillips Curve and examined the tradeoff between inflation and unemployment (or GDP). We showed that the tradeoff would only be available in the very short run unless expectations were static. With changing expectations, be they rational or adaptive, the tradeoff would quickly become unfavorable to the policymaker. With rational expectations, it is perhaps safe to say that there is no long run tradeoff between inflation and output.
- We also turned the problem around to think about what the government has to do in order to reduce inflation. We showed that the situation was now reversed: with static expectations, disinflation was impossible without incurring a large increase in unemployment. With adaptive expectations, the policy maker had some choice as to the extent of the tradeoff between severity and length of a recession and with rational expectations, disinflation could in fact be painless.
- Today's lecture focuses on a paper by Jeff Fuhrer that looks at the empirical validity of the Phillips Curve. Fuhrer's paper shows that the Phillips Curve is one of the more robust economic relationships, and at least the modern expectations augmented version that we cover in intermediate level undergraduates courses remains a valid and useful tool with which we can understand macroeconomic policy.

II. READING ACADEMIC RESEARCH PAPERS

- Before we discuss the Fuhrer paper, let's take a step back and discuss how one should go about reading an academic research paper. We will be reading almost two dozen papers, some more tractable than others. It is important to realize that these papers are written for a peer audience: academic economists writing for the benefit of other academic economists, which makes the papers more than a little dense for undergraduates, even excellent economics majors like you.
- Second, academic economists are also not the most accomplished writers nor are they connoisseurs of good writing. Therefore, the articles are by no means light and easy reading, which means that a 20 page Economics paper will take you more time to read than a 150 page History or English reading.
- With that in mind, I will be summarizing the readings in my Lecture Notes to help you wade through the morass of material contained in the paper. However, it is important to realize that reading Lecture Notes is not a substitute for reading the paper. If I find out that you are ignoring the paper for the Cliff Notes version in my Lecture Notes, I will abandon this practice and force you to learn everything directly from the paper. Trust me when I say that this is not what you want to happen.

- So, how does one go about reading these papers? Well for starters, you need to have some structure in reading the paper. In every paper, you should be able to identify the following four elements:
 1. Motivation: In other words, why is the topic covered in this paper an important one? In other words, what exactly does knowing more about this topic accomplish? So a paper whose motivation is “one of the most important relationships for bettering the human condition is understanding the link between income inequality and economic growth” is better than “the literature previously has only dealt with models that have 3 equations, I want to write a model that has 4 equations”.
 2. Research Question. What is the (preferably well-defined and narrowly focused) research question that the paper is attempting to answer?
 3. Findings. What exactly does the author find as answers to the question defined as in 2) above? Are the authors results definitive, or are they dependent on certain assumptions? Is the applicability of the results limited to a particular country or to a particular era or can we generalize?
 4. Methodology This section covers the bulk of the paper and will usually be the hardest. Basically once the author has laid down the motivations as in 1) and defined the research question as in 2), what methodology does she use to get to the findings given in 3)? Is the paper a theoretical one or an empirical one? If it is a theoretical model, what are the main equations that characterize the model? If it is an empirical one, what regression equations are being used, what data is being used? Note that you do not need to follow every step of algebra along the way, that would be counter-productive. You should instead be able to follow the gist of the author’s argument and learn something about the approach she takes to answer what is hopefully an interesting question.
- I will try to follow this framework in my discussion of the papers and I hope you will do so as well. So even for the most complicated papers, you should be able to accomplish the first three and have a vague idea of the 4th. For the easiest papers, you should be able to do all 4 tasks easily.

III. THE FUHRER PAPER ON THE ROBUSTNESS OF THE PHILLIPS CURVE

- The basic motivation of the article by Jeff Fuhrer assigned for today’s lecture is the robustness of the Phillips Curve as an empirical relationship and its relevance as a tool for understanding economic fluctuations.
- Fuhrer discusses the interesting dichotomy whereby the Phillips Curve was dismissed as “a policy guide because of its presumed sensitivity to shifts in the underlying macroeconomic structure” yet it has survived and “is alive and well and living in a good number (although certainly not all) macroeconomic models”. In other words, the Phillips Curve seems to be flourishing and is still widely used, despite claims by economists back in the 1970s that it was not a useful tool for analyzing policy decisions.
- Fuhrer’s hypothesis, and the research question he sets out to answer, is that the survival of the Phillips Curve is because of its empirical validity and robustness. In other words, people use the Phillips Curve to think about economic policy decisions because the Phillips curve does

a good job of describing important economic relationships and has in fact done so for many years. Fuhrer goes so far as to claim that “the Phillips Curve is as structural a relationship as macroeconomists have ever had at their disposal”.

- Fuhrer’s results show that much of the criticism against the Phillips curve from a theoretical perspective doesn’t seem to apply from an empirical perspective. He estimates a version of the expectations augmented Phillips curve allowing for oil shocks and finds that the predictions of the model do seem to track the actual inflation rate in the economy. He also finds no evidence that there has been a change in the manner in which people form expectations, for example, over time: a model estimated using data from 1960 to 1979, does just as well in tracking inflation in the 80s and the early 90s as a model estimated using data from the 1960s through the 1990s.
- The final task is to analyze the methodology of the paper. Before we do that, we should discuss an important concept that appears in the paper, and is central to understanding the arguments against the Phillips Curve. This concept is known as the Lucas Critique.

The Lucas Critique

- The term “Lucas Critique” refers to Nobel Prize winning economist Robert Lucas’s criticism of most macroeconomic models as being flawed because they ignored the fact that relationships described by past data would not necessarily hold in the future, especially when there had been substantial changes in economic policies that would affect expectations of individuals in the economy.
- If relationships that existed in the past would not hold in the future, then economic models estimated using existing data, would not necessarily be applicable in the future.
- The Lucas critique is the primary tool that was used by economists to express skepticism about the future of the Phillips curve. Fuhrer illustrates the criticism well with a simple expectations augmented version of the Phillips Curve

$$\pi_t = \pi_t^e - \beta(u_{t-1} - u^n) + \epsilon_t$$

- Suppose expectations were adaptive: i.e. people expectations of future inflation were estimated on the basis of their past experience with inflation. As Fuhrer suggests, one simple form would be to express expected inflation as $\pi_t^e = \sum_{i=1}^{12} \alpha_i \pi_{t-i}$ which basically says that the last 12 periods worth of inflation are used to formulate expectations, with the α parameters signifying the weight, or importance, attached to each month’s observation.
- The Lucas Critique says that even if we were able to measure the magnitude of the parameters, there is no guarantee that they would remain constant over time. For example, suppose that history says that each period should be weighted the same: $\alpha_i = 1/12$ for all $i = 1 \dots 12$. Now suppose that (because of a war in the Middle East, the firing of the Fed Chairman etc.) there was a particularly bad episode of inflation in a particular month. In the future, then individuals may pay more attention to that period (increase the parameter for that period) and downgrade other periods. In this case, the model with is not informative in predicting future inflation expectations.

- The change in expectations can come about because of changes in policy as well. So the replacement of a Fed Chair who is vigilant about fighting inflation with one who is more tolerant about inflation will mean that people form expectations in a different manner under the new regime. As a result, the relationships that described the macroeconomic situation under the old regime may not be valid in the new regime. That is the essence of the Lucas Critique.
- Fuhrer's argument is that Lucas Critique is an empirical criticism not a theoretical criticism. While it is certainly possible, or even probable, that the Lucas Critique applies to the Phillips Curve, it will continue to be useful unless the shifts in the way in which people form expectations has been dramatic. Fuhrer's hypothesis is that the manner in which people form expectations has not changed dramatically over time, and that the resulting robustness of the Phillips Curve explains why it is widely used in economic policy making despite the theoretical objections.

The Model

- Suppose the "true model", i.e. the expectations augmented Phillips curve is

$$\pi_t = \sum_{i=1}^{12} \alpha_i \pi_{t-i} - \beta_1 (u_{t-1} - u^n) - \beta_2 (u_{t-2} - u^n) + \epsilon_t$$

- The first term is a measure of expected inflation, the second term covers demand-pull inflation (and the third term covers cost-push inflation by allowing for oil prices to have an impact on inflation as well).
- Both current and last period's unemployment are included as possible influences on inflation to allow for the possibility of a "speed-bump" effect, i.e. that the level as well as the change in unemployment may matter. In other words, the above specification is equivalent to a true model of

$$\pi_t = \sum_{i=1}^{12} \alpha_i \pi_{t-i} - (\beta_1 + \beta_2)(u_{t-1} - u^n) - \beta_2 (u_{t-1} - u_{t-2}) + \epsilon_t$$

- Thus its the sum of β_1 and β_2 that measure the impact of the level of unemployment on inflation while β_2 alone measures the strength of the speed-bump effect.
- To estimate the true model, Fuhrer specifies the following regression model

$$\pi_t = c + \sum_{i=1}^{12} a_i \pi_{t-i} + b_1 u_{t-1} + b_2 u_{t-2} + b_3 p o_t + \eta_t$$

- I have stuck with Fuhrer's notation, for the most part. c is the constant, η refers to the regression residual, while po refers to oil prices.
- We can see that the a_i are our estimates of the α_i coefficients, b_1 and b_2 are the estimates of $-\beta_1$ and $-\beta_2$ respectively, $b_3 p o_t$ is our estimate of the supply shock ϵ_t and the constant c is the estimate of $(\beta_1 + \beta_2)u^n$ from the true model.
- We can solve for the estimated NAIRU as $u^n = \frac{c}{\beta_1 + \beta_2} \equiv \frac{c}{-b_1 - b_2}$

- Fuhrer also constrains the α coefficients to sum to 1. This reflects the idea that in the long run (i.e. when $u = u^n$), in the absence of supply shocks, inflation should be equal to expected inflation $\pi = \pi^e$. Given our specification of $\pi_t^e = \sum_{i=1}^{12} \alpha_i \pi_{t-i}$, the only way inflation and expected inflation will be the same (constant) value in the long run is if $\bar{\pi} = \sum_{i=1}^{12} \alpha_i \bar{\pi} = \bar{\pi} \sum_{i=1}^{12} \alpha_i$ which simply implies that $\sum_{i=1}^{12} \alpha_i = 1$

Estimation

- Fuhrer then uses quarterly data from 1960 to 1993 to estimate the regression coefficients. He uses four different measures of inflation: the CPI, the GDP deflator, core CPI (which leaves out food and energy prices) as well as a measure of wage inflation using an employee compensation index (ECI). These results are reported in Table 1, 1a, 1b and 1c of the paper.
- Fuhrer finds that the estimated natural rate of unemployment is between 5.5% to 6.5%, plausible for the period in question, and that the regression coefficients all have the expected sign with oil prices having a positive effect and unemployment a negative effect (although the effect of oil prices is statistically insignificant).

Testing for Stability

- Fuhrer then compares the predictions from his model with the actual core CPI inflation rate. As Figure 2 shows, his model does a pretty good job of tracking core CPI inflation, although there are certainly periods in which his model underestimates inflation: 1975 and 1979 being the two most glaring examples. However, as he points out, there certainly is no sign that the Phillips Curve has “run amok”.
- In order to test for stability, we need to do more than just do this type of in-sample fitting exercise. Figure 4 does an out-of-sample fitting exercise, in which Fuhrer uses regression coefficients estimated using data from 1960 to 1979 to predict inflation for 1980-1994. In essence, this is where the Lucas critique should manifest itself if in fact it is a serious problem. The period before 1979 was acknowledged as a period with high inflation and monetary policy makers who were not thought to be very keen on fighting inflation, whereas the period from 1979 on has seen Paul Volcker and Alan Greenspan who are both thought to be Fed chairs who are anti-inflation. Once again there is no sign that predictions using data pre-1979 have misleading conclusions about the behavior of inflation after 1980.
- Fuhrer also does a couple of simulations (reported in Figures 3 and 5, which are a stronger test of the stability. The difference between the simulations and the fitted value from a regression is that the simulation uses the predicted values as the lagged values in the expectations term whereas Figure 3 uses the predicted data from the model and ignores the actual data. Even ignoring this information, which prevents the model from correcting itself after a bad prediction, the model does a pretty good job of predicting inflation rates in the economy.
- The difference between Figure 3 and Figure 5 is simply that the latter uses the out-of-sample regression coefficients, i.e. the regression coefficients estimated over the 1960-1979 period, to conduct the simulation for the 1980-1993 period.

- Since such graphical tests are imprecise and vulnerable to visual error, Fuhrer reports some standard statistical tests to see if the coefficients on the Phillips curve in the period prior to 1979 differ significantly from the period after 1979. The evidence in this Table is complicated but it indicates that there may have been a shift somewhere in the period between 1980 and 1982 and even if there had been a shift it does not seem to have been very large in magnitude as Figure 7 shows.
- Finally, Fuhrer finds little evidence that there is a shift in the natural rate of unemployment or in the impact of unemployment on inflation (the sacrifice ratio) over time. Therefore, based on the totality of the evidence presented, I would interpret Fuhrer's paper as being a positive argument for the relevance of the Phillips Curve, at least in the expectations augmented form. The evidence up to the early 1990s seems to indicate that economists should still use the Phillips curve as a useful way to think about the various channels that affect inflation.
- An interesting issue to explore would be to extend the Fuhrer paper to the more recent era. For example, Fuhrer's estimates find a natural rate of unemployment (NAIRU) of somewhere between 5.5% - 6.25%. However, unemployment in the late 1990s reached 4-4.5% with no signs of inflation. We may have been able to attribute this anomaly to favorable supply shocks: falls in the price of oil, cheaper imports, lower commodity prices etc.
- However, more recently the price of oil has risen dramatically and inflation has remained somewhat quiet. We have to therefore consider the possibility that the natural rate has changed over the last few years, and the stability of the Phillips curve may be called into question.