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A closer look at the Phillips curve using state-level data☆

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ABSTRACT

Studies that estimate the Phillips curve for the U.S. use mainly national-level data and find mixed evidence of nonlinearity, with some recent studies either rejecting nonlinearity or estimating only modest convexity. In addition, most studies do not make a distinction between the relative impacts of short-term versus long-term unemployment on wage inflation. Using state-level data from 1982 to 2013, we find strong evidence that the wage-price Phillips curve is nonlinear and convex; declines in the unemployment rate below the average unemployment rate exert significantly higher wage pressure than changes in the unemployment rate above the historical average. We also find that the short-term unemployment rate has a strong relationship with both average and median wage growth, while the long-term unemployment rate appears to only influence median wage growth.

1. Introduction

Economists have long posited that the Phillips curve may be nonlinear and convex and that inflation may respond asymmetrically to declines in unemployment above versus below the natural rate of unemployment.[1] Nevertheless, a linear Phillips curve remained the standard specification in the vast majority of studies until the 1990s when a series of papers found strong evidence of a convex relationship between inflation and unemployment.[2] A nonlinear Phillips curve can have starkly different policy implications than those of a linear Phillips curve. While a linear Phillips curve warrants a symmetric monetary policy response with respect to business cycle conditions of excess demand or excess supply, a nonlinear Phillips curve may imply pre-emptive measures are needed to counter inflation when, for example, the unemployment rate declines below the natural rate. Allowing excess demand conditions to persist may necessitate significant subsequent tightening to curtail inflation, adversely affecting not just actual but also potential output (Laxton et al., 1995; Laxton et al., 1999).

Despite the importance of estimating nonlinear wage-price Phillips curves, most studies focus on price inflation rather than wage inflation, use mainly national-level time-series data and find mixed evidence on nonlinearity, with some recent papers

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[1] The inverse relationship between unemployment and wages was originally proposed in a seminal paper by Phillips (1958).

[2] See for example, Akerlof et al. (1996), Clark et al. (1996), Laxton et al. (1995), Clark and Laxton (1997), Debelle and Laxton (1997), Laxton et al. (1999), Tambakis (1999), Turner (1995), Filardo (1998), Schaling (2004), Barnes and Olivei (2003), Huh et al. (2009), and Fuhrer et al. (2012).

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either rejecting nonlinearity or estimating only modest convexity.[3] Variation in national data on inflation and unemployment may be too limited to yield robust and statistically significant estimates of nonlinearity in the Phillips curve (Coen et al., 1999). Meanwhile, much of the recent Phillips curve research using regional data has sidestepped nonlinearity and instead focused on heterogeneity across regions, states' monetary policy responses (Carlino and DeFina, 1998; Carlino and DeFina, 1999), or the stability of a linear Phillips curve (Fitzgerald and Nicolini, 2013).[4]

Following Blanchflower and Oswald (1994), a separate but related strand of the literature uses household-level micro data and regresses the level of nominal wages on their first lag and the local unemployment rate to estimate the "wage curve". In such specifications, a small or insignificant coefficient on lagged nominal wages can be interpreted as the rejection of a traditional Phillips curve model that involves a regression of nominal wage inflation on lagged price inflation and the unemployment rate.[5] Using annual data from the March CPS and finding lack of autoregression in the estimated wage curve, Blanchflower and Oswald (1994) rejected the traditional Phillips curve. Using micro and state level data and alternative measure of wages, subsequent papers, however, have challenged the Blanchflower and Oswald (1994) findings and concluded that the traditional Phillips curve is still very relevant (Blanchard and Katz, 1996, 1999; Card, 1995; Whelan, 1997). With a few exceptions, the wage curve literature also largely focuses on the linear effects of the local unemployment rate.[6]

Most previous estimates of the standard linear Phillips curve also have not distinguished between the relative impacts on wage inflation of short-term versus long-term unemployment. There is an ongoing debate about whether the long-term unemployed continue to matter for wage inflation. Under the assumption that the Phillips Curve accurately captures the relationship between wages and unemployment, a weak or nonexistent relationship between the long-term unemployment rate and wage inflation would suggest that a substantial number of the long-term unemployed are effectively out of the labor force and out of reach of employers.[7] Improvements in short-term unemployment could, therefore, generate higher wage pressures than that suggested by changes in the headline rate. In this case, monetary policymakers would need to adjust interest rates sooner to curtail inflation. On the other hand, if the long-term unemployed continue to matter for wage inflation, then an elevated long-term unemployment rate would help keep inflation in check, putting off eventual interest rate hikes.[8]

We make three contributions to the existing literature on nonlinear Phillips curves in the U.S. case. First, unlike previous research that primarily estimates time-series models using national data, we estimate nonlinear specifications of the wage-price Phillips curve using state-level panel data which has rich variation in wage inflation and unemployment rates. Our paper is different from some papers estimating nonlinear models in the wage curve literature—e.g. Bratsberg and Turunen (1996) and Blanchflower and Oswald (2005)—in that we estimate a traditional wage-price Phillips curve, use more recent data, and consider alternative wage measures. Additionally, we examine the sensitivity of the wage-price Phillips curve estimates to different data frequencies and evaluate the ability of standard Phillips curve models to forecast real wage growth. Second, using quarterly data, we estimate wage-price Phillips curve separately for each state and show that there is substantial heterogeneity in the curve's slope and shape across states. Third, we contribute to an emerging literature that allows the response of real wage inflation to vary by the type of labor market slack. We estimate Phillips curve specifications that distinguish between the relative wage growth impacts of short-term versus long-term unemployment.

Our analysis of state-level data from1982 to 2013 yields four main findings. First, the Phillips curve is nonlinear and strongly convex and unemployment rate declines below the historical average unemployment rate exert significantly higher wage pressures than declines at above-average unemployment rates. Our choice of a specific knot—the average unemployment rate in our sample—for the piecewise-linear specification of the Phillips curve that we estimate, may be somewhat arbitrary. We therefore test nonlinearity in the Phillips curve along a range of unemployment rates on either side of the average rate and come to the same conclusion—the Phillips curve using state-level data is nonlinear and strongly convex. Second, using quarterly data, we uncover substantial heterogeneity in the slope and shape of the Phillips curve across states. Third, in evaluating the out-of-sample predictive ability of our estimated models using state-level panel data, we find—consistent with previous research on inflation forecasting—that the Phillips curve specification does not significantly improve upon forecasts obtained from simple autoregressive models of real wage growth. However, unlike previous research, we find that Phillips curve-based forecasts outperform naïve random walk forecasts of real wage growth. Using state-level data from1994 to 2013, our fourth main finding is that short-term unemployment has a strong relationship with inflation in both average and median wages, but long-term unemployment appears to be significantly associated only with inflation in median wages.

The remainder of the paper is organized as follows. We start with the theoretical motivation for our research in Section 2. Section 3 describes the econometric specification and Section 4 discusses the data. Section 5 presents the results

[3] See for example, Gordon (1997), Dupasquier and Ricketts (1998), Eliasson (2001), Tambakis (2009), Ball and Mazumder (2011). Stiglitz (1997) are exceptions that find evidence of a concave Phillips curve.

[4] Aaronson and Sullivan (2000) and Wall and Zoega (2004) estimated Phillips curves using cross-state variation in unemployment and wage growth but used data before 2000. Johnes and Hyclak (1995) and Payne (1995) estimated state-specific linear Phillips Curves using data through 1986 and 1991, respectively. Martínez-García and Wynne (2014) estimate the linear Phillips Curve using city-level data but do not explore nonlinearity.

[5] See Blanchard and Katz (1999) and Whelan (1997) for the relationship between the wage curve and the standard Phillips curve.

[6] Bratsberg and Turunen (1996) estimated a model of the wage curve with a cubic in the local unemployment rate using NLSY data from 1979 to 1993 and found evidence of convexity in unemployment and the log wage relationship. Blanchflower and Oswald (2005) estimated wage curve versions with log of unemployment rate to introduce nonlinearity using CPS-ORG data from 1979 to 2001. See Nijkamp and Poot (2005) for a comprehensive review.

[7] See Krueger et al. (2014), Aaronson and Jordan (2014), Smith (2014), Kiley (2014), Linder et al. (2014) for U.S. evidence and Llaudes (2005) for Europe.

[8] An important caveat to this interpretation in the context of this paper is that the measure of wages used in estimated wage-price Phillips curve models excludes fringe benefits and other non-pecuniary aspects of employment.