Discussion of “Optimal Inflation and the Identification of the Phillips Curve” by Michael McLeay and Silvana Tenreyro

Marc P. Giannoni*
Federal Reserve Bank of Dallas
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1 Introduction

Since Phillips (1958), economists have sought to estimate a Phillips curve (PC) relationship, or a positive relation between inflation $\pi_t$ and a measure of the output gap $x_t$. While historically, such a relationship could be easily detected, the PC appears to have flattened in the U.S. more recently. Some authors have suggested that inflation does not depend on slack, that it is largely exogenous. This raises the key question: What changed? That answer to that question is critical for much of macroeconomics, and in particular for monetary policy. With most central banks around the world seeking to stabilize inflation around a target level (e.g., 2 percent in the U.S.), it is crucial to understand the determinants of inflation, and to know whether monetary policy can still affect inflation.

Several potential explanations have been provided for the flattening of the PC. Some have suggested that structural changes in the economy in recent decades have played a significant role (e.g. Duca (2019)). In many of models of sticky prices, more rigid prices than in the past or increases in market concentration and pricing power (De Loecker and Eeckhout (2017)) could also result in a flattening of the PC. McLeay and Tenreyro (2019) argue instead that monetary policy itself is responsible for the flattening of the PC. The explanation is simple: If the central bank conducts optimal monetary policy, seeking to minimize deviations of inflation from target and output from potential output, then it should set its policy instruments to increase inflation when output is below potential and vice versa. It follows that optimal policy causes a negative correlation between inflation and the output gap. That negative correlation blurs in turn the positive correlation implied

*The views expressed in this discussion are those of the author and do not necessarily represent those of the Federal Reserve Bank of Dallas or the Federal Reserve System. Contact: Marc P. Giannoni, Federal Reserve Bank of Dallas, 2200 N. Pearl St., Dallas, TX 75201. Email: marc.giannoni@dal.frb.org.
by the PC, so that in equilibrium, the correlation between inflation and the output gap may be positive, negative or null, depending on the variability of shocks perturbing either the PC or the optimal policy relationship. The authors make the point very clearly through a sharp and elegant analysis, in the context of a simple New Keynesian model.

After exposing the identification problem in estimating the slope of a PC, McLeay and Tenreyro propose strategies to estimate the PC and present evidence of a robust PC in the U.S. This is a very nice and transparent paper that should be read by all of those who are interested in understanding and estimating the Phillips curve.

In the remaining of this discussion, I will briefly review the authors’ story in the historical context, and will quibble in Section 3 with the authors’ proposed identification of the PC, focusing in particular on the role of expectations.

2 The Story

A key point of the paper is that one should distinguish between (i) a reduced-form PC, that is an empirical relationship between inflation and a measure of the output gap; and (ii) a structural PC, that is, the underlying relationship between inflation, the output gap, inflation expectations and possibly other factors, resulting from the firms’ optimal setting of their prices. In the debate about the flattening of the PC, the two concepts are often mixed, as the structural PC may be difficult to identify. As the authors make clear, optimal policy can lead to a flattening or even a negative relationship between inflation and the output gap, in the reduced-form PC, even though there is as well defined positively-sloped underlying structural PC. The authors’ result does not rely on assuming that the policymaker conducts optimal policy under discretion and that it has a quadratic objective function. Consider the standard (structural) New Keynesian PC (equation (1) in the paper) that characterizes the trade-off between inflation, $\pi_t$, and the output gap, $x_t$, faced by the central bank:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t$$  \hspace{1cm} (1)

with a slope $\kappa$ that is positive by assumption. In the face of “cost-push” shocks $u_t$ it is generally not possible to stabilize both inflation and the output gap. Suppose that the central bank can control the output gap, e.g., via a short-term policy rate; that it observes $u_t$; and that it seeks to stabilize inflation at its target ($\pi_t = 0$) as in the case of a pure inflation targeting regime. Optimal policy would then imply that the output
gap respond negatively to the cost-push shock

\[ x_t = -\kappa^{-1}u_t, \]

so that, \textit{in equilibrium}, inflation and hence inflation expectations are completely stabilized around the inflation target:

\[ \pi_t = 0, \quad E_t\pi_{t+1} = 0, \]

as illustrated by the horizontal red line in Figure 1 (which is adapted from Figure 3 in the paper). The implication of this policy is that inflation would be uncorrelated with the output gap. In other words, even though the underlying structural PC implies a positive relationship between inflation and the output gap, inflation targeting gives rise to a flat reduced-form PC relationship, with inflation apparently unrelated to the output gap.

![Figure 1: Structural Phillips Curve and Optimal Policy](image)

In the case that the central bank cares both about inflation and output gap deviations from target, as the authors point out, optimal policy under discretion gives rise to a negative relationship between inflation and the output gap. Indeed, when the central bank seeks to minimize the loss function

\[ E_0\sum_{t=0}^{\infty}\beta^t\left[\pi_t^2 + \lambda x_t^2\right] \] (2)
subject to the behavior of the private sector represented by the structural PC (1), optimal policy under
discretion, i.e., taking private-sector expectations $E_t \pi_{t+j}, E_t x_{t+j}$ as given, results in the optimal targeting
rule:
\[
\pi_t = -\frac{\lambda}{\kappa} x_t
\] (3)
which states that the central bank seeks to increase inflation when output is below potential and vice versa,
as illustrated by the downward sloping red line in Figure 1. As exogenous shocks $u_t$ shift the PC but not
the optimal policy relation (2), equilibrium realizations of inflation and the output gap draw not the Phillips
curve, but rather the optimal target criterion (2). In equilibrium, $\pi_t, x_t$ depend only on $u_t$
\[
\pi_t = \frac{\lambda}{\kappa^2 + \lambda (1 - \beta \rho)} u_t, \quad x_t = -\frac{\kappa}{\kappa^2 + \lambda (1 - \beta \rho)} u_t
\]
(where $\rho$ is the degree of serial correlation in $u_t$) so that the correlation between inflation and the output gap
\[
cov(\pi_t, x_t) = \frac{-\lambda \kappa}{(\kappa^2 + \lambda (1 - \beta \rho))^2} \text{var}(u_t) < 0
\]
is necessarily negative.

2.1 Targeting Rule vs. Taylor Rule

Some readers may find a target criterion of the form (3) to be unrealistic. We should however note that its
characterization of monetary policy is not too different from that under a conventional Taylor rule. Indeed,
the optimal target criterion (3) implies that the policy rate $i_t$ is set so as to satisfy $\pi_t + \frac{\lambda}{\kappa} x_t = 0$. The policy
rate can thus be related to inflation and the output gap according to a conventional Taylor-type rule
\[
i_t = \phi \left( \pi_t + \frac{\lambda}{\kappa} x_t \right)
\]
with a large coefficient $\phi (\to \infty)$. If, in addition, policymakers care to also stabilize other variables such
as the interest-rate, then the optimal policy response to inflation and the output gap would likely be of a
similar form but with a smaller coefficient $0 < \phi < \infty$.

2.2 Historical Context

As the authors recognize, the flattening or disappearance of an empirical relationship such as the reduced-
form PC as a consequence of a successful monetary policy is an old idea that goes back at least to Kareken and
Solow (1963), who emphasized that if monetary policy succeeds at offsetting all shocks that affect income,
then we would observe fluctuations in money growth and a perfectly steady path for income. Similar ideas have been reinforced and generalized by many authors since then, most prominently with Goodhart’s ‘Law’ (1975)\textsuperscript{1} and the Lucas (1976) critique,\textsuperscript{2} and it is still mentioned in recent work (e.g., Hooper, Mishkin and Sufi (2019)). Unfortunately, it appears that much of the profession is quick to forget these powerful lessons when the empirical relationship between two key macroeconomic variables appears to have weakened, and so it is important that McLeay and Tenreyro remind us of this. As we learned for Lucas (1976), these lessons don’t apply merely to relationships between two macroeconomic variables; they can be more pervasive. For instance, when Boivin and Giannoni (2006) documented the fact that impulse response functions of inflation and output to an unexpected 25 basis points change in the federal funds rate had become more muted in the post-1980 period, compared to the 1960-1980 period, they asked whether this was due to a structural change in the economy (such as a flattening of the structural PC or a diminished sensitivity of economic activity to interest rate changes), or to a change in policy itself; they found that a more aggressive stance of policy toward inflation stabilization in the post-1980 period could explain most if not all of the change in estimated impulse response functions.

\section{Identifying the Structural Phillips Curve}

Aside from making it very clear that one should not conclude that the PC has disappeared based on correlations between inflation and the output gap, or simple regressions, McLeay and Tenreyro describe in simple terms the identification problem, propose ways to address it, and provide evidence that there is structural PC with positive slope between inflation and the output gap. As Figure 1 illustrates, shocks to the cost-push shocks \( u_t \) help trace the policy rule, not the PC. If the policy rule is itself subject to disturbances \( e_t \) so that it becomes

\begin{equation}
\pi_t = -\frac{\lambda}{\kappa} x_t - e_t,
\end{equation}

then fluctuations in \( e_t \) may help trace the structural PC. The identification problem arises when we face shocks to both the policy (targeting) rule and the PC.

Focusing on equations (1) and (4) provides a transparent way of characterizing the identification problem, in a near-static environment (for given inflation expectations), in which the PC implies a positive contemporaneous relation between \( \pi_t, x_t \), while policy implies a negative contemporaneous relation between these two variables. If only we could control for the cost-push shocks \( u_t \), then shocks to the policy rule (represented by

\textsuperscript{1}Goodhart (1981): “Any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes.”

\textsuperscript{2}Lucas (1976): “A change in policy [parameters] affects the behavior of the system in two ways: first by altering the time series behavior of [policy variables]; second by leading to modification of the behavioral parameters [...] governing the rest of the system.” [...] It follows that any change in policy will systematically alter the structure of econometric models.”
either red line in Figure 1) would trace out the structural PC. Similarly, the identification problem can be partly addressed in the case of regional PC subject to region-specific cost-push shocks, but with monetary policy responding to aggregate economic conditions, as McLeay and Tenreyro as well as other recent studies have proposed (Hooper, Mishkin and Sufi, 2019).

3.1 Difficulties with Identification via Disturbances to the Optimal Target Criterion

While the authors make a strong case for identifying the PC using equations (1) and (4), I am concerned that it may not be as easy to identify the PC in more complicated setups, in particular when the policy rule disturbances $e_t$ are not exogenous and depend on other variables, including variables affecting the residuals $u_t$ themselves, or if the residuals $u_t$ capture more than exogenous “cost-push shocks”, indeed if they depend on variables that also shift the policy rule.

To illustrate this point, I will consider a few examples:

- Take again the simple PC (1) and the objective function (2), but assume that optimal policy is conducted under commitment. Then, as pointed out by McLeay and Tenreyro, optimal policy can be represented by an optimal target criterion of the form (4) with $e_t = -\frac{1}{\kappa}x_{t-1}$. If the cost-push shock is serially correlated, then $e_t$ and $u_t$ are correlated. A suitable instrument is thus needed.

- Assume instead that inflation involves some inertia as modeled, e.g., in Christiano, Eichenbaum and Evans (2005), and as appears realistic in the data. Then, as shown in Giannoni and Woodford (2004) (equ. 12), lagged inflation appears both in the PC (1) and in the optimal target criterion (4), so that $e_t$ and $u_t$ would both be functions of lagged inflation.

- When the representative household face habit persistence in expenditures, then again, as shown in Giannoni and Woodford (2004) (equ. 47 and 53), both the PC and the optimal target criterion involve the lagged output gap, so that $u_t$ and $e_t$ in (1) and (4) would be both functions of $x_{t-1}$, and hence would be correlated.

- Suppose alternatively, that the policymaker faces a PC of the form (1) but cares about interest-rate variability in addition to the two other terms entering her objective function (2). Then, the optimal target criterion involves a relationship between current and forecasts of inflation, output gaps as well as lags of the output gap and interest rates (see Giannoni and Woodford (2004), equ. 22). Again, that would imply that the terms $u_t$ and $e_t$ in (1) and (4) would be correlated.
Similar concerns arise when the model involves both price and wage stickiness, so that a PC arises for price and for wage inflation; when monetary policy actions have delayed effects on macroeconomic variables, so that optimal policy depends on expectations of future inflation and output gaps, and so on.

3.1.1 Identifying the PC: Static vs. Dynamic?

While McLeay and Tenreyro make an important conceptual point, and provide a very intuitive way of characterizing the difficulty in identifying the PC in a near-static framework, I am skeptical that one can fully recover the Phillips curve without taking a stronger stance on dynamic relationships linking the key macroeconomic variables. Although the simple New Keynesian PC considered is an invaluable tool to develop intuition, much of the empirical literature suggests that inflation responds to measures of slack in a more inertial fashion. Similarly, while the simple model considered assumes that policymakers can instantaneously affect economic activity and the output gap, empirical evidence suggests the effects are more sluggish. (If not, it would be difficult to explain why inflation has been below its target and economic activity has been below estimates of its potential for so many years, following the Great Recession). This implies that the dynamic relationship between inflation and the output gap is more complex than described by the simple New Keynesian model, and that it is important to properly model these dynamics in order to identify a PC.

Estimated DSGE model are a valuable tool to characterize the joint dynamics of key macroeconomic variables and thus of the complex interactions between the PC and policy. In such dynamic models, inflation expectations play a key role, and a monetary policy aimed at stabilizing inflation and hence inflation expectations does also imply a flattening the reduced-form PC. A potential downside of such fully-specified models is that they are necessarily misspecified. A key question then is whether such models can explain important recent episodes. In particular, Del Negro, Giannoni and Schorfheide (2015) study whether a standard DSGE model along the lines of Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007) augmented with financial frictions, and estimated with data up to 2008Q3 can explain the macroeconomic behavior during and after the Great Recession. They find that as soon as credit spreads jump in the Fall 2008, the model successfully predicts the sharp contraction in activity and the modest and protracted decline in inflation, as shown in Figure 2. They also find that data on credit spreads and inflation expectations, in addition to the standard data series used by e.g., Smets and Wouters (2007), are important in properly characterizing the state of the economy.
To understand why inflation does not collapse given the sharp drop in output, it is useful to consider a simplified version of the forward-looking PC considered in the model. That simplified PC, which is similar to (1) (except that $x_t$ is replaced with real marginal costs), implies that inflation does not depend only on the current gap (or marginal cost), but on the entire path of future gaps:

$$\pi_t = \sum_{j=0}^{\infty} \beta^j E_t [\kappa \overbrace{x_{t+j}}^{\text{gaps}} + \overbrace{u_{t+j}}^{\text{mark-up shocks}}].$$

It follows that inflation and inflation expectations in the model remain well anchored, despite the sharp collapse in output, because monetary policy is expected to be aggressive enough to close the gaps in the future.

Similarly to McLeay and Tenreyro, while the model includes a structural PC that involves a positive relationship between inflation and the output gap, inflation was predicted to move relatively little in the face of the output collapse. However, in contrast to McLeay and Tenreyro, according to the DSGE model, it was not the contemporaneous monetary stimulus (at the end of 2008 and in early 2009) that helped stabilize inflation; indeed, short-term nominal rates were constrained by the zero lower bound at that time. Instead, the expectation of future stimulus induced expectations of closing output gaps in the future, and hence helped keep inflation near its target.
4 Conclusion

McLeay and Tenreyro have written a very nice paper that clearly and elegantly exposes the identification problem in estimating the slope of a Phillips Curve when policymakers seek to stabilize inflation and/or the output gap. They propose interesting strategies to estimate the PC and present evidence of a robust PC in the U.S. The simplicity of the framework considered allows the authors to provide numerous insights. I have expressed some reservations about the ability to generalize the results beyond the current framework, in particular when one faces more complex dynamic interactions between inflation, inflation expectations, activity and policy. In more complicated environments, I suspect that DSGE model estimation remains necessary to better characterize the joint dynamics of macro variables, and the role of expectations.

References


