Macroeconomics III - Ph.D.

**Spring 2016**

# Introduction: Nominal Rigidities, the Role of Technology Shocks, and Monetary Policy

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- The paradigm so far: **Real Business Cycle Model** (neoclassical growth model)

- Bulk of fluctuations explained by technology shocks (Kydland-Prescott, 1982)

- Main **ingredients** of RBC

1. Microfoundations

2. Dynamic (Stochastic) General Equilibrium

3. All markets frictionless

4. Prices adjust instantaneously

$\rightarrow$Note: (1) and (2) alive and kicking, (3) and (4) questionable

- In this course:

1. We will go **beyond RBC** paradigm $\longrightarrow$ Build so-called **New Keynesian Framework**

2. Role of money and **monetary policy**

3. Imperfections in goods markets (monopolistic competition)

4. Role of nominal rigidities (price and/or wage stickiness)

5. Reconsideration of role of technology shocks

- Why **beyond RBC?** $\longrightarrow$ (at least) **4 arguments**

1. No role for monetary policy / monetary policy shocks

2. Perfect flexibility of prices (and wages)

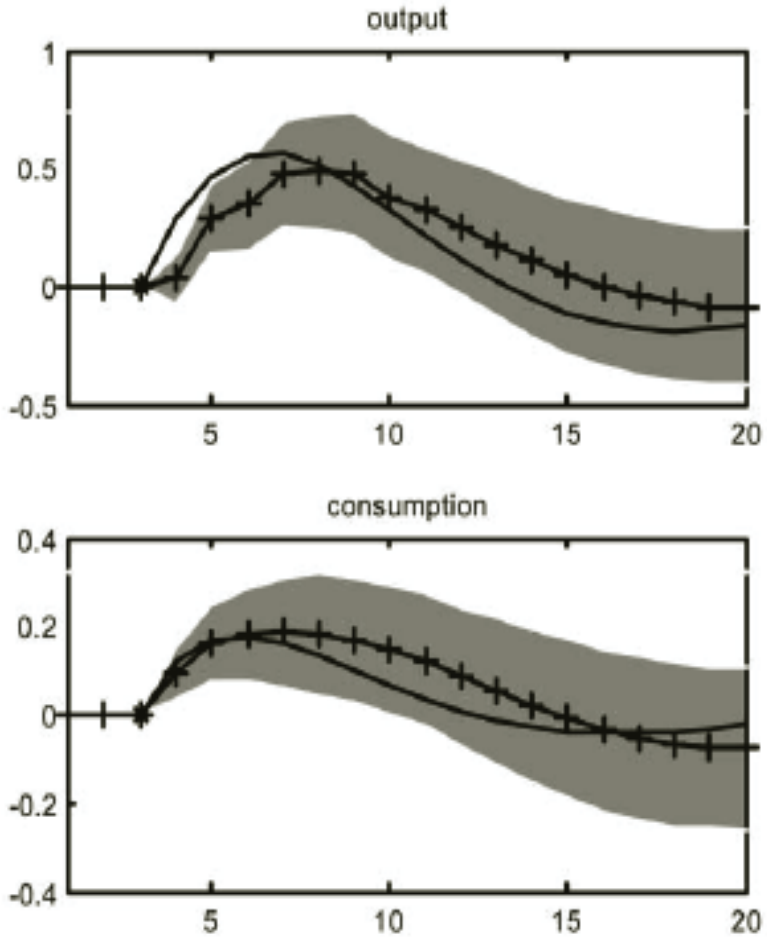
3. Weak propagation mechanism (Cogley-Nason, 1995)

4. Effects of technology shocks on labor market (Gali, 1999 and Gali and Rabanal, 2004)

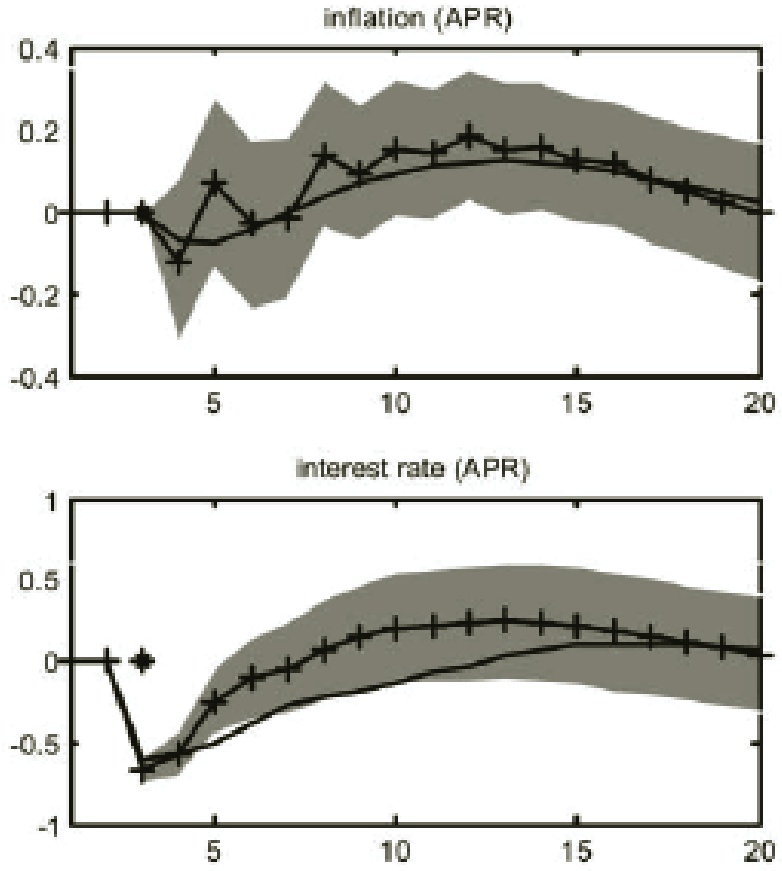
- **Reading**: Nakamura and Steinsson (2013), "Price Rigidity: Microeconomic Evidence and Macroeconomic Implications", *Annual Review of Economics*

- http://www.columbia.edu/~en2198/papers.html

- **Criticism 1**: RBC model cannot replicate evidence of **non-neutrality** of money (Christiano et al., 2005)




Effects of an increase in the money supply (source CEE, 2005)




Effects of an increase in the money supply (CEE, 2005)

$\longrightarrow$An increase in **money supply**

1. Prolonged, but not immediate, positive effect on **output** and **consumption**
   $\longrightarrow$Clear **non-neutrality**

2. Delayed positive effect on **inflation** (persistence)

3. Negative effect on **nominal interest rate** (liquidity effect)

**Criticism 2**: Prices change only **infrequently**: (*monthly*) evidence for Euro Area (source Altissimo, Ehrmann and Smets, 2006)

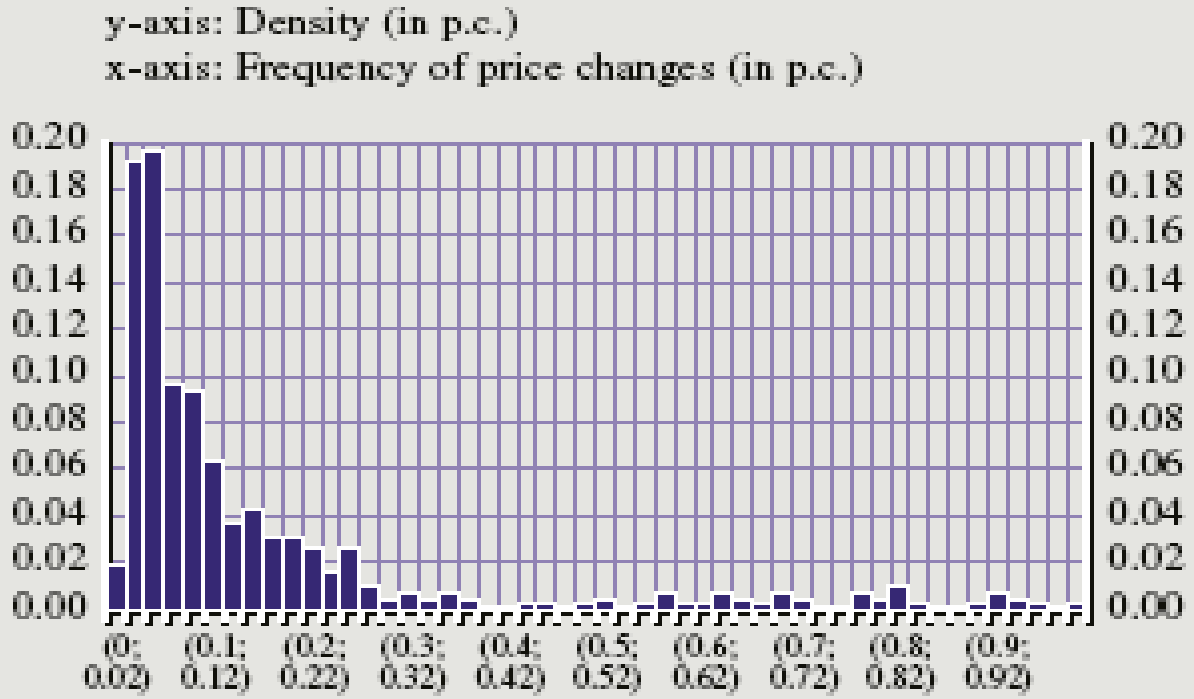
| Euro Area | consumer | producer |
|---|---|---|
| **Share of prices changed each month** | 15% | 15-23% |

## Table 4.1 Frequency of consumer price changes by product type, in %

| Country | Unprocessed food | Processed food | Energy (oil products) | Non-energy industrial goods | Services | Total, country weights | Total, Euro area weights |
|---|---|---|---|---|---|---|---|
| Belgium | 31.5 | 19.1 | 81.6 | 5.9 | 3.0 | 17.6 | 15.6 |
| Germany | 25.2 | 8.9 | 91.4 | 5.4 | 4.3 | 13.5 | 15.0 |
| Spain | 50.9 | 17.7 | n.a. | 6.1 | 4.6 | 13.3 | 11.5 |
| France | 24.7 | 20.3 | 76.9 | 18.0 | 7.4 | 20.9 | 20.4 |
| Italy | 19.3 | 9.4 | 61.6 | 5.8 | 4.6 | 10.0 | 12.0 |
| Luxembourg | 54.6 | 10.5 | 73.9 | 14.5 | 4.8 | 23.0 | 19.2 |
| The Netherlands | 30.8 | 17.3 | 72.6 | 14.2 | 7.9 | 16.2 | 19.0 |
| Austria | 37.5 | 15.5 | 72.3 | 8.4 | 7.1 | 15.4 | 17.1 |
| Portugal | 55.3 | 24.5 | 15.9 | 14.3 | 13.6 | 21.1 | 18.7 |
| Finland | 52.7 | 12.8 | 89.3 | 18.1 | 11.6 | 20.3 | - |
| Euro Area | 28.3 | 13.7 | 78.0 | 9.2 | 5.6 | 15.1 | 15.8 |

$\longrightarrow$Substantial degree of **heterogeneity** in the frequence of (monthly) price changes across products (source Altissimo, Ehrmann and Smets, 2006)

## Figure 4.1 Distribution of product-specific and country-specific frequencies of price changes

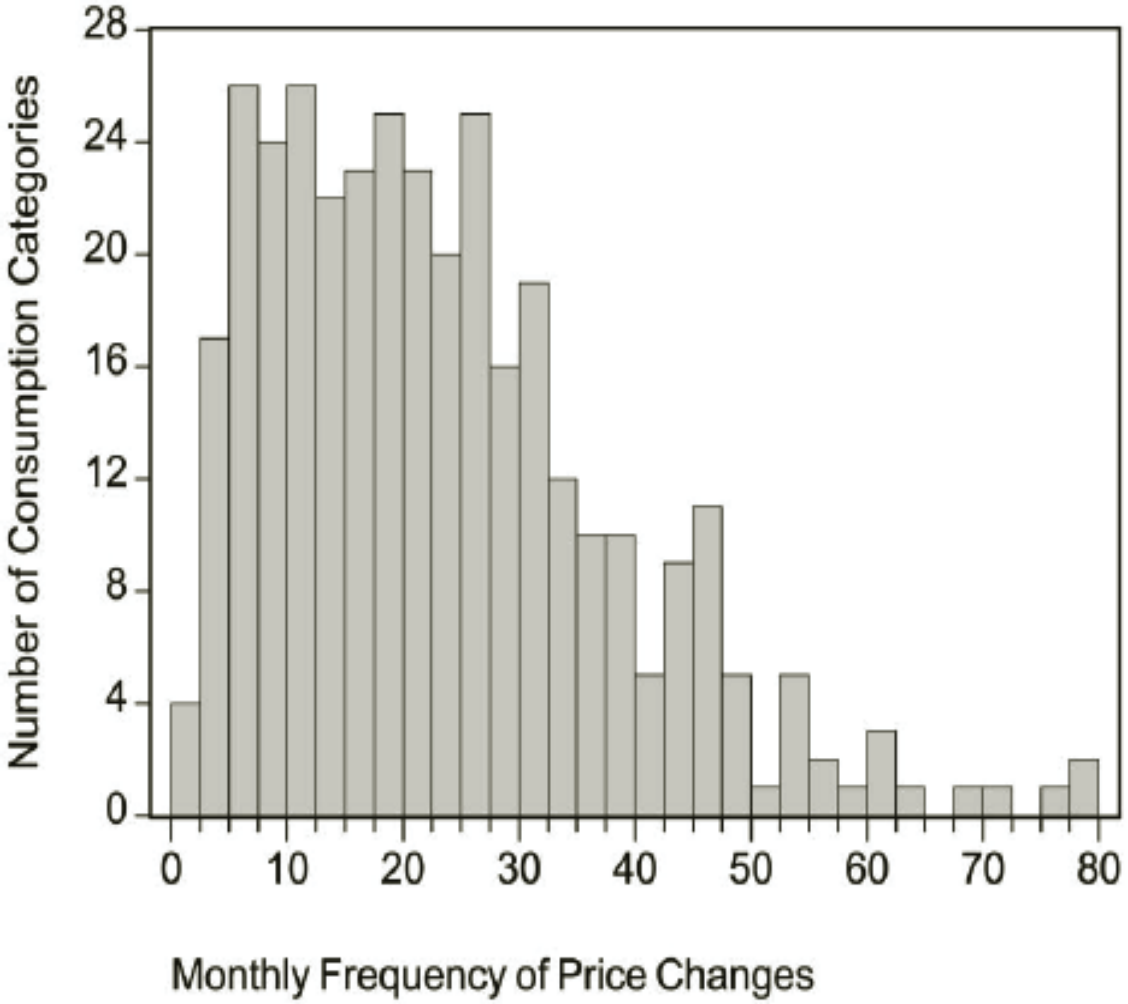



Source: Dhyne et al. (2005).

Median duration of price spell in Euro Area: between **4 to 5 quarters**

- What about the **US?**

$\longrightarrow$Recent micro-based evidence points to **smaller degree of price stickiness** (Bils and Klenow, 2004)


Number of Consumption Categories
28
24
20
16
12
8
4
0
0
10
20
30
40
50
60
70
80
Monthly Frequency of Price Changes

- Median duration of price spell in the US is **4.3 months (**Bils and Klenow, 2004**)**

- Nakamura-Steinsson (2006): accounting for **sales** bring it back to median duration of **8-11 months**.

- Non-neutrality of money is big challenge for RBC model

- Yet, is it monetary **shocks** or is it monetary **policy**? **Systematic (**rule-based**)** vs. **Non-Systematic** (shocks) component of policy

TABLE 1

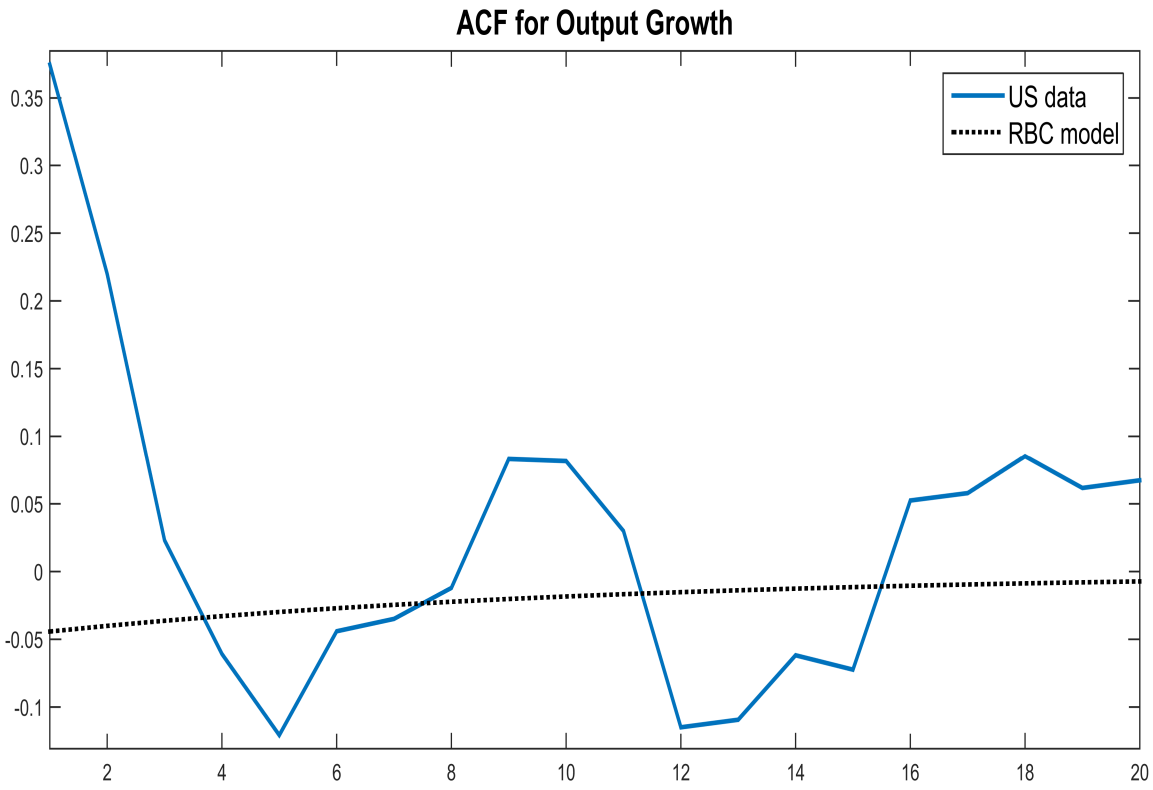
PERCENTAGE VARIANCE DUE TO MONETARY POLICY SHOCKS

| | 4 Quarters Ahead | 8 Quarters Ahead | 20 Quarters Ahead |
|---|---|---|---|
| Output | 15 | 38 | 27 |
| | (4,26) | (15,48) | (9,35) |
| Inflation | 1 | 4 | 7 |
| | (0,8) | (1,11) | (3,18) |
| Consumption | 14 | 21 | 14 |
| | (4,26) | (5,37) | (4,26) |
| Investment | 10 | 26 | 23 |
| | (2,21) | (7,39) | (6,32) |
| Real wage | 2 | 2 | 4 |
| | (0,8) | (0,14) | (0,15) |
| Productivity | 15 | 14 | 10 |
| | (3,25) | (3,26) | (3,20) |
| Federal funds rate | 32 | 19 | 18 |
| | (18,44) | (8,27) | (5,27) |
| M2 growth | 19 | 19 | 19 |
| | (8,29) | (8,26) | (8,24) |
| Real profits | 13 | 18 | 7 |
| | (5,25) | (6,31) | (2,20) |

NOTE.—Numbers in parentheses are the boundaries of the associated 95 percent confidence interval.

Contribution of monetary policy **shocks** to variance of output is **small** (source: CEE, 2005)

**Criticism 3**: RBC model has **weak propagation mechanism** (Cogley and Nason, 1995)


ACF for Output Growth
US data
RBC model
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
2
4
6
8
10
12
14
16
18
20

- **Criticism 4**: Are Technolgy Shocks Really the **Source** of Business Cycle Fluctuations?

- **Reading.** Gali J., "Technology, Employment and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations ?", *American Economic Review* (1999)

$\rightarrow$Note: productivity $\simeq$ real wage

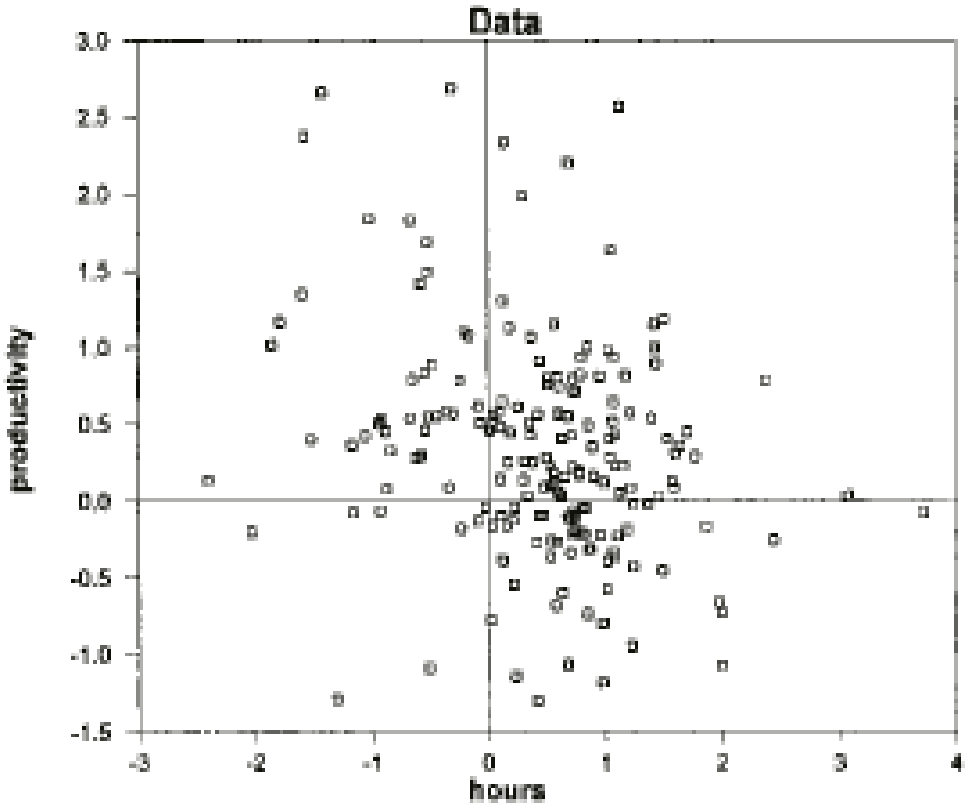



Figure 1: **Unconditional** Correlation between Productivity and Hours in the Data is close to zero (Gali 1999)

- Effect of a Technology Shock on labor demand

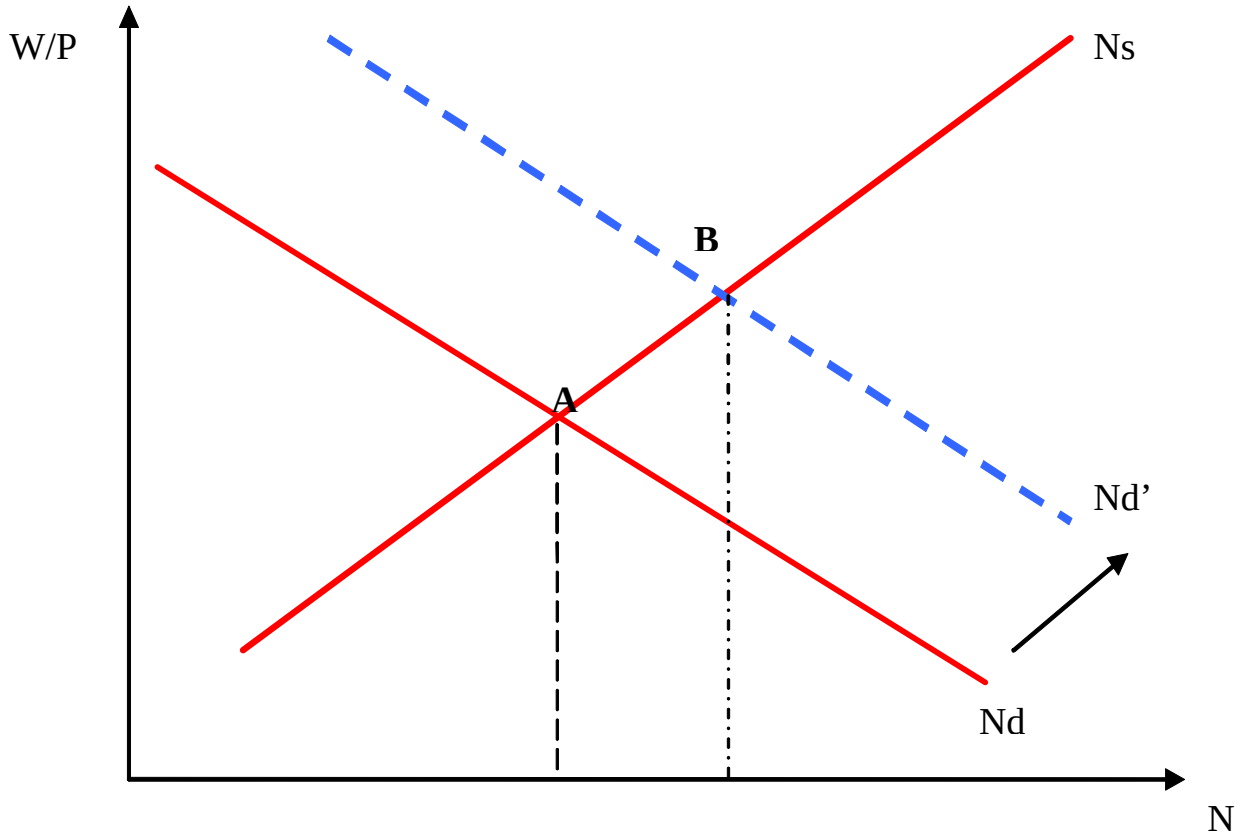
Suppose production function

$$Y_t = A_t N_t^{\alpha}$$

First order condition for choice of labor input

$$\frac{W_t}{P_t} = \alpha \frac{A_t}{N_t^{1-\alpha}}$$

For any given real wage, a rise in productivity entails a rise in labor input $\longrightarrow$Labor demand shifts outward



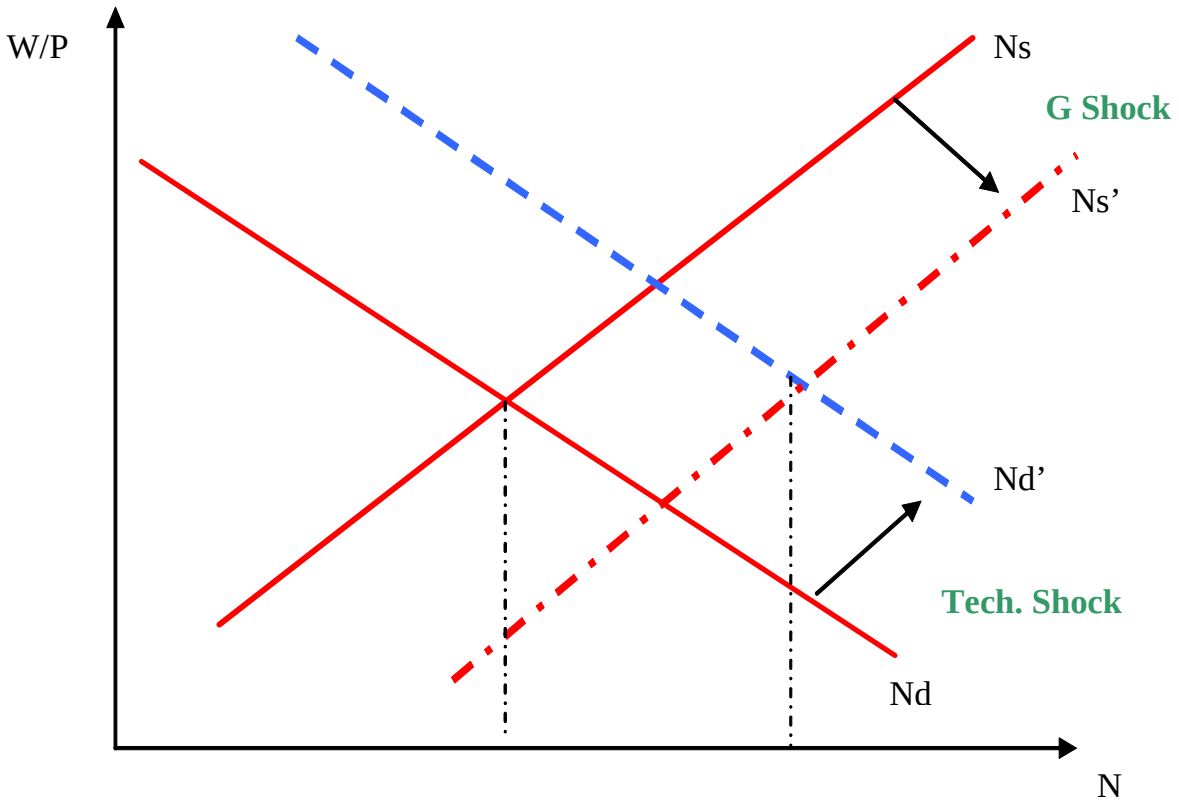

Effect of a positive technology shock in the labor market

- RBC model predicts strong positive correlation between real wage (productivity) and hours

- To obtain low correlation between W/P and N need also a **shift in labor supply**

- Candidate: **government spending** shock (Christiano and Eichenbaum, 1992)

- A rise in G financed with lump-sum taxes makes household poorer (marginal utility of wealth rises) $\rightarrow$household is willing to **work more**$\rightarrow$labor supply shifts outward

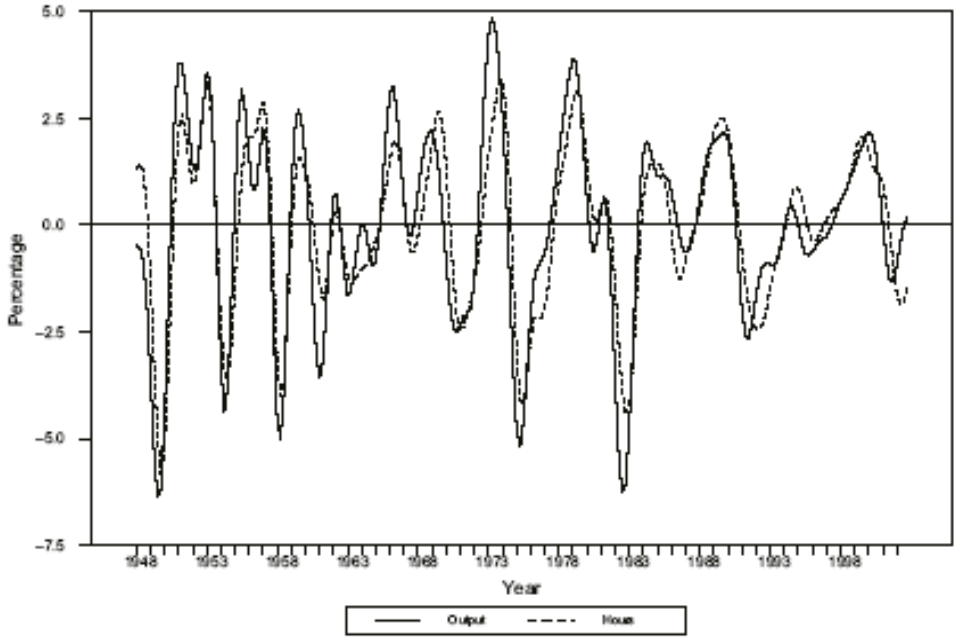


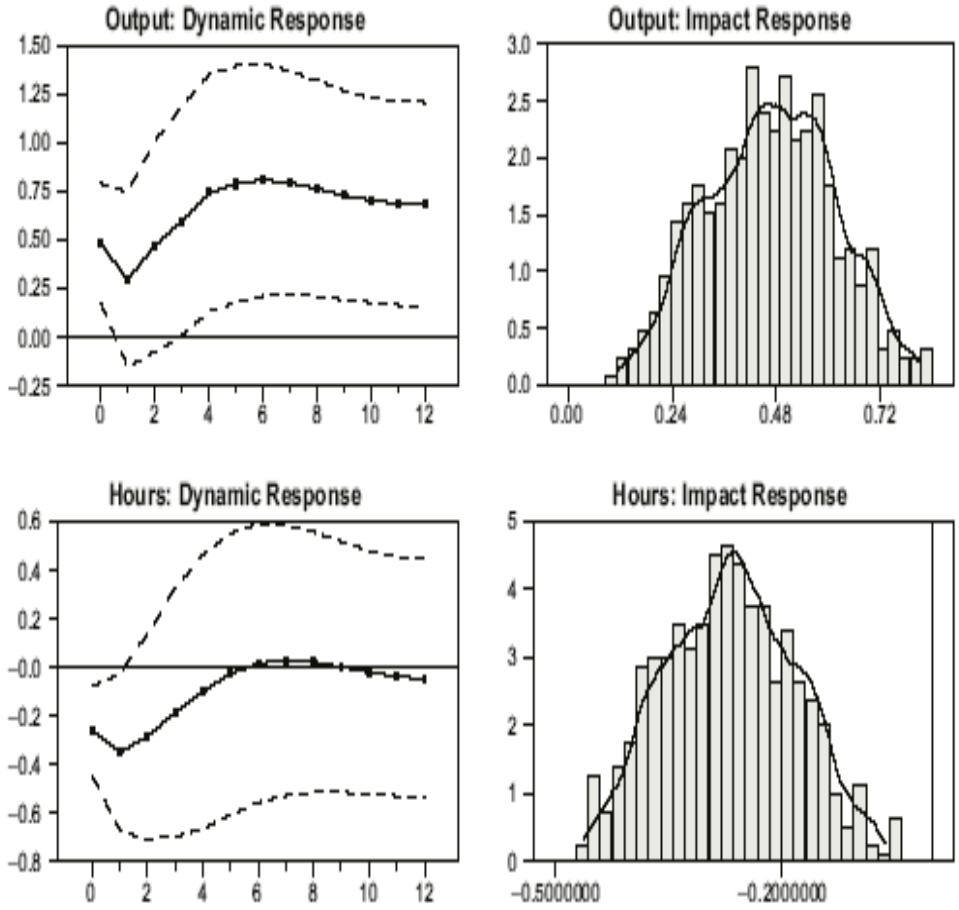

Simultaneous Effect on the Labor Market of Technology and Government Spending Shocks

- Are Government spending shocks enough?

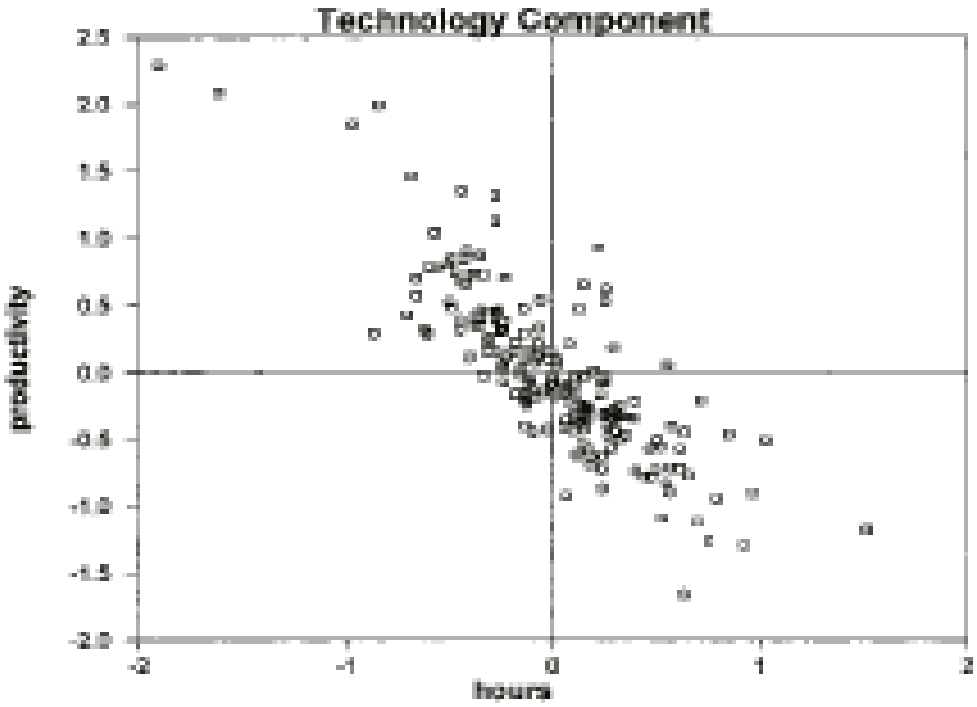
- Gali (AER, 1999)

Positive Output-Employment **comovement** is key business cycle fact (unconditional correlation)






The **Estimated** Effects of Technology Shocks (source Gali and Rabanal, 2004)




Estimated correlation between hours and productvity **conditional** on technology shocks (Gali 1999)

- Data seem to suggest that labor hours **decrease** in response to technology shocks (large literature on this)

- Hence it is the transmission mechanism of technology shocks in RBC models which seems questionable

- However, lively debate on this (Altig et al., 2006)

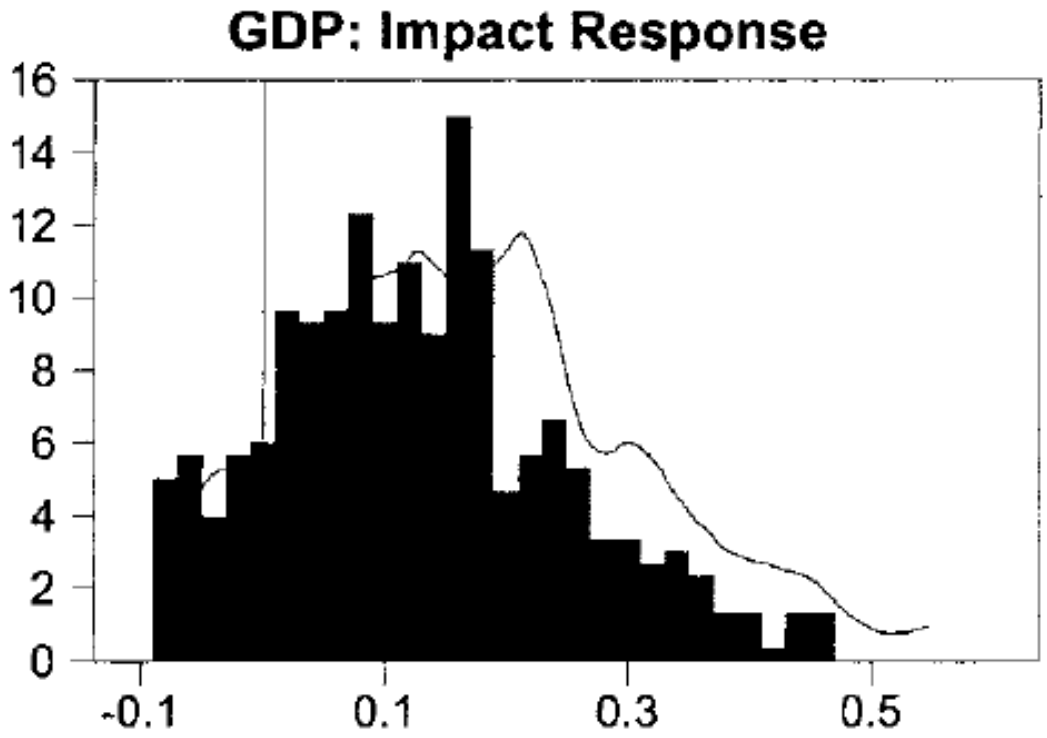



Figure 2: Effects of technology shocks in the Euro Area: GDP (source Gali 2004)

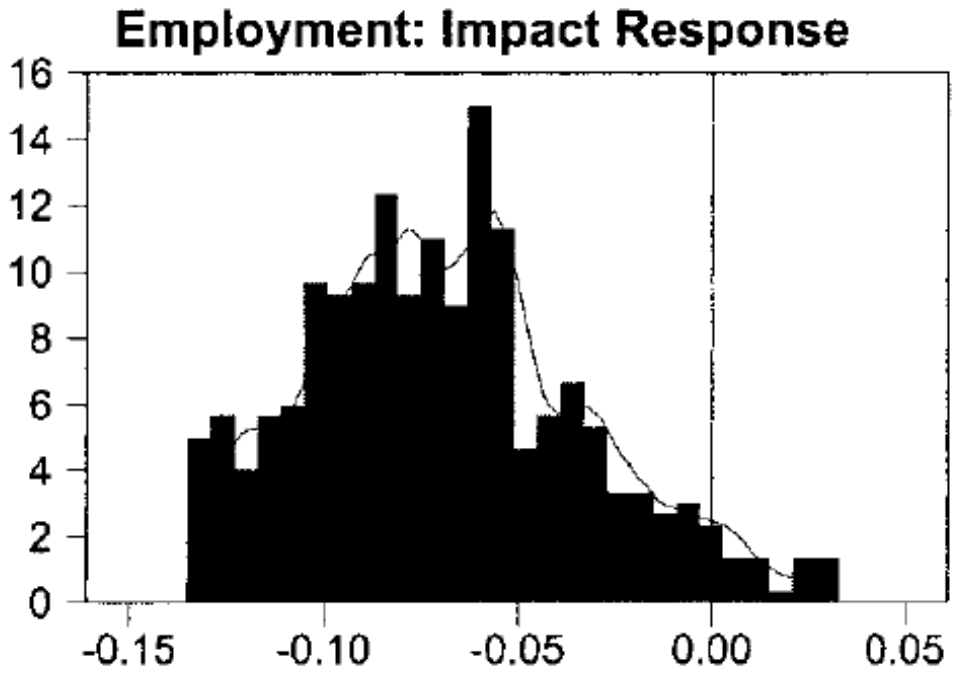
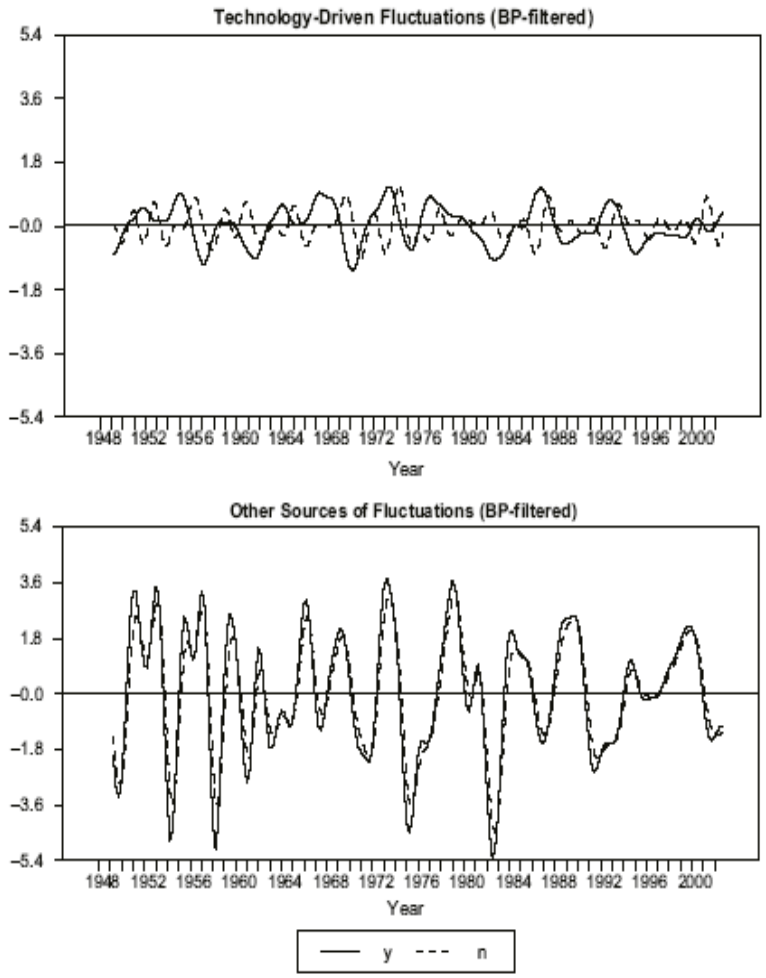



Figure 3: Effects of technology shocks in the Euro Area: Employment (source Gali 2004)




Decomposing **technology** vs. **non-technology** component in the comovement between **Output and Hours**