Matching efficiency and business cycle fluctuations

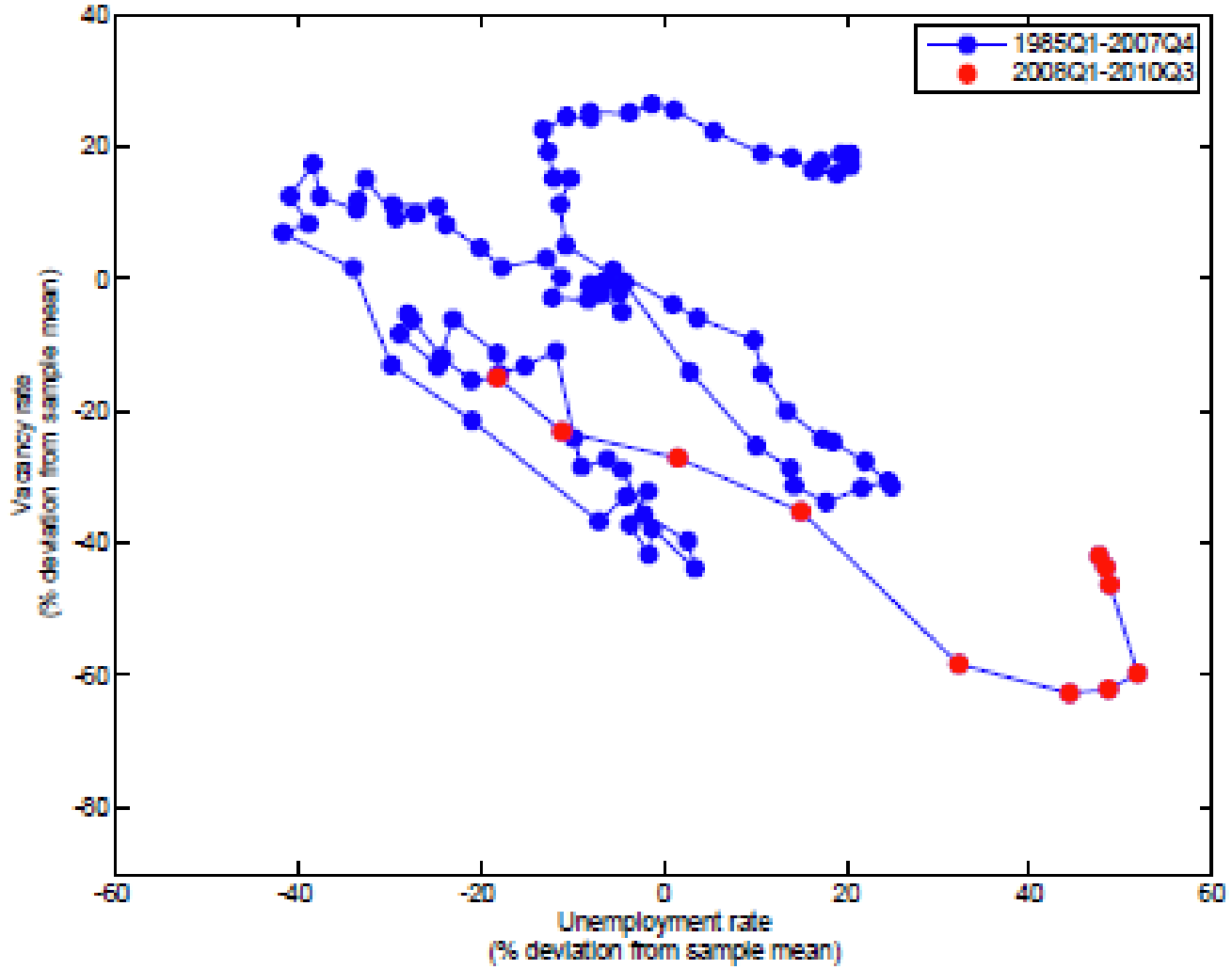
National Bank of Serbia, research seminar

Francesco Furlanetto
Norges Bank

Nicolas Groshenny
Reserve Bank of New Zealand

February 3, 2012

Motivation: Beveridge curve



Motivation: Beveridge curve

Kocherlakota (2010): Shift in the Beveridge curve due to **mismatch**.

"Firms have jobs but can't find appropriate workers. The workers want to work, but can't find appropriate jobs. There are many possible sources of mismatch – geography, skills, demography – and they are probably all at work."

Motivation

- Micro-approach: Measure mismatch from disaggregated data (Sahin, Song, Topa and Violante, 2011, Barnichon and Figura, 2011, Herz and van Rens, 2011)

- Macro-approach: shocks to the matching efficiency, as a technology shock in the matching function

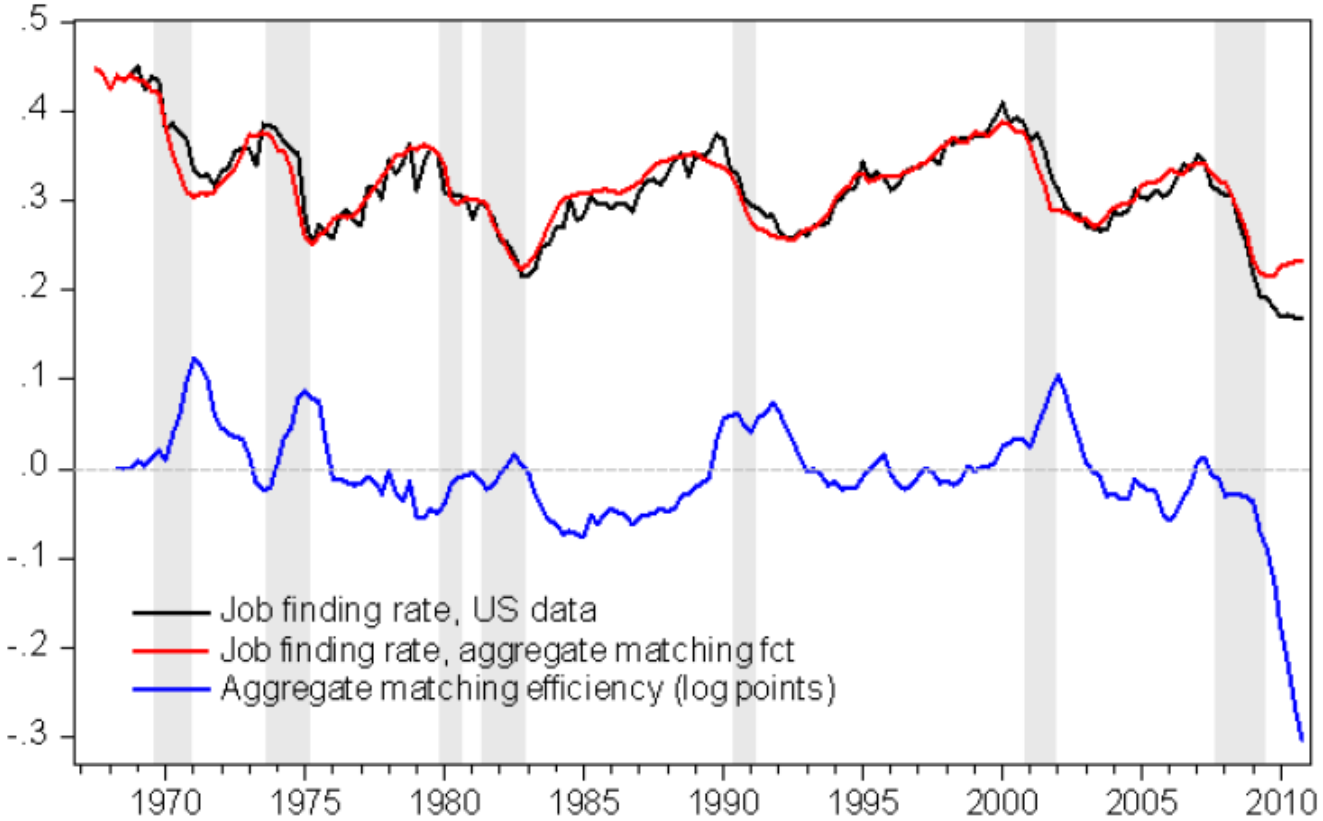
$$M_t = \zeta_t S_t^{\sigma} V_t^{1-\sigma}$$

$$\ln \zeta_t = \rho_{\zeta} \ln \zeta_{t-1} + \epsilon_{\zeta t}$$

Solow residual of the matching function:

$$M_t = \zeta_t S_t^{\sigma} V_t^{1-\sigma} \qquad Y_t = A_t K_t^{\alpha} N_t^{1-\alpha}$$

Motivation (from Barnichon and Figura, 2011a)



Interpretations

- Skill mismatch
- Geographical mismatch (with house-locking effects), (Nenov, 2012)
- Reduction in search intensity by workers (longer unemployment benefits)
- Reduction in search intensity by firms
- Shifts in the composition of the unemployment pool (Barnichon and Figura, 2011a)

Our contribution

- Careful analysis of the transmission mechanism of shocks to the matching efficiency in the simplest New Keynesian model (three equation model a la Galí + search and matching frictions in the labor market)

- Unemployment is present because of
  - **Nominal rigidities (cyclical)**
  - **Search and matching frictions (structural)**

- Why is this needed?

	Unemployment	Vacancy
Lubik (2009)	92%	38%
Krause, Lubik, Lopez-Salido (2008)	37%	1%
Justiniano and Michelacci (2011)	11%	3%

Preview of the results

The transmission mechanism crucially depends on

- **The form of the hiring cost function**
  - Pre-match hiring cost: propagation
  - Post-match hiring cost: no propagation
- **The degree of nominal rigidities** and the degree of inertia in monetary policy
  - Sticky prices: negative effect on vacancies and positively sloped Beveridge curve
  - Flexible prices: positive effect on vacancies and positively/negatively sloped Beveridge curve

Related literature: structural factors and unemployment

- Literature on **search and matching frictions in the New Keynesian model** (Walsh, 2005, Trigari, 2006, Sveen and Weinke, 2008 and 2009)
  - Papers that include matching efficiency shocks: Andolfatto (1996), Cheremukhin and Restrepo-Echevarria (2011), Lubik (2009), Krause, Lubik, Lopez-Salido (2008), Justiniano and Michelacci (2011)
- Literature on the importance of **reallocation shocks vs aggregate shocks** (Lilien, 1982, and Abraham and Katz, 1986)
- Literature on **matching efficiency in the Great Recession**: Barnichon and Figura (2011b) and Furlanetto and Groshenny (2011)

Model: overview

- Simplest New Keynesian model with labor market frictions
  - No capital, no wage rigidities, no real rigidities
- **Households**: perfect risk sharing between employed and unemployed
- **Intermediate good producing firms** (perfectly competitive) and final good producing firms (monopolistic competition)
- Wage determined through Nash bargaining
- Fiscal policy is budget balanced
- Monetary policy is a Taylor rule with interest rate smoothing responding to output growth

Model: households

Household problem is standard with perfect consumption insurance

$$E_t \sum_{s=0}^{\infty} \beta^s \ln C_{t+s}$$

$$P_t C_t + \frac{B_t}{R_t} \leq B_{t-1} + W_t N_t + b\left(1 - N_t\right) - T_t + D_t$$

Model: intermediate good producing firms

$$E_t \sum_{s=0}^{\infty} \beta^s \Lambda_{t+s} \left(Z_{it} Y_{it} - W_{it} N_{it} - H_{it}^k \right)$$

subject to

$$\begin{aligned} Y_{it} &\leq A_t N_{it} \\ N_{it} &= (1-\rho) N_{it-1} + M_{it} \end{aligned}$$

where $M_{it} = Q_t V_{it}$

Model: details on the labor market

- Probability of filling a vacancy taken as given by the firm:

$$Q_t = \frac{M_t}{V_t}$$

- The matching process is described by the function

$$M_t = \zeta_t S_t^{\sigma} V_t^{1-\sigma}$$

where $S_t = 1 - (1-\rho) N_{t-1}$ and $U_t = 1 - N_t$

$$\ln \zeta_t = \rho_\zeta \ln \zeta_{t-1} + \epsilon_{\zeta t}$$

Model: hiring costs

- Pre-match hiring costs: linear cost of posting a vacancy (Pissarides, 2000)

$$H_{it}^{pre} = \phi_N V_{it}$$

- Post-match hiring costs: quadratic training costs (Gertler and Trigari, 2009)

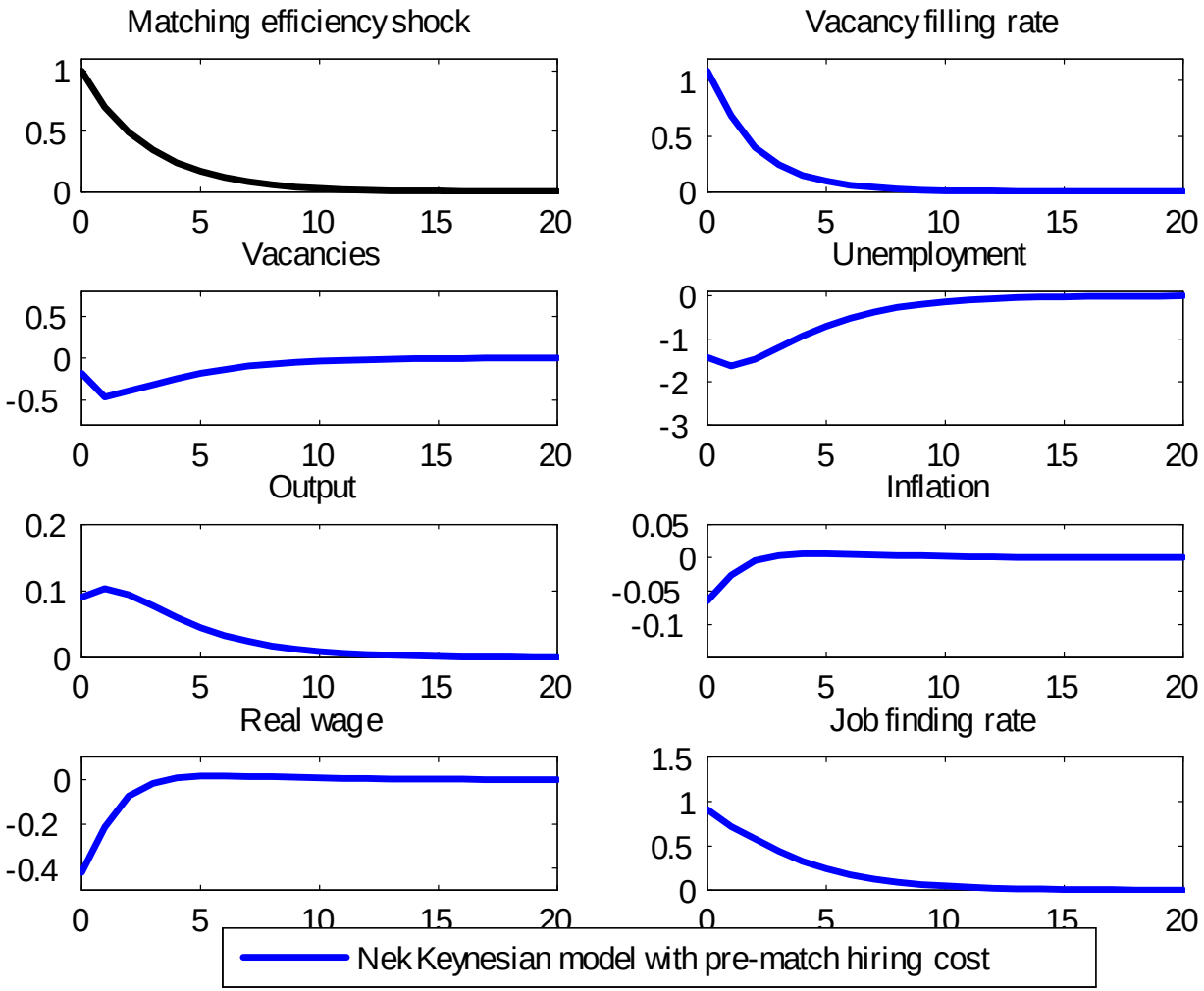
$$H_{it}^{post} = \frac{\phi_N}{2} \left[\frac{M_{it}}{N_{it}} \right]^2 N_{it}$$

Calibration

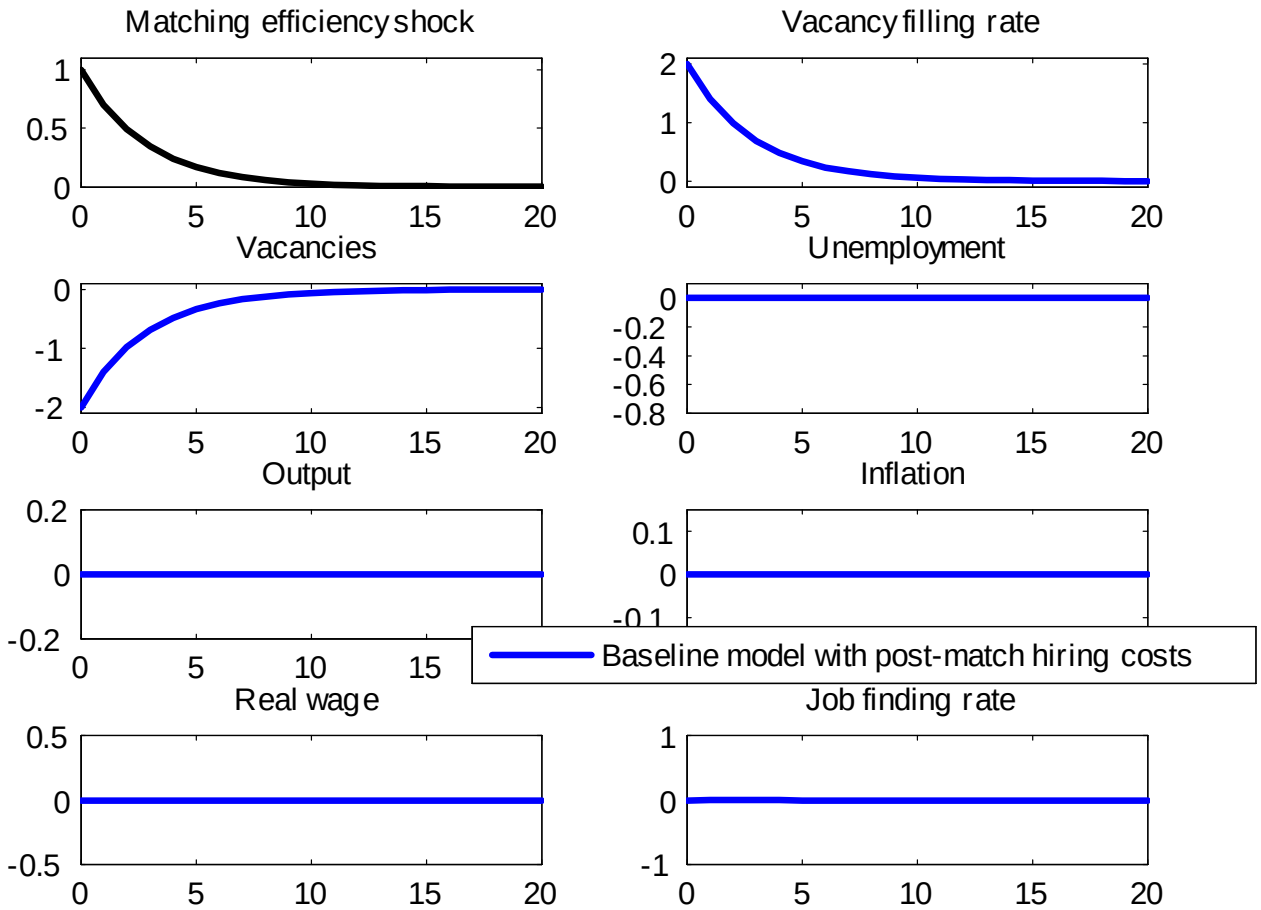
Table 1: Calibrated parameters

Discount rate	β	0.99
Elasticity of substitution between goods	θ	11
Interest rate smoothing	ρ_r	0.8
Response to inflation in the Taylor rule	ρ_π	1.5
Response to output growth in the Taylor rule	ρ_y	0.5
Calvo coefficient for price rigidity	α	0.75
Probability to fill a vacancy within a quarter	Q	0.7000
Separation rate	ρ	0.1
Unemployment rate	U	0.06
Unemployment benefits	τ	0.4
Pre-match hiring cost parameter	ϕ_V, ϕ_N	$1\% GDP$

First result: matching shocks and pre-match hiring costs



First result: matching shocks and post-match hiring costs



First result: intuition

- Pre-match hiring cost:

$$\frac{\phi_V}{Q_t} + RW_t = Z_t + A_t + \beta(1-\rho)\frac{\Lambda_{t+1}}{\Lambda_t}\frac{\phi_V}{Q_{t+1}}$$

- Post-match hiring cost:

$$\phi_N X_t (1 - X_t) + RW_t = Z_t + A_t + \beta(1-\rho)\frac{\Lambda_{t+1}}{\Lambda_t}\phi_N X_{t+1}$$

where $X_t = \frac{M_t}{N_t}$

First result: evidence on hiring costs

- Silva and Toledo (2009) and Yashiv (2000): training cost component is dominant
- Christiano, Trabandt and Walentin (2011): same result in an estimated DSGE model
- The larger the importance of the training cost component, the lower the importance of shocks to the matching efficiency
  - Important to use a realistic hiring function (Yashiv, 2006)

Second result: matching shocks, nominal rigidities and the Beveridge curve

- With post-match hiring costs: vertical conditional Beveridge curve
- With pre-match hiring costs: positively sloped conditional Beveridge curve
  - Matching shocks could help explain an outward shift in the unconditional Beveridge curve...
  - ...but cannot be a main driver of aggregate fluctuations

Second result: matching shocks, nominal rigidities and the Beveridge curve

- Effect of positive mismatch shocks on vacancies

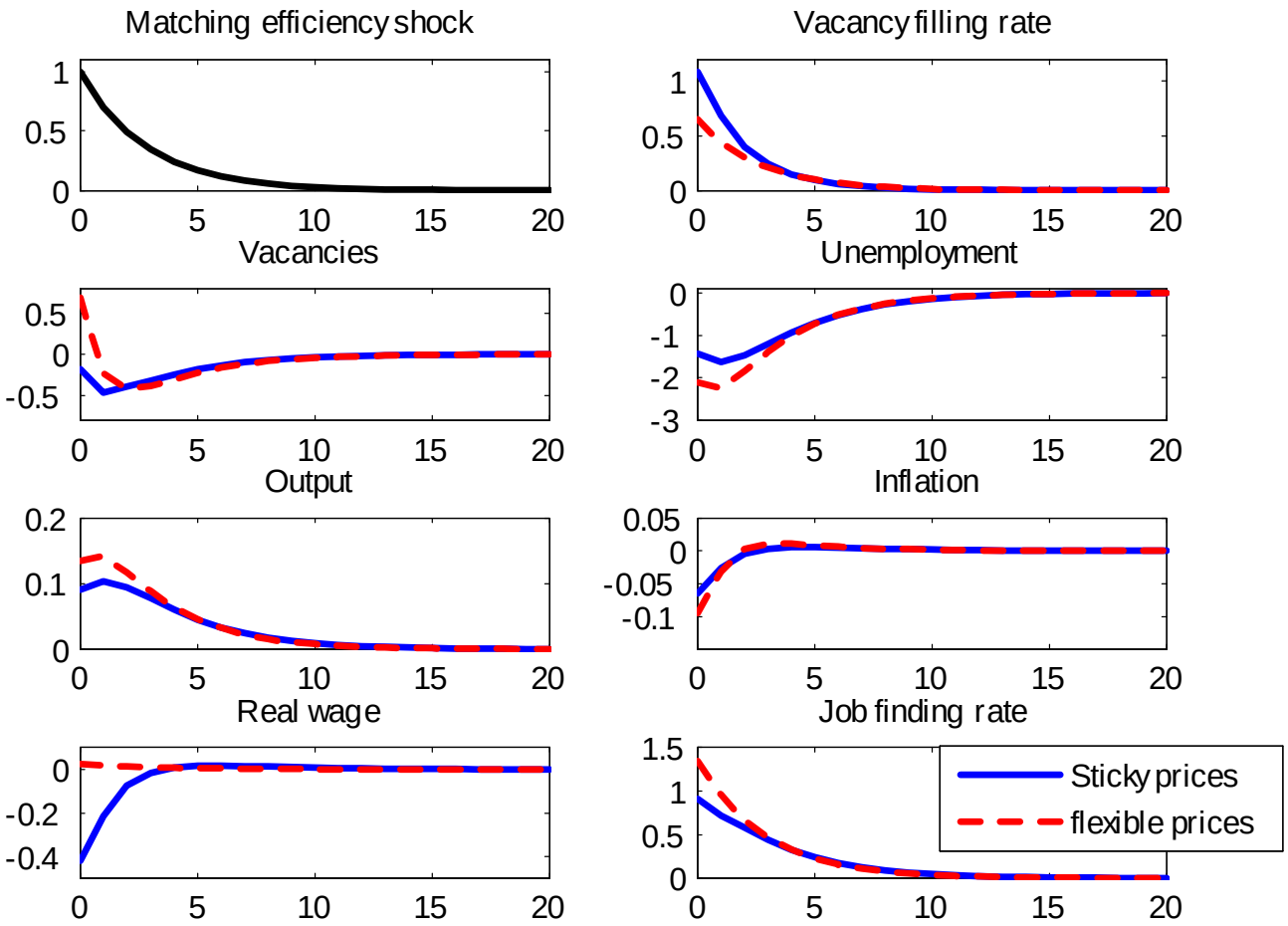
$$M_t = \zeta_t S_t^{\sigma} V_t^{1-\sigma}$$

- Effect of positive technology shocks on hours/employment

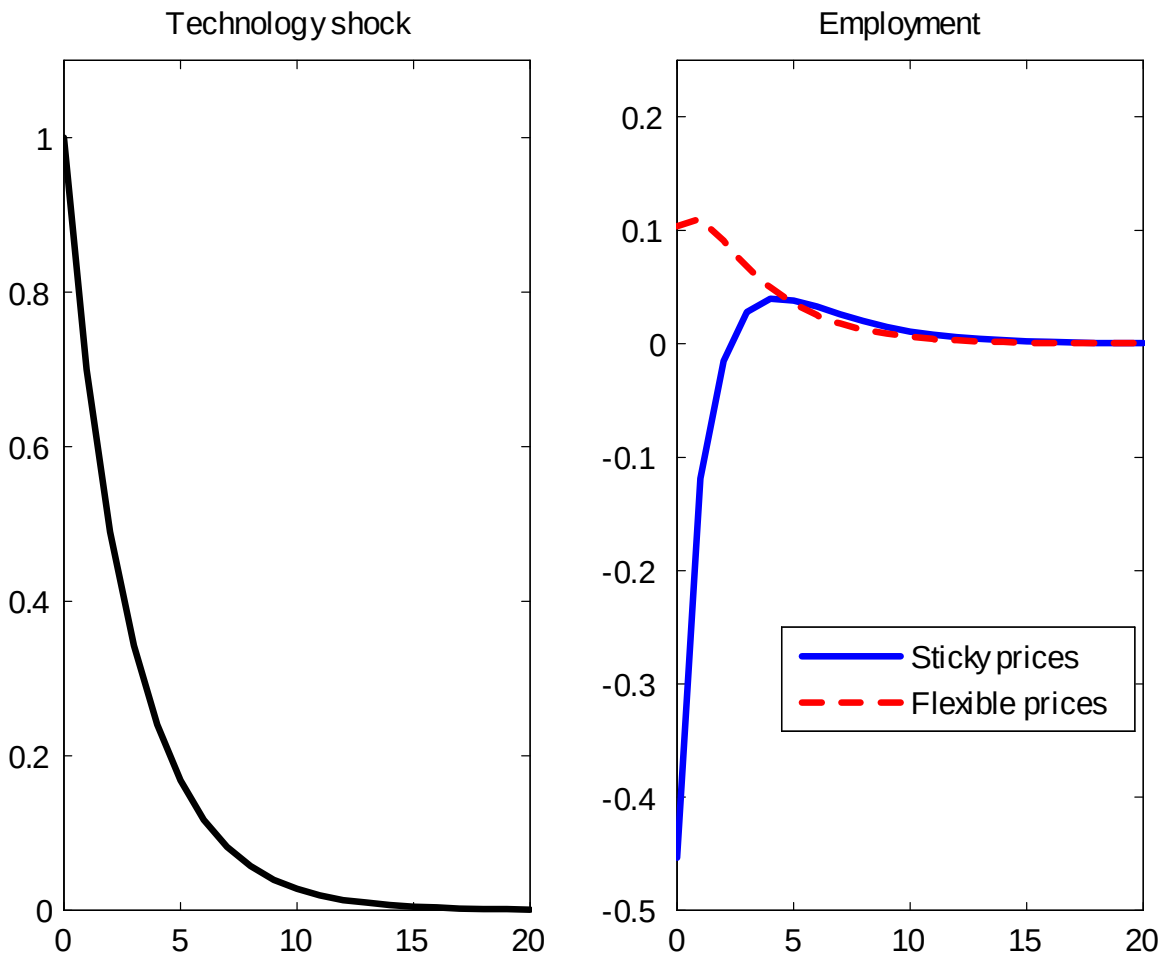
$$Y_t = A_t K_t^{\sigma} N_t^{1-\sigma}$$

- Identical conditions to obtain a negative response
  - Nominal rigidities and not too aggressive monetary policy (Galí, 1999)
  - Real rigidities (Francis and Ramey, 2005)

Second result: matching shocks, nominal rigidities and the Beveridge curve



Matching shocks, nominal rigidities and the Beveridge curve



A special case

Exogenous money and fixed prices (as in Gali, 1999)

$$
\begin{aligned}
m_t^{oney} - p_t &= y_t \\
y_t &= a_t + n_t \\
n_t &= (1-\rho)\, n_{t-1} + \rho m_t \\
m_t &= \sigma s_t + (1-\sigma)\, v_t + \ln \zeta_t
\end{aligned}
$$

$$
\begin{aligned}
\ln \zeta_t &= -(1-\sigma) v_t \\
v_t &= -\frac{\ln \zeta_t}{(1-\sigma)}
\end{aligned}
$$

Why is this important?

- The response of vacancies is important to determine the conditional Beveridge curve!

Under sticky prices...

Table 5: $\text{corr}(U_t, V_t)$ with pre-match hiring costs and sticky prices

$\rho_\zeta = 0.9$	0.95
$\rho_\zeta = 0.7$	0.97
$\rho_\zeta = 0.5$	0.99
$\rho_\zeta = 0.1$	1
$\rho_\zeta = 0$	1

...but under flexible prices...

Table 6: corr(U_t, V_t) with pre-match hiring costs and flexible prices

$\rho_\zeta = 0.9$	0.85
$\rho_\zeta = 0.7$	0.23
$\rho_\zeta = 0.5$	-0.23
$\rho_\zeta = 0.1$	-0.59
$\rho_\zeta = 0$	-0.64

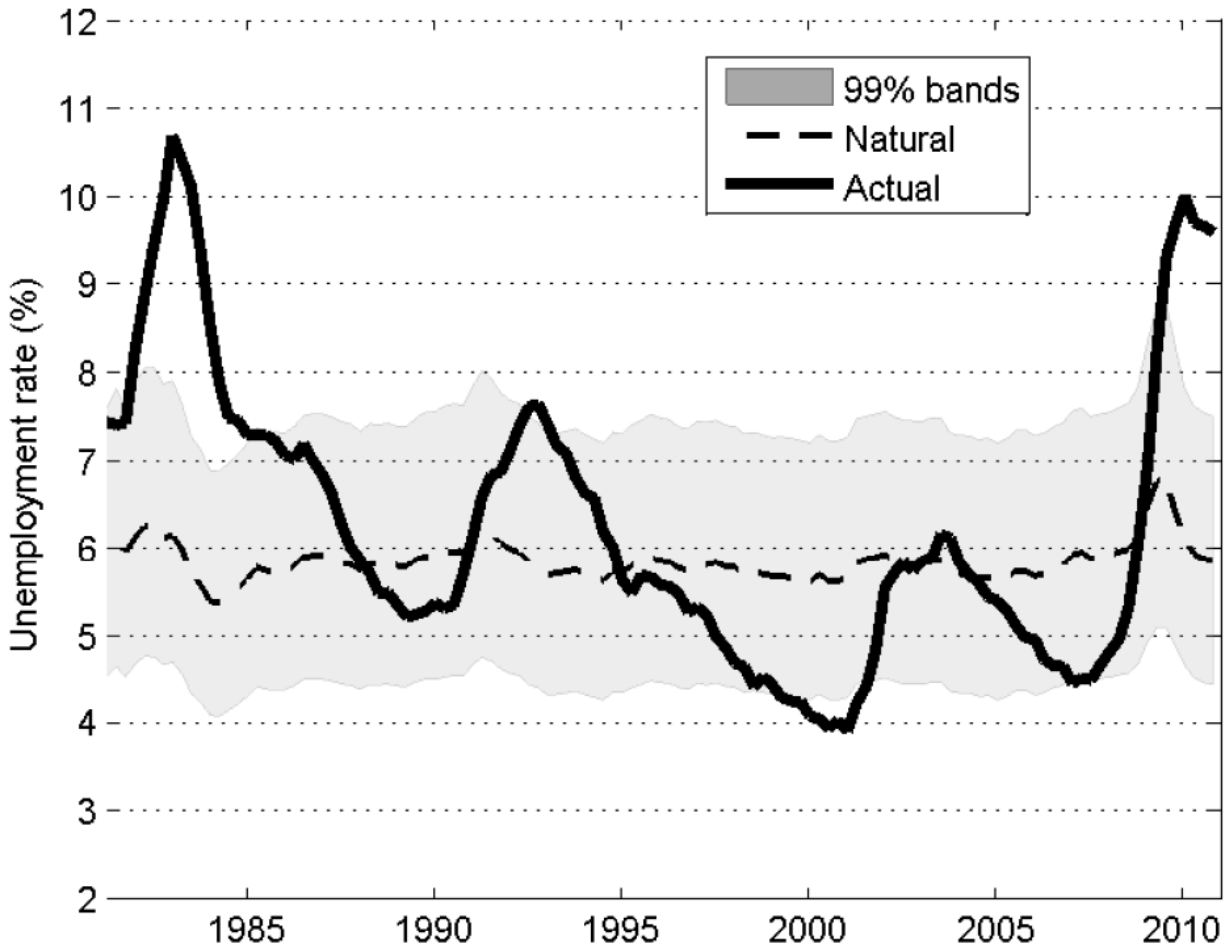
Matching shocks, nominal rigidities and the Beveridge curve

- We confirm the Abraham and Katz (1986) conjecture under sticky prices:
  - Positively sloped Beveridge curve
  - the shock cannot be important but can be seen as a shifter of the Beveridge curve
- ...but under flexible prices
  - Positively or negatively sloped Beveridge curve
  - the shock can be more important but then it is not a shifter of the Beveridge curve

Conclusion

- The transmission mechanism of matching efficiency shocks depends crucially **on the form of the hiring cost function** and **on the degree of nominal rigidities**
- The larger the importance of the training cost component, the lower the importance of shocks to the matching efficiency
- The interpretation of matching efficiency shocks as shifters of the Beveridge curve (Abraham and Katz, 1986) is warranted only when prices are sticky

Model with post-match hiring costs: the natural rate (from Furlanetto and Groshenny, 2012b)



Historical decomposition

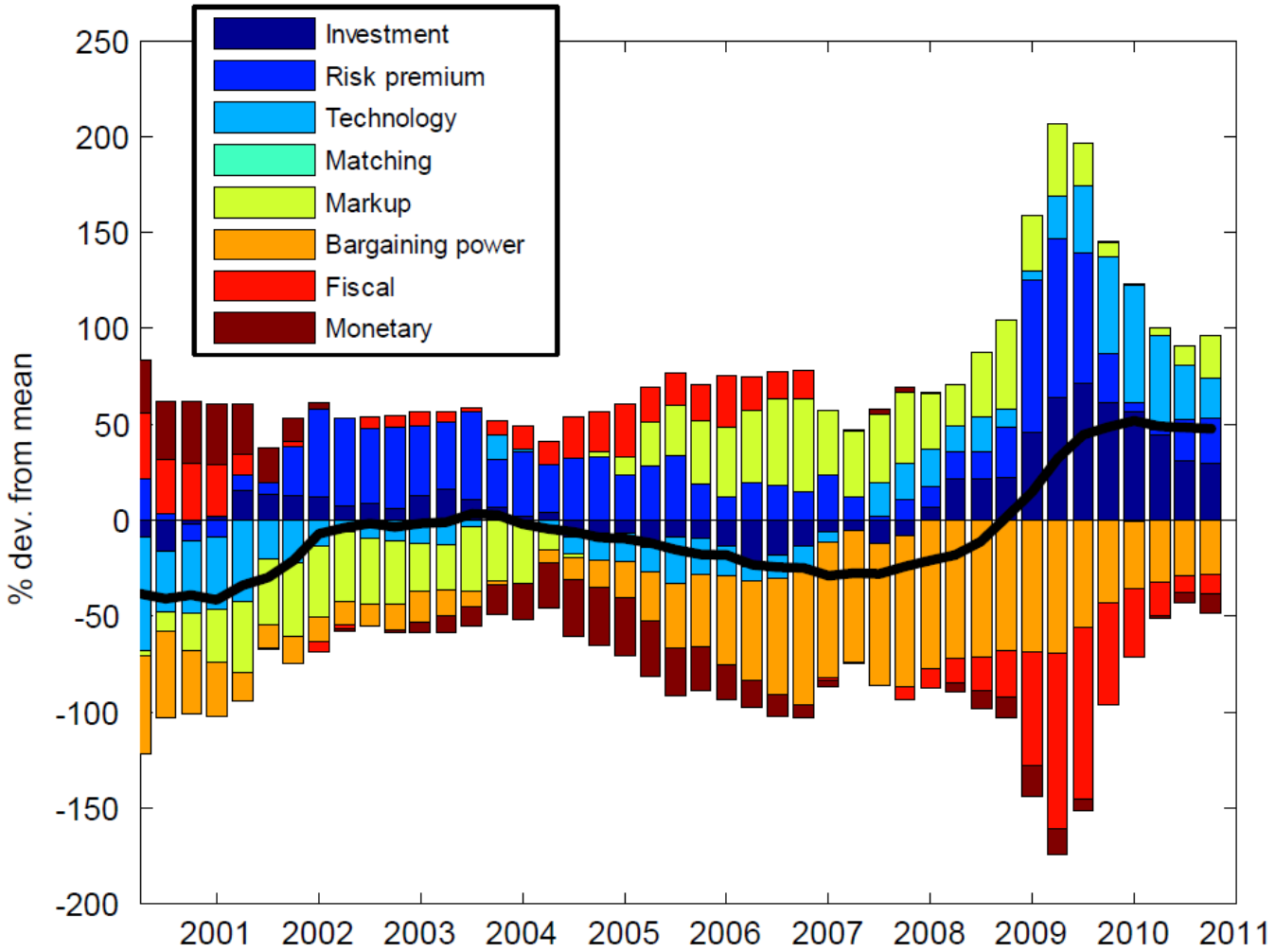
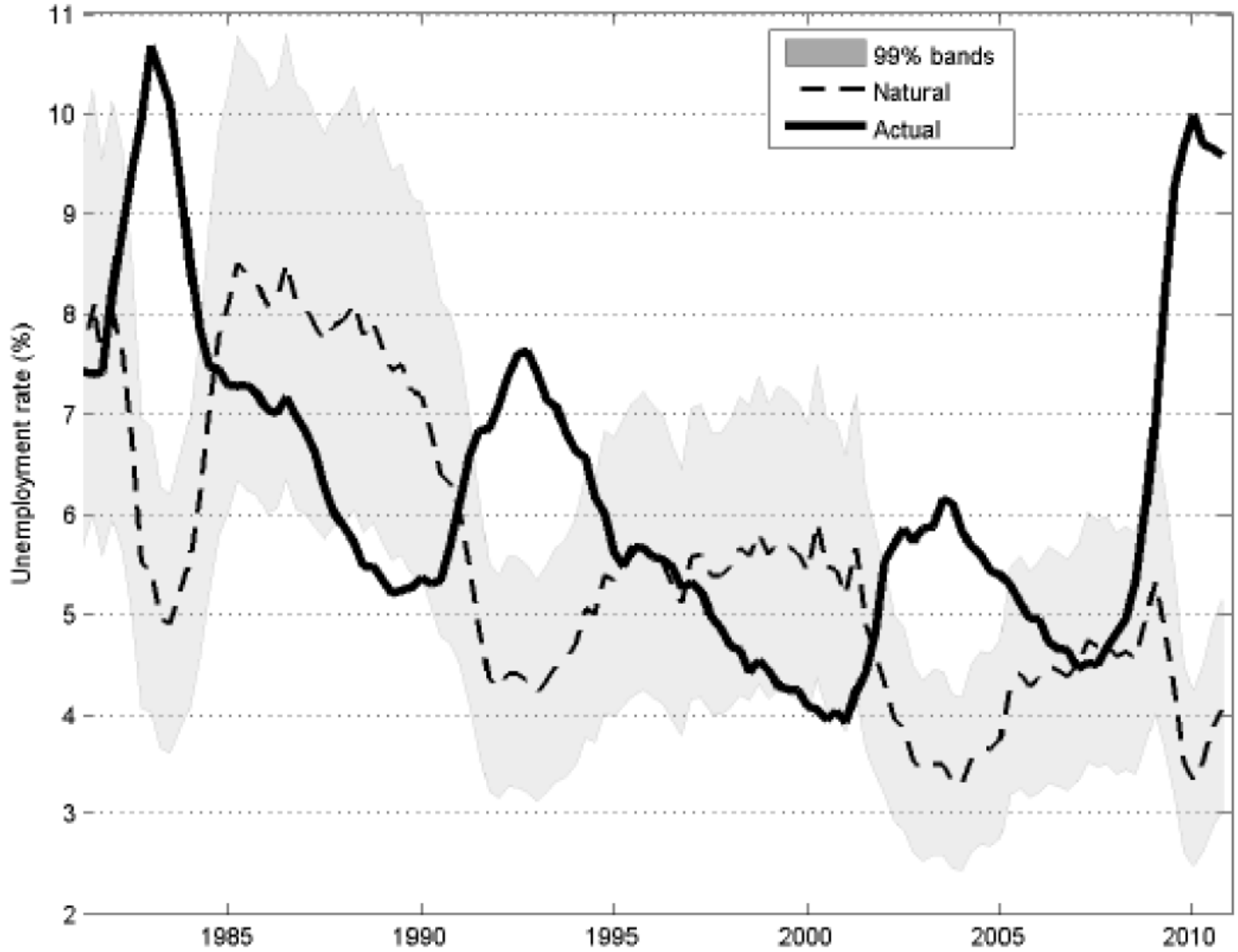


Figure:

Model with pre-match hiring costs: the natural rate (from Furlanetto and Groshenny, 2012b)



Historical decomposition