

The History of the Phillips Curve: An American Perspective

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Markets and Models in the AWH Phillips Tradition

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What this Paper Covers and What it Doesn't

- Take the subtitle seriously
 - From “An American Perspective”
 - After Phillips, the conceptual literature has been dominated by Americans
 - Econometric analysis of the success and failure of the PC has been disproportionately on American data
- Hereafter “Phillips Curve” is abbreviated “PC”
- No attempt here to survey the vast PC literature on other countries
 - Except to raise the big question: which models apply to which types of inflationary episodes?

My Gratitude to ESAM Organizers

- They suggested topic “History of the Phillips Curve”
- Otherwise, I might have written a much narrower paper reporting empirical results and debating empirical methods
- Today’s paper is broader, more provocative, more interesting. Thank you, organizers!
 - This talk contains a lot that some people may find controversial, and so I look forward to the discussion period at the end

There is a 50-page Paper on which this presentation is based, Available on the web

- It has been uploaded to the conference web site.
- Also to my personal web site, just google “Robert J. Gordon”
- While visiting my web site, don’ t miss the 280 photos of economists, including 20 Nobel winners, from 1967 to 2008.
- For that alone, you can just google “Photos of Economists”

For Instance, Tom Sargent
in 1978



And Sir Clive Granger



This Paper: Partly What You Would Expect, Partly Not

- What You'd Expect
 - Consensus interpretation of
 - Phillips 1958 (fun to reread)
 - Don't forget Irving Fisher (1926)
 - Samuelson-Solow 1960
 - Demise of large-scale econometric models in 1960s
 - Battle between U Chicago vs. MIT in 1960s
 - Friedman-Phelps natural rate hypothesis
 - Lucas and rational expectations
 - Lucas and Sargent (1978). Positive correlation of inflation and unemployment in 1970s left “Keynesian economics lying in wreckage”
- Not much controversy here, except for interpreting the great irony: F-P-L won the neutrality battle even as their models of information barriers were rejected.

Big Surprise!

Fork in the Road after 1975

- Nobody has previously written about the fork in the road
- Two different schools of thought emerged after 1975 to rescue the PC from the Lucas-Sargent “wreckage”
- Post-1975 “Left Fork”: New model combining dynamic AD and AS shocks with long-run neutrality and pervasive inertia.
 - Based on new theory of policy responses to supply shocks
 - Incorporates supply shock variables explicitly into PC equation, identifies sources of negative and positive correlation between inflation and output or unemployment gap. Makes macroeconomics symmetric with microeconomics
- Post-1975 “Right Fork”: Main features are that expectations can jump in response to policy, game between policymakers and private expectations, NKPC incorporates forward-looking expectations
 - But no inclusion of supply shocks, no explanation for PC shift from negative to positive correlation and back to negative again. Dodges issue of pervasive inertia and persistence
- Unique contribution of this paper – to pay attention to both Left Fork and Right Fork and appreciate their value. They are valid, but apply to different types of inflation

The Phillips Curve is Born: The Role of Unanswered Puzzles

- Phillips Curve widely accepted because it provided an answer to a macro puzzle
- US inflation doctrine in chaos in late 1950s
 - Keynesian supply curve, reverse “L”
 - Demand pull, cost push, demand shift?
 - Couldn’t understand why inflation was positive in 1955-58 when (quote from S-S)
 - “growing overcapacity, slack labor markets, slow real growth, no apparent buoyancy in overall demand”
- Phillips (1958) esp as interpreted by S-S (1960) was an epochal clarifying beacon

Other Classic Examples of How Events Foster Acceptance of Ideas

- Puzzle of Great Depression created Keynesian doctrine
- Puzzle of accelerating 1960s inflation created acceptance of Friedman-Phelps natural rate hypothesis
- Puzzle of positive inflation-unemployment correlation created acceptance of post-1975 dynamic aggregate demand-supply model
 - In micro, P and Q can be positively or negatively correlated
 - Why not also in macro? A blockbuster insight that most of the PC literature in the past decade has ignored

What the Phillips Article Actually Said

- Solid nonlinear negative correlation wage change and unemployment, 1861-1913
- Two additional variables mattered
 - Rate of change of unemployment, created counterclockwise loops (Lipsey documented this)
 - No role of prices in general, just import prices
 - He viewed price level as a weighted average of labor costs (80%) and import prices (20%)
 - Preview of supply shocks (which include import prices)

Phillips fit the 1861-1913 Relationship

- $w_t = -0.90 + 9.64U_t^{-1.39} \quad (1)$
- Then he compares two subsequent periods with that fitted equation
 - 1913-48 points lie on the same line except for big negative outliers 1921-22 which he attributes to “negative retail price changes”
 - 1948-57 also lies on the line except big positive outliers 1951-52, lagged effects of sterling devaluation in 1949 and following import price increases
- Zero inflation requires 2.5 percent unemployment
- No policy implications, no conjectures on what might make the curve shift

Samuelson-Solow (1960)

- Christened the term “Phillips Curve”
 - Entered the language of macro economics almost immediately
- Examined the data (no regressions)
 - PC doesn't work Great Depression or wars
- Zero inflation unemployment rate?
 - Prewar years 3 percent (excluding Great Depression)
 - Postwar “5 to 6 percent” and they wonder why

Why the Postwar Upward Shift?

- Samuelson-Solow Conjectures
 - US trade unions “less responsible” than UK
 - Expectation of permanent full employment
 - Smallness of UK makes their labor markets more flexible than US
- They explicitly state that policymakers can choose points along the PC
- They conjecture PC shifts in long-run but say they could be either up or down
 - High U could either reduce expectations or raise structural unemployment

Did Irving Fisher Discover the Phillips Curve First?

- 1926 obscure journal, I arranged to have reprinted in *JPE* in 1973
- Inflation causes changes in *level* of U
 - Why? Costs are sticky “by contract or custom”
- Monthly data 1915-25; he gets correlation of 0.90 of U on 5 month distributed lag of inflation
- Doesn't notice data for 1903-15 in his own plot; U variance similar but inflation variance much lower

The Policy-Exploitable Tradeoff: 1960-67

- Heller, Tobin, Solow convinced Kennedy and Johnson to “get the country moving again” by choosing a point on the PC to the northwest
- 1964-65 tax cuts occurred *after* U had fallen below 5.5 percent (S-S & current)
- Floodgates of Vietnam spending in 1965-66
- Our first look at Figure 1

Inflation and Unemployment Rates, 1960:Q1 – 2007:Q4



Second Aspect of pre-NRH Period, 1960-67

- Computer power made possible large-scale econometric models (Brookings, MPS, DRI)
- Wage change was a PC depending on U , sometimes ΔU , inflation lags, maybe payroll taxes. Sum of inflation lag coefficients < 1.0
- Price level depended on wage level adjusted for trend productivity (SULC) and a measure of the level of demand

Rivalry between Chicago and MIT Econ Departments

- “Battle of the Radio Stations” (*AER* 1965)
 - Did “only monetary” or “only fiscal” policy matter?
 - Bizarre to us graduate students – IS-LM model shows both should matter except in extreme cases
- Rivalry between MF and FM came to climax with MF’s Presidential Address and the implosion of Modigliani’s cherished MPS model
- Important difference: Chicago economists visited Latin America. How could there be a long-run tradeoff or indeed any tradeoff at all except over the shortest run

Logical Problems with PC Tradeoff

- Why did the nominal wage adjust so slowly, especially downward?
- Why did the PC lie so far to the right?
- How could PC be stable over history, given history of hyperinflations and Latin American-style macro volatility

Friedman-Phelps NRH

- Exists a natural rate of U, call it U^N
- Any attempt by policymakers to select $U \neq U^N$ would cause expected inflation to differ from actual inflation, which in turn would shift PC up or down.
- Impeccable timing, since inflation was then soaring above the prediction of the large-scale econometric models. Score: MF=1, FM=0
- A great idea supported by an implausible theory. MF firms knew P but workers did not, they were “fooled”. For Phelps both were fooled.
 - Yet CPI available costlessly within one month
 - How could multi-year business cycles be motivated when the theory said that they should last no more than one month?!

Lucas and Rational Expectations

- Workers would not make the same mistakes repeatedly
- Distinction firms vs. workers dropped. Now all agents were “yeoman farmers”, observing their own prices but not aware of the economywide price.
- Same problem of costlessly available information
- Valuable insight:
 - Farmer’s supply response depends on known past variance of shocks
 - No supply response if past own-price movements have been perfectly correlated with macro price movements (no change in relative prices)
 - Implies slope of PC varies depending on history of macro volatility

Policy Ineffectiveness Proposition

- Output does not respond to anticipated changes in money, only monetary “surprises”
- Failed empirically because of two assumptions inherited from Friedman-Phelps
 - Market-clearing and imperfect information
- “Emperor(s) Had no Clothes”
 - Sims (2008): “Models of the Lucas supply curve were highly abstract and unrealistic.”

Empirical Destruction of Policy Tradeoff

- As if forecasting errors in late 1960s and Friedman's victory were not enough
- Policy tradeoff rests on a particular coefficient, $\alpha < 1$, but by early 1970s estimated $\alpha = 1$
- $p_t = \alpha p_{t-1} + \beta U_t + e_t$ (2)
- $p_t = \beta U_t / (1 - \alpha)$ (3)

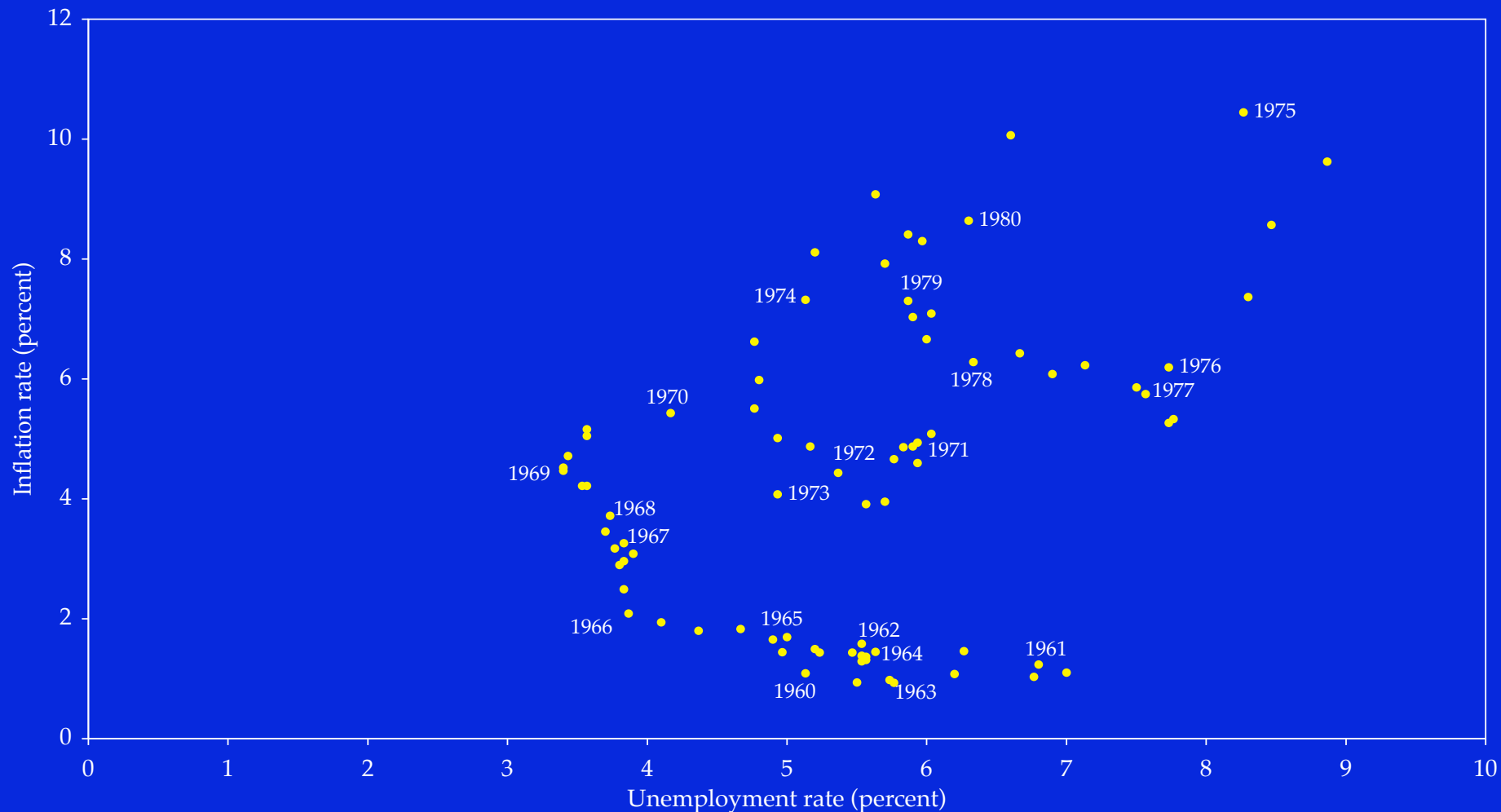
Sargent's (1971) Logical Rebuttal

- $p_t = \alpha E p_t + \beta U_t + e_t$ (4)
- $E p_t = \nu p_{t-1}$ (5)
- $p_t = \alpha \nu p_{t-1} + \beta U_t + e_t$ (6)
- Sargent: (6) cannot estimate both α and ν
- No reason for $\nu=1$. This would only occur with extremely strong serial correlation that didn't occur in most of US history
- Attempts to defend the policy tradeoff promptly ceased, so devastating was Sargent's logic

1970s: Positive Correlation & Inflation Leads Unemployment!



Scatter Plot Just through 1980 (U vs. 4-qtr PCE Inflation)



The Negative PC was Dead and Buried

- Lucas-Sargent (1978): “The task which faces contemporary students of the business cycle [is] that of sorting through the wreckage . . . Of that remarkable intellectual event called the Keynesian Revolution”
- Irony #1: It was Friedman-Phelps-Lucas “New Classical Macro Mark I” (NCM #1) which lay in wreckage as a theory of the business cycle
- Irony #2: Starting in 1975 the PC was resurrected by incorporating a novel idea from microeconomics: both supply and demand matter

Parts 3 and 4 of Paper: The 1975 Fork in the Road

- Left fork: supply joins demand in the dynamic aggregate supply/demand model, incorporating long-run neutrality and inertia
 - The *theory* of New Keynesian economics provided numerous models to motivate the role of inertia and stickiness
 - Once inflation depends on inertia, and does not mirror observed changes in nominal GDP growth, then real GDP is no longer an object of choice but becomes a residual. Thus the left fork revived Keynesian, non-market clearing macro

The Right Fork of the Road

- Sargent, Kydland, Prescott, Gali, Gertler
- All models have in common
 - Lack of inertia and persistence
 - No explicit incorporation of supply shocks
 - Expectations can jump spontaneously in response to actual and anticipated changes in policy
- The Right Fork is essential to understanding the ends of hyperinflations (Sargent, 1982) and other cases of high macro volatility (Argentina)

Part 3 of Paper: The Left Fork in the Road

- Demise of NCM #1, a different form of “wreckage”
- Could not explain multi-year business cycles with one-month information lags
- Inability to develop a symmetric explanation of price and output behavior
- Barro (1977) could not demonstrate the required corollary to the Lucas supply function: the full and prompt responsiveness of inflation to anticipated changes in nominal GDP

First Element in Resurrection: Theory of Policy Responses to Supply Shocks

- Gordon (1975, 1984), Phelps (1978)
- Price elasticity of demand for oil < 1 , thus its expenditure share must increase
- Expenditure share of non-oil must decrease
- How can this happen? Need wedge between nominal GDP and nominal wage growth
 - Solutions: negative wage growth, positive nominal GDP growth (with accelerating inflation), or partial nominal GDP response which causes a recession
- *New York Times* (1976): “A New Theory: Inflation Creates Recession”. Lo and Behold, look back at Figure 1

Notice how Inflation Leads Unemployment, 1973-83



Revival of the PC Took Place on Three Fronts

- Theory of Supply Shocks integrated into a Dynamic AS-AD Model
 - Micro S & D shocks allow any correlation between P & Q. Now same was true for inflation and output (first-order difference equations link inflation *rate* with U *level*)
 - Twin peaks of inflation and U, and lead of inflation ahead of U, explained by model. No more puzzles, no more “wreckage”
- Development of econometric “mainstream” model, 1977-80, part 5 of this paper
- A new generation of macro textbooks, both published in 1978
 - Rudi Dornbusch’s 1975 classroom handout
- New abbreviation “NAIRU” replaces “natural rate of unemployment” even though it is not symmetric

Conceptual Differences between Left and Right Forks

- Mainstream model features long lags on inflation which are *not* interpreted as representing long lags in forming expectations
 - Instead, influence of explicit and implicit wage and price contracts
 - Also important, micro information barriers to knowledge of which suppliers will change prices by how much, and when
 - “Input-output approach”
- Demand represented by U gap or output gap
- Supply represented by explicit supply shock variables (z) defined so that when $z=0$ there is no upward or downward pressure on inflation rate
 - Changes in relative price of food and energy, changes in relative price of imports, and changes in trend productivity growth
- Three-cornered approach – demand, supply, inertia, christened the “triangle model”

Mainstream Model: Empirical Success and Failure

- Model specified in its present form in 1980, published in 1982
- First test, the Volcker disinflation
 - The actual sacrifice ratio turned out to be much less than many had forecast
 - In a VAR model, endogenizing of oil and import prices made them a channel by which monetary and fiscal policy conquered inflation so rapidly

Narrative of Inflation Behavior after 1986: Role of AS and AD



The Model Needed One Major Fix

- Unlike much econometric work that relies entirely on goodness of fit and significance of coefficients, the triangle model was always tested by post-sample dynamic simulations
 - Important in any model with a strong influence of the lagged dependent variable
- Forecasts in dynamic simulations began to drift away from actual inflation in 1994-95.
Predicted too much inflation

Solution? Allow the NAIRU to Vary over Time

- Stock-Watson (1997) contributed method, using my triangle model
- I refined triangle model (1997), using their method
- The TV-NAIRU drifted down during the 1990s, helping to explain why low unemployment in 1997-2001 did not cause an inflation acceleration as in 1964-70 or 1987-90
- Partial explanation of the declining TV-NAIRU by Katz and Krueger (1999)

Part 4: The Right Fork

- All Right Fork models share in common ability of expectations to jump without regard to inertia
- Kydland and Prescott
 - Faster inflation under discretion than under policy rules that prevent attempts to exploit policy tradeoff
 - Credibility of monetary policy gained by sticking to rules
- This line of research ignores
 - Policy dilemma when facing adverse supply shocks
 - Information available to policymaker: oil prices, food prices, exchange rates

New-Keynesian Phillips Curve (NKPC)

- Possible Confusion between New Keynesian Economics and NKPC
- NKE starting with Fischer (1977) and Taylor (1980) developed theories to explain price and wage stickiness
- When prices and/or wages are sticky, expectations are inherently *backward looking* because agents forming expectations are aware of the influence of the past
- Thus NKPC with its emphasis on *forward looking* expectations is incompatible with the NKE types of theoretical models

Differences between NKPC and Triangle Model

- $$p_t = \alpha E_t p_{t+1} + \beta(U_t - U_t^*) + e_t \quad (8)$$
- No explicit treatment of supply shocks; these are suppressed into the error term
- Expectations are explicitly forward looking, ignoring role of inertia in anchoring expectations
- This version supplements expected future inflation with the unemployment gap (Mankiw exposition). Other NKPC expositions use output gap or change in marginal cost (MC), the real wage divided by productivity
- Problem: MC is endogenous and requires three separate equations, one each for inflation, wage change, and productivity change. Some NKPC expositions treat ΔMC as exogenous

The Challenge of Persistence

- Since private agents know that inflation is persistent and depends on its own lagged values, how could central bank alter expectations *directly* by mere pronouncements?
- Expectations only adjust *indirectly* with evidence that higher U has succeeded in pushing inflation down
- Fuhrer (1997) argues that data cannot distinguish between forward and backward looking expectations
- This led to “hybrid” (both backward and forward) NKPC variants, but forward-looking expectations are always proxied by lags with various restrictions
- If there are enough backward-looking agents, as in the input-output paradigm, how can the forward-looking agents ignore the resulting persistence?

Constraints on the Formation of Expectations

- Recent Literature has ignored *micro uncertainty* and has turned to credible explanations of imperfect *macro* information
- #1 Lags to learn about structure of economy (yes, we learn about TV-NAIRU only after the fact)
- #2 Impfct Info about Goals of Central Bank (yes, Fed's Taylor Rule coefficients changed sharply after 1990)
- #3 Costs of frequent adjustments in expectations, “rational inattention” Good idea, more appropriate for micro expectations in the context of the input-output approach

Which Fork Applies to Which Episodes?

- Right Fork: hyperinflations, Argentina, other unstable economies (Zimbabwe)
- Convergence of inflation rates within Europe 1975-95 can only be explained by policy-based expectations. Italian agents learned to watch the Bundesbank as much as the Banca d' Italia

The Left Fork Does a Much Better Job for Postwar US

- But what about pre-1954 US? My 1982 JPE paper created quarterly data going back to 1890
- American PC relationship doesn't work in 1930s or two World Wars
- Faster price adjustment to nominal GDP changes when outside information of something special – World War I
- Dummy variables: two World Wars, NRA, Korea, Nixon controls
- Gradual upward shift in coefficient on lagged inflation (Sargent, 1971) from 0.4 pre-1929, to 0.6 1929-53, to 1.0 post-1953

Part 5: NKPC vs. Triangle, Specification and Results

- Recall NKPC

$$p_t = \alpha E_t p_{t+1} + \beta(U_t - U_t^*) + e_t \quad (8)$$

- Instrument future expectations; first stage of 2SLS is

$$E_t p_{t+1} = \sum \lambda_i p_{t-1} + \varphi(U_t - U_t^*) \quad (9)$$

- Substitute (9) into (8)

$$p_t = \alpha \sum \lambda_i p_{t-1} + (\alpha\varphi + \beta)(U_t - U_t^*) + e_t \quad (10)$$

- Roberts version of NKPC assumes fixed NAIRU & $\alpha = 1$

$$p_t = \sum \lambda_i p_{t-1} + \gamma + \beta U_t + e_t \quad (11)$$

The Triangle Model with a Time-Varying NAIRU

- $p_t = a(L)p_{t-1} + b(L)(U_t - U_t^N) + c(L)z_t + e_t \quad (13)$
- $U_t^N = U_{t-1}^N + \eta_t, E\eta_t = 0, \text{var}(\eta_t) = \tau^2 \quad (14)$
- Differences from NKPC
 - Long lags on lagged inflation
 - Additional lags on unemployment gap
 - Explicit inclusion of supply shock variables (z_t)
- Estimated TV-NAIRU contrasted with actual U and H-P filtered U
 - Change in Stock-Watson treatment since 1997
 - How do users of the H-P filter explain the gyrations of TV-NAIRU without appealing to supply shocks?

NAIRU vs. U Rate: Estimated vs. H-P Filter

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Estimated Coefficients and Simulation Performance

Variable	Lags	NKPC	Triangle
Constant		1.16 **	
Lagged Dependent Variable	1-24 ^a		1.01 **
	1-4	0.95 **	
Unemployment Gap	0-4		-0.56 **
Unemployment Rate	0	-0.17 *	
Relative Price of Imports	1-4		0.06 **
Food-Energy Effect	0-4		0.89 **
Productivity Trend Change	1 5		-0.95 **
Nixon Controls "on"	0		-1.56 **
Nixon Controls "off"	0		1.78 **
R ²		0.78	0.93
S.E.E		1.17	0.64
S.S.R		244.0	64.6
Dynamic Simulation 1998:Q1 - 2007:Q4	Note b		
Mean Error		-2.75	0.29
Root Mean-Square Error		3.20	0.70
a) Lagged dependent variable is entered as the four-quarter moving average for lags 1, 5, 9, 13, 17, and 21, respectively			
b) Dynamic simulations are based on regressions for the sample period 1962:Q1-1997:Q4 in which the coefficients on the lagged dependent variable are constrained to sum to unity.			

Prediction through 1997, Dynamic Simulation 1998-2007



Which Differences Account for the Better Performance

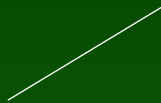
- The Paper has an Appendix that exhibits 24 different versions, varying lag lengths, and present or absence of supply shock variables.
- All these differences contribute. The Roberts-NKPC model is *nested* in a version of the triangle model that has a fixed NAIRU
- Differences then become exclusion restrictions that can be tested, and all are rejected.

Fragility of Conclusion that PC Slope has become Flatter

- Consider elementary analysis of specification bias.
- Omit variable(s) positively correlated with inflation
 - Presumably negative coefficient on unemployment gap is biased toward zero because equation offers no other explanation of positive correlation of inflation with unemployment
- Thus Roberts/NKPC coefficients on U are both too low (biased toward zero) and also vary over time in response to omission of supply shock variables

U coefficient in 90-quarter Rolling
Regressions starting 1963 to 1986

Final Slide of Results: Contribution of Supply Shocks



Conclusion: Identifying the Left and Right Forks and Welcoming Them Both

- Part 2 of Paper on pre-1975 starts with Phillips, Samuelson-Solow, and Fisher
- Familiar Story: destruction of policy tradeoff by Friedman-Phelps NRH
- Positive correlation of inflation and U in 1970s led to declaration that PC lay in “wreckage”

Ironically, the “Wreckage” was the New Classical Macro Itself

- Macro Information Barriers lasted only one month; couldn't explain multi-year information barriers
- Policy ineffectiveness? Empirical work showed
 - Monetary surprises had little effect on output
 - They were incapable of explaining multi-year business cycles
 - Were inconsistent with persistence of inflation

Post-1975: The Left Fork vs. the Right Fork

- The Left Fork in the Form of the “Mainstream” or “Triangle Model”
 - Broadened causes of inflation inertia beyond expectations
 - Retained long-run monetary neutrality
 - Incorporated explicit supply-shock variables
 - Allowed for a time-varying NAIRU

What the Triangle Model Explains

- The Twin Peaks of Inflation and Unemployment in the 1970s and early 1980s
- Why Inflation Led Unemployment 1973-83
- The “valley” of low inflation and low U in the late 1990s
- One major revision since 1982 publication; NAIRU must be allowed to vary over time
 - Resulting TV-NAIRU looks very different than a H-P filter over actual unemployment data
- NKPC empirical explanation nested in more comprehensive triangle approach; all exclusion restrictions are rejected

The Right Fork Models May Apply to a Broader Span of History

- Game between policymakers and policy-sensitive expectations essential to understand
 - Ends of hyperinflations
 - Volatile macro environments (Argentina)
 - Expectations based on events outside one's country (inflation convergence within Europe)
 - Breakdown of PC in US history – Great Depression, World War I

Novelty in this Paper

- Two Forks in Road after 1975 in the reconstruction of the PC
- Each Fork is important and helps us understand how inflation behaves, albeit in different environments
- The two approaches need to pay more attention to each other
- This paper represents a start toward that long-needed reconciliation