Start-ups, Credit, and the Jobless Recovery

Immo Schott (EUI)

DNB Annual Research Conference
October 17th & 18th, 2013

motivation

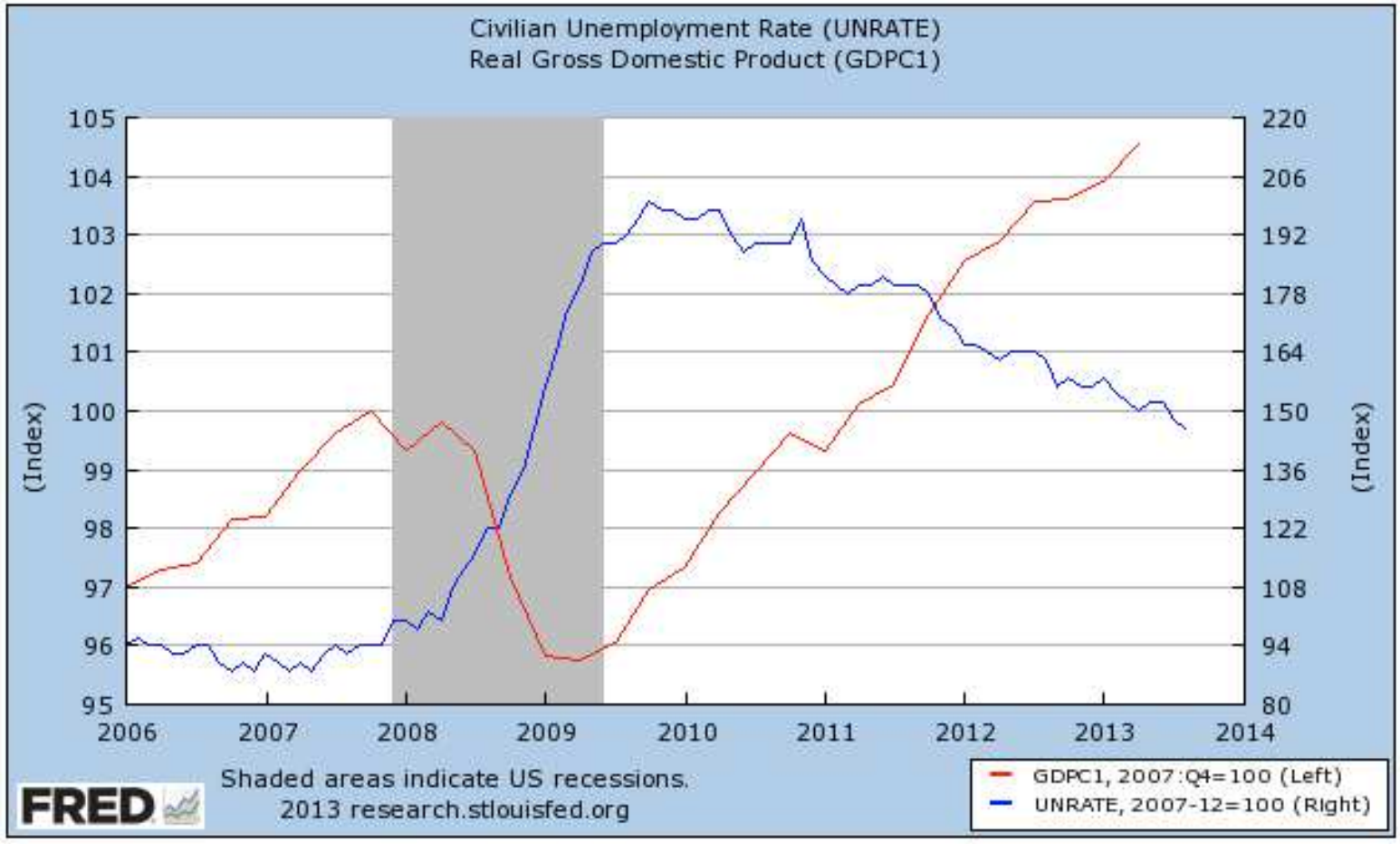

Figure : Jobless Recovery. Source: St.Louis FED, June 2013. past recessions

in this paper...

- Link **firm dynamics**, the **financial environment**, and **unemployment**
  - the 'jobless recovery' is largely the result of low job creation by start-ups.
  - low start-up job creation can be linked to a deterioration in their lending environment.
  - unprecedented fall in the value of real estate decreased collateral value to start a business.
- The model replicates several facts of the recovery
  - underproportional employment growth relative to GDP
  - increase and persistence in unemployment since 2006
  - start-up job creation begins to fall before the recession

a simple counterfactual

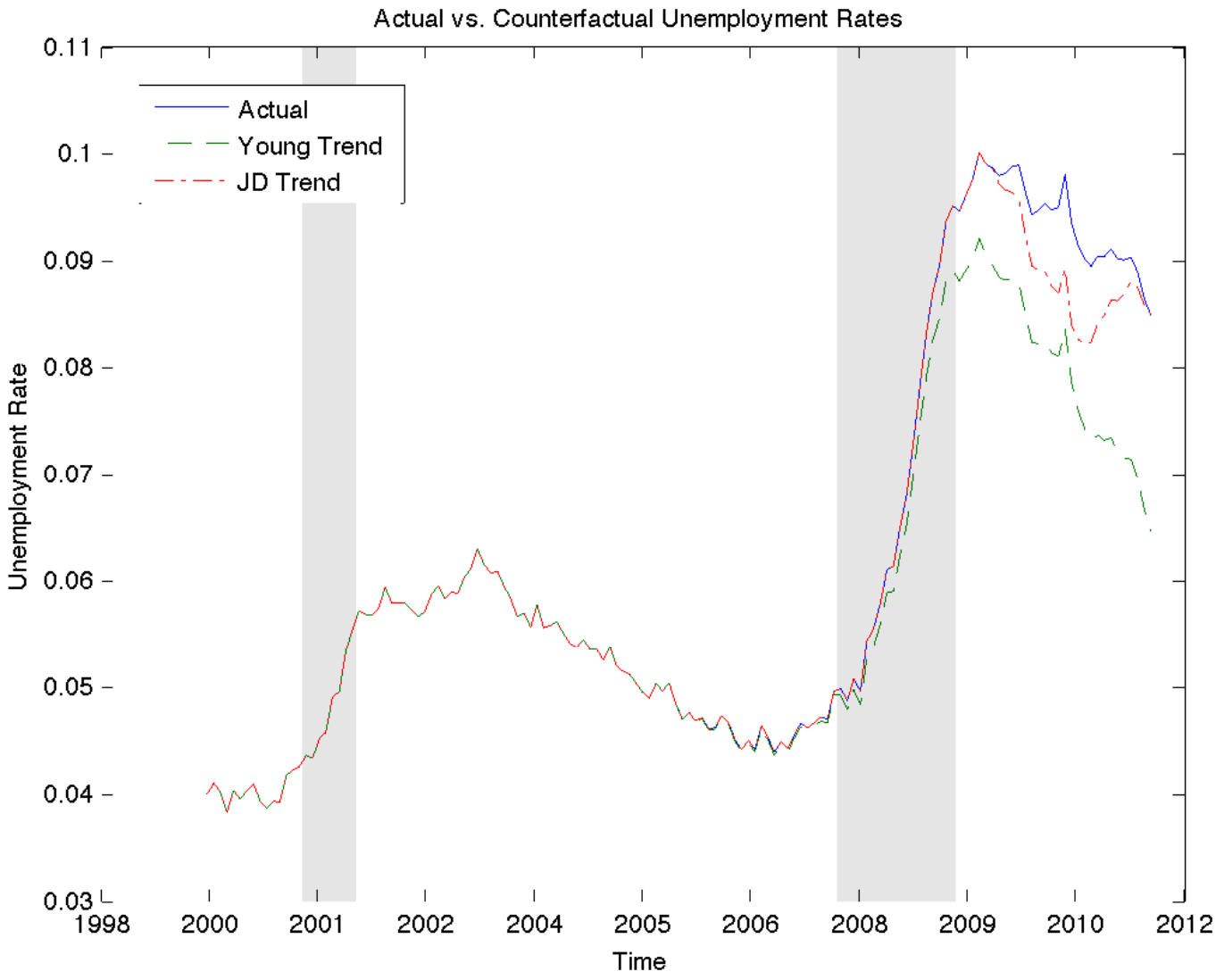

Figure : Actual vs. counterfactual UE. More: JC&JD, Inflows&Outflows

the importance of start-ups

- Start-ups are the engine of job creation in the US
  - they create about 3 Million jobs per year: more
- Yet since 2007 there has been a decline
  - JC by start-ups fell by 30%: more
  - Start-ups had the largest average decline in gross JC: more

start-up financing

- Start-ups rely heavily on external financing
- Personal savings or assets were used as collateral to initiate more than 70% of nascent businesses
  - Most important source of funding of entrepreneurs
  - See Avery et al (1998), Moon (2009), Duke/Board of Governors (2011)
- Significant effect of HPI on # of start-up on the state-level.
  - See HPI Regressions

outline

- Previous literature
- Model
- Results

this paper

- Heterogeneous firm paper which links real estate to entrepreneurship
  - Generates jobless recovery
  - Technology shocks alone only explain 1/2 of the increase in unemployment
- Mechanism generates a realistic amount of variability in entry rates
  - entry (& exit) propagate exogenous shocks
- Model matches
  - macro moments (unemployment, vacancies)
  - employment change distribution
  - age-employment distribution of firms

literature

- **Heterogeneous Firms & Financial Constraints**: Midrigan and Xu (2010), Khan and Thomas (2011), Siemer (2013)
- **Entry**: Haltiwanger et al (2010), Fort et al (2013); Clementi & Palazzo (2010), Sedlacek (2011), Coles & Kelishomi (2011), Lee & Mukoyama (2012)
- **Search w/ multi-worker plant**s: Cooper et al (2007), Kaas and Kirchner (2011), Schaal (2011), Elsby and Michaels (2013), Moscarini and Postel-Vinay (2013) and Acemoglu and Hawkins (2013)
- **Jobless Recovery**: Bachmann (2011), Berger (2012), Gali, Smets, Wouters (2012), Drautzburg (2013)
- **Real estate, collateral**: Chaney et al (2012), Liu et al (2013), Liu et al (2013b)

the model

- workers and entrepreneurs (in fixed mass), plus a competitive bank
- all agents own one unit of housing h. Its price it q^h.
  - workers: supply labor, and consume income
  - entrepreneurs: own firms, use labor input to produce homogeneous good
    - heterogeneous shocks to profitability
  - bank: provides start-up financing, is owned by all agents
- to hire divisible labor, firms must post vacancies $v \rightarrow$ filled with endogenous probability $H(U, V) = m/V$.
- firms make take-it-or-leave-it offer to workers

timing

- A period plays out like this:
  - aggregate state realizes
  - potential entrants enter until $Q^e(a, \theta) = \tilde{c}_e$
    - $\tilde{c}_e$ is borrowed from the bank
  - idiosyncratic shocks ε realize
  - firms decide on their employment level, production takes place
  - incumbent firms decide whether or not to exit
    - entrants can default on loans (exit)

workers

- Either unemployed or employed

$$W^u(a,h) = Z(b(a)+\pi^b)+\varphi(h)+\ldots$$

$$\beta E_{a'|a}[\phi(U,V)W^e(a',h)+(1-\phi(U,V))W^u(a',h)],$$

$$W^e(a,h) = Z(\omega(a)+\pi^b)+\varphi(h)+\beta E_{a'|a}[(1-\delta)W^e(a',h)+\delta W^u(a',h)]$$

entrepreneurs

- Production technology $F(e)$, with $F_e(e) > 0$ and $F_{ee}(e) < 0$
- State vector at time t is $s = (\varepsilon, e; a, \theta)$, where $\theta = \frac{V}{U}$ reflects labor market tightness
- Period profits are:

$$\pi(a, \varepsilon, e) = a\varepsilon F(e) - e \cdot w(a) - F - \mathbb{C}$$

- $\mathbb{C}$ includes fixed and variable adjustment costs to labor
  - discrete choice: hiring, firing, inaction Policy Function
- Incumbent entrepreneurs do not borrow funds

entrepreneur's labor choice

- The value $Q^c(s)$ of a continuing firm:

$$Q^c(s) = \max\{Q^v(s), Q^n(s), Q^f(s)\}$$

- Value of posting vacancies, given $\Delta e = H(U, V)v$

$$Q^v(s) = \max_v \pi(a, \epsilon, e) + \beta E_{\varepsilon', a'} \max\{Q^c(x', e'; \theta'), Q^x(0, e)\}$$

- Value of firing, given $\Delta e = -f$

$$Q^f(s) = \max_f \pi(a, \epsilon, e) + \beta E_{\varepsilon', a'} \max\{Q^c(x', e'; \theta'), Q^x(0, e)\}$$

- Value of inaction

$$Q^n(s) = \pi(a, \epsilon, e_{-1}) + \beta E_{\varepsilon', a'} \max\{Q^c(x', e'; \theta'), Q^x(0, e)\}$$

exit

- Value of exiting with employment e_{-1}

$$Q^x(a, e_{-1}) = 0 - F_f - C_f e_{-1} \leq 0.$$

- Exit whenever

$$E_{a',\epsilon'|a,\epsilon}\left[Q^c(a', \varepsilon', e_{-1}, \theta') - Q^x(a', e_{-1})\right] < 0.$$

Policy Function

entry

- Value of entry for ex-ante identical entrants given by

$$Q^e(a,\theta) \equiv \int_{\epsilon} Q^c(a,\varepsilon_{i,0},0,\theta)d\nu.$$

- Entry cost $\tilde{c}_e \equiv \tilde{R} \cdot c_e$. Consists of c_e and interest payments $\tilde{R}$
- Entrants borrow at intra-period non-default loan rate $\tilde{R}_t$ (defined next slide)
- Free entry requires

$$\tilde{c}_e = Q^e(a,\theta)$$

- Firms entering in period t have mass M_t

Proposition

There exists a unique value of M_t each period such that $\tilde{c}_e = Q^e(a,\theta)$

- *intuition: as $M_t \uparrow \implies \theta \uparrow$ and the value of entry falls*

start-up loans

- To pay the entry cost c_e new firms must obtain a loan from the bank.
- An entering entrepreneur may exit, hence walk from loan obligation.
- Use real estate h as collateral to secure part of the loan.

Proposition

The non-default interest rate $\hat{R}$ *is given by* $\hat{R} = \frac{c_e}{\int_{\bar{\varepsilon}^x}^{\infty} c_e \, d\nu}$. *The overall effective* interest rate $\tilde{R}$ is given by

$$\begin{cases} \tilde{R} = \frac{q^h}{c_e} + \frac{c_e - q^h}{\int_{\bar{\varepsilon}^x}^{\infty} c_e \, d\nu} & \text{if } q^h < c_e \\ \tilde{R} = 1 & \text{if } q^h \geq c_e \end{cases}$$

factors influencing $\tilde{R}$

Proposition

$\tilde{R}$ is weakly decreasing in q^h and a. $\tilde{R}$ is weakly increasing in θ.

- Intuition:
  - if $q^h \uparrow$ the collateralizable fraction of the loan increases
  - since $\frac{\partial \bar{\varepsilon}^x}{\partial a} \leq 0$ if $a \uparrow$ this implies $\int_{\bar{\varepsilon}_0}^{\infty} c_e d\nu \uparrow$ and $\hat{R} = \frac{c_e}{\int_{\bar{\varepsilon}_0}^{\infty} c_e d\nu} \downarrow$
  - since $\frac{\partial \bar{\varepsilon}^x}{\partial \theta} \geq 0$ if $\theta \uparrow$ this implies $\int_{\bar{\varepsilon}_0}^{\infty} c_e d\nu \downarrow$ and $\hat{R} = \frac{c_e}{\int_{\bar{\varepsilon}_0}^{\infty} c_e d\nu} \uparrow$

distribution of firms

- λ is the joint distribution over employment and profitability
- law of motion is $\lambda' = T(\lambda, M)$

$$\lambda'((e\ x)' \in E \times X) =$$
$$\int_{x \in x'} \int_{E \times X} (1 - \phi_x(x, e; \theta)) \times 1_{\{\phi_e(x,e;\theta) \in e'\}} \times F(dx'|x)\lambda(dex)$$
$$+ M \times \int_{x \in x'} \int_{0 \times X} \times 1_{\{\phi_e(x,0;\theta) \in e'\}} \times F(dx'|x)\nu(dx)$$

- This defines the operator T. For the case $x = \varepsilon$ a stationary distribution exists.

recursive equilibrium

- Given stochastic processes, λ_0 and $\lambda' = T(\lambda, M)$ a (boundedly rational) RE consists of
- *i)* value functions, *ii)* policy functions, *iii)* $\{w_t\}_{t=0}^{\infty}$, $\{\hat{R}_t\}_{t=0}^{\infty}$, $\{U_t\}_{t=0}^{\infty}$, $\{V_t\}_{t=0}^{\infty}$, $\{\lambda_t\}_{t=0}^{\infty}$, and $\{M_t\}_{t=0}^{\infty}$ s.t.
- *i)* and *ii)* solve the firm problem
- $\{w_t\}_{t=0}^{\infty}$ and $\{\hat{R}_t\}_{t=0}^{\infty}$ are determined through the worker's participation constraint and the bank's zero-profit condition
- measure of entrants M_t is determined by free-entry

approximate equilibrium

- Firms need θ in order compute the vacancy-filling rate

$$\theta' = H(a, a', \lambda)$$

- The aggregate variable θ is determined in equilibrium similar to Krusell, Smith (1998) .
- Prediction rule generates an $R^2 = 0.9994$ and a maximum forecast error of 0.005%

$$\log \theta_t = b_0 + b_1 \log \theta_{t-1} + b_2 \log A_t + b_3 \log A_{t-1} + b_4 \cdot I(A_t \neq A_{t-1})$$

stationary distribution

- without aggregate shocks, a stationary distribution λ^* exists
- constant mass of entrants, and a constant number of exiting firms each period

	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5
DATA	11.09%	8.54%	7.22%	6.29%	5.55%	4.97%
Model	11.86%	9.89%	8.83%	7.91%	7.07%	6.29%
	Age 6-10	Age 11-15	Age 16-20	Age 21-25	Age 26+	
DATA	18.67%	12.91%	9.42%	7.18%	8.16%	
Model	18.82%	13.59%	7.30%	3.91%	4.52%	

Table : Firm distribution by age. Census and I.

calibration 1/2

Calibrated Parameters	Symbol	Value	Target
Discount Factor	β	.9967	$r^{ann} = 4\%$
Curvature of profit function	α	.65	—
Autocorrelation of a	ρ_a	.958	HP-filtered Output 1970-2011
Standard deviation of ν_a	σ_a	.009	HP-filtered Output 1970-2011
Autocorrelation of q^h	ρ_q	0.9565	HPI 1975-2012
Standard deviation of ν_q	σ_q	.008	HPI 1975-2012
Matching elasticity	γ	.6	Literature
Match efficiency	μ	.5132	$\phi = 0.45, \theta = 0.7$
Sensitivity of outside option to a	b_1	0.5	Cooper et al (2007)

calibration 2/2

- The adjustment costs, ρ_ϵ, σ_ϵ, and c_o are estimated via SMM
- The targets are derived from the employment change distribution
- I calibrate= c_o through the average firm size of 21.43
- details in the paper

results

	σ_U	ρ_U	σ_V	ρ_V	$\rho_{U,V}$	σ_θ	ρ_θ	$\rho(Y, M^E)$
US Data	0.13	0.948	0.16	0.93	-0.896	0.316	0.94	0.09
Benchmark Model	0.13	0.996	0.17	0.91	-0.86	0.303	0.943	0.09
No Financial Friction	0.17	0.995	0.198	0.95	-0.94	0.359	0.984	0.15
No Shocks to a	0.02	0.99	0.02	0.90	-0.89	0.03	0.97	0.07

Table : Data and Model Moments. Source: FRED, FHFA, and BLS.

Shock to *a*

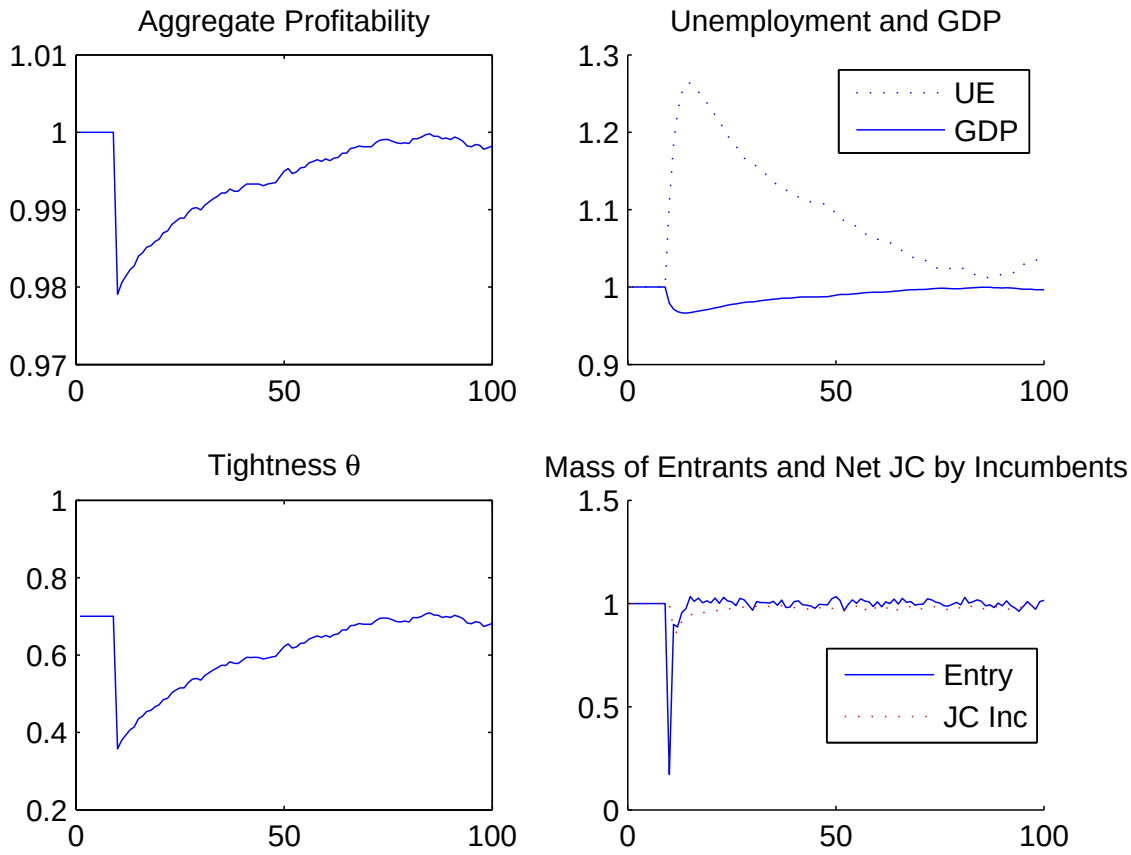

Figure : Impulse Response Functions for a shock to *a*. Simulation results from 1'000 repetitions of 200 periods.

Shock to q^h

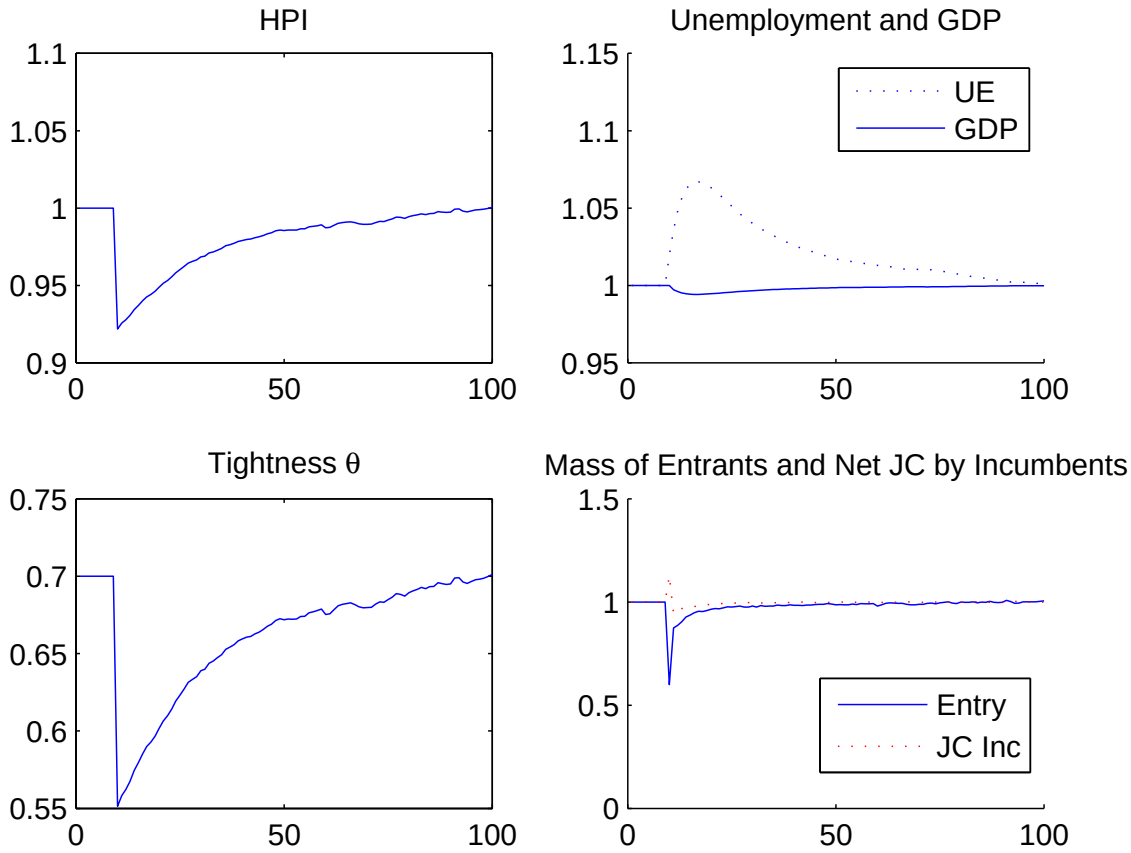

Figure : Impulse Response Functions for a shock to q^h. Shock to both

policy experiment

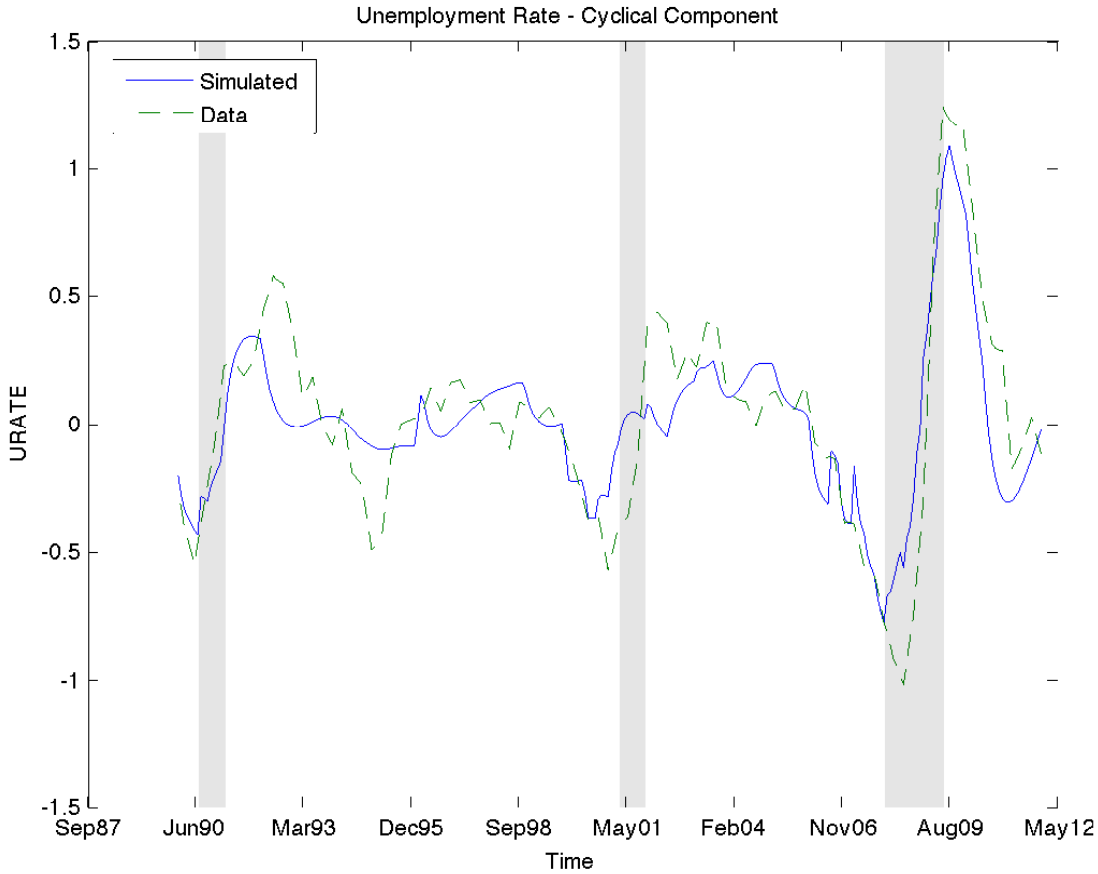

Figure : Cyclical component of the unemployment rate. Data vs. simulation using estimated processes for a and q^h 1990 - 2011. Shaded areas are NBER recession dates.

policy experiment - results

- Recovery is 'jobless' because of the ongoing negative influence of the low HPI on start-up job creation.
- Start-up job creation decreases prior to the beginning of the recession, as in the data
- Incumbents' job creation begins to recover before job creation by start-ups
  - This is the effect of a low θ
- Same experiment with shocks only to q^h
  - does not generate enough variation in U more
- Same experiment with shocks only to a
  - does not generate enough persistence more

conclusion

- Severe recession with a jobless recovery
- Accompanied by unprecedented fall in the value of real estate
  - I claim that these two facts are related
  - idea: start-ups require external financing, for which real estate is used as collateral
  - value of collateral falls, start-up costs increase, # of new firms declines
- The model can
  - explain important factor for jobless recovery
  - generate realistic amount of variability in entry rates

thanks...

UR during recessions

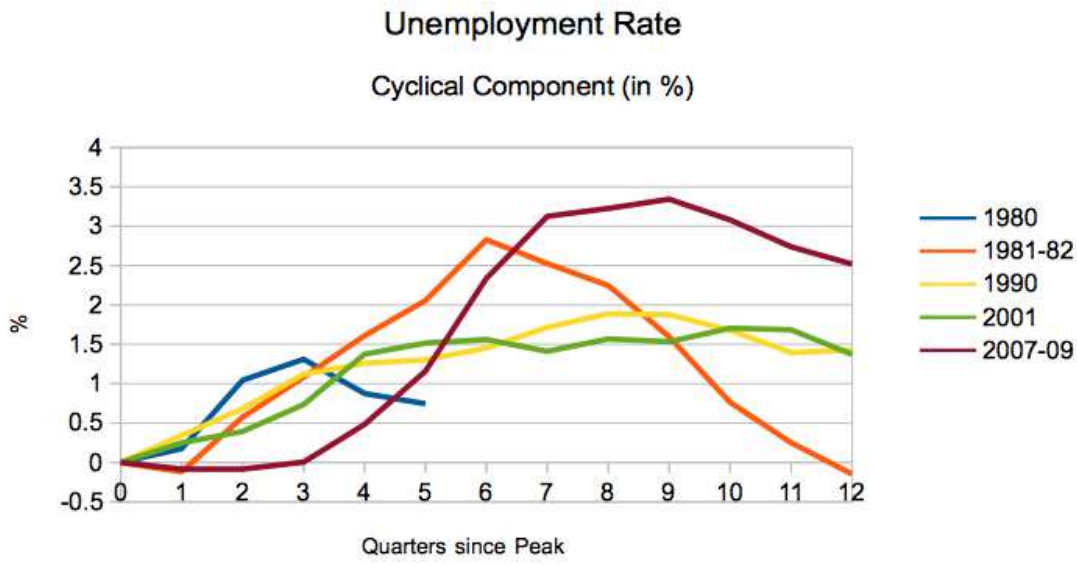

Figure : Recessions and Recoveries. Source: St.Louis FED, June 2013

back

the importance of start-ups

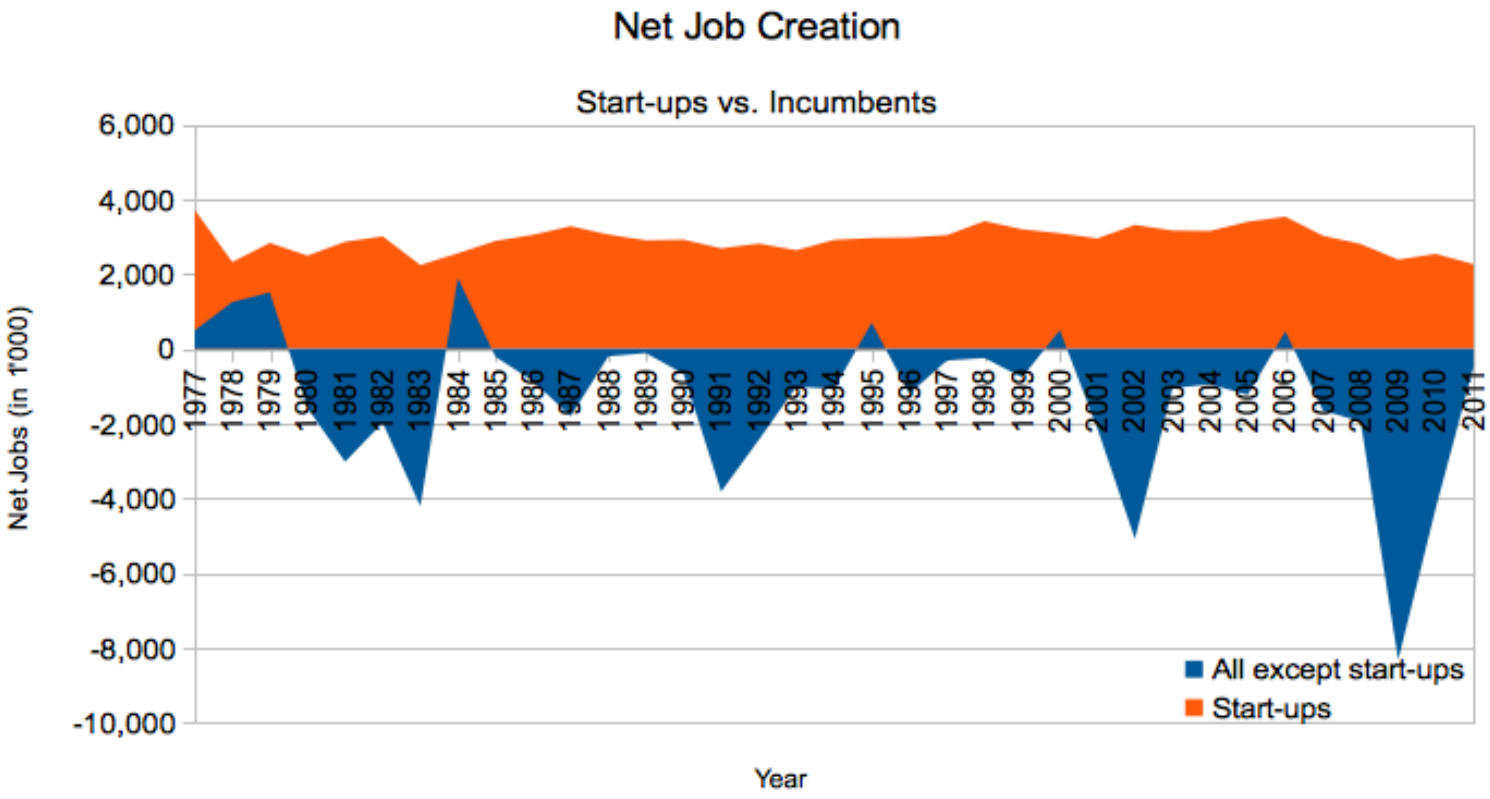

Figure : Net job creation by start-ups vs. incumbents. Source: Census, Longitudinal Business Database back

start-up JC during recessions

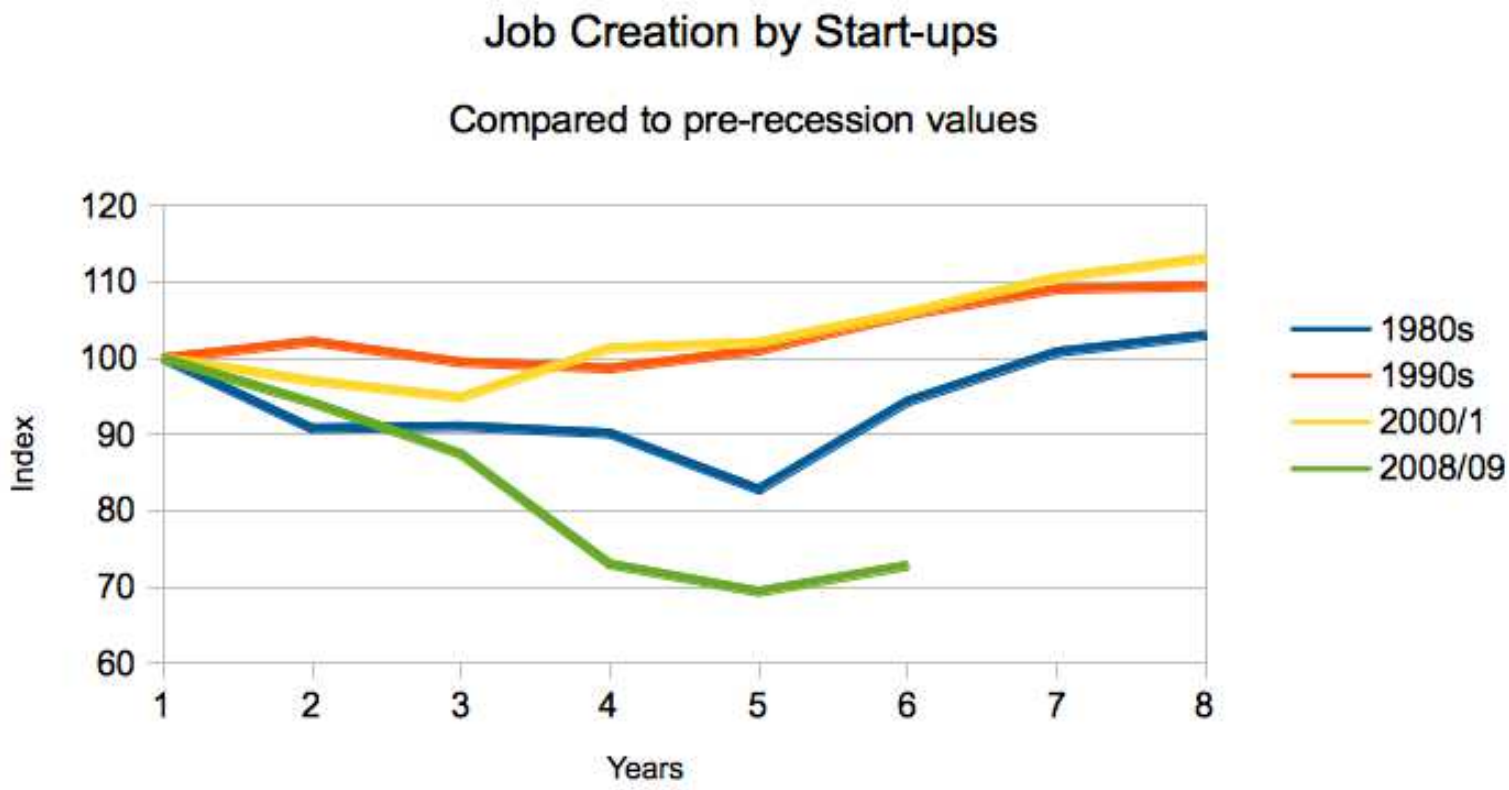

Figure : Job Creation by Startups during Recessions. Source: Census BDS back

HPI

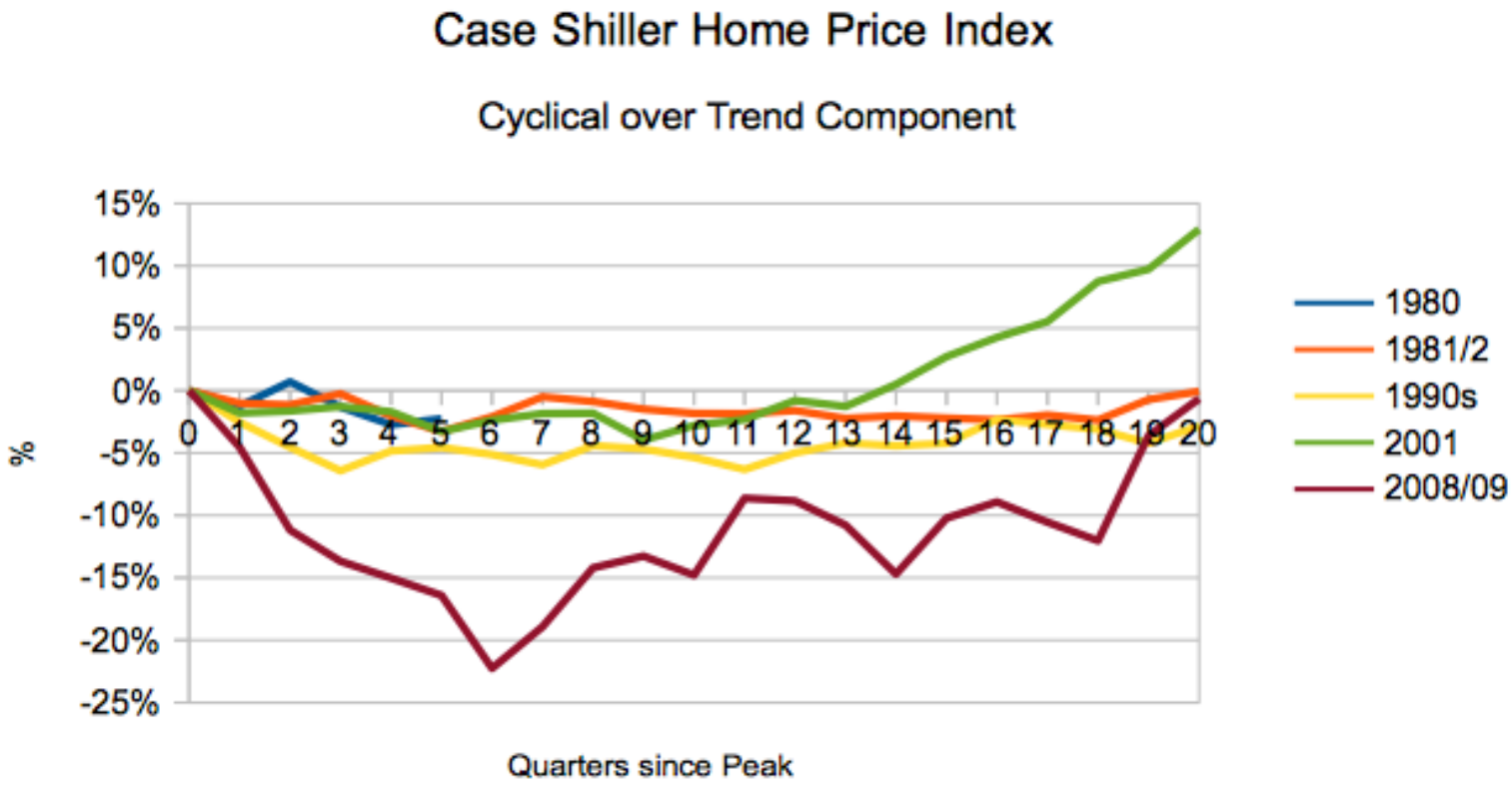

Figure : Cash Shiller Home Price Index. HP-filter $\lambda = 1600$. The x-axis shows quarters since the respective pre-recession quarter (based on NBER classification). Inflation-adjusted, not seasonally adjusted. Source: Standard&Poor's. Own computations back

State-level regressions

Table 3: Descriptive Regressions at the state level

	(1)	(2)	(3)	(4)
hpi	11.9366*	9.4346*	10.2039*	8.7394*
	(2.32)	(2.36)	(2.04)	(2.14)
pi		0.0153***		0.0149***
		(13.98)		(14.67)
ue			-87.2835*	-38.4972
			(-2.58)	(-1.13)
_cons	-50.4743	96.9491***	-48.6150	-50.1817
	(-1.87)	(5.27)	(-0.62)	(-0.69)
N	3276	3276	3276	3276
r2	0.0567	0.0775	0.0590	0.0779

Dependent variable: Establishment Birth. t statistics in parentheses. All series are quarterly and have been HP-filtered with $\lambda = 1600$. Source: BLS, FHFA, BEA. All regression include year- and state dummies. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

back

JC vs JD

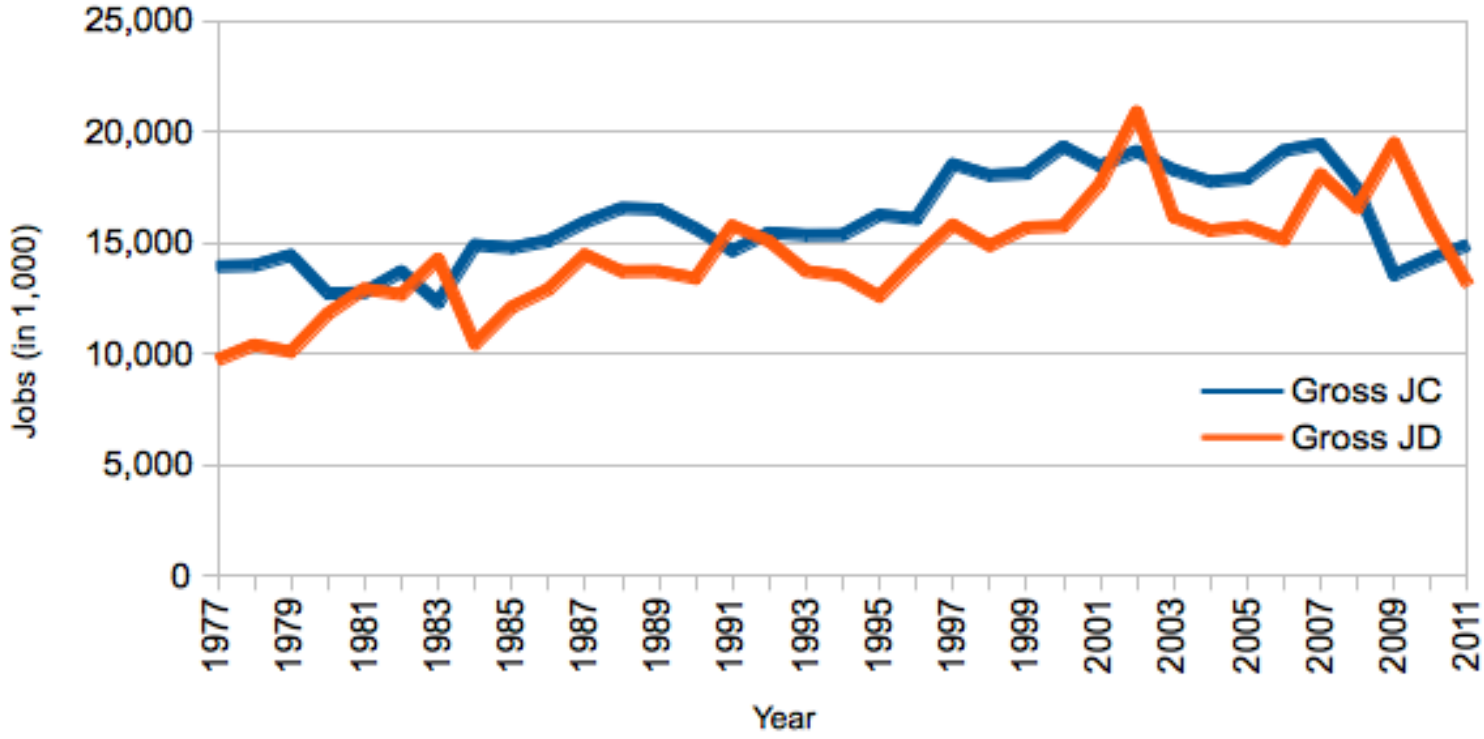

Figure : Gross job creation and destruction 1977-2011. Source: Census, BDS . back

JC vs JD (2)

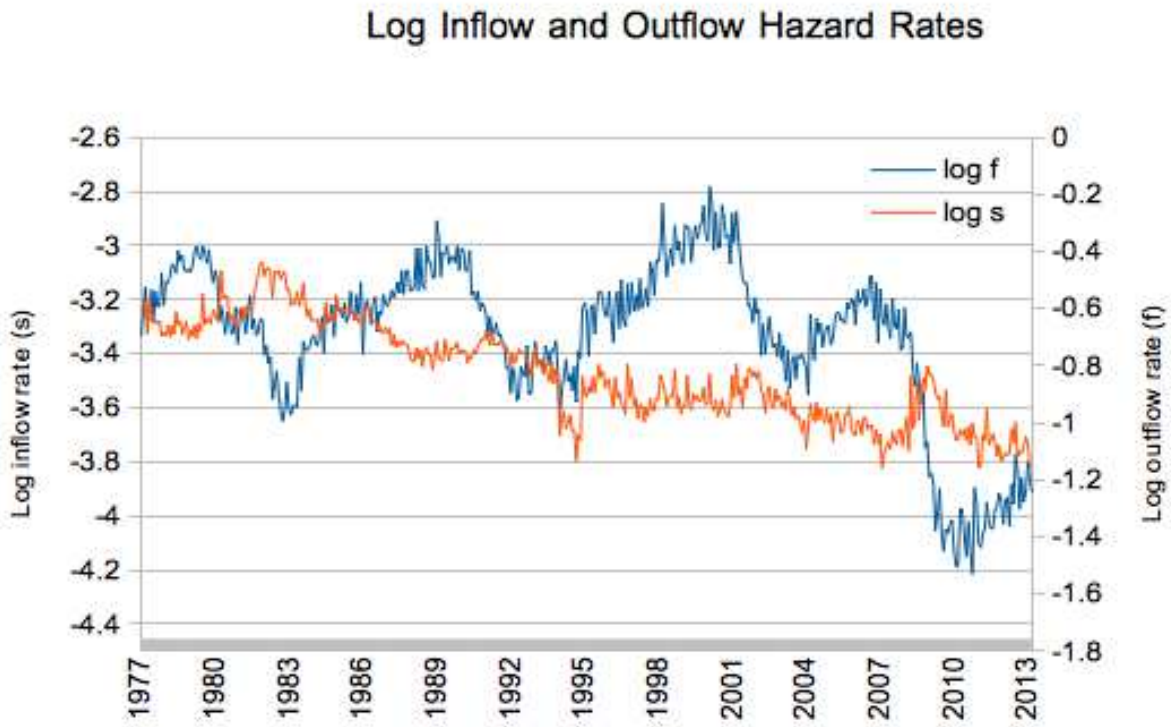

Figure : Log inflow hazard rate s (orange, left scale) and log outflow hazard rate f (blue, right scale). Source: BLS, CPS, own computations. $u^*/l_t = \frac{s_t}{s_t+f_t}$ yields $d\log\tilde{u}_t \approx (1-\tilde{u}_t)[d\log s_t - d\log f_t]$ as in Elsby et al (2009) back

JC by Firm Age

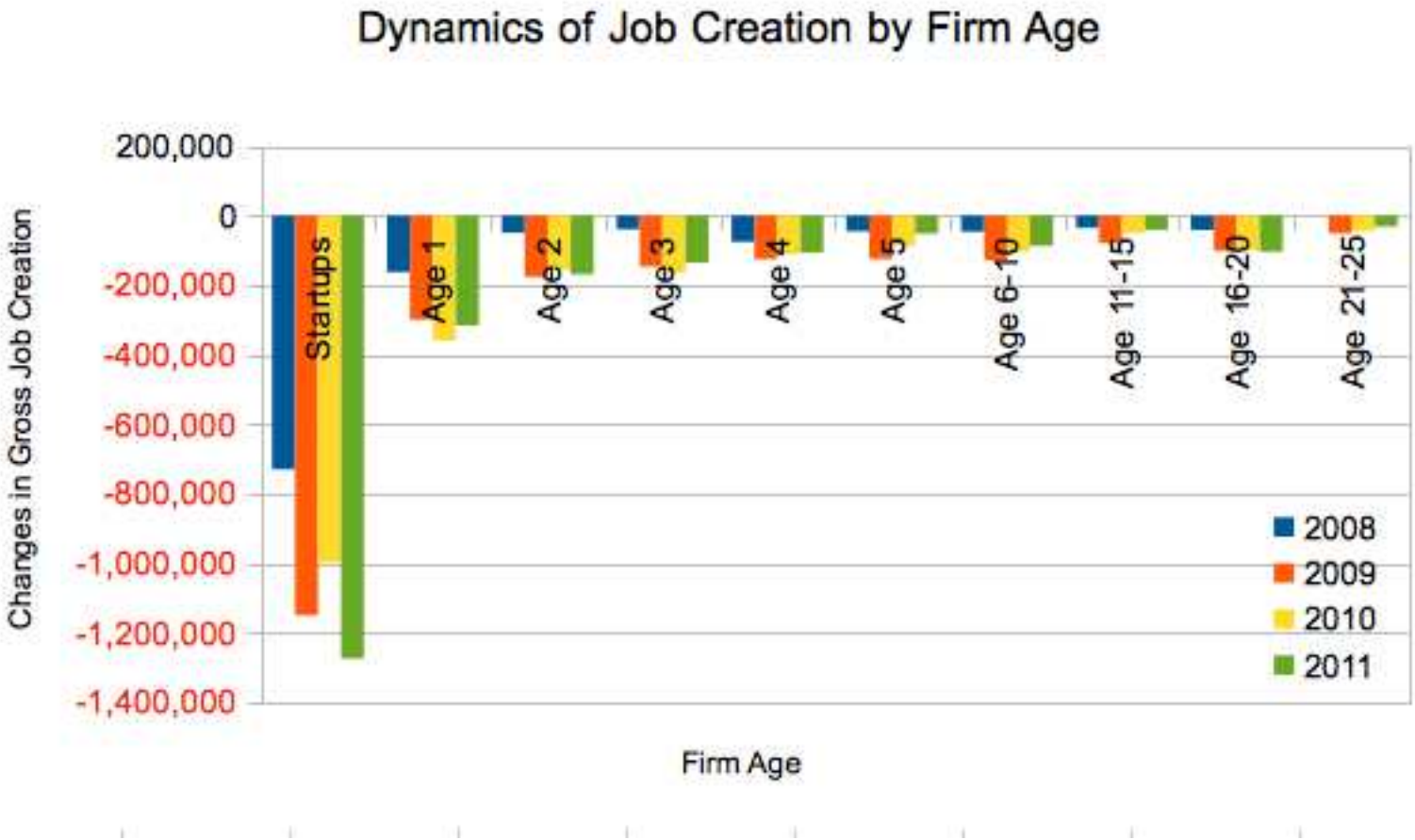

Figure : Changes in gross job creation relative to base year 2007. For aggregated age groups averages are shown. Source: BLS, Business Employment Dynamics, own computations. back

Employment Policy Function

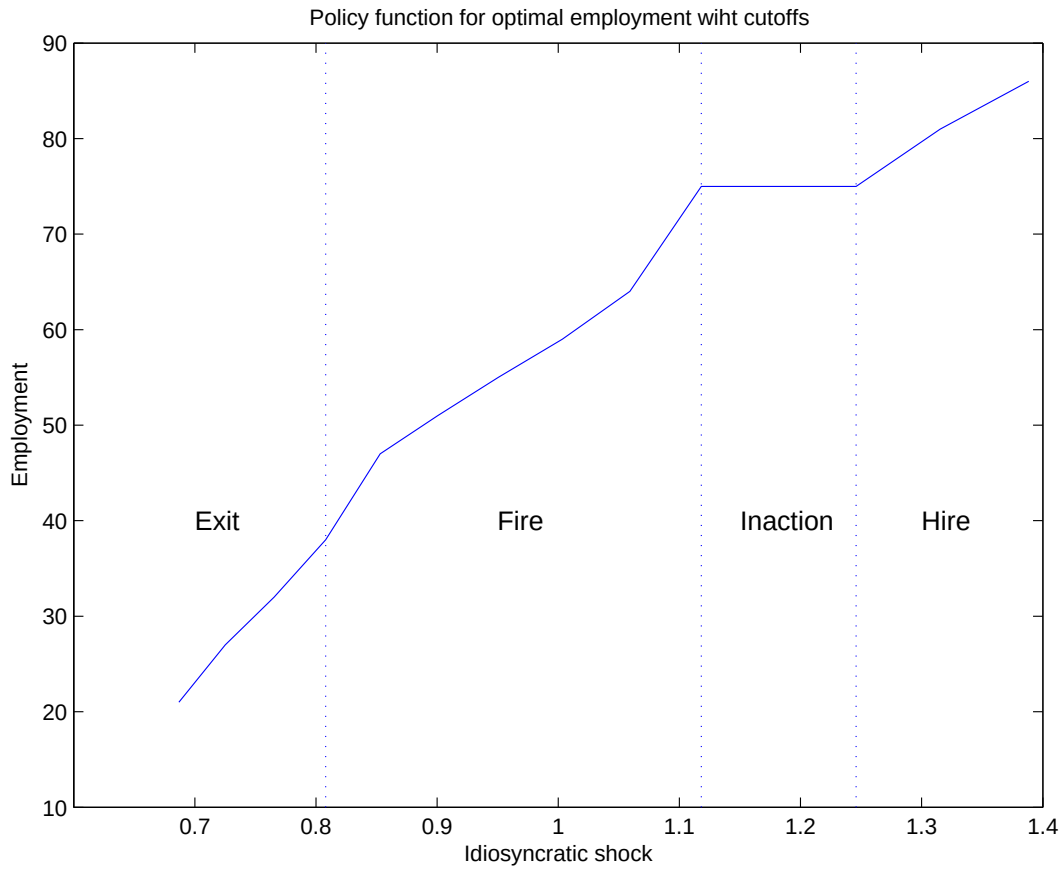

Figure : Target Employment as a function of ε given θ, a, e back

Equilibrium ctd...

- *i)* value functions $Q(s)$ and $Q^e(a, \theta)$, *ii)* policy functions for employment and exit, and *iii)* bounded sequences of non-negative negotiated wages $\{w_t\}_{t=0}^{\infty}$ and interest rates $\{\hat{R}_t\}_{t=0}^{\infty}$, unemployment $\{U_t\}_{t=0}^{\infty}$, vacancies $\{V_t\}_{t=0}^{\infty}$, incumbent measures $\{\lambda_t\}_{t=0}^{\infty}$ and entrant measures $\{M_t\}_{t=0}^{\infty}$ such that
- *i)* and *ii)* solve the firm problem subject to the worker's participation constraint
- $\{\hat{R}_t\}_{t=0}^{\infty}$ is given by the bank's zero-profit condition
- labor market tightness is determined vacancies and unemployment
- measure of entrants given by free-entry condition
- exogenous shocks move according to their LOMs.

back

Policy Experiment 2

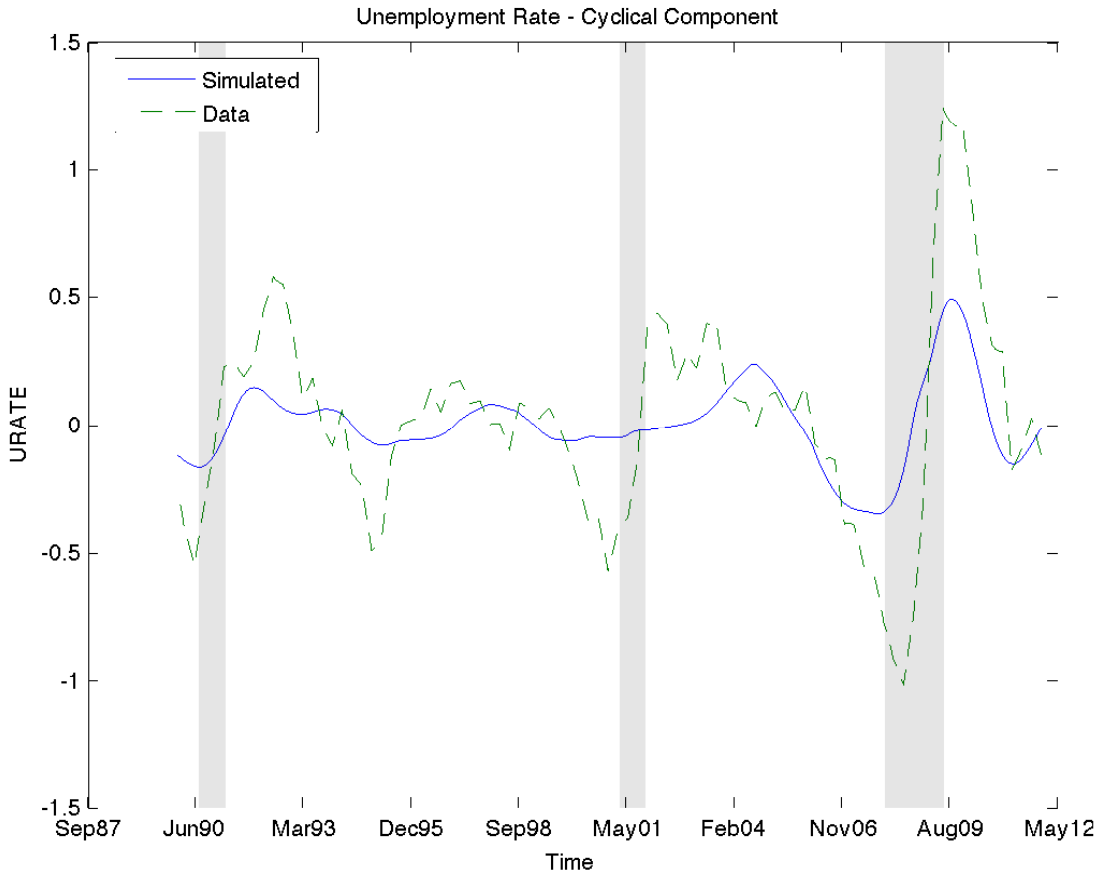

Figure : Cyclical component of the unemployment rate. Data vs. simulation using estimated processes only for q^h between 1990 and 2011. Shaded areas correspond to NBER recession dates. back

Policy Experiment 3

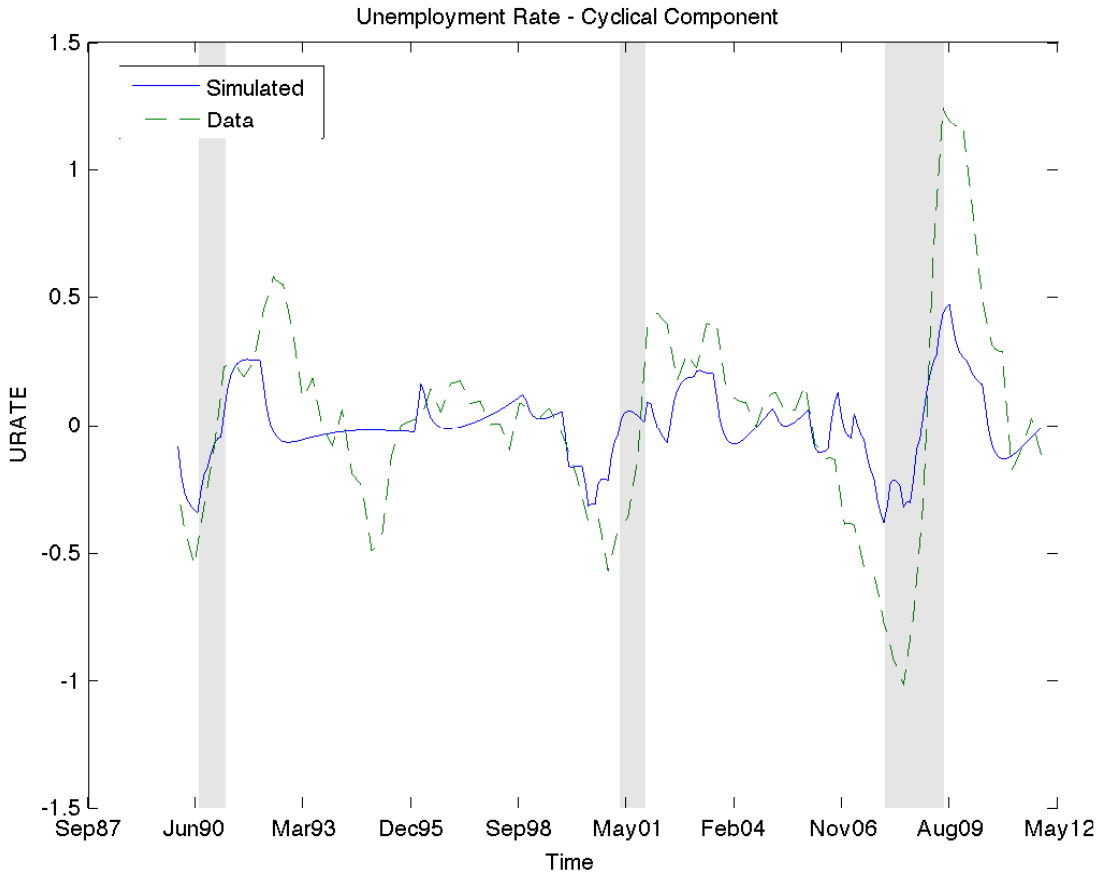

Figure : Cyclical component of the unemployment rate. Data vs. simulation using estimated processes only for *a* between 1990 and 2011. Shaded areas correspond to NBER recession dates. back

Impulse Response for a and q^h

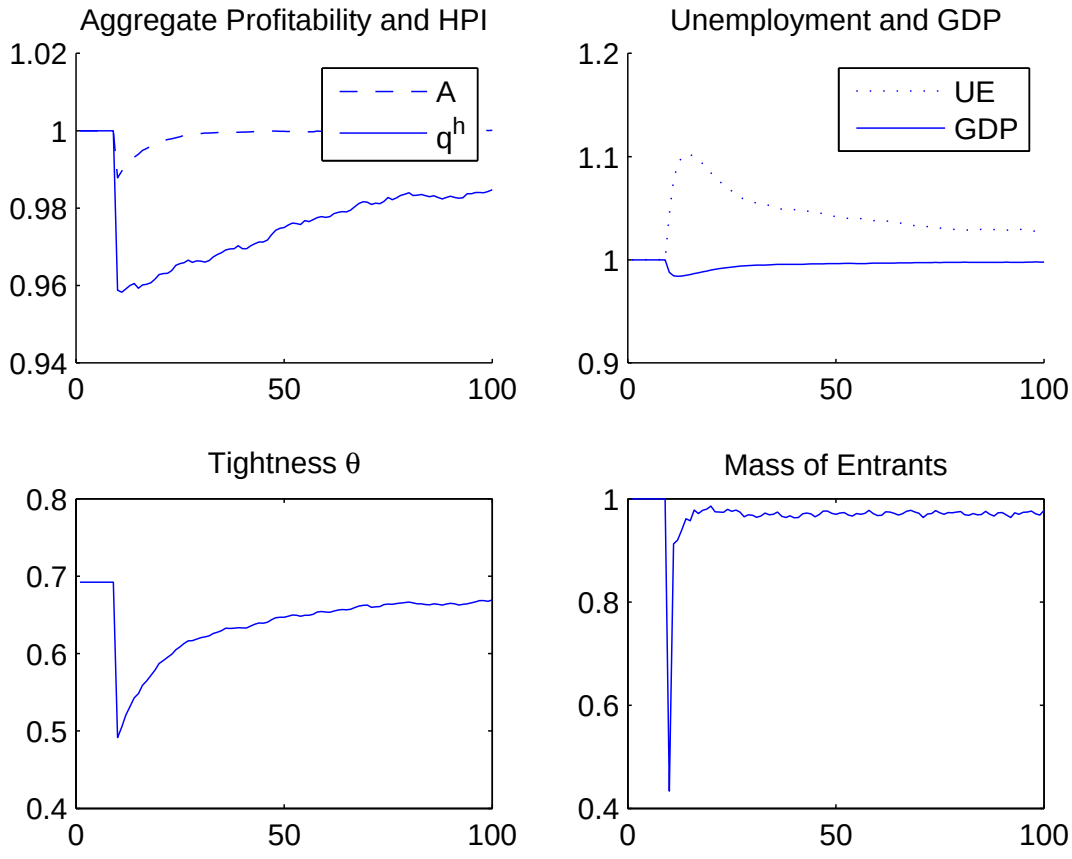

Figure : Impulse Response Functions for a shock to a and q^h. back