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# Modern DSGE models: Theory and evidence

DISCUSSION OF H. UHLIG'S AND M. EICHENBAUM'S PRESENTATIONS

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# PLAN OF DISCUSSION

1. CRITICISM OF DSGE MODELS BY HARALD

2. PRAISE OF DSGE MODELS BY MARTY

1+2 = BALANCED VIEW

# 1.1. URGENT: INFLATION AND THE PHILLIPS CURVE

❑ Inflation follows a seemingly exogenous process, unrelated to measures of slack.
   ❑ Smets and Wouters (2007): shocks to price- and wage-markups account for most of the movements in inflation.

   *"Inflation, in essence, dances to its own music"*

❑ This disconnect between inflation and slack poses a challenge to New Keynesian models, for which the Phillips curve is a key building bloc.

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❑ This disconnect between inflation and slack poses a challenge to New Keynesian models, for which the Phillips curve is a key building bloc.

**Does it?**

❑ On the contrary: this disconnect is exactly what a New Keynesian model with a welfare-optimizing Central Bank would predict (McLeay and Tenreyro, 2018)

# 1.1. INFLATION AND THE PHILLIPS CURVE

$Loss = E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \lambda u_t^2)$    (Gali 2008 $u_t = -x_t$)

Under discretion

$\min \pi_t^2 + \lambda u_t^2$

s.t.:

$\pi_t = E_t \pi_{t+1} - \kappa u_t + \epsilon_t$    (PC)

Solution: Targeting rule

$\pi_t = \frac{\lambda}{\kappa} u_t$    (TR)

Phillips curve
π = −κu

Targeting rule
$\pi = \frac{\lambda}{\kappa} u$

Loss
π² + λx²

π

u

Observed inflation: inherits properties of exogenous shock process:
$\pi_t = f(\epsilon_t)$

# 1.1. INFLATION AND THE PHILLIPS CURVE

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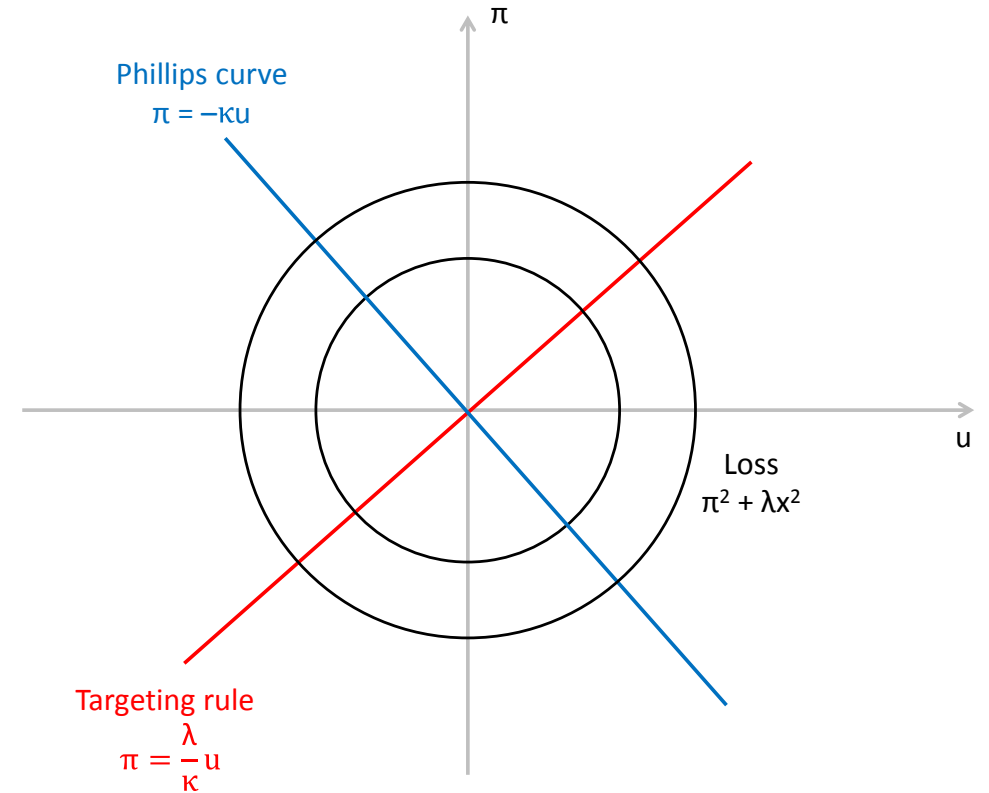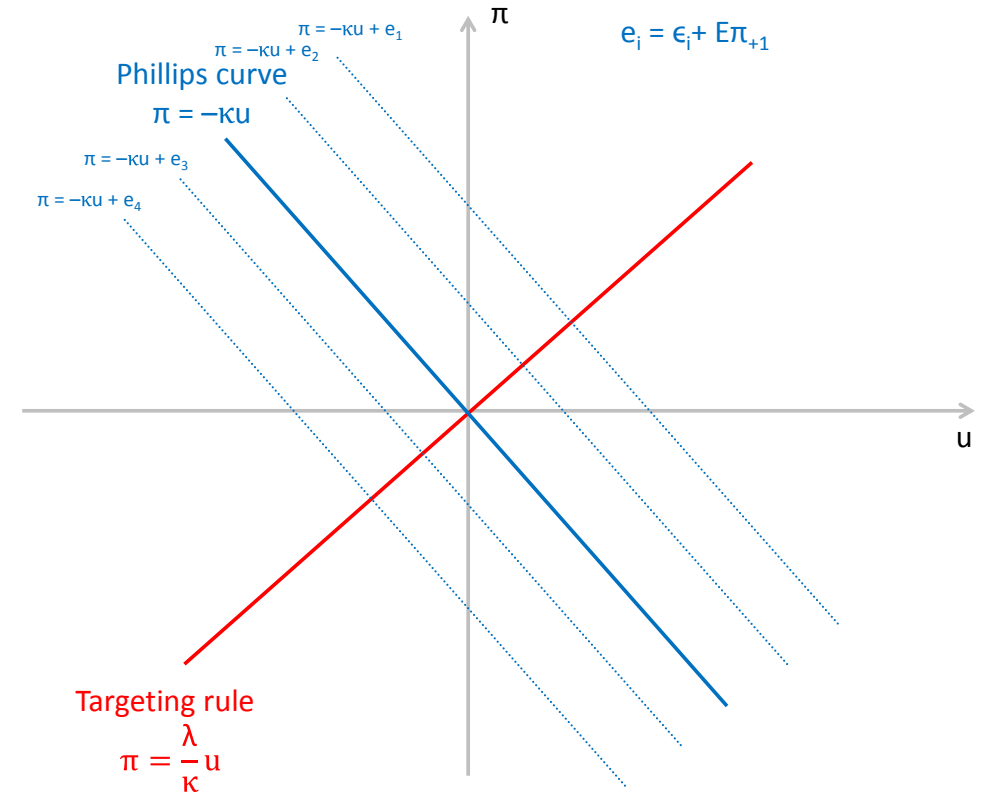
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Phillips curve
$\pi = -\kappa u$
$\pi = -\kappa u + e_1$
$\pi = -\kappa u + e_2$
$\pi = -\kappa u + e_3$
$\pi = -\kappa u + e_4$
$e_i = \epsilon_i + E\pi_{+1}$

Targeting rule
$\pi = \frac{\lambda}{\kappa} u$

Observed inflation: inherits properties of exogenous shock process:

If $\epsilon_t = \rho \epsilon_{t-1} + v_t$,

$$\pi_t = \frac{\lambda}{\kappa^2 + \lambda(1 - \beta\rho)} \epsilon_t$$

*"Inflation dances to its own music"*

# 1.1. INFLATION AND THE PHILLIPS CURVE

Under commitment:

$$\min E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \lambda u_t^2)$$

s.t.:

$$\pi_t = E_t \pi_{t+1} - \kappa u_t + \epsilon_t \qquad \text{(PC)}$$

Solution: Targeting rule

$$p_t = \frac{\lambda}{\kappa} u_t \qquad \text{(TR)}$$

Observed inflation: inherits properties of exogenous shock process:

$$\pi_t = f(\epsilon_t, \epsilon_{t-1}, \epsilon_{t-2} \dots)$$

❑ Formulas: Barro and Gordon (1983)

❑ New Keynesian framework predicts that equilibrium inflation rates should be uncorrelated with slack, as long as central banks are doing a sensible job

❑ Challenge for econometricians, not for the model. (McLeay and Tenreyro, 2018)
   ✓ Well identified studies find a healthy PC. E.g. disaggregated data (regions, countries within a monetary union) help.

# 1.2. IMPORTANT. Ch#1, 2: Asset pricing, financial frictions

❑Importance of asset pricing and the need to incorporate financial frictions

❑Both critical during the financial crisis but more generally for the transmission of shocks and the effect of macroeconomic policies.

❑ Particularly important when CB move beyond interest rate policy to QE, forward guidance, etc.

❑ Solutions to "asset pricing" challenge offered by Harald fall within the representative agent sphere.

✓ Representative agents' models impose a tight connection between assets and households' consumption decisions. Inequality In asset holdings in our economies call for a move to heterogeneous agent models to break the tight connection.

❑ Is a fully microfounded model always better?

❑ The path _often_ followed by macroeconomists to microfound has been to assume unrealistically rational, forward-looking, optimizing behaviour. That might not lead to a better representation of reality.

❑ If the only path is to build on an unrealistic microfoundation, it might be better to stick to a macro model that focuses on the correct wedge or friction, even if in an ad hoc way.

# 1.3. IMPORTANT. Ch#4: Taylor rule

❑ "Strange" feature of the model: a persistent expansionary monetary policy shock can result in higher equilibrium nominal rates.

❑ Well known by New Keynesians. Galí (2008, ch.3, p.51)

❑ Real rates fall due to a <u>rise in inflation expectations</u>—fall is so large that it causes the CB to raise the nominal rate.

  ✓ Underscores the power of expectations in these models. In practice the expectation channel is less powerful--and, if this is the case, the policy advice is less useful.

  ✓ A reason why the BoE and other central banks use models that deviate from RE.

# PLAN OF DISCUSSION

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# 2.1. DSGE MODELS

1. Useful to evaluate the effects of policies; allow us to quantify different trade-offs involved in households', firms' and policymakers' decisions, as well as general equilibrium effects. Becoming better at forecasting.

2. Transparent, so we can easily gauge their scope and limitations.

3. Used by many Central Banks: Federal Reserve Bank, European Central Bank, International Monetary Fund, Bank of Israel, Czech National Bank, Sveriges Riksbank, Bank of Canada, and Swiss National Bank.

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4. Also used by the Bank of England (COMPASS) - in conjunction with a suite of ancillary models and empirical analyses. A piece in a bigger puzzle.

5. They are work in progress. And probably will always be, as economies - and our understanding of them - keep evolving. (As do our technical capabilities to solve and handle models!)

# DSGE Models for (Monetary) Policy Analysis

❑Key friction to break monetary neutrality: nominal rigidity.

❑Most micro-empirical analyses focused on price rigidity.

✓Yet DSGE models like CEE (2005) rely crucially on <u>wage rigidity</u>.

✓ Price rigidity plays virtually no role in CEE (2005). The crucial friction to generate quantitatively large effects from monetary policy on activity is <u>wage rigidity.</u>

# WAGE RIGIDITY  Olivei-Tenreyro (AER 2007)

❏ "Beige Book" survey of firms in New England:
*i) How often do you change employees' compensation (base pay/health insurance)?; ii) Typically, in which month of the year is the decision to change compensation taken and iii) when does the change become effective?*

  ✓90% of the firms made changes to compensation <u>once a year</u>.

  ✓>50 % took decisions in the <u>fourth quarter</u>

  ✓Change effective in first quarter.

❏Radford Survey of IT companies:

  ✓90% of firms decide pay changes <u>once a year</u> at the <u>end of their fiscal year</u> (focal pay administration w/ annual reviews).

  ✓60% ends fiscal year in December.

❏ 80% of the firms in Russell 3000: fiscal year ends in December (Audit Analytics, 2017)

# WAGE RIGIDITY: Does it matter?

❑ Concentration of wage-setting decisions in the fourth quarter of the calendar year implies a differential degree of wage rigidity within the calendar year

  ❑ High wage rigidity early in the year ➡ Monetary policy shocks should have large output effects

  ❑ Low wage rigidity late in the year ➡ Monetary policy shocks should have small output effects

❑ Olivei and Tenreyro (2007) test this hypothesis and find it to be borne out by the data. Almost all of the empirical relation between monetary policy innovations and output is driven by the response to monetary interventions taking place in Q1 or Q2.

# Empirical strategy.

Olivei and Tenreyro (2007, 2010)

❑ Introduce "quarterly dependence" in an otherwise standard VAR (Recursive ID).
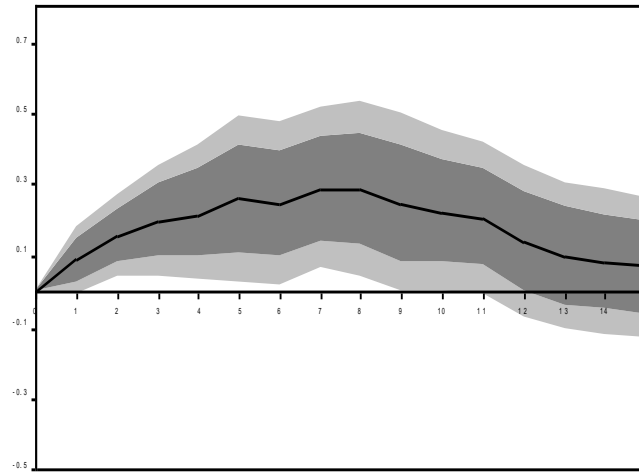
# Response of GDP to 25bp fall in FFR
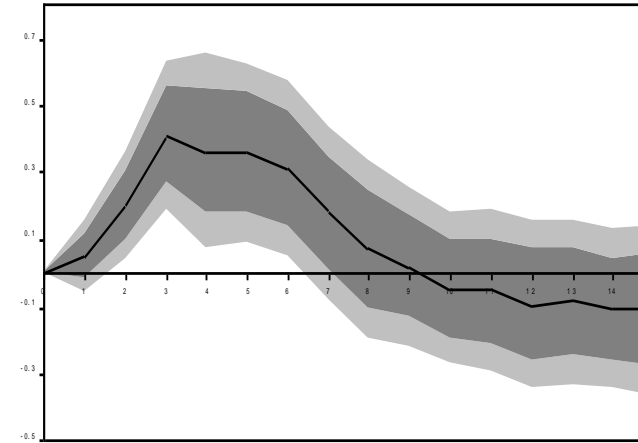## No quarterly dependence. Quarterly data. Standard model 1966 Q1-2002 Q4.



lnGDP

Quarters after the shock
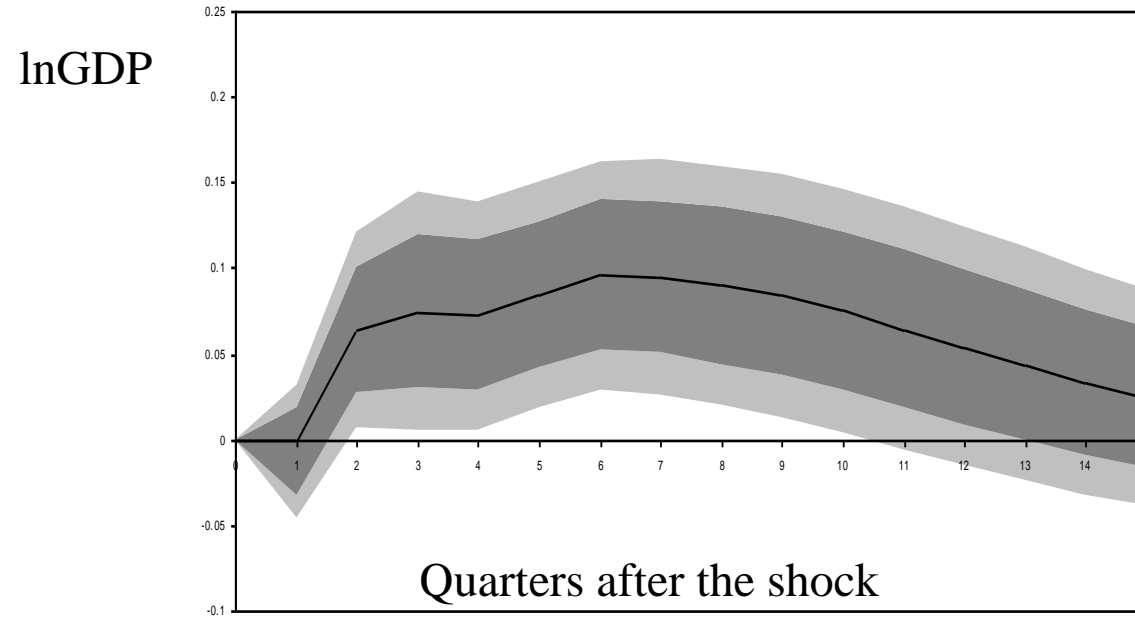
# Response of GDP to 25bp fall in FFR Quarterly dependence.

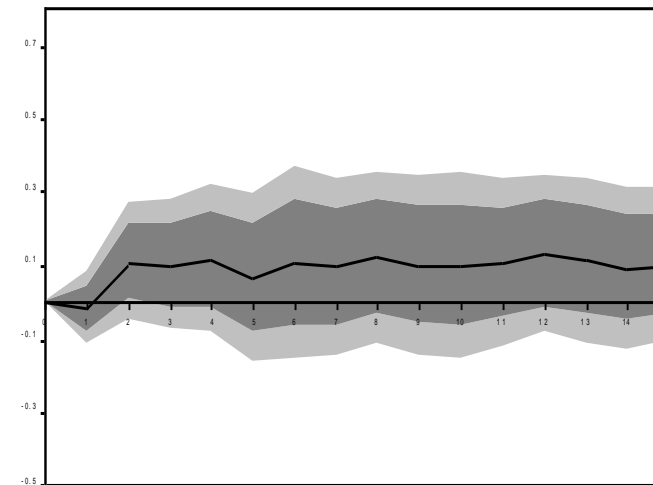## First-quarter shock



## Second-quarter shock
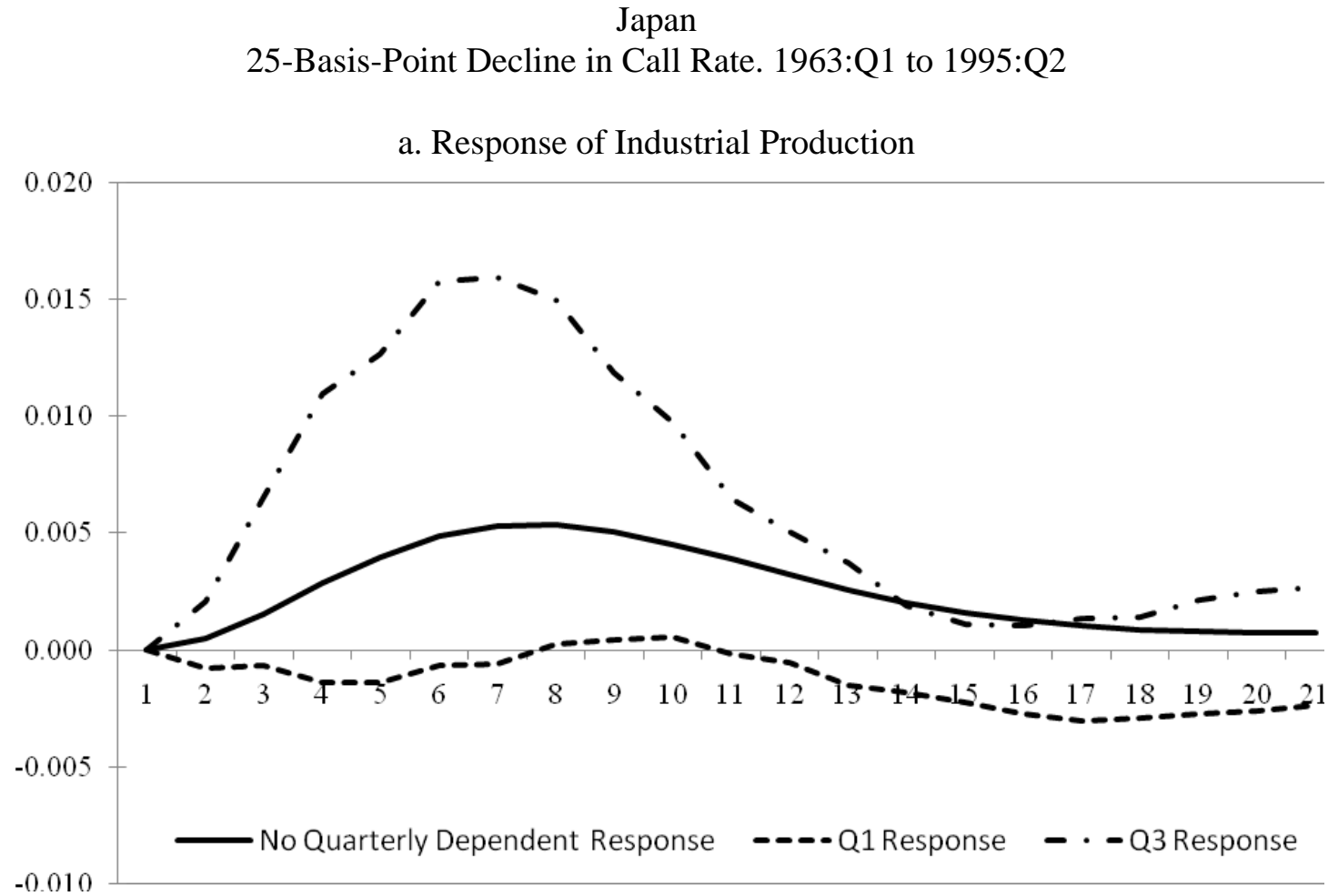


## Third-quarter shock
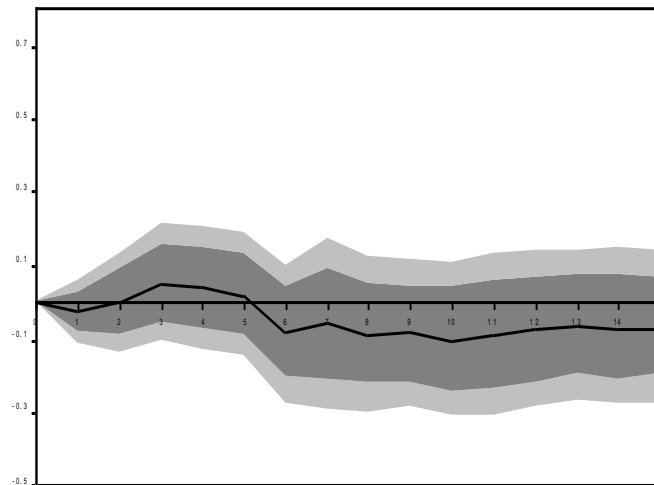


## Fourth-quarter shock

# EVIDENCE FROM OTHER COUNTRIES (Olivei Tenreyro 2010)

❑ Japan: "Shunto" or spring offensive; wages at most <u>large</u> firms are set in the spring

Japan
25-Basis-Point Decline in Call Rate. 1963:Q1 to 1995:Q2

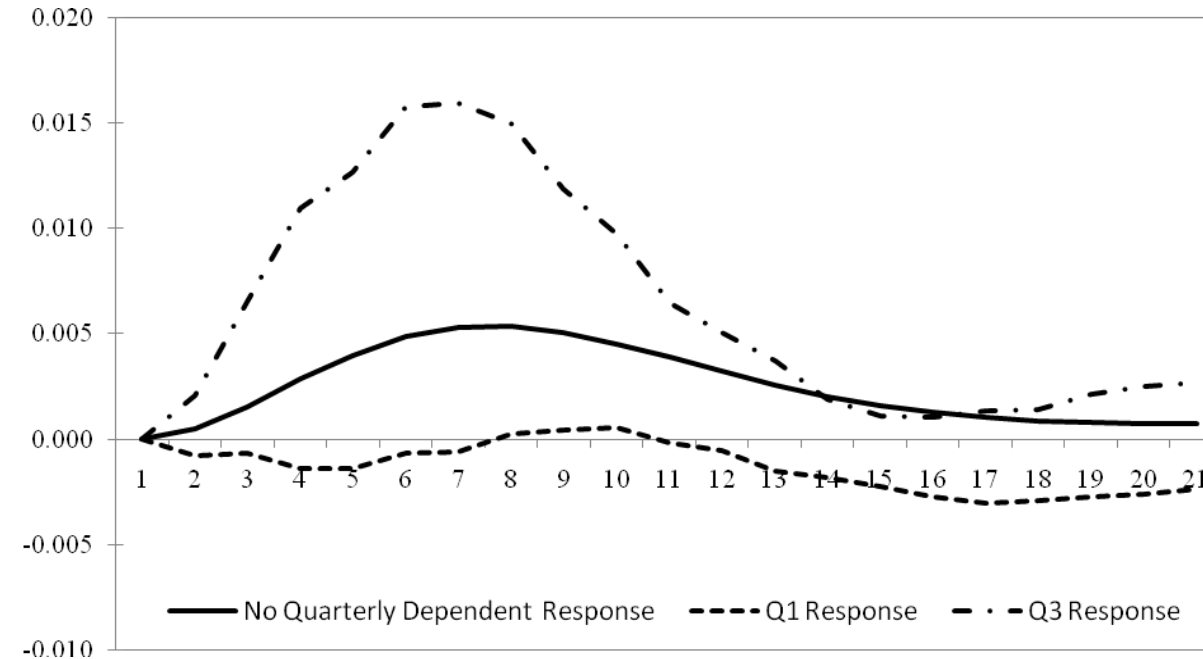a. Response of Industrial Production

# EVIDENCE FROM OTHER COUNTRIES (Olivei Tenreyro 2010)

❑ Japan: "Shunto" or spring offensive; wages at most <u>large</u> firms are set in the spring; smaller firms follow.
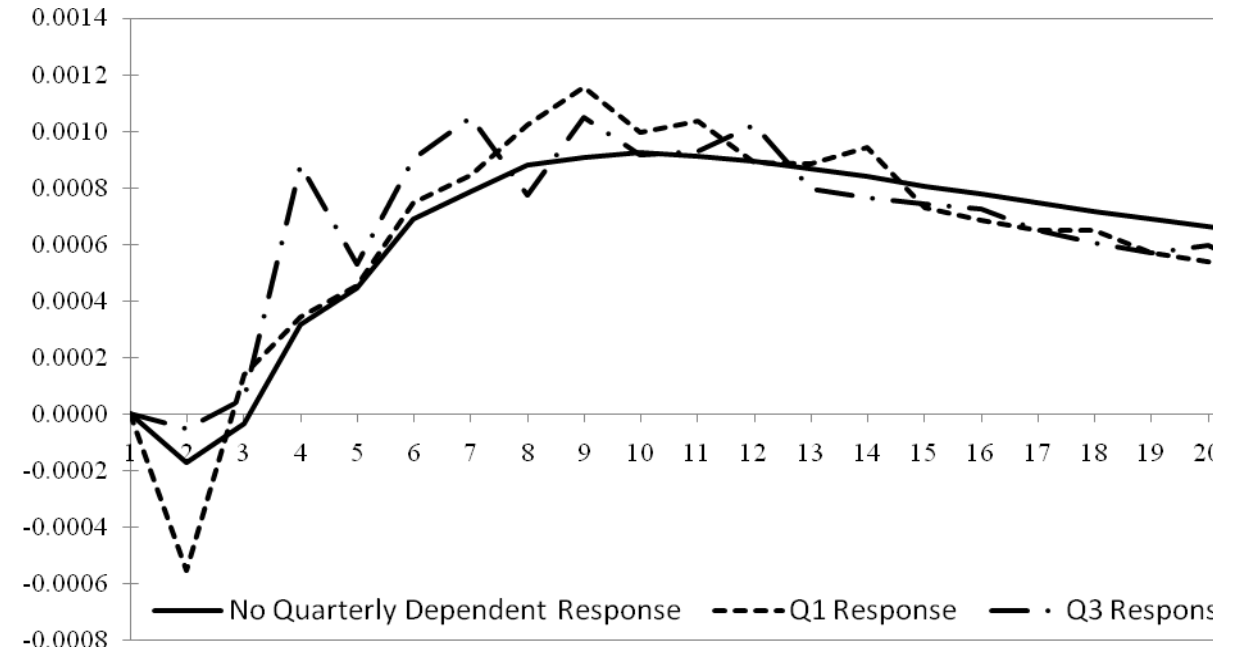
Japan
25-Basis-Point Decline in Call Rate. 1963:Q1 to 1995:Q2

a. Response of Industrial Production

France
25-Basis-Point Decline in Call Rate. 1963:Q1 to 1998:Q4

a. Response of GDP



❑ Europe (Germany, UK and France): more staggering on wage setting decisions; big lags between decision and implementation dates; higher prevalence of multi-year contracts (Germany).

# SUMMARY OF EVIDENCE

❑Quarterly-dependent responses of activity and prices/wages together with surveys are consistent with a wage-rigidity explanation.

✓CEE (2005) model with seasonal adjustment frequencies can match the quarterly-dependent patterns in the data (Olivei-Tenreyro 2007).

✓CET (2016)? Might need to temper the RE forward-looking behaviour in the bargaining protocol with practical HR constraints to match quarterly-dependence in MP effects.

# TAKING STOCK AND GOING FORWARD

❑DSGE offer a useful organising framework for the evaluation of policies.

❑They are one of many inputs in the analysis. They are work in progress. Many margins need improving:

✓Asset pricing and financial frictions.

✓Interactions between fiscal and monetary policy. Particularly with i) unconventional policies; ii) distributional effects taking centre stage in the political debate.

✓Tight connection between consumption and (unequal) asset holdings (call for heterogeneous agent models?)

✓Effective bounds on policies (ZLB, limits to QE)

✓Microfoundations? Empirically grounded ones, please.

❑Will they help predict the next crisis?

✓ Maybe, if they are like the ones observed in the past (though one would expect policy makers to act before that happened, in which case we wouldn't see "old crises in equilibrium"!)

✓ No, if the next crisis takes an unexpected shape, not currently modelled.