The Job Ladder: Inflation vs. Reallocation

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Summer 2018

Introduction

Introduction

- **Objective:** to document and to explain wage growth over the business cycle.
- **Organizing framework:** the **Job Ladder**.
  - Workers all agree on ranking of employers/jobs.
  - Employed workers receive outside job offer at some finite, procyclical rate (search frictions).
- In this world, outside job offers generate:
  - Employer-to-employer (EE) **reallocation** if accepted;
  - Rent extraction and **inflationary pressure** if matched by current employer, thus declined.
- **Inflation vs. reallocation:** which one dominates depends on the amount of 'slack' on the labor market, i.e. how well matched (and thus prone to decline outside offers) workers are.

Introduction

- Traditional measures of aggregate slack focus on the unemployment rate.
- With frictional reallocation up and down a job ladder, slack exists also in employment when average match quality is low.
  - When workers are near the top of the job ladder, poaching them becomes difficult, and job offers mostly redistribute rents from firms to workers.
  - From the employers' point of view, these wage raises are inflationary cost shocks.
- Hence, **the EE rate should predict growth in real MC, and inflation**.

Two Parts of this Talk

1. **Empirical evidence** on labor cost growth and EE reallocation.
    - **nominal wage growth comoves with the pace of EE transitions**, not with Unemployment-to-Employment (UE) transitions, whether or not we condition on the Unemployment rate (U).
2. **New Keynesian DSGE model with On-the-Job Search**, featuring an endogenous balance between labor reallocation and rent extraction.
    - **a novel propagation mechanism**: average match quality in employment is a slow-moving state variable, which propagates aggregate shocks.
    - **a theory of the wage markup and the labor wedge**: both are endogenous and time-varying in our model.
    - **a tractable treatment of search frictions & on-the-job search in the NK framework**.

Descriptive Evidence

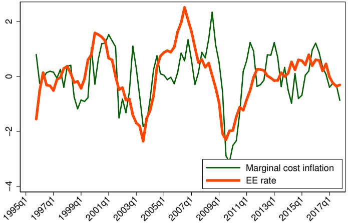
EE Reallocation and Labor Cost Growth

EE Reallocation: Orders of Magnitude

- Monthly EE transition probability is about 2% of employment.
- Monthly UE transition probability is about 30% of unemployment.
- Employment (E) stock is 10-20 times the unemployment (U) stock.
  - EE and UE flows are of similar magnitudes.
- Nearly half of all completed unemployment spells are recalls by the same employer Fujita and Moscarini (2013)
  - A large share of UE hires in fact do not reallocate labor input between firms.
- **Conclusion:** **the majority of employment reallocation between firms is EE**.

Aggregate Time Series Evidence

MC inflation and EE:



Source: BLS, CPS data compiled by Fallick and Fleischman (2004), and authors' calculations.
All series HP−filtered and MA−smoothed (4−quarter symmetric smoothing), and rescaled

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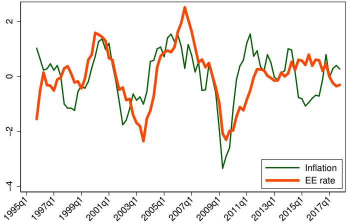

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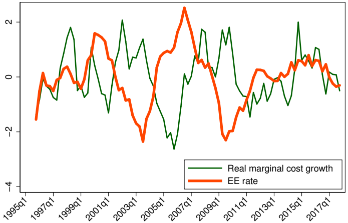
Real MC growth and EE:



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All series HP−filtered and MA−smoothed (4−quarter symmetric smoothing), and rescaled

Notes:

- Marginal cost (MC) defined as ECI/ALP.
- "Inflation" is growth in GDP deflator (similar picture with CPI inflation).

(X)

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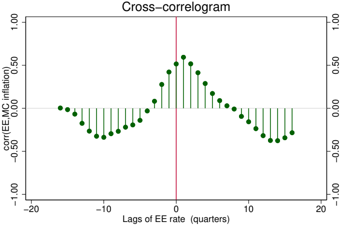

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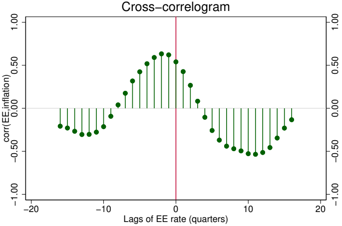

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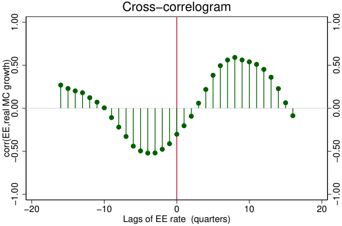

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(X)

Micro Evidence from the SIPP

- Representative survey.
- Similar to monthly CPS:
  - (much) smaller cross-section but with 3-5 year longitudinal links.
- Rich information about wages.
- Detailed information about **start and end dates of labor market spells**.
- We use data from 1996-2014 (after SIPP redesign).

Micro Evidence from the SIPP

- We consider worker groups by age, gender, ethnicity, education, state of residence, employer size, major industry, and occupation (some, but not all, interacted).
- We define a **market** m_t as a worker group $\times$ calendar month.
- We construct market-average rates of unemployment $\overline{U}^{m_t}$ and transition $\overline{EE}^{m_t}$, $\overline{UE}^{m_t}$, $\overline{EU}^{m_t}$, $\overline{NE}^{m_t}$, $\overline{EN}^{m_t}$.
- Finally, we regress growth rate of individual nominal earnings on individual EE_{it} transition indicator, on $\overline{U}^{m_{it}}$, $\overline{EE}^{m_{it}}$, $\overline{UE}^{m_{it}}$, $\overline{EU}^{m_{it}}$, $\overline{NE}^{m_{it}}$, $\overline{EN}^{m_{it}}$, and on demographic group fixed effects.

Micro Evidence from the SIPP

Dependent variable: log change in monthly nominal earnings					
Mkt. EE rate	0.0287 (.0006)			0.0383 (.0006)	0.0415 (.0006)
Mkt. UE rate		−0.0004 (.00004)		−0.0011 (.00004)	−0.0011 (.00004)
Mkt. U rate			−0.0184 (.0003)	−0.0170 (.0004)	−0.0096 (.0003)
Mkt. EU rate					−0.0500 (.0007)
Mkt. NE rate					0.0257 (.0002)
Mkt. EN rate					−0.0786 (.0005)
# obs.			10,784,966		

Source: SIPP data processed by Moscarini and Postel-Vinay (2017). Monthly data, 1996m1-2013m7 (with gaps). Standard errors in parentheses. All regressions include a linear time trend, demographic group FE's, and a control for individual EE transition.

- The job-to-job transition rate contains predictive power for earnings inflation, above and beyond the unemployment rate and UE/NE rates.

A New Keynesian DSGE Model with a Job Ladder

Environment

- Discrete time t.
- All agents are are infinitely lived with discount factor $\beta \in (0, 1)$.
- The economy has **three sectors**:

1. **Service sector:** upstream firms hire labor in a frictional labor market to produce a "service", and sell it in a competitive market to...
2. **Intermediate goods sector:** monopolistically competing firms, which use only services as input, produce differentiated intermediate goods and sell them to...
3. **Final good sector:** perfectly competitive firms, which aggregate intermediate goods into a final good, sold to households.

Service Sector

- Linear technology using only labor: each unit of labor ("job match") produces y units of the service.
- The service is sold to intermediate good producers on a competitive market at price ω_t.
- Productivity y is match-specific and drawn iid once and for all when the match forms, from a cdf Γ.

Intermediate Goods Sector

- Monopolistically competitive firms, indexed by $i \in [0, 1]$ produce differentiated intermediate goods.
- Linear technology transforms one unit of service into z_t units of output of intermediate good i.
- Firm sells variety to final good producers at price $p_t(i)$.
- **Nominal rigidity**: intermediate good producers can only change their price $p_t(i)$ with probability ν each period (Calvo pricing).

Final Goods Sector

- Perfectly competitive firms buy quantities $c_t(i)$ of the intermediate inputs and use them to produce a homogeneous final good with a CES technology:

$$Q_t = \left(\int_0^1 c_t(i)^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}}, \qquad \eta > 1$$

- The final good trades at price P_t.

Households

- A representative household
  - owns shares of all firms
  - consumes C_t units of the final good
  - supplies labor to the service sector
- We consider "large households":
  - measure-one continuum of members $j \in [0, 1]$
  - each member j has indivisible unit endowment of labor time per period, employed or not $e_t(j) \in \{0, 1\}$
- Preferences:

$$U(C_t) + b \int_0^1 (1 - e_t(j))\, dj$$

Frictional Labor Market

- Service sector firms can post vacancies v at unit cost κ per period, in units of the final good.
- Unemployed workers search for these vacancies.
- Employed workers
  - also receive each period, with probability $s \in (0, 1]$, an iid opportunity to search for a vacant job (a new match)
  - face a job destruction probability δ each period
- Job market tightness is defined as:

$$\theta = \frac{v}{u + s(1-\delta)(1-u)}$$

- Job seekers and vacancies meet according to a CRS meeting function:
  - probability $\phi(\theta) \in [0, 1]$ of a job seeker worker meeting an open vacancy

Wage Setting

- Service sector employers can commit to state-contingent contracts, renegotiated only by mutual consent, when worker receives outside offer
- Incumbent employers and poachers Bertrand-compete in contracts.
- Limited commitment: parties can unilaterally separate.

Financial Markets

- Cashless economy, numéraire money.
- Households trade:
  - a nominal one-period risk-free bond, price $(1+R_t)^{-1} \leq 1$
  - shares of three mutual funds owning all final good, intermediate good, and service producers, share prices p_t^F, p_t^I, p_t^S.
- **Monetary policy**: R_t is set by the monetary authority.
  - The monetary authority typically follows a Taylor rule.
  - In the application:

$$\ln(1+R_t) = \varpi_R \ln(1+R_{t-1}) + (1-\varpi_R)\left[\psi_\pi \ln(1+\pi_{t-1}) + \psi_Q \ln\left(\frac{Q_{t-1}}{Q}\right) - \ln\beta\right] + \varepsilon_t^R$$

Timing

1. **TFP shock:** nature draws the intermediate-sector TFP z_t; simultaneously the monetary authority sets R_t
2. **Price setting:** intermediate good producers adjust prices $p_t(i)$ with probability ν
3. **Production and trade:** firms and households produce and exchange goods and services; service sector employers pay wages according to current contracts; previously unemployed workers receive utility from leisure b; households trade bonds and shares with each other and the monetary authority
4. **Job destruction:** existing matches break up with probability δ
5. **Job creation:** firms post vacancies; previously unemployed and (still) employed workers search for those vacancies; upon meeting, a vacancy and a worker draw a permanent match quality y; the firm and worker's current employer (if there is one) compete for the worker's services; offer holders accept or reject their offers and change status accordingly.

Household Optimization

- Household problem:

$$\max_{\left\{C_t, B_t, \xi_t^F, \xi_t^I, \xi_t^S, a_t(j)\right\}} \mathbb{E}_0 \sum_{t=0}^{+\infty} \beta^t \left[U\left(C_t\right) + b \int_0^1 \left(1 - e_t(j)\right) dj \right]$$

subject to:

- the intertemporal budget constraint:

$$P_t C_t + \frac{B_{t+1}}{1+R_t} + \xi_{t+1}^F p_t^F + \xi_{t+1}^I p_t^I + \xi_{t+1}^S p_t^S \leq \int_0^1 e_t(j) w_t(j) dj$$
$$+ \xi_t^F \left(\Pi_t^F + p_t^F\right) + \xi_t^I \left(\int_0^1 \Pi_t^I(i) di + p_t^I\right) + \xi_t^S \left(\Pi_t^S + p_t^S\right) + B_t$$

- the law of motion of labor supply

$$e_{t+1}(j) = e_t(j)(1-\delta) + \left(1 - e_t(j)\right) \phi(\theta_t) a_t(j)$$

- a NPG condition

Household Decisions

- **Goods, service, and financial markets**: business as usual...
- Isoelastic demand, price index $P_t^{1-\eta} = \int_0^1 p_t(i)^{1-\eta} di$ for final good.
- SDF and Euler equation

$$D_t^{t+\tau} = \beta^\tau \frac{U'(C_{t+\tau})}{U'(C_t)} \qquad \mathbb{E}_t\left[D_t^{t+1}\frac{P_t}{P_{t+1}}\right] = \frac{1}{1+R_t}$$

- Price of mutual fund shares reflect expected PDV of future profits.

Labor Market Turnover Decisions

- Turnover decisions $a_t(j)$ only enter household optimization through
  - value of leisure $b \int_0^1 (1 - e_t(j))\, dj$
  - labor income $\int_0^1 e_t(j) w_t(j) dj$
  - laws of motion of employment status $e_t(j)$ and wage $w_t(j)$
- To choose $a_t(j)$, household solves the sub-problem:

$$\max_{\{a_t(j)\}} \int_0^1 \left\langle \mathbb{E}_0 \sum_{t=0}^{+\infty} \beta^t \left[b\,(1 - e_t(j)) + U'\,(C_t)\, e_t(j) \frac{w_t(j)}{P_t} \right] \right\rangle dj$$

subject to the laws of motion of $e_t(j)$:

$$e_{t+1}(j) = e_t(j)(1 - \delta) + (1 - e_t(j))\, \phi(\theta_t) a_t(j)$$

and $w_t(j)$ (derived from Bertrand competition between prospective employers).

Labor Market Turnover Decisions

- **Key**: acceptance decisions $a_t(j)$ taken independently across members j.
  - Household is one of many, does not internalize congestion externalities in the search market (not even those created by its own members on each other).
  - Only interaction between household members is through income pooling.
- This allows to consider labor turnover decisions separately for each member j.
- Decisions are based on "usual" individual value functions.
  - Employed member ($e_t(j) = 1$):

$$V_{et}^{j}\left(w_t(j), y_t(j)\right) = \frac{w_t(j)}{P_t}$$
$$+\mathbb{E}_t\left\langle D_t^{t+1}\left[\delta V_{u,t+1}^{j} + (1-\delta)V_{e,t+1}^{j}\left(w_{t+1}(j), y_{t+1}(j)\right) \mid e_t(j) = 1, w_t(j), y_t(j)\right]\right\rangle$$

  - Unemployed member ($e_t(j) = 0$):

$$V_{ut}^{j} = \frac{b}{U'\left(C_t\right)} + \mathbb{E}_t\left[D_t^{t+1}V_{u,t+1}^{j}\right] = \frac{b}{U'\left(C_t\right)\left(1-\beta\right)}$$

Equilibrium

Labor Market Equilibrium

- We focus on the labor market (the rest is standard NK fare). (details)
- Vacancy-posting is dictated by the **free-entry condition**:

$$\kappa \frac{\theta_t}{\phi(\theta_t)} = \frac{u_t}{u_t + (1-\delta)\, s\, (1-u_t)} \int_{\underline{y}}^{\overline{y}} \mathbb{E}_t \left[D_t^{t+1} S_{t+1}(y) \right] \gamma(y) dy$$

$$+ \frac{(1-\delta) s (1-u_t)}{u_t + (1-\delta)\, s\, (1-u_t)} \int_{\underline{y}}^{\overline{y}} \gamma(y) \int_{\underline{y}}^{\overline{y}} \max \left\{ \mathbb{E}_t \left[D_t^{t+1} \left(S_{t+1}(y) - S_{t+1}(y') \right) \right], 0 \right\} \frac{\ell_t(y')}{1-u_t} dy' dy$$

- The expected surplus of a type-y job at the time an offer is made is:

$$\mathbb{E}_t \left[D_t^{t+1} S_{t+1}(y) \right] = \mathbb{E}_t \left[\sum_{\tau=1}^{+\infty} (1-\delta)^{\tau-1} D_t^{t+\tau} \left(\frac{\omega_{t+\tau}}{P_{t+\tau}} y - \frac{b}{U'(C_{t+\tau})} \right) \right]$$

$$= \mathcal{W}_t y - \frac{b}{U'(C_t)} \frac{\beta}{1-\beta(1-\delta)}$$

where $\mathcal{W}_t = \beta \mathbb{E}_t \left[\frac{U'(C_{t+1})}{U'(C_t)} \left(\frac{\omega_{t+1}}{P_{t+1}} + (1-\delta) \mathcal{W}_{t+1} \right) \right]$ is the expected PDV of a unit flow of Service.

Labor Market Equilibrium

- The value of an offer is increasing in match quality y.
- Workers always choose match of higher quality, independently of state of the economy: **equilibrium is rank-preserving**.
- Law of motion of the measure of workers in type-y matches (employment distribution):

$$\ell_{t+1}(y) = (1-\delta)\left\{\left[1 - s\phi(\theta_t)\overline{\Gamma}(y)\right]\ell_t(y) + s\phi(\theta_t)\gamma(y)\int_{\underline{y}}^{y}\ell_t(y')\,dy'\right\} + \phi(\theta_t)\gamma(y)u_t$$

- Integrating over y yields the law of motion of unemployment:

$$u_{t+1} = [1-\phi(\theta_t)]\,u_t + \delta(1-u_t)$$

Job Creation

- The **Free-entry Condition** writes as:

$$\kappa \frac{\theta_t}{\phi(\theta_t)} = \frac{u_t}{u_t + (1-\delta)\, s\,(1-u_t)} \left[\mathcal{W}_t \mathbb{E}_\Gamma(y) - \frac{\beta b / U'(C_t)}{1 - \beta\,(1-\delta)} \right] + \frac{(1-\delta) s (1-u_t)}{u_t + (1-\delta)\, s\,(1-u_t)} \mathcal{W}_t \int_{\underline{y}}^{\overline{y}} \gamma(y) \int_{\underline{y}}^{y} \frac{\ell_t\,(y')}{1-u_t} \,(y - y')\, dy'\, dy$$

- Vacancy creation depends on the weighted average of the expected returns from unemployed hires and from employed hires. (link to the literature)

The MPL Gap

- We highlight a new transmission mechanism of aggregate shocks to job creation:
  - Service providers also mind the expected return from an **employed** hire.
  - This depends entirely on the distribution of employment $\ell_t(\cdot)$, a slow-moving aggregate state variable.
  - We call this object the **Marginal Productivity of Labor (MPL) gap**.

- This term introduces an additional, time-varying component to labor demand, with a complex cyclical pattern:
  - After a recession, more workers are in low-quality jobs at the bottom rungs of the ladder, hence easily "poachable".
  - As time goes by, employed workers climb the ladder: they become better matched and more expensive to hire, ultimately putting pressure on wages.
  - Crucially, this process is slow (as the EE transition rate is low): our model features a slow-moving, endogenous propagation mechanism of temporary aggregate shocks.
  - The propagation is also transmitted to real wages, thus, ultimately, to inflation.

The Marginal Cost

- The cost of labor services, ω_t, is a natural (and easy) measure of employment costs.
  - It incorporates the average wage, and an annuitized value of hiring costs.

(more on wages)

- The **marginal cost** faced by intermediate good producers (which is what matters in price-setting) is ω_t / z_t.

Results

(preliminary)

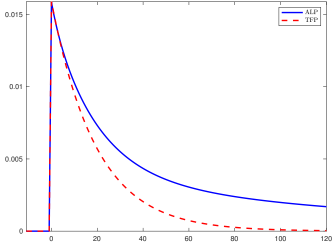
Calibration

TFP process: $\ln z_t = (1-\varpi_z)\mu_z + \varpi_z \ln z_{t-1} + \varepsilon_t^z$				
ϖ_z	σ_z	μ_z		
0.95	5E−3	$-0.5\sigma_z^2/\left(1-\varpi_z^2\right)$		
Monetary policy rule: $\ln(1+R_t) = \varpi_R \ln(1+R_{t-1}) + (1-\varpi_R)\left[\psi_\pi \ln(1+\pi_{t-1}) + \psi_Q \ln\left(\frac{Q_{t-1}}{Q}\right) - \ln\beta\right] + \varepsilon_t^R$				
ϖ_R	σ_R	ψ_π	ψ_Q	
0.975	2.4E−3	38.3	2.28	
Preferences/match quality: $\Gamma(y) = 1 - \left(y/\underline{y}\right)^{-\alpha_y}$, $\mathbb{E}_\Gamma(y) = 1$				
σ	η	β	b	α_y
0.5	6	0.9957	0	1.2
Matching/hiring/job destruction/pricing frictions				
ξ	s	δ	κ	ν
0.6	0.4513	0.014	105.8	0.1111

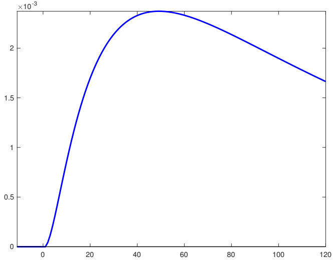
- We simulate the fully nonlinear model, using parameterized expectations.

Impulse Response Functions: Positive TFP Shock

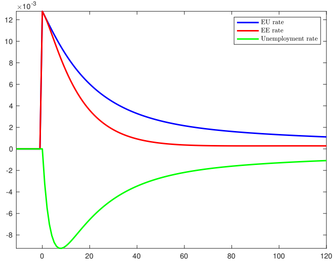
ALP and TFP



Mean match quality

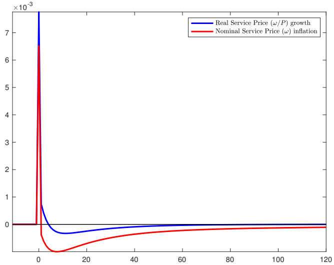


EU, EE, and unemployment rates

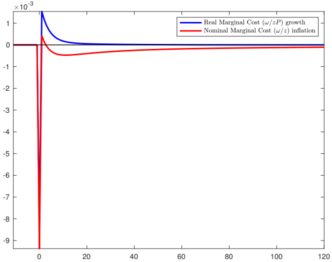


Impulse Response Functions: Positive TFP Shock

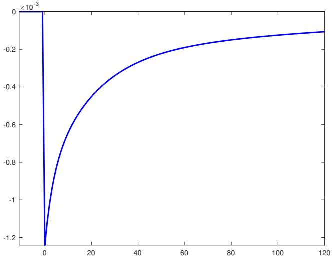
Service price growth



Marginal cost growth



Inflation



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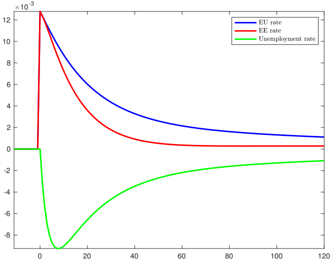


Propagation

- The model propagates TFP shocks a lot:

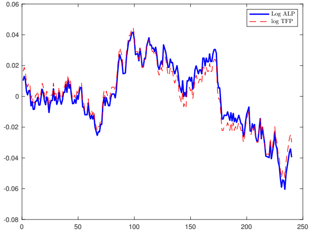
Half-life of...	log TFP	log ALP	log JFR	log u
	13.5	82.1	80.1	78.3

- OJS and the slow-moving Productivity Gap play a key part in this.
  - If we shut down OJS (so the Productivity Gap stays constant and plays no part):

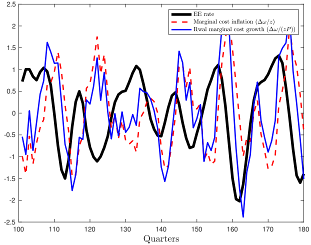
Half-life of...	log TFP	log ALP	log JFR	log u
	13.5	13.5	14.4	14.6

Time Series Simulation

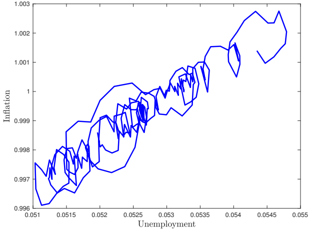
ALP and TFP



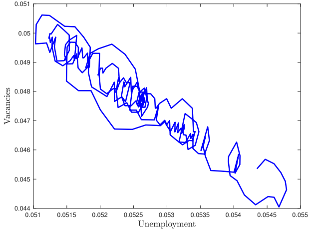
EE and marginal cost



Phillips curve



Beveridge curve



(data)

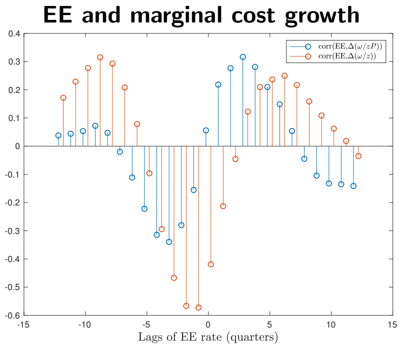
Amplification

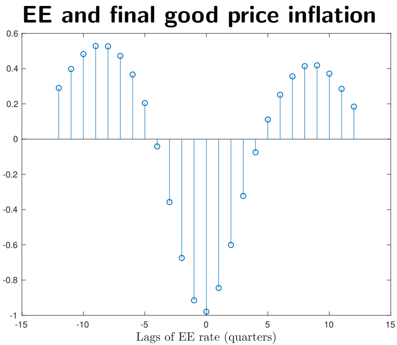
- This basic version of the model generates very little amplification of TFP/Monetary policy shocks:

$$\frac{\mathrm{StD}\left(\ln\theta\right)}{\mathrm{StD}\left(\ln \mathrm{ALP}\right)} = 0.81$$

- This is not surprising given the size of the surplus implied by dispersion in match quality y.
- There are easy fixes (Moscarini and Postel-Vinay, 2018).

EE, Marginal Cost and Inflation





(data)

Provisional Conclusions

- The EE rate contains statistical predictive power for growth in marginal costs, and for inflation, independently of the unemployment rate.
- Job creation, hence output and interest rates depend on (mis)allocation — not only on size — of employment.
  - Unemployment is just the bottom rung of a much higher ladder.
- We hope that our model will help us better understand the inflation/workforce allocation nexus, and eventually help design monetary policy.

Thank You!

- **Final good producers:**

$$\Pi_t^F = \max_{c_t(i), i \in [0,1]} P_t \left(\int_0^1 c_t(i)^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}} - \int_0^1 p_t(i) c_t(i) di$$

implying: $c_t(i) = Q_t \left(\frac{p_t(i)}{P_t} \right)^{-\eta}$ where $P_t = \left(\int_0^1 p_t(i)^{1-\eta} di \right)^{\frac{1}{1-\eta}}$

- **Intermediate good producers:**

$$\frac{\Pi_t^I(i)}{P_t} = \max_{p(i)} \mathbb{E}_t \sum_{\tau=0}^{+\infty} (1-\nu)^\tau D_t^{t+\tau} Q_{t+\tau} \left(\frac{p(i)}{P_{t+\tau}} \right)^{-\eta} \frac{p(i) - \omega_{t+\tau}/z_{t+\tau}}{P_{t+\tau}}.$$

implying the reset price: $p_t^* = \frac{\eta}{\eta-1} \frac{\mathbb{E}_t \sum_{\tau=0}^{+\infty} (1-\nu)^\tau D_t^{t+\tau} Q_{t+\tau} P_{t+\tau}^{\eta-1} \frac{\omega_{t+\tau}}{z_{t+\tau}}}{\mathbb{E}_t \sum_{\tau=0}^{+\infty} (1-\nu)^\tau D_t^{t+\tau} Q_{t+\tau} P_{t+\tau}^{\eta-1}}$

(back)

Link to the Literature

- The expected returns from an unemployed hire are

$$\mathcal{W}_t \mathbb{E}_\Gamma(y) - \frac{\beta b / U'(C_t)}{1-\beta(1-\delta)} = \mathbb{E}_t \left[\sum_{\tau=1}^{+\infty} (1-\delta)^{\tau-1} D_t^{t+\tau} \left(MPL_{t+\tau} - MRS_{t+\tau} \right) \right]$$

where:

$$MPL_{t+\tau} = \frac{\omega_{t+\tau}\mathbb{E}_\Gamma(y)}{P_{t+\tau}} \qquad \text{and} \qquad MRS_{t+\tau} = \frac{b}{U'(C_{t+\tau})}$$

Link to the Literature

$$MPL_{t+\tau} = \frac{\omega_{t+\tau}\mathbb{E}_{\Gamma}(y)}{P_{t+\tau}} \qquad \text{and} \qquad MRS_{t+\tau} = \frac{b}{U'(C_{t+\tau})}$$

- The Business Cycle accounting literature defines the **labor wedge** as the ratio MRS/MPL.
  - The labor wedge is procyclical and plays a key role for amplification.
- Estimated NK models define the **wage markup** as the ratio between the real wage and the MRS.
  - Changes in the wage markup are key to explain inflation and output dynamics.
  - Lacking a mechanism to generate endogenous changes in the wage mark-up, the literature attributes them to shocks, estimated to be procyclical.
  - In our model, the ratio of $\omega_{t+\tau}/P_{t+\tau}$ (the real cost of labor services) to the MRS is naturally interpreted as the wage markup.

Link to the Literature

- Thus, in our model the labor wedge is the reciprocal of the wage markup.
- If all markets were competitive:
  - both the labor wedge and the wage mark-up would be identically equal to one, with workers on their labor supply curve and firms on their labor demand curve.
- If the labor market were competitive but the intermediate good market were monopolistically competitive:
  - intermediate good producers would charge a constant mark-up over the marginal cost of labor
  - the labor wedge would be less than one and the wage mark-up larger than one, but both would be constant.
- With a frictional labor market:
  - the labor wedge is smaller than one and the wage mark-up is larger than one (to compensate for hiring costs)
  - crucially, **both are endogenous and time-varying**.

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More on wages

- The price of labor services, ω_t, is a natural (and easy) measure of labor costs.
- However, it does not equal the average wage (it incorporates an annuitized value of hiring costs).
- Under some additional assumptions, one can construct an explicit wage function:

$$\frac{w_t\left(y, y_n\right)}{P_t} = \frac{\omega_t}{P_t} y_n - s\phi(\theta_t)(1-\delta)\mathcal{W}_t \int_{y_n}^{y} \overline{\Gamma}(x)dx$$

  where y is current match quality and $y_n \leq y$ is the quality of the match last used as a bargaining threat.
- The average wage is then obtained by integration of $w_t\left(y, y_n\right)$ against the joint distribution of (y, y_n), the dynamics of which are derived from flow-balance equations.

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