Heterogeneous Passthrough from TFP to Wages

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Introduction: Motivation

Why and how do firm-level shocks affect worker's wages?

- Crucial for research in income inequality and labor income risk.
- Not clear *theoretically* what we should expect to find *empirically*.
- Under canonical perfectly competitive model, individual wages **should not** depend on idiosyncratic firm shocks.
- Departures from competitive benchmark may drive links between firm shocks and wages.
    - Labor adjustment costs, market power, financial constraints, etc.

Introduction: This Project

1. Measure *passthrough elasticity* from firms' *productivity* shocks to wages.

    - Object of interest: %Δ in wage from %Δ in TFP $\left(\frac{\partial W_{ijt}}{\partial TFP_{jt}} \frac{TFP_{jt}}{W_{ijt}}\right)$

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2. We develop general model of employment and wage setting which:
   - Admits multiple dimensions of worker and firm heterogeneity.
   - Nests various passthrough and wage-setting mechanisms.
   - Requires few/weak assumptions on production, costs, and labor market structure.

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   - Nests various passthrough and wage-setting mechanisms.
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3. This framework allows us to
   - Separately identify changes in firm shocks from endogenous responses.
   - Obtain robust estimates of passthrough at firm and worker level.
   - Evaluate different theories of passthrough.
   - Decompose passthrough into passthrough to markdown and passthrough to MRPL

General Setting

Economy with Firms $j \in J$ and Workers $i \in I$.

Firm j produces output with capital K_{jt}, materials M_{jt} and labor L_{jt}

$$Y_{jt} = F(K_{jt}, L_{jt}, M_{jt})e^{\nu_{jt}}$$

- $\nu_{jt} = \omega_{jt} + \varepsilon_{jt} = \mathbb{E}[\omega_{jt}|\omega_{jt-1}] + \eta_{jt} + \varepsilon_{jt}$
- η_{jt} is *persistent* shock to productivity.
- ε_{jt} is *transitory* ex-post shock.

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Worker i characterized by time-varying productivity/ability A_{it}

- A_{it} is function of innate ability, experience, education, etc.

Labor input L_{jt} is the sum of ability-weighted hours of labor.

$$L_{jt} = \sum_{i \in I_j} A_{it} H_{ijt}$$

WAGES

Substitutability of labor *conditional on ability* implies:

- Firms pay single "ability price" W_{jt} per hour of ability-adjusted labor.
- Worker hourly wage is $W_{ijt} = A_{it} \times W_{jt}$

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Timing and Wage Setting:

- Capital is predetermined: $K_{jt+1} = (1 - \delta)K_{jt} + K^{I}_{jt}$.
- Firms observe $\mathcal{I}_{jt} = \{\eta_{jt}, \bar{Z}_{jt}, \tilde{Z}_{jt-1}, P_t, \mathcal{I}_{jt-1}\}$ and post expected wage $\overline{W}_{jt}$
  - $\bar{Z}_{jt}$ are predetermined/exogenous state variables (including K_{jt}).
  - $\tilde{Z}_{jt}$ are endogenous variables chosen in period t (including $L_{jt}, M_{jt}, K^{I}_{jt}$).
- After $\tilde{Z}_{jt}$ and $\overline{W}_{jt}$ chosen, firms observe ε_{jt} and set $W_{jt} = \overline{W}_{jt} f^{c}(\varepsilon_{jt})$.
- $f^{c}(\varepsilon_{jt})$ represents ex-post wage adjustments (bonuses etc).

Firm Problem

$$V_{jt}(\mathcal{I}_{jt}) = \max_{\tilde{Z}_{jt}} \mathbb{E}\left[P_t^Y F(K_{jt}, L_{jt}, M_{jt}) e^{\nu_{jt}} \mid \mathcal{I}_{jt}\right] - \overline{W}_{jt} L_{jt} - \Phi_{jt}$$

$$- P_t^I K_{jt}^I - P_t^M M_{jt} + \beta \mathbb{E}\left[V_{jt+1}(\mathcal{I}_{jt+1}) | \mathcal{I}_{jt}\right]$$

- Labor supply function $L_{jt} = g(\overline{W}_{jt}, \bar{Z}_{jt}, \tilde{Z}_{jt})$
- Adjustment/employment cost function $\Phi_{jt} = \Phi(\bar{Z}_{jt}, \tilde{Z}_{jt}, \tilde{Z}_{jt-1})$.

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Firm's FOC provide optimal wage setting policy:

$$\overline{W}_{jt} = \frac{\varepsilon^L_{\overline{W}jt}}{1 + \varepsilon^L_{\overline{W}jt}} \left(\overline{\mathrm{MRPL}}_{jt} - \frac{\partial \Phi_{jt}}{\partial L_{jt}} + \frac{\partial}{\partial L_{jt}} \beta \overline{V}_{jt+1}\right)$$

- ε^L_{jt} is labor supply elasticity.
- $\overline{\mathrm{MRPL}}_{jt} \equiv \mathbb{E}[\mathrm{MRPL}_{jt} | \mathcal{I}_{jt}]$, and $\overline{V}_{jt+1} \equiv \mathbb{E}\left[V_{jt+1}(\mathcal{I}_{jt+1}) | \mathcal{I}_{jt}\right]$.

Recovering Joint Distribution of Ability, Wages, TFP

Ability: Assume $A_{it} = A_i \times \Lambda_t(X_{it})$

- A_i is unobserved time-invariant ability for individual i.
- X_{it} are time-varying worker characteristics (age, education, etc)
- Λ_t allowed to be time varying (increasing returns to education).

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This provides two estimating equations:

1. Use (log) wage equation to recover A_{it} controlling for firm variation.

$$w_{ijt} = a_i + \lambda_t(X_{it}) + w_{jt}$$

2. Use (log) production function to estimate ν_{jt} controlling for ability

$$y_{jt} = f(k_{jt}, \ell_{jt}, m_{jt}) + \nu_{jt}$$

Next: Explain how we take these to the data.

Main Data Source

Matched employer-employee panel data from Statistics Denmark

Firm-level data: 0.8 million firm-year observations

- Majority of Danish firms from 1995 to 2010
- Annual revenues, capital stock, intermediate expenditure, employment, location, industry, etc.

Worker-level data: 7.3 million worker-year observations

- Hourly wages, occupation, within firm position, education, etc.
- Spousal linkages and information on these same variables

Wages set flexibly during this period. Little to no collective bargaining.

Sample Selection

Estimation: Ability and Firm-level Wage

Estimate worker-quality using two-way fixed effect model

$$\underbrace{w_{ijt}}_{\text{Log hourly wage}} = \underbrace{\alpha_i + \mathbf{X}_{it}\Gamma_t}_{\text{Ability units}} + \underbrace{w_{jt}}_{\text{Per-unit ability price}} + \xi_{ijt}$$

- Worker ability includes unobserved and observed characteristics.
- Allows for time-varying firm ability price, w_{jt}.

Identification | Multi-job Connected Set | SMB

Estimation: Firm-Level TFP

Estimate firm productivity using *non-parametric* approach building on Gandhi et al. (2020)

$$y_{jt} = f(k_{jt}, m_{jt}, \ell_{jt}) + \underbrace{\omega_{jt} + \epsilon_{jt}}_{\nu_{jt}}, \quad \omega_{jt} = \mathbb{E}[\omega_{jt} | \omega_{jt-1}] + \eta_{jt}$$

- Allow arbitrary substitution patterns between inputs.
- Knowledge of f and ϵ_{jt} provides distributions of MRPL_{jt} and *markdowns* (μ_{jt}).

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Controlling for labor quality matters:

- Also obtain "uncorrected" estimate of $\tilde{\nu}_{jt}$ using labor input $\tilde{\ell}_{jt} = h_{jt}$.
- Dispersion in TFP (ν_{jt}) reduced by 60% relative to $\tilde{\nu}_{jt}$. More Graph

Jointly estimating worker ability and TFP vital for results.

- Not controlling for worker ability → over-estimate passthrough.
- Using revenue/VA shock instead of TFP → under-estimate passthrough.

Key Estimating Equation

Our main equation to estimate $\epsilon^{W}_{\text{TFP}} = \frac{\partial \log W_{ijt}}{\partial \log TFP_{jt}}$ is derived directly from the model and timing assumptions:

$$w_{jt} = f^{w}(\eta_{jt}, \varepsilon_{jt}, \omega_{jt-1}, \bar{Z}_{jt}, \tilde{Z}_{jt-1})$$

We use a first-order linear approximation of f^{w}, where:

- $\bar{Z}_{jt}$ includes (logs of): K_{jt}, industry, firm age.
- $\tilde{Z}_{jt}$ includes (logs of): L_{jt} and workforce characteristics (size, age, education, experience, tenure, mobility rate, occupation composition etc).

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We estimate:

$$\Delta w_{jt} = \alpha + \underbrace{\beta^{\eta}\eta_{jt} + \beta^{\varepsilon}\varepsilon_{jt}}_{\text{TFP Shocks}} + \underbrace{\bar{Z}_{jt}\Gamma^{1} + \tilde{Z}_{jt-1}\Gamma^{2} + \beta^{w} w_{jt-1} + \delta_t}_{\text{Controls}} + \zeta_{ijt}$$

β^{η} and β^{ε} are *average* passthrough elasticities of η and ε to wages.

Summary/Key Estimating Equation

Our approach has several key advantages:

- Separately identifies persistent (η_{jt}) from transitory (ϵ_{jt}) shocks.
- Weak parametric and distributional assumptions on shock processes.
- Can separately analyze wage effects of *positive* vs. *negative* shocks.
- Peels changes in labour *quantity* and *quality* out of firm shock.
- Can decompose passthrough into Δ Markdown and Δ MRPL.

Theoretical Implications

$$\overline{W}_{jt} = \frac{\varepsilon^{L}_{\overline{W}jt}}{1+\varepsilon^{L}_{\overline{W}jt}}\left(\overline{\mathrm{MRPL}}_{jt} - \frac{\partial \Phi_{jt}}{\partial L_{jt}} + \frac{\partial}{\partial L_{jt}}\beta \overline{V}_{jt+1}\right)$$

- Perfectly competitive labor markets generate zero passthrough.

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- Perfectly competitive labor markets generate zero passthrough.
- Atomistic monopolistic competition model without other frictions generates positive, homogeneous and symmetric passthrough.
- Deviating from the simple case (adjustment costs, market power, etc) can generate heterogeneous and asymmetric passthrough.

Results

Firm-level Average Passthrough

$$\Delta w_{jt} = \alpha + \underbrace{\beta^{\eta}\eta_{jt} + \beta^{\varepsilon}\varepsilon_{jt}}_{\text{TFP Shocks}} + \underbrace{\bar{Z}_{jt}\Gamma^1 + \tilde{Z}_{jt-1}\Gamma^2 + \beta^w w_{jt-1} + \delta_t}_{\text{Controls}} + \zeta_{ijt}$$

	Persistent Shock				Transitory Shock		
	(1)	(2)	(3)		(4)	(5)	(6)
	Δ	$\Delta > 0$	$\Delta < 0$		Δ	$\Delta > 0$	$\Delta < 0$
β^{η}	0.31***	0.36***	0.22***	β^{ε}	0.25***	0.20***	0.31***
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)

- Passthrough is positive and asymmetric.
- Persistent shocks (η) have larger effect than Transitory shocks (ε).

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Recovering joint distribution of ability and TFP matters!

- Δ ability price from Δ value-added = .06 (no tfp)
- Δ mean wage from Δ TFPL = .58 (no akm)
- Δ mean wage from Δ value-added = .12 (neither)

Persistence of Passthrough

$$\Delta w_{jt} = \alpha + \underbrace{\beta^{\eta}\eta_{jt} + \beta^{\varepsilon}\varepsilon_{jt}}_{\text{TFP Shocks}} + \underbrace{\bar{Z}_{jt}\Gamma^1 + \tilde{Z}_{jt-1}\Gamma^2 + \beta^w w_{jt-1} + \delta_t}_{\text{Controls}} + \zeta_{ijt}$$

	Periods After Shock			
	1	2	3	4
β^{η}	0.36^{***}	0.33^{***}	0.31^{***}	0.27^{***}
	(0.01)	(0.01)	(0.01)	(0.01)
β^{ε}	0.29^{***}	0.14^{***}	0.03^{***}	-0.03
	(0.01)	(0.01)	(0.01)	(0.02)

- Balanced panel of firms in sample for 4+ years.
- Effect of transitory shock (ε) gone after 4 periods.
- Effect of persistent shock (η) remains relatively constant.

Decomposition of Passthrough

We can identify the firm's expected markdown $\overline{\mu}_{jt}$

$$W_{jt} \quad = \quad \mu_{jt}\mathrm{MRPL}_{jt}$$

where

$$\mu_{jt} = \frac{\varepsilon^{L}_{\overline{W}jt}}{1+\varepsilon^{L}_{\overline{W}jt}}\left(1-\left(\frac{\partial\Phi}{\partial L_{jt}}-\frac{\partial}{\partial L_{jt}}\overline{V}_{jt+1}\right)\overline{\mathrm{MRPL}_{jt}}^{-1}\right)\frac{f^{c}(\epsilon_{jt})}{e^{\epsilon_{jt}}}$$

	Persistent Shock (η_{jt})		
LHS Var	η_{jt}	$\eta_{jt} > 0$	$\eta_{jt} < 0$
$\Delta \log W_{jt}$	0.31^{***}	0.36^{***}	0.22^{***}
$\Delta \log \mathrm{MRPL}_{jt}$	2.31^{***}	2.23^{***}	2.39^{***}
$\Delta \log \mu_{jt}$	-2.00^{***}	-1.87^{***}	-2.17^{***}

- A 1% increase in TFP leads to a 1.87% decrease in markdowns.
- Markdowns more sensitive to negative shocks than positive shocks.

Heterogeneity in Decomposition

LHS Var	**Markdown** $\mu_{jt-1} < 0.5$		**Markdown** $1 > \mu_{jt-1} > 0.8$	
	$\eta_{jt} > 0$	$\eta_{jt} < 0$	$\eta_{jt} > 0$	$\eta_{jt} < 0$
$\Delta \log W_{jt}$	0.24^{***}	0.17^{***}	0.45^{***}	0.23^{***}
$\Delta \log \text{MRPL}_{jt}$	1.18^{***}	2.96^{***}	1.81^{***}	2.15^{***}
$\Delta \log \mu_{jt}$	-0.94^{***}	-2.79^{***}	-1.36^{***}	-1.92^{***}

- Firms with more market power (low μ_{jt}) have less passthrough.
- Especially true for positive shocks.
- Mostly due to low markdown firms being larger with higher returns-to-scale.

Heterogeneity in Productivity

	Productivity Quintile (ω_{jt-1})				
	1	2	3	4	5
$\eta > 0$	0.42^{***}	0.39^{***}	0.34^{***}	0.30^{***}	0.25^{***}
$\eta < 0$	0.28^{***}	0.21^{***}	0.19^{***}	0.14^{***}	0.15^{***}

- Passthrough decreasing in productivity.
- Consistent with predictions of oligopsonistic labor market model.
- Positive asymmetry for most firms is consistent with adjustment costs.

Similar patterns with firm size, returns-to-scale, and market share.

- Firms with 200+ workers (1% of firms) employ 44% of workers.
- Passthrough at these firms is negative asymmetric: 0.01 ($\eta > 0$) and 0.14 ($\eta < 0$)
- To understand how passthrough affects workers → worker level estimation.

Worker-level Selection Model

$$\Delta\hat{w}_{ijt} = \Delta a_{it} + \Delta w_{jt} = \alpha + \underbrace{\beta^{\eta}\eta_{jt} + \beta^{\varepsilon}\varepsilon_{jt}}_{\text{TFP Shocks}} + \underbrace{\Delta Z_{jt}\Gamma + \Delta X_{it}\Omega + \delta_t}_{\text{Controls}} + \varepsilon^{x}_{ijt}$$

Main Issue

- Workers more likely to leave firms with negative shocks - exiting sample.
- Utility from working at firm j: $U_{ijt} = f^{u}(X_{it}, \tilde{X}_{it}, \mathcal{I}_{jt}) + \varepsilon^{u}_{ijt}$
    - $\tilde{X}_{jt}$ are non-wage worker characteristics (relationship status, etc)
- Estimates may be biased since

$$\mathbb{E}[\Delta w_{ijt} | X_{it}, \tilde{X}_{it}, \mathcal{I}_{jt}] = \alpha + \beta^{\eta}\eta_{jt} + \ldots + \mathbb{E}[\varepsilon^{x}_{jt} | \varepsilon^{u}_{jt} > -f^{u}]$$

Solution: Heckman-style Selection Correction.

Exclusion restriction: $\tilde{X}_{it}$ (relationship status and spouse's firm/wage shocks) affect employment but not *firm-level* wage setting. i.e. $\tilde{X}_{it} \notin \mathcal{I}_{jt}$.

Worker-level Results

$$\Delta\hat{w}_{ijt} = \alpha + \underbrace{\beta^{\eta}\eta_{jt} + \beta^{\varepsilon}\varepsilon_{jt}}_{\text{TFP Shocks}} + \underbrace{\Delta Z_{jt}\Gamma + \Delta X_{it}\Omega + \delta_t}_{\text{Controls}} + \underbrace{\rho\tilde{\lambda}_{ijt}}_{\text{Correction}} + \varepsilon^{x}_{ijt}$$

Dependent variable log-change in real wages, Δw_{ijt}

	Uncorrected			Corrected		
	(1)	(2)	(3)	(4)	(5)	(6)
	Δ	$\Delta > 0$	$\Delta < 0$	Δ	$\Delta > 0$	$\Delta < 0$
β^{η}	0.033***	0.044***	0.022***	0.077***	0.061***	0.131***
	(0.004)	(0.004)	(0.009)	(0.007)	(0.004)	(0.007)

- Correction $\rightarrow$ Increase in passthrough of persistent shocks.
- Mostly due to increase in passthrough of negative shocks.

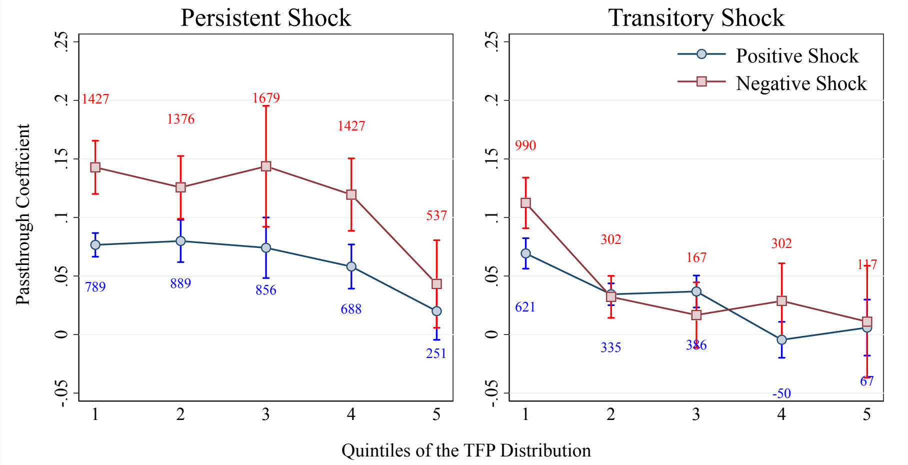
Passthrough Heterogeneity

- Firm heterogeneity
  - High productivity firms have lower passthrough Figure
  - Firms with more labor market power have lower passthrough Figure
- Worker heterogeneity
  - Higher wage workers face higher passthrough Figure
  - High ability workers also face higher passthrough Figure
- Positive passthrough $\rightarrow 0$ in great recession. Negative passthrough unaffected. Table
- Passthrough effects are twice as large for switchers. Table

Conclusion

- Positive and significant passthrough from TFP shocks
  - Larger (asymmetric) passthrough than existing literature
  - A change of one st.dev. in TFP implies 1.8 pp change in wages ($1,100)
  - Large passthrough to wage markdowns.
- Selection is important when estimating worker-level passthrough
- Large heterogeneity across worker and firm types
  - Workers more exposed to negative shocks.
  - Passthrough $\uparrow$ in wages and ability, $\downarrow$ in TFP and Market Power.
- Data suggest that both market power and adjustment costs are significant drivers of passthrough.

Heterogeneity: Firm Productivity



- Higher passthrough for workers at low TFP firms

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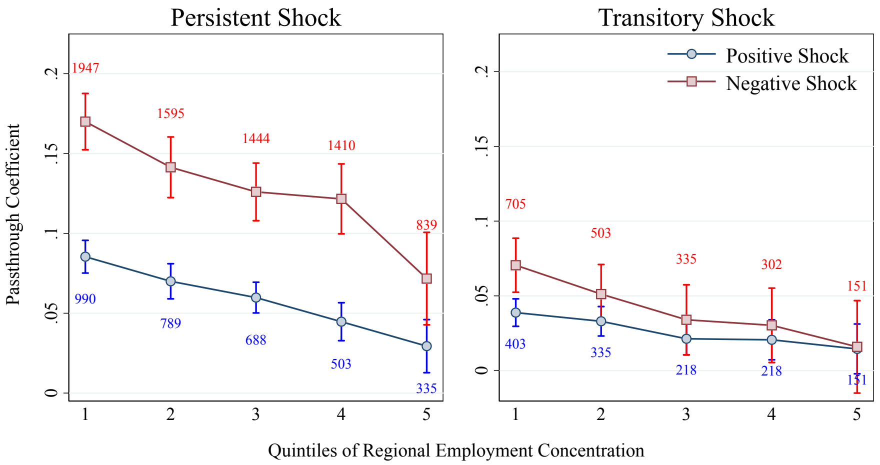
Percent Effects

Heterogeneity: Labor Market Power

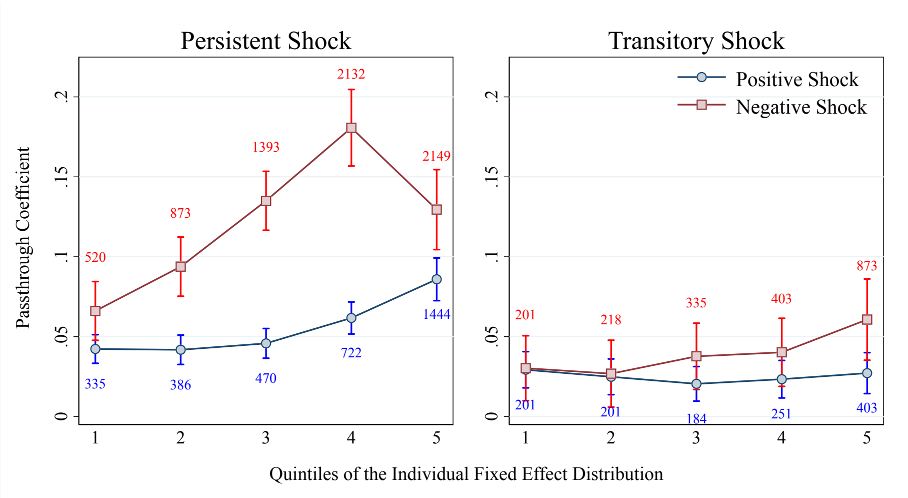


- Labor Market Concentration defined as share of employment within a year-municipality pair
- Higher concentration is associated with lower passthrough, especially for negative shocks

Back

Percent Effects

Heterogeneity: Worker Ability



Worker Ability defined as $\widehat{a}_{ijt} \equiv \exp(\hat{\alpha}_i + X_{it}\hat{\beta})$ from akm regression.

Percent Effects

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Heterogeneity: Stayers vs. Switchers

Dependent variable log-change in real wages, Δw_{ijt}

	Stayers			Switchers		
	(1)	(2)	(3)	(4)	(5)	(6)
	ΔTFP_{jt}	$+\Delta TFP_{jt}$	$-\Delta TFP_{jt}$	ΔTFP_{jt}	$+\Delta TFP_{jt}$	$-\Delta TFP_{jt}$
β_1^{η}	0.077***	0.061***	0.131***	0.026***	0.025***	0.027***
β_1^{ε}	0.034***	0.025***	0.032***	0.049***	0.057***	0.040***
\$Val. β^{η}	\$873	\$688	\$1,495	\$2,166	\$2,099	\$1,914
\$Val. β^{ε}	\$336	\$252	\$437	\$470	\$554	\$369
% Inc. β^{η}	1.5%	1.2%	2.5%	3.8%	3.7%	3.4%
% Inc. β^{ε}	0.6%	0.4%	0.7%	0.8%	0.9%	0.7%

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Heterogeneity: Recessions

	(1)	(2)	(3)	(4)	(5)	(6)
	No Recessions		**2002-2003**		**2008-2009**	
	$+\Delta TFP_{jt}$	$-\Delta TFP_{jt}$	$+\Delta TFP_{jt}$	$-\Delta TFP_{jt}$	$+\Delta TFP_{jt}$	$-\Delta TFP_{jt}$
Persistent (β^{η})	0.056^{***}	0.136^{***}	0.067^{***}	0.105^{***}	0.014	0.141^{***}
Transitory (β^{ε})	0.025^{***}	0.046^{***}	0.025^{***}	0.035^{***}	0.032^{***}	0.025^{***}
\$Val. β^{η}	\$638	\$1,528	\$756	\$1,192	\$167	\$1,662
%Inc. β^{η}	1.1%	2.6%	1.3%	2.0%	0.2%	2.7%
\$Val. β^{ε}	\$252	\$453	\$252	\$353	\$336	\$269
%Inc. β^{ε}	0.4%	0.8%	0.4%	0.6%	0.5%	0.4%

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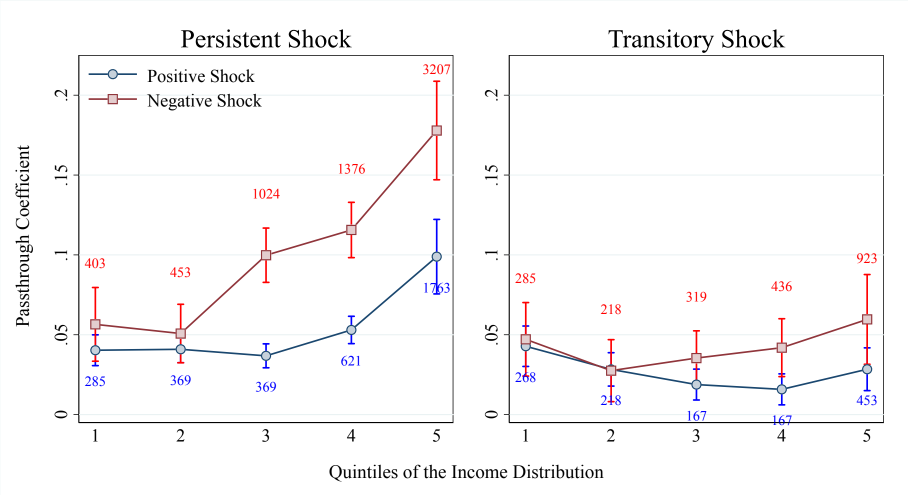
Heterogeneity: Wage Quintiles



- More heterogeneity across income distribution when the persistent shock is negative. Low wage workers experience relatively low gain and low pain. Back

Sample Selection

Firms: TFP shocks

- All firms in register with at least one employee
- Around 0.8 million firm-year observations

Workers: Change in Annual Wage

- Full-time workers who are 15 years and older
- Annual earnings above 30,000 DKK ($4,600 USD)
- No public sector or self-employed workers
- 7.3 million worker-year observations

Sum. Stats Back

Summary Statistics Back

	Mean	Std.dev.	N
	Workers Characteristics		
Annual Wages (dkk)	363,661	208,240	8.98M
Hourly Wages (dkk)	234	147	7.36M
Age	41.7	11.3	8.98M
	Firms Characteristics		
Log Value Added	14.6	1.33	0.71M
Log TFP	7.94	0.58	0.71M
Firm Age (years)	13.1	12.5	0.71M
Number of Employees	19.8	192.7	0.71M

1 USD$ = 6.55 dkk

AKM Identification ‣ Back

- Identify returns to covariates using "common switchers"

$$
\begin{aligned}
w_{ijt} - w_{mjt} &= \alpha_i - \alpha_m + (\mathbf{X}_{it} - \mathbf{X}_{mt})\Gamma_t + \xi_{ijt} - \xi_{mjt} \\
w_{ikt-1} - w_{mkt-1} &= \alpha_i - \alpha_m + (\mathbf{X}_{it-1} - \mathbf{X}_{mt-1})\Gamma_{t-1} + \xi_{ikt-1} - \xi_{mkt-1} \\
\implies \Delta w_{it} - \Delta w_{mt} &= (\mathbf{X}_{it} - \mathbf{X}_{mt})\Gamma_t - (\mathbf{X}_{it-1} - \mathbf{X}_{mt-1})\Gamma_{t-1} + \Delta\xi_{it} + \Delta\xi_{mt}
\end{aligned}
$$

- Identify firm time effects using all switchers

$$
\psi_{j(i,t)t} - \psi_{k(i,t-1)t-1} = w_{ijt} - w_{ikt-1} + \mathbf{X}_{it}\Gamma_t - \mathbf{X}_{it-1}\Gamma_{t-1} + \xi_{ijt} - \xi_{ikt-1}
$$

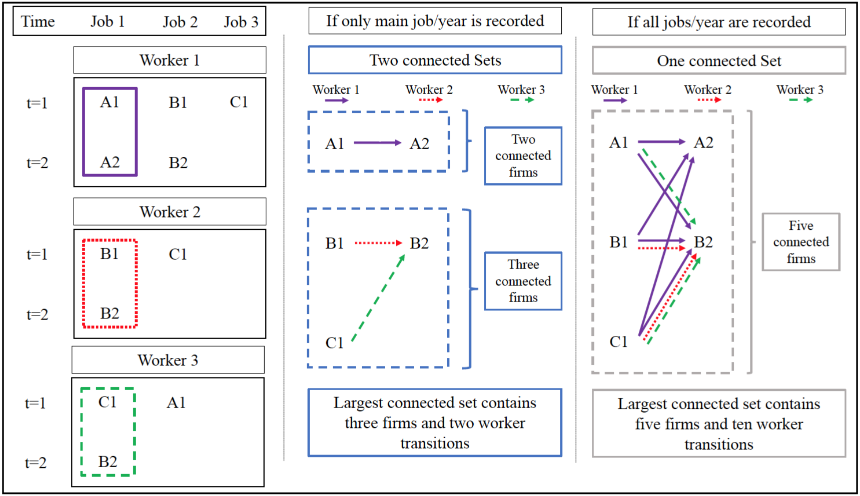
- Worker time invariant fixed effects then recovered as

$$
\alpha_i = \mathbb{E}_{j(i,t)t}\left[w_{ijt} - \psi_{j(i,t)t} + \mathbf{X}_{it}\Gamma_t\right]
$$

- Multiple jobs per worker provides additional identification

$$
w_{ijt} - w_{ikt} = \psi_{jt} - \psi_{kt} + \xi_{ijt} - \xi_{ikt}
$$

Connected Set Using Multiple Jobs ▸ Back



Note: 54.4% of workers have held a second job in at least one year, and 4.7% of workers have held three or more jobs in one year.

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Accounting for Small Mobility Bias ▸ Back

	Minimum number of ex-ante connections:								
Min # Connections:	1	2	3	4	5	10	15	50	100
Share Explained by:									
$\alpha_i + X_{it}\Gamma$	51.0%	51.0%	51.1%	51.3%	51.4%	52.1%	52.7%	54.4%	55.4%
$\psi_{(i,t)j}$	11.3%	11.0%	10.3%	10.0%	9.5%	8.4%	7.9%	6.8%	6.4%
$2 \times Cov\left(\psi_{(i,t)j}, \alpha_i + X_{it}\Gamma\right)$	1.0%	1.0%	1.3%	1.4%	1.5%	1.6%	1.6%	1.2%	1.1%
$Corr\left(\psi_{(i,t)j}, \alpha_i + X_{it}\Gamma\right)$	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.03	0.03
Num $i \times j \times t$ obs.	57,509,434								
Unique firms	450,467								
Unique firm/times	2,967,450								
Unique Workers	4,329,825								
Largest Connected set contains:									
Firm/times	2,784,546	2,639,123	2,258,122	2,043,546	1,800,386	1,196,300	871,560	257,752	116,421
% of baseline sample	(93.8%)	(89.0%)	(76.1%)	(68.9%)	(60.7%)	(40.3%)	(29.4%)	(8.7%)	(3.9%)
Workers	4,303,394	4,299,071	4,290,456	4,281,289	4,271,422	4,219,321	4,169,563	3,931,396	3,755,195
% of the sample	(99.4%)	(99.3%)	(99.1%)	(98.9%)	(98.7%)	(97.4%)	(96.3%)	(90.8%)	(86.7%)
Firms	412,822	389,135	349,627	313,090	281,466	188,705	138,320	39,909	17,532
$i \times j \times t$ observations	57,295,638	57,130,540	56,666,144	56,308,219	55,812,613	53,721,761	51,828,097	44,116,870	39,491,246
Mean hourly wage	5.17	5.17	5.17	5.17	5.17	5.18	5.19	5.2	5.21
Variance of hourly wage	0.30	0.30	0.30	0.30	0.30	0.29	0.29	0.26	0.25
R^2	0.63	0.63	0.63	0.63	0.62	0.62	0.62	0.62	0.63
RMSE	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.33	0.32
% of Firms in connected set:									
<=2 connections	35.1%	14.8%	4.0%	2.30%	1.40%	0.55%	0.35%	0.04%	0.00%
<5 connections	39%	31.90%	21.90%	15.60%	7.90%	1.80%	1.10%	0.14%	0.00%
<10 connections	57.00%	54.70%	47.30%	42.20%	35.10%	13.00%	5.80%	0.80%	0.20%
Mean connections	42.0	44.2	51.2	56.1	62.9	89.9	117.8	325.6	632.1
Median connections	8	8	10	12	14	21	29	81	166

Notes: Table II presents the results of our AKM wage decomposition exercise and analyses the effects of limited mobility bias in our estimates. Specifically, it shows how the contribution of worker's characteristics, firms' characteristics and sorting varies at different minimum thresholds of number of ex-ante connections. Our procedure is to use the full sample to characterize the graph of connections between workers and firms. We then obtain for each firm-time pair the number of (ex-ante connections) in this graph and drop any firm-times which have below the minimum number of connections listed in the top row of each column. We then recalculate the largest connected set and estimate our AKM model on that subset of firms and workers. All estimations are obtained by pooling data from 1991 to 2010.

Moments of the TFP Distribution and Shocks

Controlling for worker ability greatly reduces the dispersion in firm-level TFP and shocks

Table 1: Moments of the log-TFP and TFP shock Distribution

		Std. Dev.	P75-P25	P90-P10	Skewness
Log TFP, ν_{jt}	Hours	1.57	1.75	3.55	-1.82
	AKM	0.63	0.67	1.43	1.41
TFP shock, η_{jt}	Hours	0.64	0.43	1.10	0.50
	AKM	0.19	0.13	0.29	8.14

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TFP distribution Back