Has the Phillips Curve Flattened and Why?

Atsushi Inoue$^1$  Barbara Rossi$^2$  Yiru Wang$^3$

$^1$Vanderbilt University
$^2$ICREA-Universitat Pompeu Fabra, Barcelona School of Economics and CREI
$^3$University of Pittsburgh

Inflation: Drivers and Dynamics 2022
Introduction

Inflation and unemployment seem to have become disconnected during recent years.

▶ The correlation between inflation and real activity at business cycle frequencies has decreased in the 1990s (e.g. Atkeson and Ohanian, 2001, Stock and Watson, 2007, 2008, 2020).

▶ It also fell during the years of the expansion that followed the recent financial crisis of 2007-2009 – the missing deflation: Hall (2011), Ball and Mazumder(2011), Coibion and Gorodnichenko (2015), Bobeica and Jarocinski (2019).

▶ Why did the cyclical correlation decrease?
Introduction

Inflation and unemployment seem to have become disconnected during recent years.

▶ The correlation between inflation and real activity at business cycle frequencies has decreased in the 1990s (e.g. Atkeson and Ohanian, 2001, Stock and Watson, 2007, 2008, 2020).

▶ It also fell during the years of the expansion that followed the recent financial crisis of 2007-2009 – the missing deflation: Hall (2011), Ball and Mazumder (2011), Coibion and Gorodnichenko (2015), Bobeica and Jarocinski (2019).
Inflation and unemployment seem to have become disconnected during recent years.

- The correlation between inflation and real activity at business cycle frequencies has decreased in the 1990s (e.g. Atkeson and Ohanian, 2001, Stock and Watson, 2007, 2008, 2020).

- It also fell during the years of the expansion that followed the recent financial crisis of 2007-2009 – the missing deflation: Hall (2011), Ball and Mazumder(2011), Coibion and Gorodnichenko (2015), Bobeica and Jarocinski (2019).

- Why did the cyclical correlation decrease?
Why did the cyclical correlation decrease?

Why did the cyclical correlation between inflation and unemployment decrease?

- Flattening of the slope of the Phillips curve?
Why did the cyclical correlation decrease?

Why did the cyclical correlation between inflation and unemployment decrease?

- Flattening of the slope of the Phillips curve?

- Monetary policy getting better at stabilizing inflation, thus flattening aggregate demand?
Why did the cyclical correlation decrease?

Why did the cyclical correlation between inflation and unemployment decrease?

- Flattening of the slope of the Phillips curve?
- Monetary policy getting better at stabilizing inflation, thus flattening aggregate demand?
- Inflation or economic slack are mis-measured?
Why did the cyclical correlation decrease?

Why did the cyclical correlation between inflation and unemployment decrease?

- Flattening of the slope of the Phillips curve?

- Monetary policy getting better at stabilizing inflation, thus flattening aggregate demand?

- Inflation or economic slack are mis-measured?

If the Phillips curve indeed became flat, it would imply that more extreme policy measures would be necessary to maintain inflation at its target value... Hence its high policy relevance.
Challenges

One of the main challenges in the estimation of the Phillips curve is due to endogeneity, as inflation and unemployment are jointly determined in equilibrium.
Challenges

One of the main challenges in the estimation of the Phillips curve is due to endogeneity, as inflation and unemployment are jointly determined in equilibrium.

Two main approaches to handling endogeneity:

▶ Estimating the Phillips curve as part of a structural macroeconomic model (either Structural VARs or DSGEs)
Challenges

One of the main challenges in the estimation of the Phillips curve is due to endogeneity, as inflation and unemployment are jointly determined in equilibrium.

Two main approaches to handling endogeneity:

▶ Estimating the Phillips curve as part of a structural macroeconomic model (either Structural VARs or DSGEs)

▶ Focusing only on the Phillips curve relationship via instrumental variables (IV) methods.
Challenges

One of the main challenges in the estimation of the Phillips curve is due to endogeneity, as inflation and unemployment are jointly determined in equilibrium.

Two main approaches to handling endogeneity:

▶ Estimating the Phillips curve as part of a structural macroeconomic model (either Structural VARs or DSGEs)

▶ Focusing only on the Phillips curve relationship via instrumental variables (IV) methods.

▶ While it is well-known how to estimate DSGEs and Structural VARs in the presence of instabilities...
Challenges

One of the main challenges in the estimation of the Phillips curve is due to endogeneity, as inflation and unemployment are jointly determined in equilibrium.

Two main approaches to handling endogeneity:

▶ Estimating the Phillips curve as part of a structural macroeconomic model (either Structural VARs or DSGEs)

▶ Focusing only on the Phillips curve relationship via instrumental variables (IV) methods.

▶ While it is well-known how to estimate DSGEs and Structural VARs in the presence of instabilities...

▶ ... On the other hand, DSGEs and Structural VARs are full-information estimation procedures: potential mis-specification in any other part of the model might potentially contaminate the Phillips curve estimate
Our approach

▶ We focus instead on a limited-information-IV approach à la Galí-Gertler (1999), or Galí, Gertler and Lopez-Salido (2005)
Our approach

- We focus instead on a limited-information-IV approach à la Galí-Gertler (1999), or Galí, Gertler and Lopez-Salido (2005).

- Limited-information approaches are not affected by potential mis-specification in other parts of the model.
Our approach

▶ We focus instead on a limited-information-IV approach à la Galí-Gertler (1999), or Galí, Gertler and Lopez-Salido (2005)

▶ Limited-information approaches are not affected by potential mis-specification in other parts of the model.

▶ However time-variation in the Phillips curve using instrumental variables is not studied in the literature due to lack of methodologies.
Our approach

▶ We focus instead on a limited-information-IV approach à la Galí-Gertler (1999), or Galí, Gertler and Lopez-Salido (2005)

▶ Limited-information approaches are not affected by potential mis-specification in other parts of the model.

▶ However time-variation in the Phillips curve using instrumental variables is not studied in the literature due to lack of methodologies.

The contribution of this paper is to directly estimate the time-varying structural Phillips curve via limited-information methods.
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
Main contributions

The contribution of this paper is to directly estimate the time-varying structural Phillips curve via limited-information (IV) methods.

► No methods were available to estimate IV with time-varying parameters.
Main contributions

The contribution of this paper is to directly estimate the time-varying structural Phillips curve via limited-information (IV) methods.

- No methods were available to estimate IV with time-varying parameters.

- Our approach relies on the novel methodology proposed by Inoue et al. (2022)
Main contributions

The contribution of this paper is to directly estimate the time-varying structural Phillips curve via limited-information (IV) methods.

- No methods were available to estimate IV with time-varying parameters.

- Our approach relies on the novel methodology proposed by Inoue et al. (2022)

- We estimate local projections and instrumental variables models with time-varying parameters (TVP-LP-IV).
Main contributions

The contribution of this paper is to directly estimate the time-varying structural Phillips curve via limited-information (IV) methods.

▶ No methods were available to estimate IV with time-varying parameters.

▶ Our approach relies on the novel methodology proposed by Inoue et al. (2022)

▶ We estimate local projections and instrumental variables models with time-varying parameters (TVP-LP-IV).

▶ We also propose a novel TVP-LP-IV methodological approach robust to weak instruments.
Empirical findings

Our main empirical findings are as follows:

▶ We find that the decrease in the correlation between unemployment and inflation cannot be attributed to monetary policy; rather, to the decrease in the slope of the Phillips curve.
▶ Our time-varying estimation dates the decrease in the slope of the Phillips curve back to the 1980s, although it started reverting back in the most recent pandemic period.
Our main empirical findings are as follows:

▶ We find that the decrease in the correlation between unemployment and inflation cannot be attributed to monetary policy; rather, to the decrease in the slope of the Phillips curve.
Empirical findings

Our main empirical findings are as follows:

- We find that the decrease in the correlation between unemployment and inflation cannot be attributed to monetary policy; rather, to the decrease in the slope of the Phillips curve.

- Our time-varying estimation dates the decrease in the slope of the Phillips curve back to the 1980s, although it started reverting back in the most recent pandemic period.
Relationship to literature: Overview

In contrast to our work, most of the existing literature relies either on:

- **reduced-form time-varying** parameter approaches (Stock-Watson, 2008; Ball-Mazumder, 2019)

- **semi-structural time-varying** parameter approaches (Galí-Gambetti, 2018; Bergholt et al., 2022);

- **structural models estimation in given sub-samples** (Del Negro et al., 2020);

- **IV estimation in given sub-samples** (Barnichon-Mesters, 2020, 2021)

In contrast to these works, we focus on the structural Phillips curve, estimated via IV, allowing for general forms of time-variation.
Reduced-form approaches attempt at studying the correlation between inflation and unemployment.

- Stock and Watson (2008) suggest that Phillips curve forecasts are better than competing multivariate forecasts, although their performance is episodic, pointing to instabilities.

- Ball and Mazumder (2019) argue that expected inflation was backward-looking until the late 1990s, but then became strongly anchored at the central bank’s target value.

Differently from them, we also address the endogeneity problem and estimate the structural Phillips curve.
Relationship to literature: Semi-structural Approaches

There are also semi-structural approaches:

- Galí and Gambetti (2018) estimate a time-varying parameter Vector Autoregression (VAR) model to identify economic shocks, then use such shocks to purge the Phillips curve variables and achieve identification.

- Bergholt et al. (2022) estimate structural shocks using sign restrictions in constant-parameter VARs; then, they investigate changes in the Phillips curve over time using inflation and unemployment data purged by the relevant shocks in either sub-samples or rolling windows.

Differently from them, we directly estimate the Phillips curve using instrumental variable methods that do not require identifying all the structural shocks in the economy.
A third strand of the literature relies on structural models.

- Del Negro et al. (2020) investigate whether the flattening of the Phillips curve is the explanation behind the disconnect between inflation and unemployment by focusing on (Structural) Time-varying parameter VARs and DSGE models in sub-samples, before and after 1989.

Differently from their work, we rely directly on estimating the structural Phillips curve via limited-information methods, which are more robust to mis-specification than full-information methods, and let the instability in inflation dynamics to freely emerge within our time-varying instrumental variable (TVP-IV) estimator.
A fourth strand of the literature focuses on IV or external information.

- McLeay and Tenreyro (2019) argue that, if inflation follows a seemingly exogenous statistical process, unrelated to the output gap, that does not mean that the Phillips curve has disappeared: by increasing inflation when output is below potential, monetary policy can generate a negative correlation between inflation and the output gap, blurring the identification of the Phillips curve.

- Barnichon and Mesters (2020, 2021) estimate the Phillips curve and the Phillips multiplier using narrative monetary policy shocks as instruments to address the endogeneity problem. To take into account time-variation, they split the sample at a known break date.

These papers do not allow for general patterns of time variation, which is instead the main contribution of our paper.
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
The Phillips relation

We consider the Phillips relation:

\[ E_t \Delta_4 \pi_t^4 = \beta_{0,t} + \beta_{1,t} x_t^4 , \quad (1) \]

where:

- \( z_t^4 \) is the change in the average value of variable “z” between times t and t-3
- \( \Delta_4 = (1 - L^4) \), \( L \) denotes the lag operator such that \( Lx_t = x_{t-1} \)
- \( x_t \) is a measure of slack (mainly unemployment gap, CBO)
- \( \pi_t \) is inflation, measured by personal consumption expenditure price index (PCE excluding food and energy, PCExFE).
Our TVP-LP estimate of $\beta_{1,t}$ in red; Stock and Watson’s (2020) sub-sample estimates in black. Dotted lines are 90 percent bands.
The Phillips relation

- The slope of the Phillips relation substantially flattened over time, no matter whether we estimate the relation in sub-samples or using our time-varying estimator.

It has disappeared in the data in the most recent period.

But this does not mean that the Phillips curve has disappeared!

The Phillips relation measures the correlation between inflation and unemployment, while the Phillips curve measures the trade-off between inflation and unemployment due to supply shocks.
The slope of the Phillips relation substantially flattened over time, no matter whether we estimate the relation in sub-samples or using our time-varying estimator.

It has disappeared in the data in the most recent period.
The Phillips relation

- The slope of the Phillips relation substantially flattened over time, no matter whether we estimate the relation in sub-samples or using our time-varying estimator.

- It has disappeared in the data in the most recent period.

- But this does not mean that the Phillips curve has disappeared!
The Phillips relation

- The slope of the Phillips relation substantially flattened over time, no matter whether we estimate the relation in sub-samples or using our time-varying estimator.

- It has disappeared in the data in the most recent period.

- But this does not mean that the Phillips curve has disappeared!

- The Phillips relation measures the correlation between inflation and unemployment, while the Phillips curve measures the trade-off between inflation and unemployment due to supply shocks.
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
The structural Phillips curve


\[ \pi_t = c_t + \gamma_{f,t} \pi_{t+1} + \gamma_{b,t} \pi_{t-1} + \lambda_t x_t + u_t, \]

where:

- $\pi_t$ denotes inflation.
- $x_t$ denotes the measure of real marginal cost (the unemployment gap)
- $u_t$ is an unobserved shock
The structural Phillips curve specification (continue)

- inflation $\pi_t$: measured by the GDP deflator.
The structural Phillips curve specification (continue)

- inflation $\pi_t$: measured by the GDP deflator.
- Forcing variable: the unemployment gap (cbo).
The structural Phillips curve specification (continue)

- inflation $\pi_t$: measured by the GDP deflator.
- Forcing variable: the unemployment gap (cbo).
The structural Phillips curve specification (continue)

- inflation $\pi_t$: measured by the GDP deflator.

- Forcing variable: the unemployment gap (cbo).


- Instrument set: two lags of the unemployment gap and output gap.
The structural Phillips curve specification (continue)

- inflation $\pi_t$: measured by the GDP deflator.
- Forcing variable: the unemployment gap (cbo).
- Instrument set: two lags of the unemployment gap and output gap.
- The instruments are strong in this specification
The structural Phillips curve specification (continue)

- inflation $\pi_t$: measured by the GDP deflator.
- Forcing variable: the unemployment gap (cbo).
- Instrument set: two lags of the unemployment gap and output gap.
- The instruments are strong in this specification
- Approach: We estimate it using the TVP-IV approach developed in Inoue et al. (2022). The parameter path is estimated according to a minimum weighted average risk criterion.
The slope of the structural Phillips curve

Our TVP-IV estimate of $\lambda_t$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
The forward-looking inflation parameter in the structural Phillips curve

Our TVP-IV estimate of $\gamma_{f,t}$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
The backward-looking inflation parameter in the structural Phillips curve

Our TVP-IV estimate of $\gamma_{b,t}$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
Summary of empirical results

- Our results confirm a flattening of the slope of the Phillips curve ($\lambda_t$) in the last two decades.
Summary of empirical results

- Our results confirm a flattening of the slope of the Phillips curve \( (\lambda_t) \) in the last two decades.

- The slope has decreased, in absolute value, from around \(-0.12\) in the early 1970s to around \(-0.04\) in the most recent sample. In particular, notice how it trended downward in the 1990s, becoming effectively indistinguishable from zero.
Summary of empirical results

- Our results confirm a flattening of the slope of the Phillips curve ($\lambda_t$) in the last two decades.

- The slope has decreased, in absolute value, from around $-0.12$ in the early 1970s to around $-0.04$ in the most recent sample. In particular, notice how it trended downward in the 1990s, becoming effectively indistinguishable from zero.

- The importance of the forward-looking component ($\gamma_{f,t}$) has slightly decreased from around 0.45 in the early 1970s to around 0.35, suggesting agents becoming less forward-looking.
Summary of empirical results

► Our results confirm a flattening of the slope of the Phillips curve ($\lambda_t$) in the last two decades.

► The slope has decreased, in absolute value, from around $-0.12$ in the early 1970s to around $-0.04$ in the most recent sample. In particular, notice how it trended downward in the 1990s, becoming effectively indistinguishable from zero.

► The importance of the forward-looking component ($\gamma_{f,t}$) has slightly decreased from around 0.45 in the early 1970s to around 0.35, suggesting agents becoming less forward-looking.

► The importance of the backward-looking component in the Phillips curve ($\gamma_{b,t}$) has remained constant over time.
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
The Phillips multiplier

Barnichon and Mesters (2021) propose the “Phillips multiplier” as an alternative measure of the inflation-unemployment trade-off faced by policymakers.

\[
\sum_{j=0}^{h} \pi_{t+j} = \mathcal{P}_h \sum_{j=0}^{h} u_{t+j} + \text{controls} + e_{t+h},
\]

(2)

where \( \mathcal{P}_h \) is the “Phillips multiplier.”

▶ We will estimate a **time-varying Phillips multiplier** \( \mathcal{P}_{h,t} \) using our method.
Barnichon and Mesters (2021) propose the “Phillips multiplier” as an alternative measure of the inflation-unemployment trade-off faced by policymakers.

\[
\sum_{j=0}^{h} \pi_{t+j} = \mathcal{P}_h \sum_{j=0}^{h} u_{t+j} + \text{controls} + e_{t+h},
\]

where \( \mathcal{P}_h \) is the “Phillips multiplier.”

- We will estimate a time-varying Phillips multiplier \( \mathcal{P}_{h,t} \) using our method.

- This will give us an estimate of the time-varying trade-off between inflation and unemployment in the classical specification of the Phillips curve a’ la GG.
The time-varying Phillips multiplier

Note: the x-axis reports the horizon of the impulse responses

The time-varying estimate of the Phillips multiplier in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
The time-varying Phillips multiplier, $\mathcal{P}_{h,t}$, $h = 12$

pre-1990 and post-1990:

The time-varying estimate of the Phillips multiplier in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
Main Empirical Conclusions

The flattening of the Phillips curve seems a robust result in our data, no matter whether we consider:

- the Phillips (cor)relation
Main Empirical Conclusions

The flattening of the Phillips curve seems a robust result in our data, no matter whether we consider:

- the Phillips (cor)relation
- the Phillips multiplier
Main Empirical Conclusions

The flattening of the Phillips curve seems a robust result in our data, no matter whether we consider:

- the Phillips (cor)relation
- the Phillips multiplier
- or the slope of the structural Phillips curve
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
Is the decrease in the correlation due to monetary policy?

Several researchers have made compelling arguments that the reason for the decrease in the cyclical correlation between inflation and unemployment is related to monetary policy actions.

- A more responsive monetary policy to inflation and economic conditions would tighten monetary policy more when it perceives inflation to be increasing, in order to keep the latter under control...
Is the decrease in the correlation due to monetary policy?

Several researchers have made compelling arguments that the reason for the decrease in the cyclical correlation between inflation and unemployment is related to monetary policy actions.

- A more responsive monetary policy to inflation and economic conditions would tighten monetary policy more when it perceives inflation to be increasing, in order to keep the latter under control...

- ... this causes unemployment to rise, resulting in a positive correlation between inflation and unemployment that biases the slope coefficient of the Phillips curve toward zero.
Is the decrease in the correlation due to monetary policy?

Several researchers have made compelling arguments that the reason for the decrease in the cyclical correlation between inflation and unemployment is related to monetary policy actions.

▶ A more responsive monetary policy to inflation and economic conditions would tighten monetary policy more when it perceives inflation to be increasing, in order to keep the latter under control...

▶ ... this causes unemployment to rise, resulting in a positive correlation between inflation and unemployment that biases the slope coefficient of the Phillips curve toward zero.

▶ See Haldane and Quah (1999); Roberts (2006); Williams (2006); Mishkin (2007); Carlstrom, Fuerst, and Paustian (2009); McLeay and Tenreyro (2018).
The Endogeneity Problem

The correlation between inflation and unemployment is the same as the slope of the Phillips curve only in the presence of no endogeneity bias and no measurement error.
The Endogeneity Problem

- The correlation between inflation and unemployment is the same as the slope of the Phillips curve only in the presence of no endogeneity bias and no measurement error.

- Thus, the endogeneity problem can be solved using valid and relevant instruments.
The Endogeneity Problem

- The correlation between inflation and unemployment is the same as the slope of the Phillips curve only in the presence of no endogeneity bias and no measurement error.

- Thus, the endogeneity problem can be solved using valid and relevant instruments.

- In the presence of an endogeneity bias due to monetary policy actions, IV estimates will still be consistent provided the instruments satisfy the required statistical conditions – that is, the chosen instruments should be both valid and relevant.
Reliability of our Estimates

Our main results feature instruments that are both valid and strong. In fact:

- Hansen’s J-statistic equals 1.955, with a p-value of 0.3763, indicating that the instruments are valid (conditional on the maintained assumption that a subset of instruments are valid).

- Ganics et al.’s (2021) weak-IV robust confidence interval for the strength of identification points to strong instruments (the min eigen value is 1.6634, with a confidence interval equal to $(1.1505, 5.7933)$, which excludes zero).

- Lewis and Mertens’s (2022) weak IV test statistic equals 16.0254, and it is greater than the 90% critical value 14.0533, indicating that the instruments are strong.
Reliability of our Estimates

Our main results feature instruments that are both valid and strong. In fact:

- Hansen’s J-statistic equals 1.955, with a p-value of 0.3763, indicating that the instruments are valid (conditional on the maintained assumption that a subset of instruments are valid).

- Ganics et al.’s (2021) weak-IV robust confidence interval for the strength of identification points to strong instruments (the min eigen value is 1.6634, with a confidence interval equal to (1.1505, 5.7933), which excludes zero).
Reliability of our Estimates

Our main results feature instruments that are both valid and strong. In fact:

▶ Hansen’s J-statistic equals 1.955, with a p-value of 0.3763, indicating that the instruments are valid (conditional on the maintained assumption that a subset of instruments are valid).

▶ Ganics et al.’s (2021) weak-IV robust confidence interval for the strength of identification points to strong instruments (the min eigen value is 1.6634, with a confidence interval equal to (1.1505, 5.7933), which excludes zero).

▶ Lewis and Mertens’s (2022) weak IV test statistic equals 16.0254, and it is greater than the 90% critical value 14.0533, indicating that the instruments are strong.
TVP-IV robust to weak instruments

Our main results are based on the specification that features strong instruments
TVP-IV robust to weak instruments

Our main results are based on the specification that features strong instruments.

However, some specifications in the literature use weak instruments.
TVP-IV robust to weak instruments

Our main results are based on the specification that features strong instruments.

However, some specifications in the literature use weak instruments.

In order to analyze the specifications in the literature, we develop a methodological approach robust to weak instruments (details in the paper).
TVP-IV robust to weak instruments

Our main results are based on the specification that features strong instruments.

However, some specifications in the literature use weak instruments.

In order to analyze the specifications in the literature, we develop a methodological approach robust to weak instruments (details in the paper).

With the method robust to weak instruments we will investigate two alternative specifications:
- I. monetary policy shocks as instruments
- II. Gali’ et al.’s (GGLS) specification
Specification I: using monetary policy shocks as IV

The model is the hybrid Phillips curve in Barnichon and Mesters (2021):

\[ \pi_t = c_t + \gamma_{f,t} \pi_{t+4}^4 + \gamma_{b,t} \pi_{t-1}^4 + \lambda_t x_t + u_t, \]

- \( \pi_t \): the (annualized) quarter-to-quarter inflation, measured by personal consumption expenditure price index (PCE excluding food and energy)
Specification I: using monetary policy shocks as IV

The model is the hybrid Phillips curve in Barnichon and Mesters (2021):

\[
\pi_t = c_t + \gamma_{f,t} \pi_{t+4}^4 + \gamma_{b,t} \pi_{t-1}^4 + \lambda_t x_t + u_t,
\]

- \(\pi_t\): the (annualized) quarter-to-quarter inflation, measured by personal consumption expenditure price index (PCE excluding food and energy)
- \(\pi_{t-1}^4 = \frac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4})\).
Specification I: using monetary policy shocks as IV

The model is the hybrid Phillips curve in Barnichon and Mesters (2021):

$$\pi_t = c_t + \gamma_{f,t} \pi_{t+4}^4 + \gamma_{b,t} \pi_{t-1}^4 + \lambda_t x_t + u_t,$$

- $\pi_t$: the (annualized) quarter-to-quarter inflation, measured by personal consumption expenditure price index (PCE excluding food and energy)
- $\pi_{t-1}^4 = \frac{1}{4} (\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4})$.
- $x_t$: the unemployment gap (Hodrick-Prescott filtered with $\lambda^{hp} = 1600$).
Specification I: using monetary policy shocks as IV

The model is the hybrid Phillips curve in Barnichon and Mesters (2021):

\[
\pi_t = c_t + \gamma_{f,t} \pi_{t+4} + \gamma_{b,t} \pi_{t-1}^4 + \lambda_t x_t + u_t,
\]

- \( \pi_t \): the (annualized) quarter-to-quarter inflation, measured by personal consumption expenditure price index (PCE excluding food and energy)
- \( \pi_{t-1}^4 = \frac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) \).
- \( x_t \): the unemployment gap (Hodrick-Prescott filtered with \( \lambda_{hp} = 1600 \)).
- Instruments: Almond parameterization of 20 lags of Romer and Romer’s monetary policy shocks (Barnichon-Mesters, 2021)
Specification I: using monetary policy shocks as IV

The model is the hybrid Phillips curve in Barnichon and Mesters (2021):

\[ \pi_t = c_t + \gamma_{f,t} \pi_{t+4}^4 + \gamma_{b,t} \pi_{t-1}^4 + \lambda_t x_t + u_t, \]

- \( \pi_t \): the (annualized) quarter-to-quarter inflation, measured by personal consumption expenditure price index (PCE excluding food and energy)
- \( \pi_{t-1}^4 = \frac{1}{4}(\pi_{t-1} + \pi_{t-2} + \pi_{t-3} + \pi_{t-4}) \).
- \( x_t \): the unemployment gap (Hodrick-Prescott filtered with \( \lambda_{hp} = 1600 \)).
- Instruments: Almond parameterization of 20 lags of Romer and Romer’s monetary policy shocks (Barnichon-Mesters, 2021)
- Approach: TVP-IV estimate with confidence bands robust to weak instruments.
The slope of the structural Phillips curve using monetary policy shocks as instruments

Our TVP-IV estimate of $\lambda_t$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
Specification II. GG/GGLS

The model is the hybrid NKPC with one lag of inflation in Galí and Gertler (1999) and Galí, Gertler and Lopez-Salido (2005).

- $\pi_t$: inflation measured by the GDP deflator
- $x_t$: unemployment gap (CBO)
- Instruments: four lags of inflation and two lags of the unemployment gap (CBO), wage inflation, and output gap (CBO).
- Approach: TVP-IV estimate with confidence bands robust to weak instruments.
Specification II. GG/GGLS

The model is the hybrid NKPC with one lag of inflation in Galí and Gertler (1999) and Galí, Gertler and Lopez-Salido (2005).

- $\pi_t$: inflation measured by the GDP deflator
Specification II. GG/GGLS

The model is the hybrid NKPC with one lag of inflation in Galí and Gertler (1999) and Galí, Gertler and Lopez-Salido (2005).

- $\pi_t$: inflation measured by the GDP deflator
- $x_t$: unemployment gap (CBO).
Specification II. GG/GGLS

The model is the hybrid NKPC with one lag of inflation in Galí and Gertler (1999) and Galí, Gertler and Lopez-Salido (2005).

- $\pi_t$: inflation measured by the GDP deflator
- $x_t$: unemployment gap (CBO).

- Instruments: four lags of inflation and two lags of the unemployment gap (CBO), wage inflation, and output gap (CBO).
Specification II. GG/GGLS

The model is the hybrid NKPC with one lag of inflation in Galí and Gertler (1999) and Galí, Gertler and Lopez-Salido (2005).

- $\pi_t$: inflation measured by the GDP deflator
- $x_t$: unemployment gap (CBO).

- Instruments: four lags of inflation and two lags of the unemployment gap (CBO), wage inflation, and output gap (CBO).

- Approach: TVP-IV estimate with confidence bands robust to weak instruments.
The slope of the structural Phillips curve: robustness to weak instruments

Our TVP-IV estimate of $\lambda_t$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
Specification

We focus on the Phillips curve during the recent financial crisis and the recent pandemics, up to 2021.
Specification

- We focus on the Phillips curve during the recent financial crisis and the recent pandemics, up to 2021.

- We focus on the hybrid NKPC with one lag of inflation.
Specification

- We focus on the Phillips curve during the recent financial crisis and the recent pandemics, up to 2021.
- We focus on the hybrid NKPC with one lag of inflation.
- Forcing variable: the unemployment gap (CBO).
- Instrument set: four lags of inflation and two lags of the unemployment gap (CBO).
Specification

▶ We focus on the Phillips curve during the recent financial crisis and the recent pandemics, up to 2021.

▶ We focus on the hybrid NKPC with one lag of inflation.

▶ Forcing variable: the unemployment gap (CBO).

▶ Instrument set: four lags of inflation and two lags of the unemployment gap (CBO), wage inflation, and output gap (CBO).
Specification

- We focus on the Phillips curve during the recent financial crisis and the recent pandemics, up to 2021.

- We focus on the hybrid NKPC with one lag of inflation.

- Forcing variable: the unemployment gap (CBO).

- Instrument set: four lags of inflation and two lags of the unemployment gap (CBO), wage inflation, and output gap (CBO).

- Approach: TVP-IV estimate with confidence bands robust to weak instruments.
The slope of the structural Phillips curve during the pandemic

Our TVP-IV estimate of $\lambda_t$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
The forward-looking inflation parameter in the structural Phillips curve during the pandemic

Our TVP-IV estimate of $\gamma_{f,t}$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
The backward-looking inflation parameter in the structural Phillips curve during the pandemic

Our TVP-IV estimate of $\gamma_{b,t}$ in red. Constant parameter estimate in black. Dotted lines are 90 percent bands.
Summary of empirical results during the pandemic

- Our results confirm that Phillips curve is becoming again alive and well.
Summary of empirical results during the pandemic

▶ Our results confirm that Phillips curve is becoming again alive and well.

▶ After hovering close to zero (in absolute value) until the mid-2000s, the slope has started to increase again.
Summary of empirical results during the pandemic

- Our results confirm that Phillips curve is becoming again alive and well.

- After hovering close to zero (in absolute value) until the mid-2000s, the slope has started to increase again.

- The importance of the forward-looking component ($\gamma_{f,t}$) has slightly increased. The upward trend, that started during the great moderation, has recently become even stronger, and the most recent estimate is around 0.6.
Summary of empirical results during the pandemic

- Our results confirm that Phillips curve is becoming again alive and well.

- After hovering close to zero (in absolute value) until the mid-2000s, the slope has started to increase again.

- The importance of the forward-looking component ($\gamma_{f,t}$) has slightly increased. The upward trend, that started during the great moderation, has recently become even stronger, and the most recent estimate is around 0.6.

- The importance of the backward-looking component in the Phillips curve ($\gamma_{b,t}$) has weakened substantially. The downward trend, which started since the 1970s, has brought the parameter to 0.2.
Outline

Introduction

Contributions

The Phillips Relation

The Structural Phillips Curve

The Phillips Multiplier

Is the decrease in the correlation due to monetary policy?

What about the Phillips curve during the pandemic?

Conclusions
Conclusions I

We contribute to the debate surrounding the instability of the relation between unemployment and inflation over time by offering insights from a **flexible time-varying instrumental variable approach**.

- We find that the weakening of the cyclical correlation between inflation and unemployment is due to a **flattening of the slope of the Phillips curve**, rather than to monetary policy.
Conclusions I

We contribute to the debate surrounding the instability of the relation between unemployment and inflation over time by offering insights from a **flexible time-varying instrumental variable approach**.

- We find that the weakening of the cyclical correlation between inflation and unemployment is due to a **flattening of the slope of the Phillips curve**, rather than to monetary policy.

- The slope of the structural Phillips curve has decreased over time since the 1980s.
Conclusions I

We contribute to the debate surrounding the instability of the relation between unemployment and inflation over time by offering insights from a flexible time-varying instrumental variable approach.

- We find that the weakening of the cyclical correlation between inflation and unemployment is due to a flattening of the slope of the Phillips curve, rather than to monetary policy.

- The slope of the structural Phillips curve has decreased over time since the 1980s.

- In the most recent period since the Great Recession and during the recent pandemic, the slope of the Phillips curve has increased again.
Conclusions II

Our results are based on an approach that has the following advantages:

▸ addressing the endogeneity problem
Conclusions II

Our results are based on an approach that has the following advantages:

▶ addressing the endogeneity problem

▶ being robust to changes in the economic environment
Conclusions II

Our results are based on an approach that has the following advantages:

- addressing the endogeneity problem
- being robust to changes in the economic environment
- do not require making auxiliary assumptions on the rest of the economy nor estimating a fully specified model, and hence are more robust to mis-specification than existing, full-information approaches
Conclusions II

Our results are based on an approach that has the following advantages:

▶ addressing the endogeneity problem

▶ being robust to changes in the economic environment

▶ do not require making auxiliary assumptions on the rest of the economy nor estimating a fully specified model, and hence are more robust to mis-specification than existing, full-information approaches

▶ the results are robust to weak identification