Measuring trends and persistence in capital and labor misallocation

Jasper de Winter[*] & Maurice Bun[*‡]

De Nederlandsche Bank (DNB)
Econometrics and Modelling Department[*]
University of Amsterdam[‡]

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Introduction

Research question

- What is the extent and nature of misallocation of capital and labor in the Dutch economy, and how has it evolved over time?

Motivation

- Several papers misallocation is a serious problem and has increased since the Great Rcession (Gopinath et al., 2017, Dias, 2018, Restuccia and Rogerson, 2017);

Main contribution

- Extent previous research by analyzing nature, persistence and trends of misallocation.

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Main messages

Main take-aways from our study

1. Misallocation of capital in the Netherlands has increased over the period 2001–2017;
2. Misallocation of labor has remained more or less stable in our sample;

3. Capital wedge is relatively **large** for small, **highly productive** firms;
4. Capital wedge is relatively **small** for (large) **unproductive** firms;

5. Misallocation of labor is **temporary** for most firms, and dies out relatively quickly;
6. Misallocation of capital is **more permanent**, and the temporary component dies out slowly.

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Data

Raw database

- Population of Dutch firms that declare corporate income tax in period 2001–2017;
- Matched with firm-level data of Dutch business registry;
- Fine grained sectoral division: NACE 5-digit,
- Number of employees (FTE/WP), size-class, balance sheet items, profit & loss account.

Analyzed database

- Repeated cross-section (highly unbalanced), restricted to non-agricultural non-financial sector;
- "Standard" cleaning (e.g. Gamberoni et al., 2016 and Gopinath et al., 2017);
- Number of observations: 1,831,575;
- Number of firms: 342,245 (+/- 110 thousand p/y)

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Hsieh and Klenow (2009) framework

Key equations Hsieh and Klenow (2009)

Production function: $Y_i = TFPQ_i L_i^{\alpha} K_i^{1-\alpha}$,

Profit maximization: $\pi_i = (1 - \tau_i^Y) P_i Y_i - wL_i - (1 + \tau_i^K) RK_i$,

Profit maximizing price: $P_i = \frac{\sigma}{\sigma - 1} MC_i$,

Marginal costs: $MC_i = \left(\frac{RK_i}{\alpha}\right)^{\alpha} \left(\frac{wL_i}{1-\alpha}\right)^{1-\alpha} \frac{(1+\tau_i^K)^{\alpha}}{TFPQ_i(1-\tau_i^Y)}$

Note

- "Wedges" on output (τ_i^Y) and capital (τ_i^Y) are non-standard elements.
- $TFPQ_i \uparrow \Rightarrow \; MC_i \downarrow \Rightarrow \; P_i \downarrow \Rightarrow \; Y_i \uparrow$;
- $\tau_i^Y \mid \tau_i^K \uparrow \Rightarrow \; MC_i \uparrow \Rightarrow \; P_i \uparrow \Rightarrow \; Y_i \downarrow$

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Hsieh and Klenow (2009) framework

Misallocation measures Hsieh and Klenow (2009)

Marg. rev. product of labor: $$MRPL_i = (1-\alpha)\left(\frac{\sigma-1}{\sigma}\right)\left(\frac{P_i Y_i}{L_i}\right) = \left(\frac{1}{1-\tau_i^Y}\right) w,$$

Marg. rev. product of capital: $$MRPK_i = \alpha_s \left(\frac{\sigma-1}{\sigma}\right)\left(\frac{P_i Y_i}{K_i}\right) = \left(\frac{1+\tau_i^K}{1-\tau_i^Y}\right) R,$$

Total rev. factor productivity: $$TFPR_i = P_i TFPQ_i \propto (MPRL_i)^{1-\alpha}(MRPK_i) \propto \frac{(1+\tau_i^K)^\alpha}{1-\tau_i^Y}$$

Note:

- In the absence of distortions $MRPK_i$ & $MRPL_i$ would be equated across all firms;
- If std($MRPK$) $\neq 0$ | std($MRPL$) $\neq 0$ $\Rightarrow$ std($TFPR$) $\neq 0$;
- Std($MRPK$), std($MRPL$), τ_i^K and τ_i^Y our measures of misallocation;

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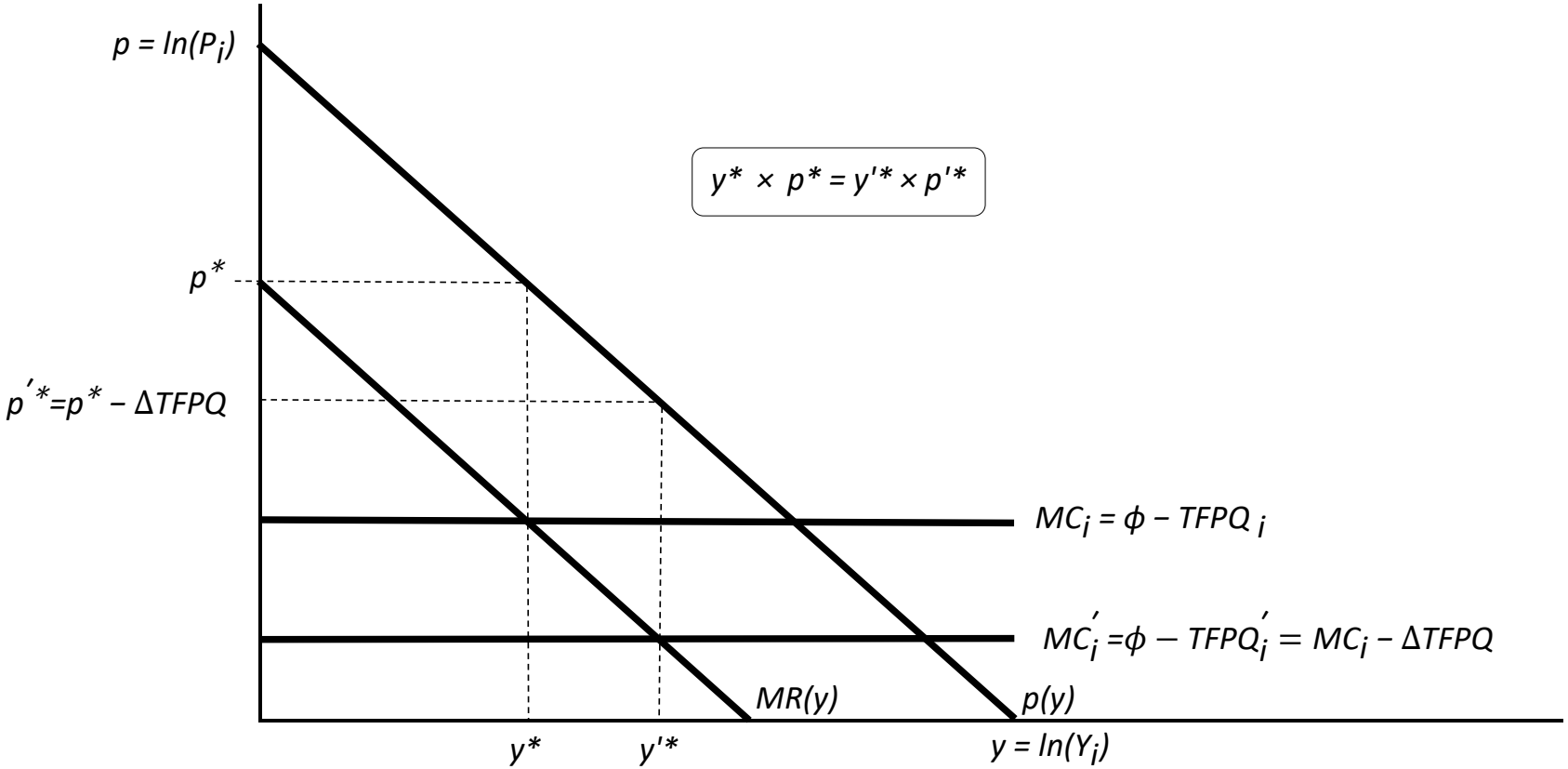
Hsieh and Klenow (2009) framework: intuition

Effect of a change in *TFPQ*



- All "wedges" are zero
- firms with higher $TFPQ_i$ produce more at lower price (p'^*)
- Consequence: economy wide *TFPQ* is at efficient level ($TFPQ_{efficient}$)

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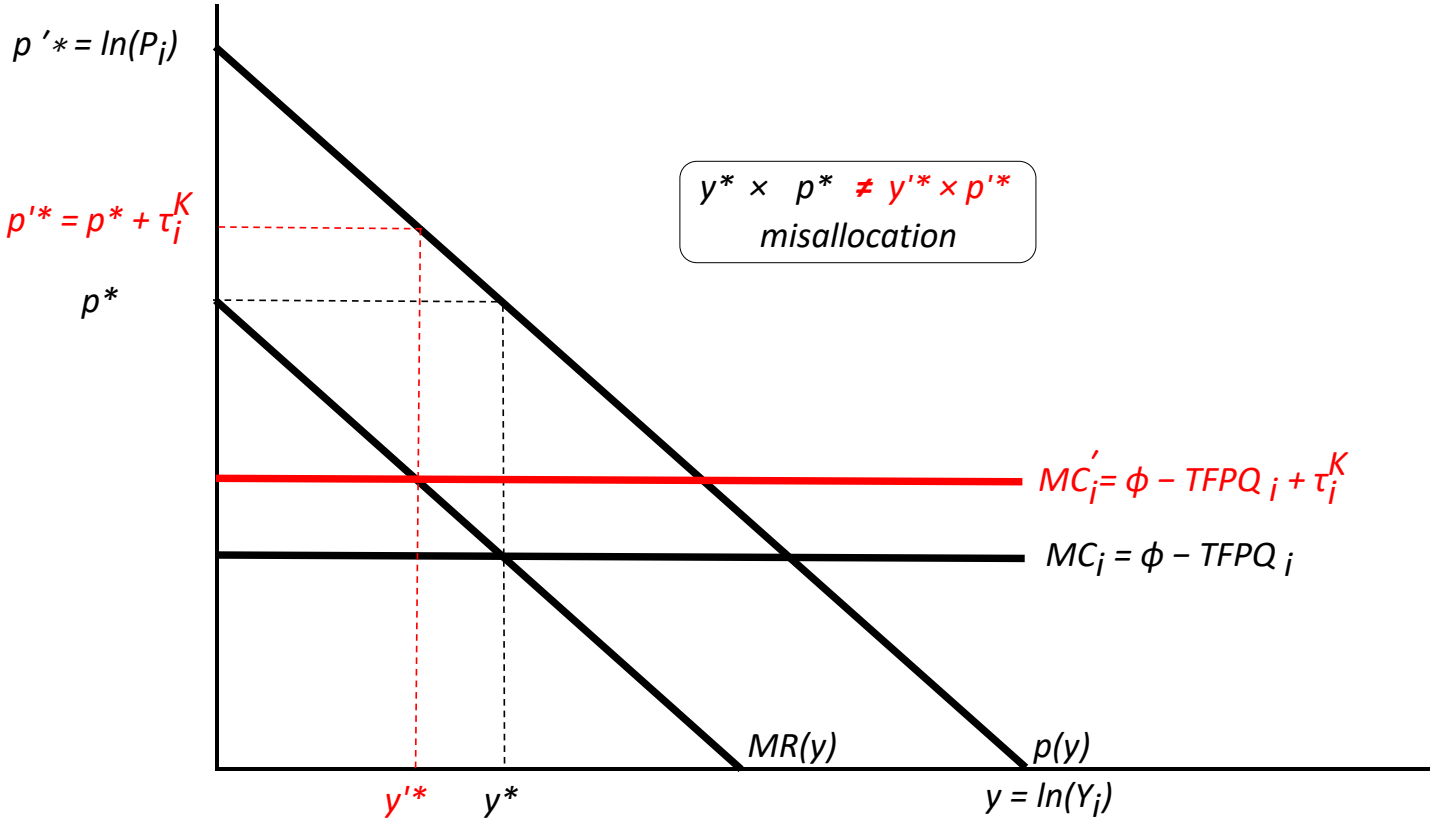
Hsieh and Klenow (2009) framework: intuition

Effect of a wedge on capital (τ^K)



- τ^K is disturbing allocation, $TFPR'^* \neq TFPR^* \Rightarrow \text{std}(TFPR) \neq 0$
- Reason: p'^* is too high and y'^* is too low given firm's $TFPQ$
- Consequence: economy wide $TFPQ$ is lower than $TFPQ_{efficient}$

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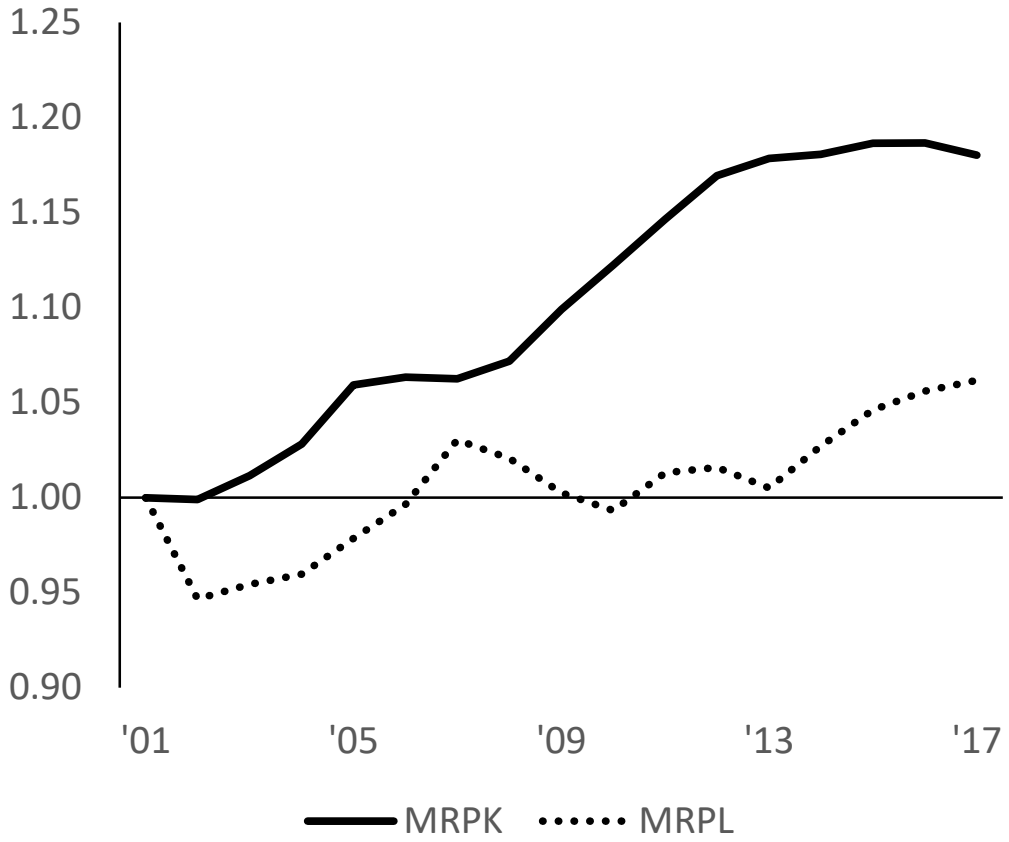
Outcome: standard deviation MRPK & MRPL

Increase std($MRPK$) >> std($MRPL$)



- std($MRPK_{industry}$) < std($MRPK_{services}$)
- std($MRPK_{large}$) < std($MRPK_{med.}$) < std($MRPK_{small}$) < std($MRPK_{micro}$)
- std($MRPL_{industry}$) < std($MRPL_{services}$)

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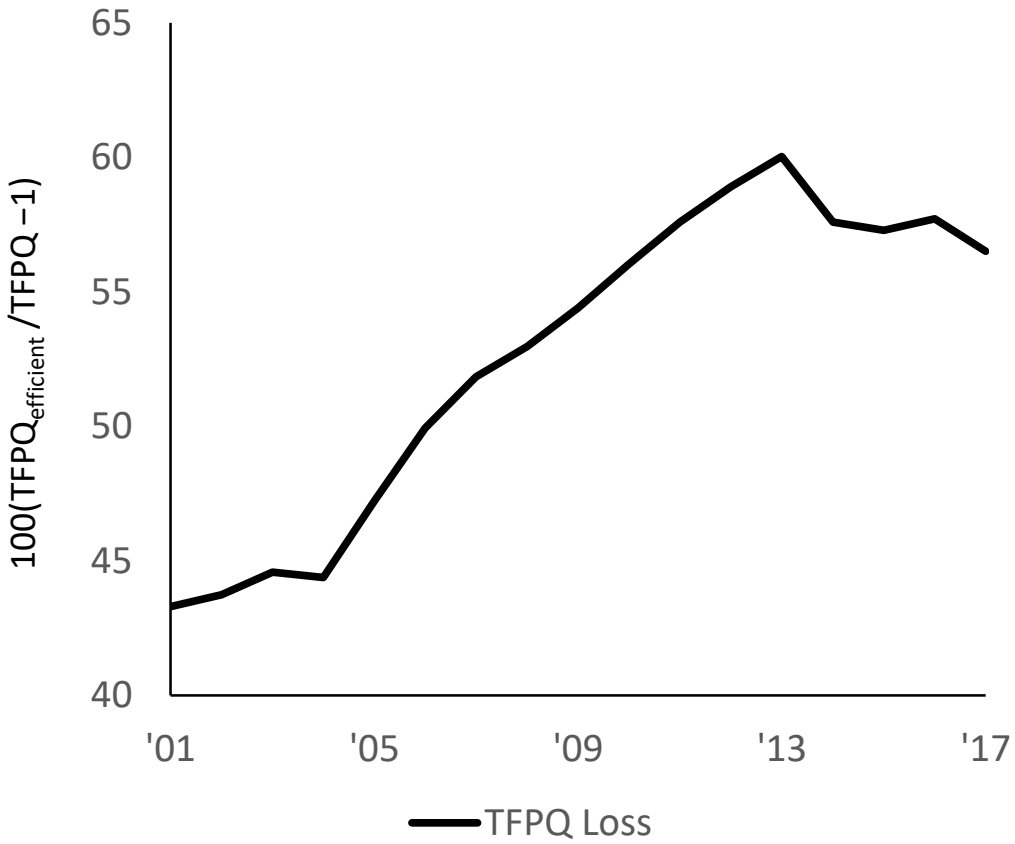
Outcome: TFP Loss

Total TFP Loss



- $TFPQ_{efficient} \Rightarrow \text{std}(MRPK) = \text{std}(MRPL) = \text{std}(TFPR) = 0$

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TFP loss: mismeasurement of misallocation?

More to misallocation than wedges. . .

Haltiwanger, Kulick, Syverson (2018), David and Venkateswaran (2019), Bils, Klenow and Ruane (2018)

Counterfactual analysis: what if only "disturbance" is . . .

Heterogeneity in production function	1%
Heterogeneous markups	25%
Adjustment costs capital	10%

Large part of our misallocation measure is "true" misallocation

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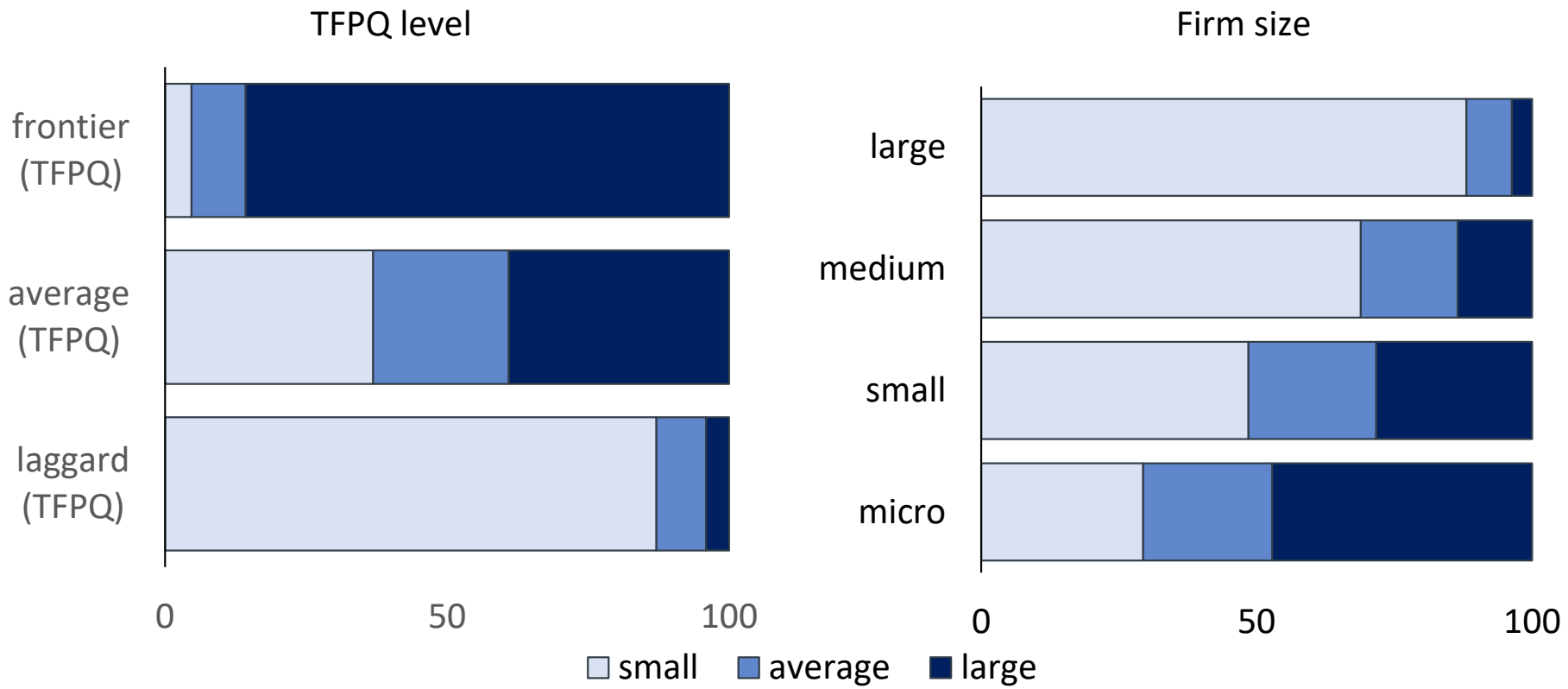
Nature of misallocation: probability high/average/low wedge

Ordered probit τ_i^K: small(decile 1:4) — average(decile 5:7) — large(decile 8:10)

Regressors: dummyset TFPQ (frontier/average/laggard), dummyset size-class (micro, small, medium, large), dummyset year (2001–2017), dummyset NACE Rev.2 (2-digit)



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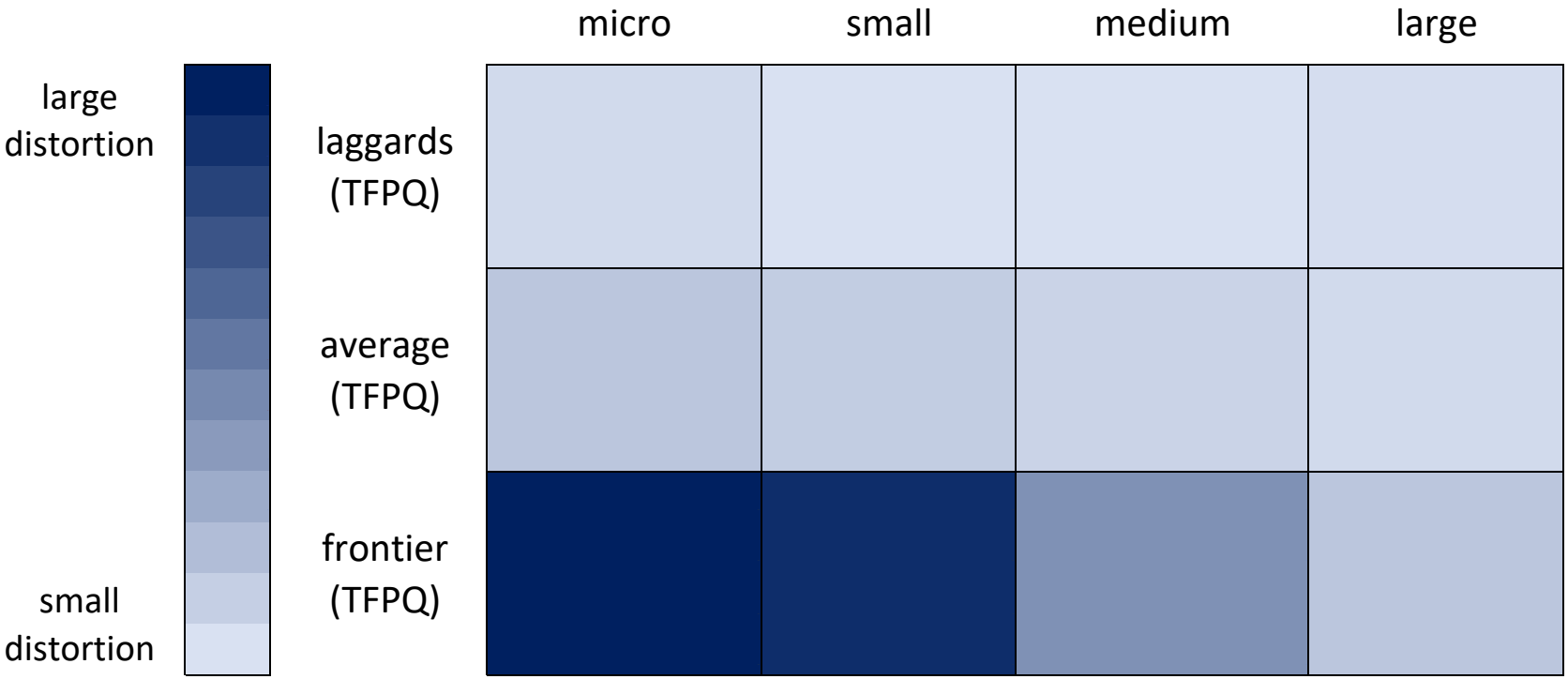
Nature of misallocation: probability high/average/low wedge

Ordered probit τ_i^K: small(decile 1:4) — average(decile 5:7) — large(decile 8:10)

Regressors: dummyset of TFPQ (frontier/average/laggard) × size-class (micro, small, medium, large) × year (2001–2017) and dummyset NACE Rev.2 (2-digit)



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Nature of misallocation:permanent and transitory components

How persistent is misallocation?

- Exploit empirical specifications from literature on individual earnings (Ng, 2008; Guvenen, 2009, Doris et al., 2013)
- Split *MRPK/MRPL* ($y_{i,t}$) in permanent ($y^P_{i,t}$) and transitory ($y^T_{i,t}$) component.

Formula's Doris et al., 2013

$$
\begin{aligned}
y_{i,t} &= y^P_{i,t} + y^T_{i,t} \\
y_{i,t} &= p_t \eta_i + \lambda_t v_{i,t} \\
v_{i,t} &= \rho v_{i,t-1} + \varepsilon_{i,t}
\end{aligned}
$$

$$
\begin{aligned}
V_{t,\infty} &= p_t^2 \sigma_\eta^2 + \lambda_t^2 \sigma_{v1}^2, && t = 1, \\
V_{t,\infty} &= p_t^2 \sigma_\eta^2 + \lambda_t^2 (\rho^{2t-2} \sigma_{v1}^2 + \sigma_\varepsilon^2 \textstyle\sum_{w=0}^{t-2} \rho^{2w}), && t > 1.
\end{aligned}
$$

Doris et al., 2013 intuition

- General Method of Moments (GMM) estimator;
- Firm-level heterogeneity in permanent component;
- Transitory component is a homogenous AR(1) process.

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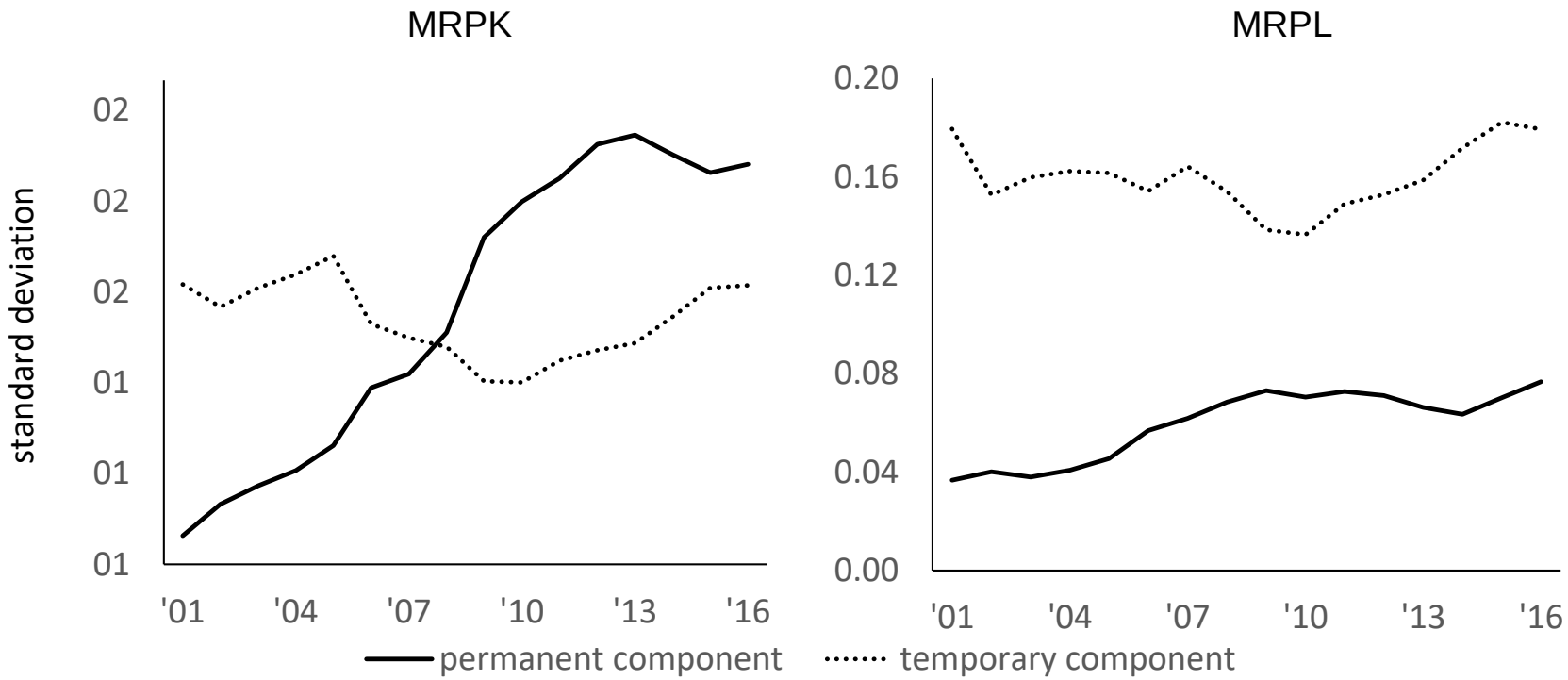
Nature of misallocation:permanent and transitory components

Permanent & transitory component MRPK and MRPL



- *MRPK* has become more permanent, *MRPL* mainly transitory;
- $\text{std}(MRPK^P_{industry}) < \text{std}(MRPK^P_{services})$
- $\text{std}(MRPK^P_{large}) < \text{std}(MRPK^P_{med.}) < \text{std}(MRPK^P_{small}) < \text{std}(MRPK^P_{micro})$

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Nature of misallocation:permanent and transitory components

Closer look at transitory component...

$$y_{i,t} = \eta_i + v_{i,t}$$
$$v_{i,t} = \boldsymbol{\rho_i} v_{i,t-1} + \varepsilon_{i,t}$$

$$y_{i,t} = (1 - \rho_i)\eta_i + \rho_i y_{i,t-1} + \varepsilon_{i,t}$$
$$y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \varepsilon_{i,t}$$

Note:

- Modelling $\boldsymbol{\rho_i}$ costly in terms of parameters;
- Need to restrict sample: balanced sample 2001–2017;
- OLS estimation;

Confirms outcome previous model...

- *MRPK*: $\bar{\rho}_i = 0.59$, std. $= 0.27$, skewness $=$ -0.93 (left-skewed)
- *MRPL*: $\bar{\rho}_i = 0.45$, std. $= 0.30$, skewness $=$ -0.06 (symmetric)

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Nature of misallocation: firms with unit roots

Alternative to permanent and transitory components

- Assume that some firms have a unit root in *MRPK/MRPL* while others have not (Ng, 2008);
- std.*MRPK/MRPL* will be increasing.

Approach:

$$V_{t,\infty} = \Lambda_\infty + \theta \cdot t + c,$$
$$\hat{\theta} = \frac{1}{T} \sum_{t=1}^{T} \Delta V_{t,N}$$

Note:

- $V_{t,\infty}$ = cross-sections varianece of y_i, t in period t;
- Λ_∞ = asymptotic cross-sectional average of η_i;
- θ = fraction of firms for which $\rho_i = 1$.

Also more perstistence in the transitory component of MRPK...

- $\hat{\theta}_{MRPK} = 0.184$, statistically significant at 1% 18.4% of firms have UR;
- $\hat{\theta}_{MRPL} = 0.063$, not statistically significant: no UR's.

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Nature of misallocation: summing up

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