Payroll Taxes, Social Insurance and Business Cycles

Michael Burda
Humboldt-Universität zu Berlin

Mark Weder
University of Adelaide

SFB-Klausurtagung, 3 Juni 2010

SFB 649 ÖKONOMISCHES RISIKO

Overview

- Introduction
- The importance of payroll taxes
- A dynamic model with a social system fully-funded by payroll taxes, when there is “misclassification” of some workers as eligible for unemployment benefits
- Model derivation, calibration
- Results: Impulse responses, simulations
- Progress on the Hall-Shimer puzzle?
- Conclusion

Preview of Results

- Payroll tax rates exhibit countercyclical behavior in several but not all OECD economies.
- A self-financing social safety net (search contingent UI plus social welfare for non-search) introduces significant endogenous propagation and better matches the data in simulations.
- A new alternative explanation of the Hall-Shimer puzzle which complements and could possibly substitute for others.

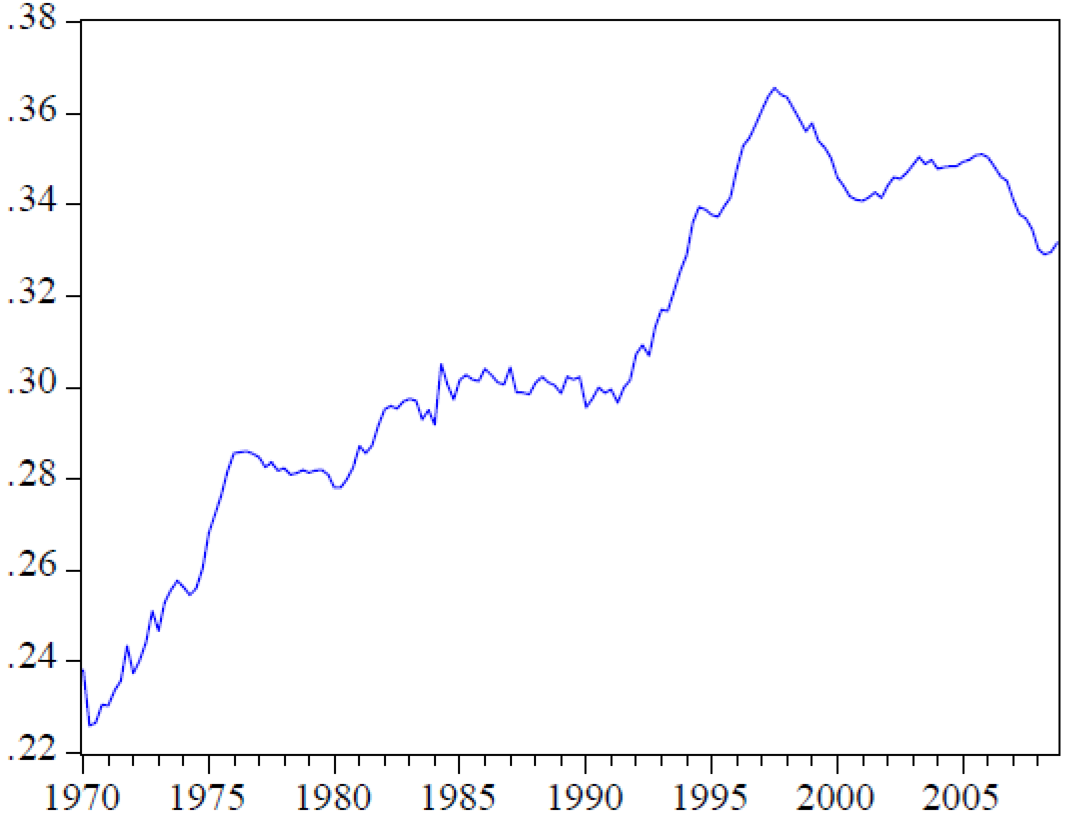
Labor facts about payroll taxes

- Payroll taxes are significant (US≈12%, S and D≈32%, DK ≈17%)
- In some OECD countries they are *countercyclical*
- Define the payroll tax rate τ as total payroll taxes paid divided by total labor compensation.
- Data: OECD Main Economic Indicators and Labor market, quarterly, 1971:1-2009:4

Table 1: Payroll taxes in select OECD countries					
Country	Ratio of payroll taxes to wage bill		Correlation of payroll tax with GDP*		
	1970-89	1990-08	1970:1-89:4	1990:1-08:4	1970:1-08:4
US	0.097	0.120	0.226	-0.276	0.147
Germany	0.278	0.337	-0.484	-0.558	-0.514
Netherlands	0.291	0.293	-0.132	-0.026	-0.098
UK	0.229	0.260	0.115	0.041	0.096
Sweden	0.246	0.319	-0.417	0.358	0.087
France	0.366	0.410	-0.039	-0.387	-0.233
Japan	0.167	0.240	-0.389	-0.096	-0.262
Canada	0.055	0.091	-0.267	-0.066	-0.206
Finland	0.143	0.166	-0.532	-0.475	-0.472

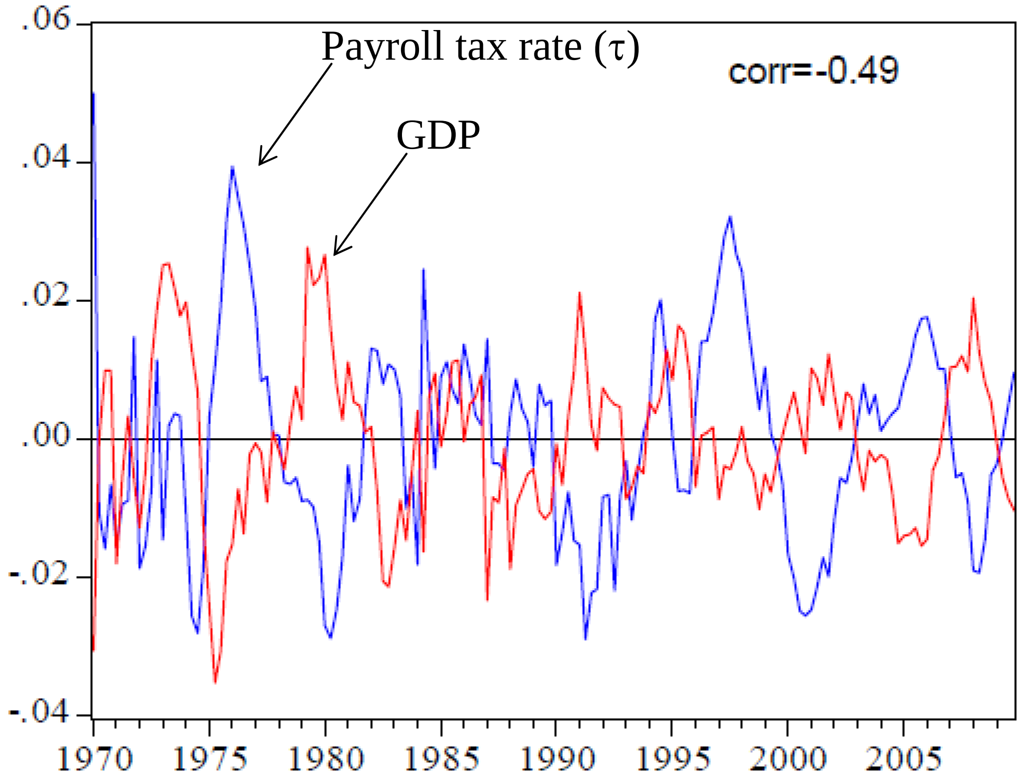
Source: OECD, authors' calculations based on quarterly seasonally unadjusted data
*Real GDP and tax rates are HP-filtered with smoothing parameter λ=1600.

Payroll taxation as a fraction of wage bill, Germany (τ)



Source: OECD, authors‘ calculations

Cyclical behavior of τ, Germany

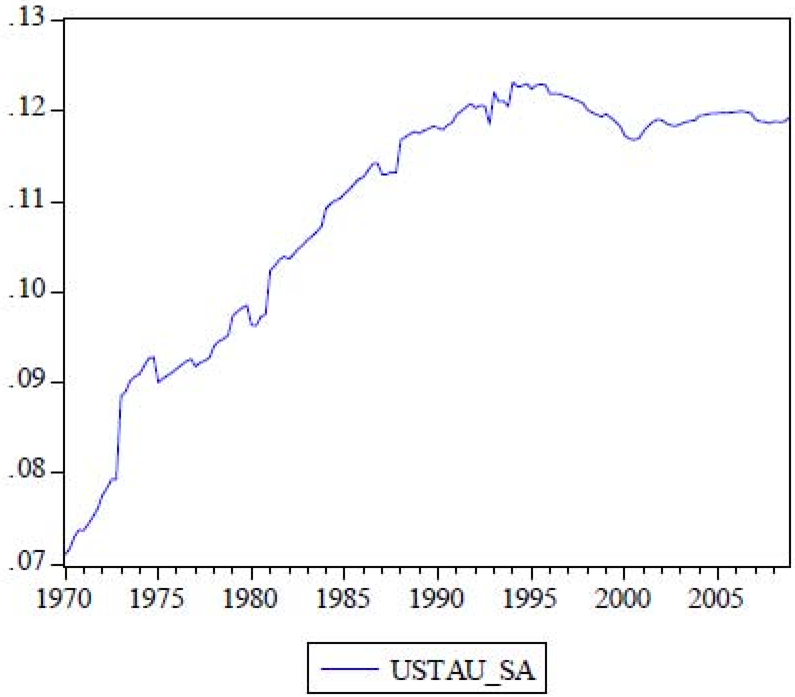


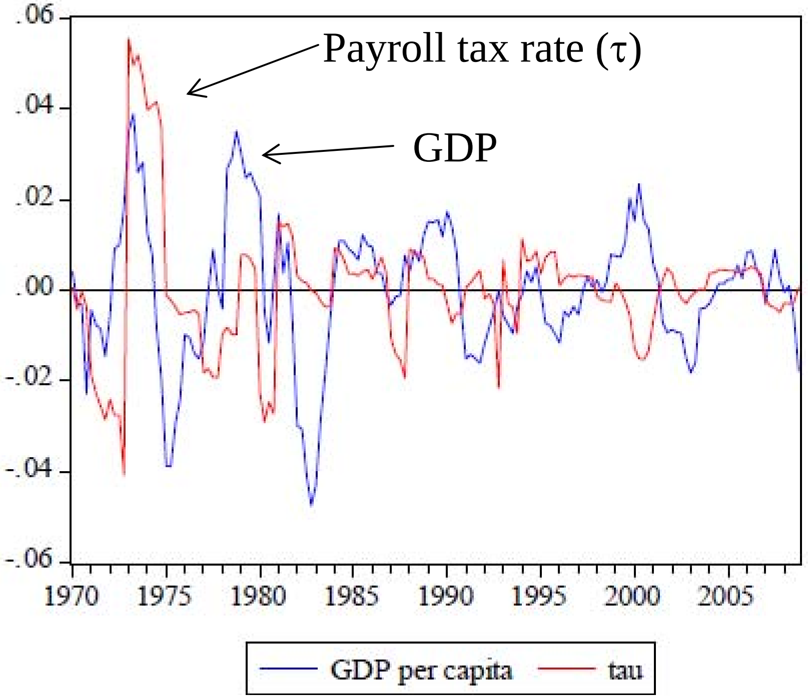
Source: OECD, authors‘ calculations. Data are HP-detrended (λ=1600)

SFB 649 ÖKONOMISCHES RISIKO

HUMBOLDT-UNIVERSITÄT ZU BERLIN

Cyclical behavior of τ, US





Source: OECD, authors' calculations. Data in right panel are HP-detrended (λ=1600)

US (HP)				
	1970-08	1980-08	1985-08	1990-08
$\rho(\tau, y)$	0.18	−0.17	−0.36	−0.51

Puzzles

Hall-Shimer Puzzle

TABLE 1—SUMMARY STATISTICS, QUARTERLY U.S. DATA, 1951–2003

		u	v	v/u	f	s	p
Standard deviation		0.190	0.202	0.382	0.118	0.075	0.020
Quarterly autocorrelation		0.936	0.940	0.941	0.908	0.733	0.878
Correlation matrix	u	1	−0.894	−0.971	−0.949	0.709	−0.408
	v	—	1	0.975	0.897	−0.684	0.364
	v/u	—	—	1	0.948	−0.715	0.396
	f	—	—	—	1	−0.574	0.396
	s	—	—	—	—	1	−0.524
	p	—	—	—	—	—	1

Source: Shimer (2005). Statistics refer to HP-detrended data (λ=100000)

Persistence

Beveridge curve

Why a model with labor market frictions?

- Gross worker flows are large and can easily exceed net flows by a factor of 20 or more.
- Average unemployment durations are significant (6-12 weeks) and long durations even more so.
- Vacancies (*v*), unemployment (*u*), and "tightness" of labor markets ($\theta = v/u$)) are much more volatile than output or labor productivity.
- Yet there is a strong negative correlation between HP-detrended *v* and *u* (Beveridge curve).

Model: Search Labor Market

- Representative household of identical workers of mass 1.
- Workers can work h_t, search s_t, enjoy leisure $1 - h_t - s_t$
- No-job to-job transitions, matches break up at rate δ^h
- Labor market, matching process joins mass of searching workers s_t with stock of available vacancies s_t
  - Matching:

$$q_t = \frac{M(s_t, v_t)}{v_t} = M(\frac{s_t}{v_t}, 1) = \frac{M(1, \theta_t^{-1})}{\theta_t} = \frac{f_t}{\theta_t}.$$

  - Matching probabilities: $q(\theta_t)$ with $q'(\theta_t)<0$; $f(\theta_t)$ with $f'(\theta_t)>0$
  - Transition equation for employment:

$$_{+1} = v_t q_t + (1 - \delta^h)h_t = s_t f_t + (1 - \delta^h)h_t$$

Model: Social Insurance

- Fully funded social system
  - Unemployment benefits b
  - Social welfare payments ε
  - Labor payroll taxation at τ_t is set period-by-period so that the government budget constraint holds:

$$bs_t + \varepsilon b(1 - s_t - h_t) = \tau_t w_t h_t.$$

- Interpretation: Searchers are paid b, while those enjoying leisure are paid εb, so ε is misclassification rate or measure of generosity of overall welfare system.

Model: Households

- Households choose sequences of consumption $\{c_t\}$, search time $\{s_t\}$, capital utilization $\{u_t\}$, capital depreciation $\{\delta^k_t\}$, employment $\{h_{t+1}\}$, and capital stock $\{k_{t+1}\}$ to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t + A \frac{(1 - s_t - h_t)^{1+\chi}}{1+\chi} \right]$$

- subject to

$$k_{t+1} + c_t = (1 - \tau_t) w_t h_t + (1 + u_t r_t - \delta^k_t) k_t + b s_t + \epsilon b (1 - s_t - h_t)$$

$$h_{t+1} = s_t f_t + (1 - \delta^h) h_t$$

$$\delta^k_t = \frac{1}{\theta} u^\theta_t$$

- Taking k_0 and h_0, wages $\{w_t\}$ capital rental rates $\{r_t\}$ and job finding rates $\{f_t\}$ as given.

Model: Households

- Recast the household's recursive problem in Bellman equation form where $V(h, k)$ is the value function:

$$V(h_t, k_t) = \max_{\{c_t, s_t, u_t, h_{t+1}, k_{t+1}\}} \left[\ln c_t + A \frac{(1 - s_t - h_t)^{1+\chi}}{1+\chi} + \beta E_t V(h_{t+1}, k_{t+1}) \right]$$

- subject to

$$k_{t+1} + c_t = (1 - \tau_t) w_t h_t + (1 + u_t r_t - \delta_t^k) k_t + b s_t + \epsilon b (1 - s_t - h_t)$$

$$h_{t+1} = s_t f_t + (1 - \delta^h) h_t$$

$$\delta_t^k = \frac{1}{\theta} u_t^\theta$$

- given k_0 and h_0, wages $\{w_t\}$ capital rental rates $\{r_t\}$ and job finding rates $\{f_t\}$.
- Let λ_t be the Lagrange multiplier at optimum.

Model: Firms

- Firms are owned by the household, and produce a single output with a constant returns technology:

$$y_t = z_t \kappa_t^{\alpha} h_t^{1-\alpha}$$

  where $\kappa_t \equiv u_t k_t$ are capital services used in production, hired at rate r_t.
- Technology z_t follows a trend-stationary autoregressive process in the natural logarithm (in particular, AR(1)).
- Firms post vacancies v_t today at cost av_t to set employment tomorrow h_{t+1} via the employment transition equation, taking the vacancy matching rate q_t as given

Model: Firms

- Firms choose sequences of capital services $\{\kappa_t\}$, vacancies $\{v_t\}$, and employment $\{h_{t+1}\}$, to maximize expected discounted present value of periodic profits $\Pi_t = z_t \kappa_t^{\alpha} h_t^{1-\alpha} - w_t h_t - r_t \kappa_t - a v_t$
- Formally in each period the representative firm's behavior is characterized by the following Bellman equation in $W(h)$:

$$W(h_t) = \max_{\{\kappa_t, v_t, h_{t+1}\}} \Pi_t + E_t\left[\rho_{t+1} W(h_{t+1})\right]$$

-using the stochastic marginal rate of substitution as discount factor $\rho_{t+1} = \beta \lambda_{t+1} / \lambda_t$

-given h_t, the sequence of job finding rates $\{f_t\}$ and subject to the employment transition equation for firm

SFB 649 ÖKONOMISCHES RISIKO

HUMBOLDT-UNIVERSITÄT ZU BERLIN

Model: Wage Determination

- Define the wage w_t as the *gross* payment by firms per worker for labor
- Period by period, the wage splits match surplus between employer and employee
- Assume Nash bargaining, with worker bargaining power given by $\mu \in [0,1]$. The wage solves

$$\max_{w_t} \left[\lambda_t^{-1} V_{h_t}\right]^{\mu} \left[W_{h_t}\right]^{1-\mu}$$

where V_h and W_h are the partial derivatives of the value function with respect to employment. This incorporates the fact that the fallbacks $V_s(h)=W_v(h)=0$.

SFB 649 ÖKONOMISCHES RISIKO

HUMBOLDT-UNIVERSITÄT ZU BERLIN

Equilibrium

- An equilibrium is defined as:

  - a set of sequences of wages $\{w_t\}$, capital rental rates $\{r_t\}$, labor market tightness $\{\theta_t\}$ and job finding rates $\{f_t\}$, such that consumption $\{c_t\}$, search time $\{s_t\}$, capital utilization rates $\{u_t\}$, capital depreciation rates $\{\delta^k_t\}$, employment $\{h_{t+1}\}$, and capital stock $\{k_{t+1}\}$ solve the household optimization problem and

  - the sequences of vacancies $\{v_t\}$, employment $\{h_{t+1}\}$ and capital services $\{\kappa_t\}$ solve the firm‘s optimization problem and

  - all resource constraints are respected

Equilibrium highlight

- **Wage equation** (gross of taxes, labor cost to firm):

$$w_t = \frac{(1-\mu)\,b}{1-\tau_t} + \mu\,(1-\alpha)\,\frac{y_t}{h_t} + \mu(1-\delta^n)\frac{a}{q_t} - \mu(1-\delta^n - f_t)\frac{a}{q_t}\,\frac{E_t\,(1-\tau_{t+1})}{1-\tau_t}$$

- As usual the wage is a weighted average of the income equivalent of leisure and labor productivity as well as the expected savings on vacancy costs.
- Now the equilibrium gross wage also depends positively on the payroll tax rate, and this depends on bargaining power.
- Taxes are endogenously determined by the state of the economy (the social system's burden is countercyclical).
- *Intertemporal path of taxes matters for the wage.*

Equilibrium highlight

- **Wage equation** (gross of taxes, labor cost to firm):

$$w_t = \frac{(1-\mu)\,b}{1-\tau_t} + \mu\,(1-\alpha)\,\frac{y_t}{h_t} + \mu(1-\delta^n)\frac{a}{q_t} - \mu(1-\delta^n - f_t)\frac{a}{q_t}\,\frac{E_t\,(1-\tau_{t+1})}{1-\tau_t}$$

- *Intertemporal path of taxes matters for the (gross) wage.*
- *Example:*
  - $z\uparrow \Rightarrow y, h, w\uparrow, s\downarrow \Rightarrow \tau\downarrow$ today, so w increase is *damped*
  - Next: holding *today's* τ *constant*, tomorrow's τ is changing. If τ is rising, this will increase today's wage, but if it continues to fall, this will further damp today's wage.
  - Thus if effects on wage bill are persistent, the future tax rates will also be lower, putting further downward pressure on *today's* wage. Result is *apparent* gross wage rigidity.

Baseline Calibration (quarterly model)

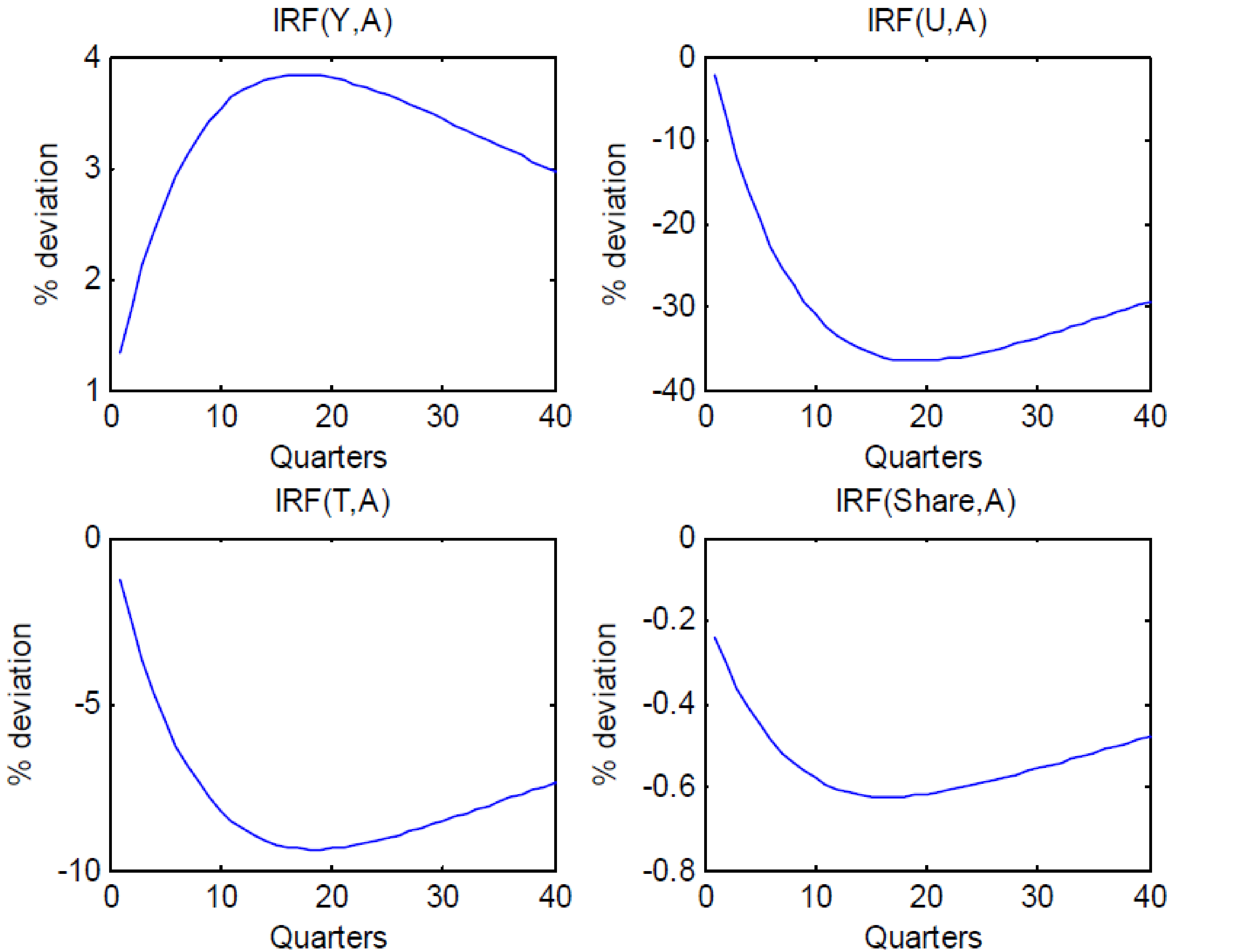
Parameter	Definition	Value	Origin
α	Elasticity of output with respect to labor	0.64	data; average labor share
β	Utility discount factor	0.99	literature
χ^{-1}	Frisch inverse elasticity of nonleisure time	5.0	Literature
δ^h	Dissolution rate of matches	0.078	data
δ^k	Steady state depreciation rate of capital	0.025	literature
μ	Bargaining power of workers	0.4174	calibrated from steady state
ψ	Elasticity of matching (u)	0.5	literature

Baseline Calibration (quarterly model)

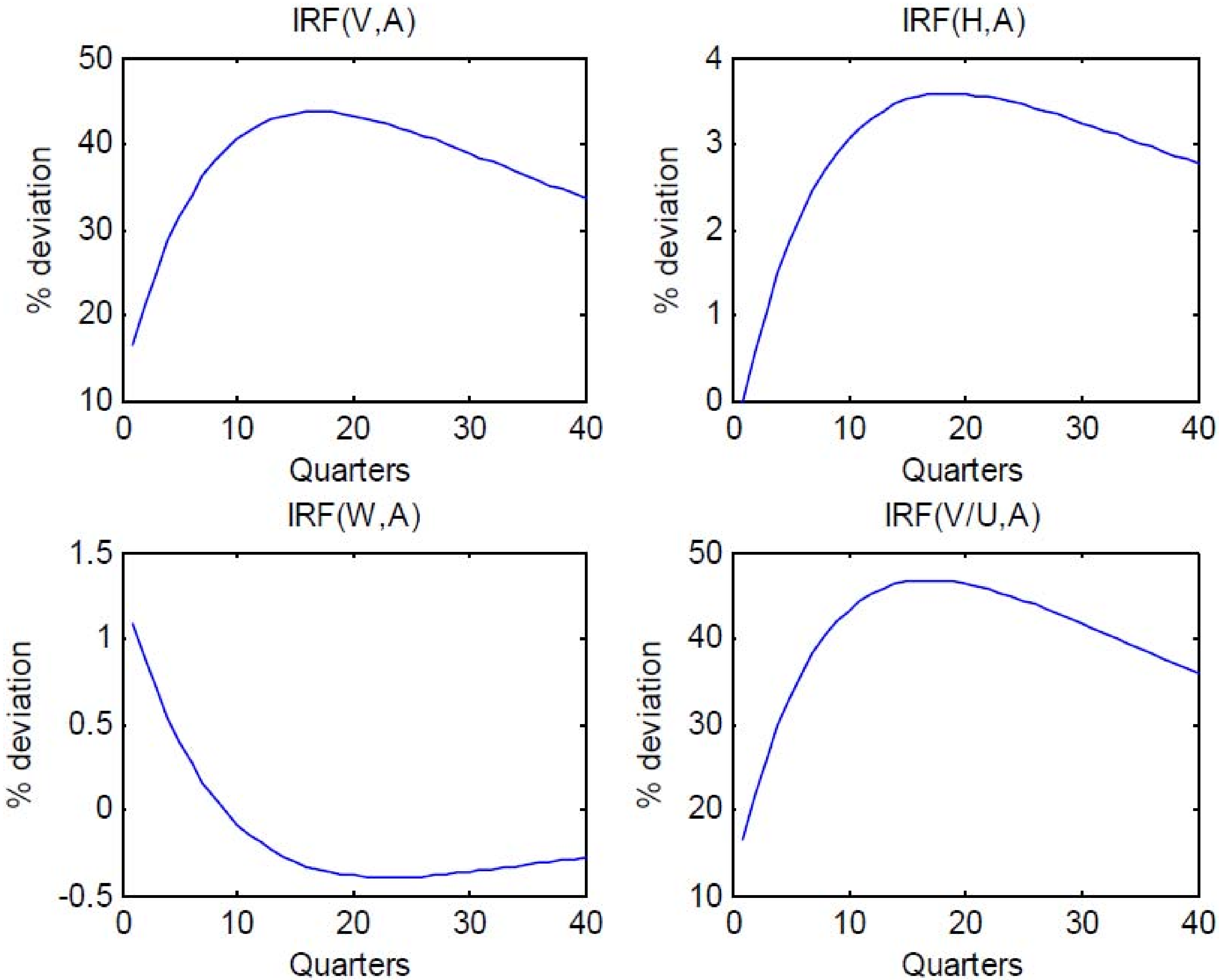
Parameter	Definition	Value	Origin
τ	Steady state payroll tax rate	0.3	avg. value Germany 1970-2008
ε	social transfer or misclassification rate	0.395	calibrated
av/y	Vacancy cost as a fraction of GDP in steady state	0.01	calibrated
ρ	Serial correlation of productivity	0.95	literature
b/w	Replacement rate in steady state	0.60	data: Germany
A	Weight for utility deriving from nonleisure activities	0.0277	calibrated from steady state

Steady state unemployment rate: 7%

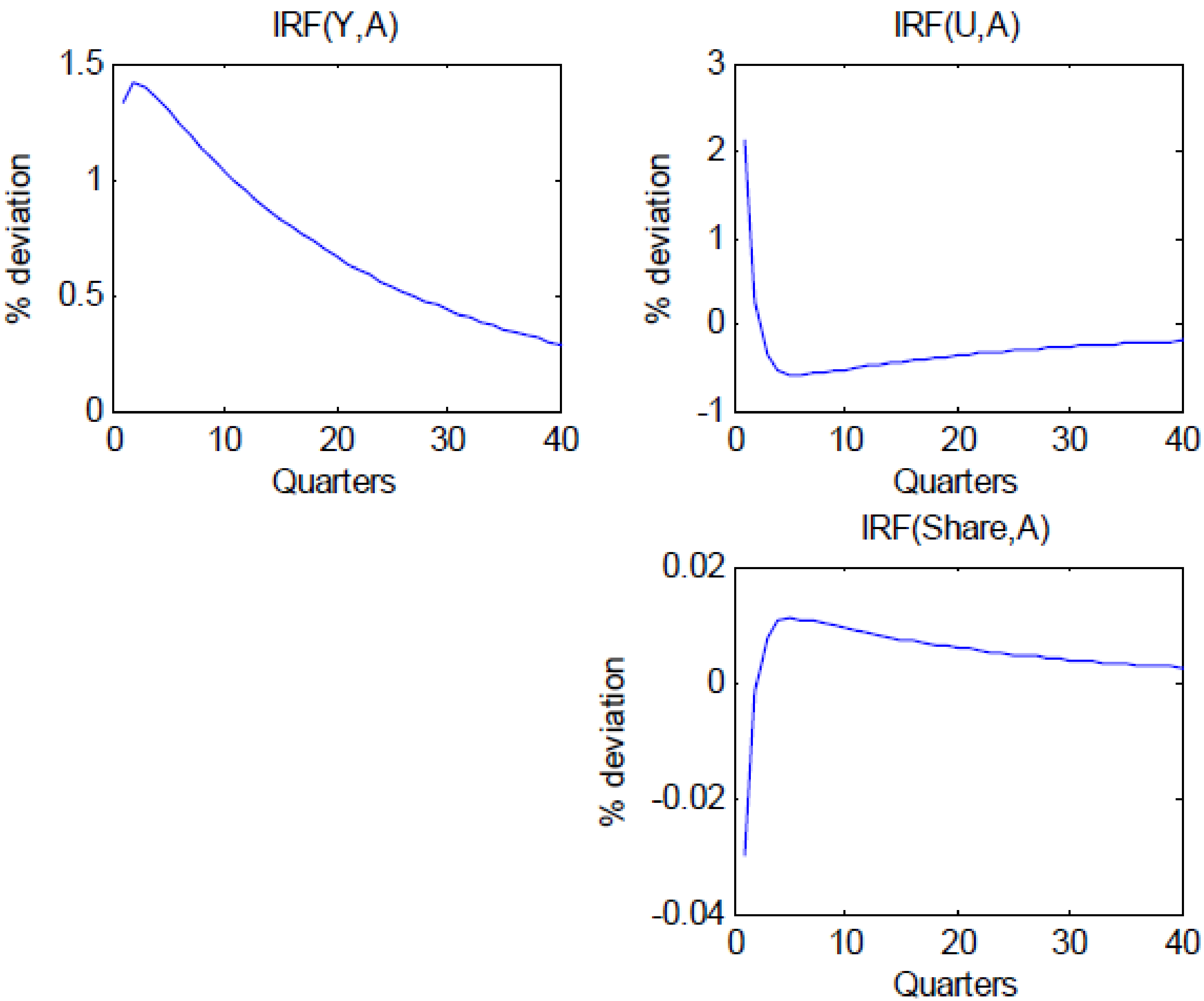
Impulse Responses: With social security



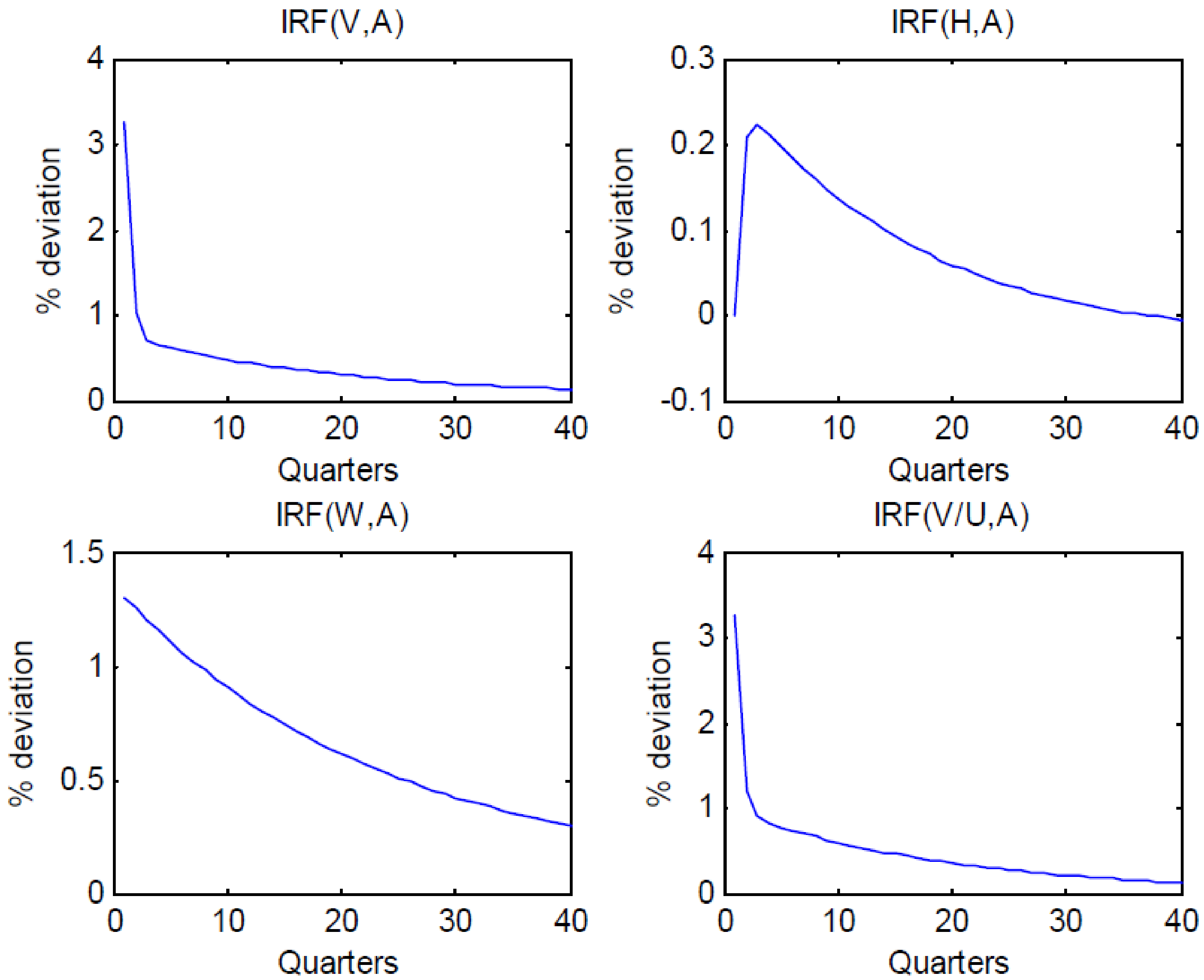
Impulse Responses: With social security



Impulse Responses: No social security



Impulse Responses: No social security



Simulation Results

- Model with payroll taxes b=0.60, ε= 0.395, τ=0.30
- Model without payroll taxes: b/w=0.01, ε=0.01, $\tau \approx 0$

Data

1. Germany, 1970:I - 2008:IV				
	v	u	θ	p
v	1	-0.81	0.96	0.30
u		1	-0.94	-0.24
θ			1	0.29
p				1

Model economies

5. Model (payroll tax)				
	v	u	θ	p
v	1	-0.80	0.99	0.59
u		1	-0.82	-0.05
θ			1	0.56
p				1

4. Model (no payroll tax)				
	v	u	θ	p
v	1	-0.02	0.99	0.72
u		1	-0.14	-0.73
θ			1	0.78
p				1

Simulation Results

The labor market			
	GER	no payroll tax	payroll tax
σ_v/σ_y	13.24	1.57	11.69
σ_u/σ_y	11.41	1.24	8.34
$\rho(v,y)$	0.67	0.64	0.99
$\rho(u,y)$	-0.74	0.09	-0.87

Persistence of labor market			
	GER	no payroll tax	payroll tax
$\rho(v,v_{-1})$	0.95	0.32	0.83
$\rho(u,u_{-1})$	0.95	0.27	0.94

Puzzles

Hall-Shimer Puzzle

TABLE 1—SUMMARY STATISTICS, QUARTERLY U.S. DATA, 1951–2003

		u	v	v/u	f	s	p
Standard deviation		0.190	0.202	0.382	0.118	0.075	0.020
Quarterly autocorrelation		0.936	0.940	0.941	0.908	0.733	0.878
Correlation matrix	u	1	−0.894	−0.971	−0.949	0.709	−0.408
	v	—	1	0.975	0.897	−0.684	0.364
	v/u	—	—	1	0.948	−0.715	0.396
	f	—	—	—	1	−0.574	0.396
	s	—	—	—	—	1	−0.524
	p	—	—	—	—	—	1

Source: Shimer (2005). Statistics refer to HP-detrended data (λ=100000)

Persistence

Beveridge curve

SFB 649 ÖKONOMISCHES RISIKO

HUMBOLDT-UNIVERSITÄT ZU BERLIN

The Hall-Shimer Puzzle

- In HP-filtered (λ=10^5) US quarterly data, the vacancy to unemployment ratio is about 20 times higher than in a model driven by productivity shocks with Nash-bargained wages
- Volatility of both unemployment and vacancies as well as the Beveridge relationship are responsible
- The Hall-Shimer fact also seems to hold in other OECD countries: Germany: "σ_θ/σ_p"$\approx$35.
- The standard model fails because Nash-bargained wages are "too flexible" and absorb too much of shocks which would otherwise lead to sharp fluctuations of v and possibly of u

Some Proposed Solutions to the Hall-Shimer Puzzle

- Hall (2005), Shimer (2005): Rigid wages
- Pissarides (2007): Additional frictions, cyclical separations
- Fujita/Ramey (2006,2007): *Not* inactivity; vacancy creation costs
- Gertler/Trigari (2006): Multiperiod wage contracting
- Nagypal (2006), Krause/Lubik (2004): On-the-job search
- Hagedorn/Manovskii (2008): “Small surplus calibration” = high income equivalent of unemployment

Simulation Results

Shimer puzzle			
	GER	no payroll tax	payroll tax
σ_θ/σ_p	34.52	1.76	20.45
$\rho(\theta, p)$	0.29	0.79	0.54

τ			
	GER	no payroll tax	payroll tax
σ_τ/σ_y	1.57	na	1.34
$\rho(\tau, y)$	-0.55	na	-0.92

Conclusions

- Payroll taxes are countercyclical in many OECD countries.
- “Bismarckian” self-financing social welfare system and payroll taxation, combined with a pervasive social insurance system, can serve as a complement or even a substitute for existing explanations of Hall-Shimer puzzle.
- Adding a self-financing social system increases internal propagation, preserves the Beveridge curve and comes closer to the Hall-Shimer ratio – while the standard model without these features misses the mark.