Institute for Employment Research
The Research Institute of the Federal Employment Agency
IAB

Heterogeneous Firms and Substitution by Tasks: the Productivity Effect of Migrants

T.A.S.K.S. 2

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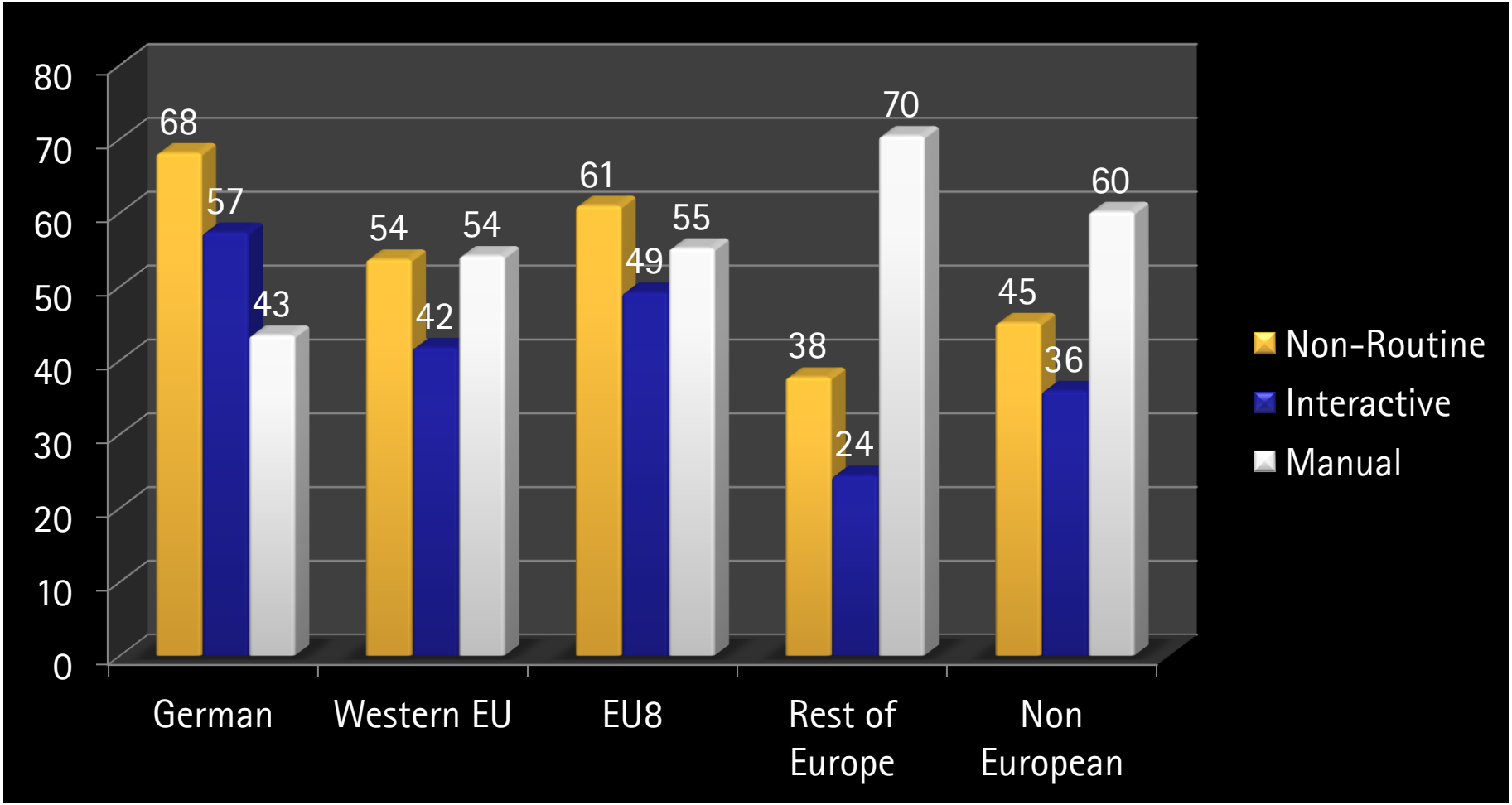
Some Stylized Facts

Agglomerations	Migrants
the average wage is higher	earn lower wages
firms are more productive	are less productive
firms employ a higher share of high qualified workers	have a higher risk of being unemployed
the share of migrants is higher	tend to move to agglomerations
offer more specialized jobs	perform different tasks than natives

Main Tasks characteristic for the job



Data Source: IAB Employment History Data 2008

1. Motivation

- Migrants tend to move to cities (two-sided causality)
- Migrants work more often in non interactive intensive jobs
- **Topic here:** Do migrants increase productivity and wages? Which mechanisms lead to this? What are the implications?
- Human capital theory:
  - Migrants lose some human capital when they move to another country

  → they turn to be less productive and thus receive lower wages
- Aim of this paper:
  - Introduce a model that explains a causal relationship between productivity and migrant share

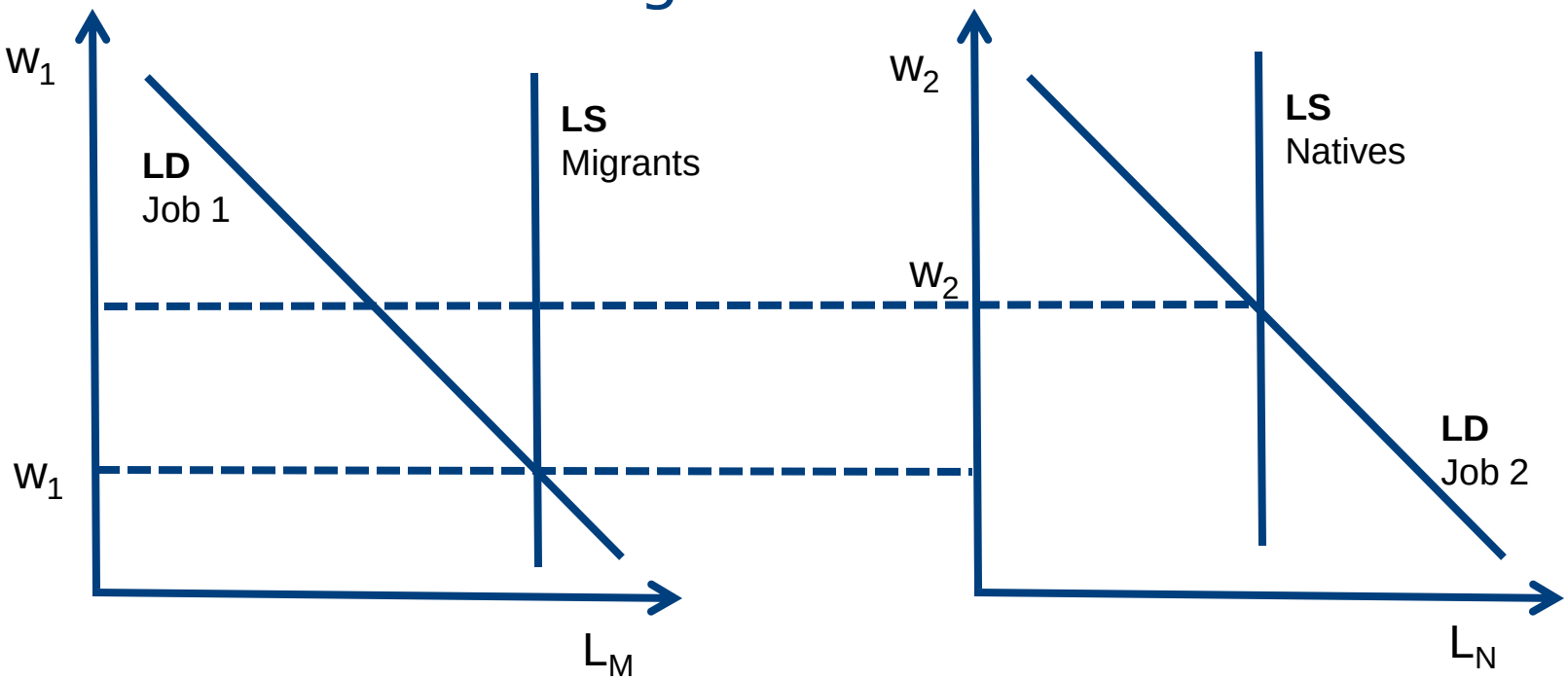
Agenda

1. Motivation
2. Basic Model: Worker and Firm Behaviour
3. Labor Market Segmentation
4. Basic Model Framework with Heterogeneous Firms
5. Link to Productivity
6. Conclusion

Model: Worker and Firm Behavior

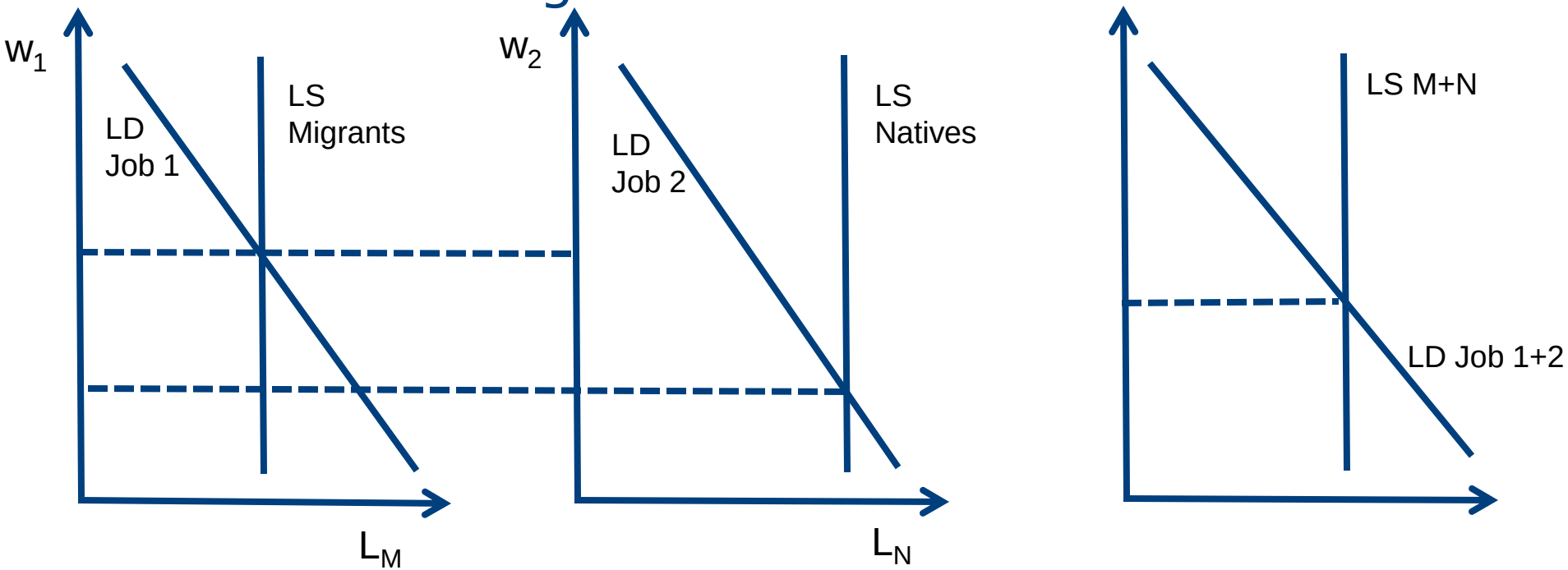
- Assumptions
  - 2 labor force groups: migrants and natives
  - 2 kinds of jobs (job1 and job 2)
  - Migrants cannot perform job 2, while natives can perform both
    - Possible reasons:
      - Certain abilities/tasks are necessary for some jobs (interactive and communication tasks)
      - Lack of integrative capability (organizational structure, ability of firm boss)
      - (Statistical) discrimination by employer or customer
  - There are no differences regarding the **productivity** in job 1 that both groups can perform
    - Here: productivity is measured as output per working hour
- What about substitution between migrants and natives?

Labor Market Segmentation: Case 1



- Natives and migrants are separated in different labor market segments
- The wage for natives exceeds the wage of migrants: $w_1 > w_2$
- Migrants and natives are not substitutes

Labor Market Segmentation: Case 2

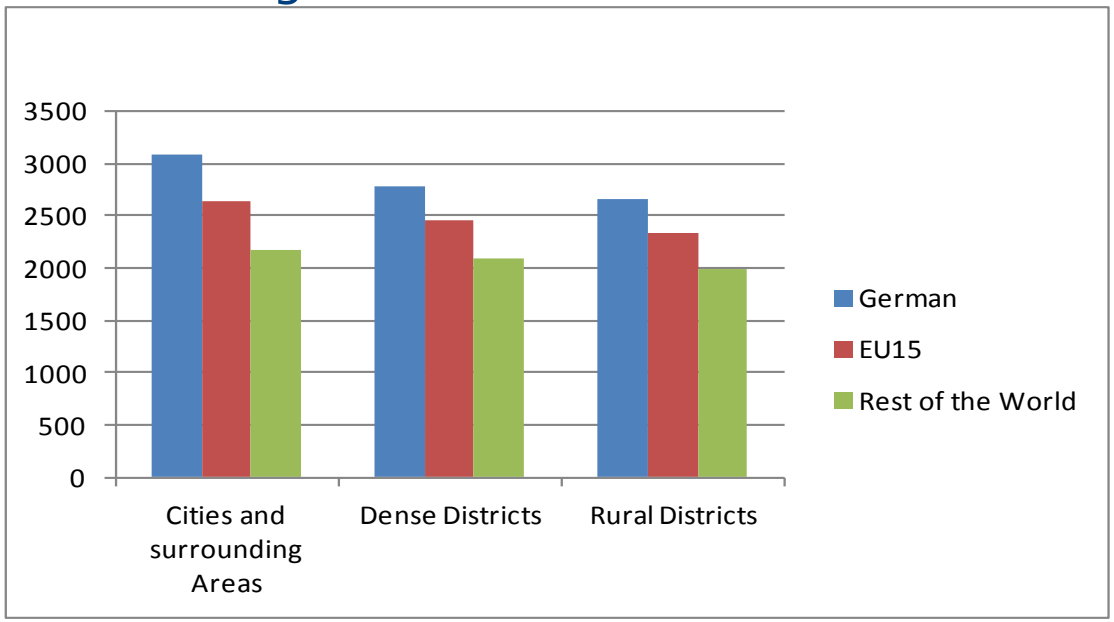


- Natives are drawn into the first job due to higher wage opportunities: labor market segments merge
- Migrants and natives are perfect substitutes

Labor Market Segmentation

Result: differences in wages between migrants and natives are expected to be lower in regions with a lower migrant share

Descriptive results for monthly wages in 2008 (data source: IEBS)



- If wages of natives are higher → natives cluster in job 2 (case 1)

Firm and Household Behavior

- Every firm draws its own share of job one, $a_f \in [0,1]$, at the time of founding from a known distribution $G(\alpha)$ and has to pay market entry costs e and per period fixed costs A and will drop out of market in the next period with probability δ
- Thus for the output q_f it holds that:

$$a_f \cdot q_f = A \cdot l_1^f \text{ and } \left(1 - a_f\right) \cdot q_f = A \cdot l_2^f \qquad (1)$$

where A is the total factor productivity and l_1^f, l_2^f are the demand of firm f of job1 and job 2

- firms face Dixit-Stiglitz monopolistic competition where the utility of households is given by a standard CES-aggregate:

$$U = \left(\int c(\omega)^\rho d\omega\right)^{\frac{1}{\rho}}$$

ω: product varieties

with $0 < \rho < 1$ and elasticity of substitution $\sigma = \frac{1}{1-\rho} > 1$

Aggregate Labor demand

- Labor demand for migrants

$$L_1^D = \frac{1}{1-G(a^*)} \int_{a^*}^{1} M \cdot l_1(a) g(a) da$$

$$= \frac{MQP^{\sigma}\rho^{\sigma}}{A\left(1-G(a^*)\right)} \int_{a^*}^{1} a \cdot \phi(a)^{\sigma} g(a) da$$

- Relative labor demand (excluding fixed and entry costs)

$$\frac{L_1^D}{L_2^D} = \frac{\int_{a^*}^{1} a \cdot \left(a + (1-a) \cdot \frac{w_2}{w_1}\right)^{-\sigma} g(a) da}{\int_{a^*}^{1} (1-a) \cdot \left(a + (1-a) \cdot \frac{w_2}{w_1}\right)^{-\sigma} g(a) da}$$

  - the right side is increasing in a^* and $\frac{w_2}{w_1}$

Wages and Cut-Off Point

- Combining the zero-profit and zero-cutoff condition yields:

$$\frac{\delta \cdot e}{F} = \int_{a^*}^{1} \left(\left(\frac{a^* + \frac{w_2}{w_1}(1-a^*)}{a + \frac{w_2}{w_1}(1-a)} \right)^{\sigma-1} - 1 \right) g(a) da$$

  - Thus the implicit function $a^*\left(\frac{w_2}{w_1}\right)$ is increasing in $\frac{w_2}{w_1}$

- Result:
  - If the wage of migrants relatively decreases, firms that are restricted in their ability to employ migrants drop out of the market
  - An increasing migrant share raises firm competition in terms of firm exits

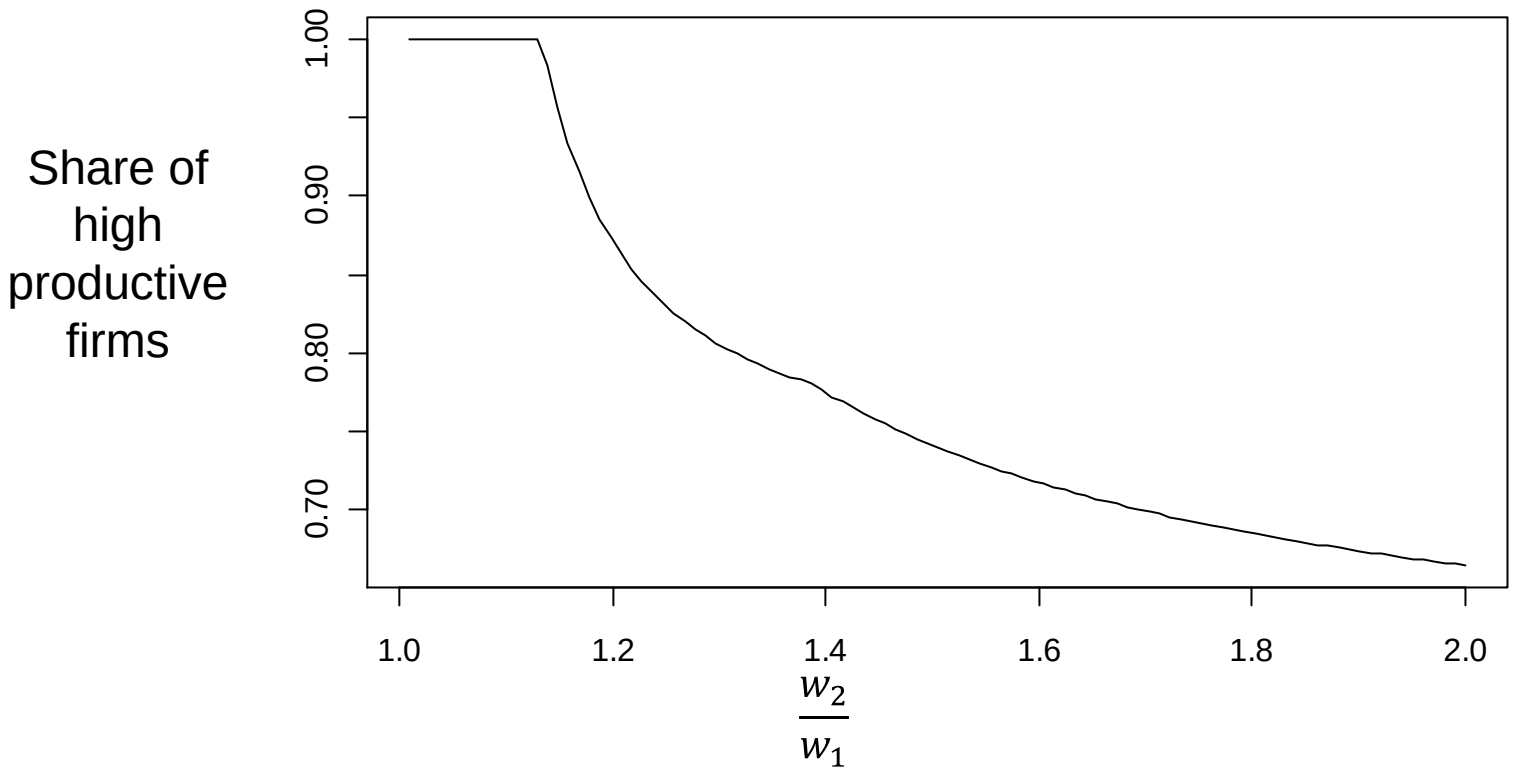
Advanced Firm Behavior and Firm Productivity

- Total factor productivity may also differ between firms
  - two levels: A_h and A_l
  - also drawn at firm founding, independently from job 1 share
- Marginal costs of the production of the symmetric good:

$$\phi_f = \frac{A_f}{w_1 \cdot a_f + w_2 \cdot (1 - a_f)}$$

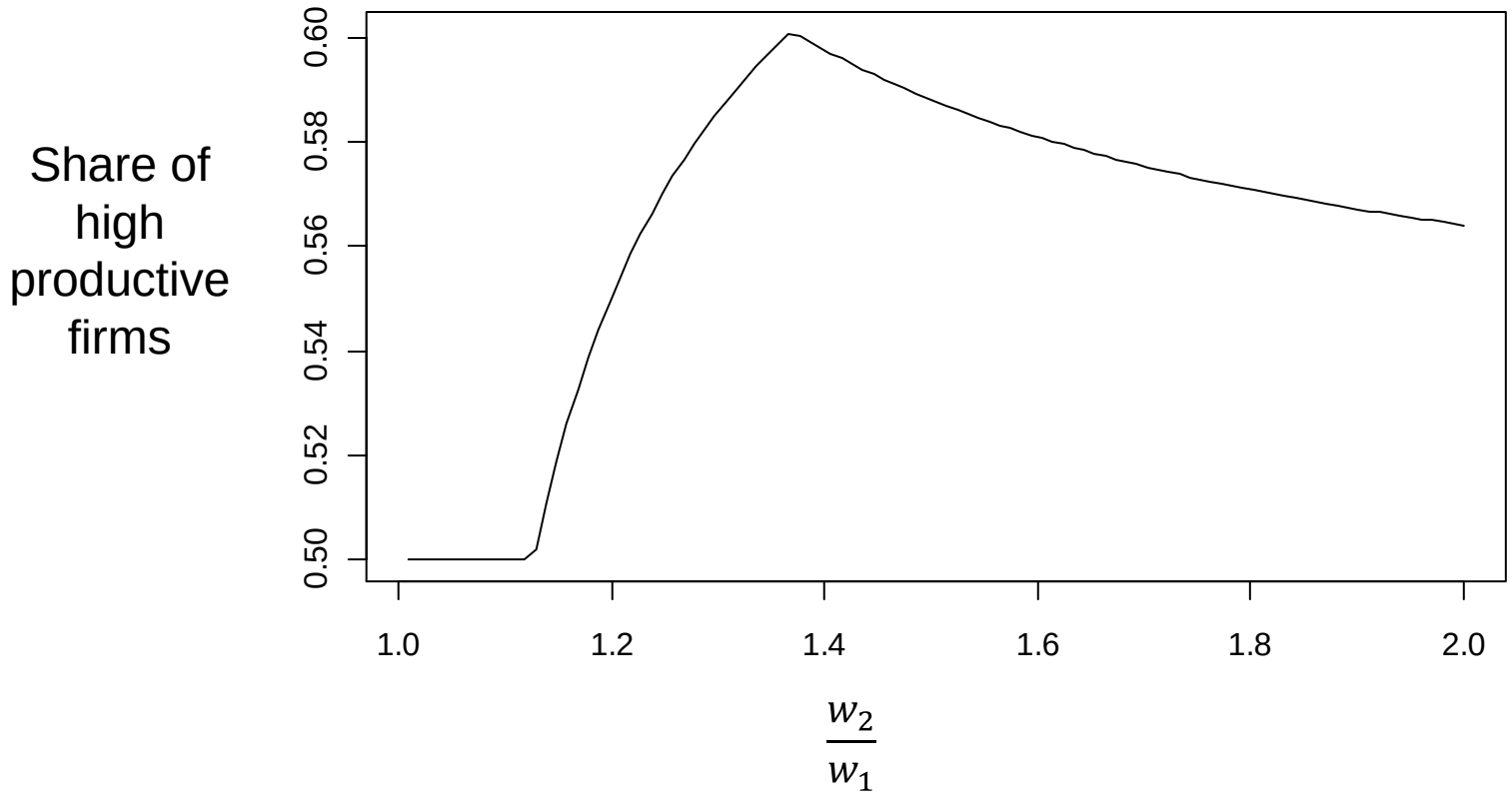
  - depends on two factors:
    - productivity advantage
    - wage costs advantage
- When there is no difference between wages of migrants and natives two cases are possible:
  - all low productive firms immediately leave the market
  - all low productive firms are profitable and thus stay in the market

Case 1:



- Low productive firms are able to substitute productivity by cost advantages and thus may stay in the market
- Average productivity decreases in relative wage (and thus migrant share)

Case 2:



- Competition effect forces both high and low productive firms to exit when there is a higher wage differential
- For lower wage differences only less productive firms are harmed

Concluding Results from the Model

- A higher migrant share may lead to higher productivity
  - two opposing effects → substitution and increased wage advantages lead to more firm failures on low productive firms
  - as migration is quite concentrated on cities it may explain part of the agglomeration advantages
- The less productive a firm is, the more likely it is to employ a higher share of migrants
- Wage advantages are substitutes to productivity

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Thank you for your attention!

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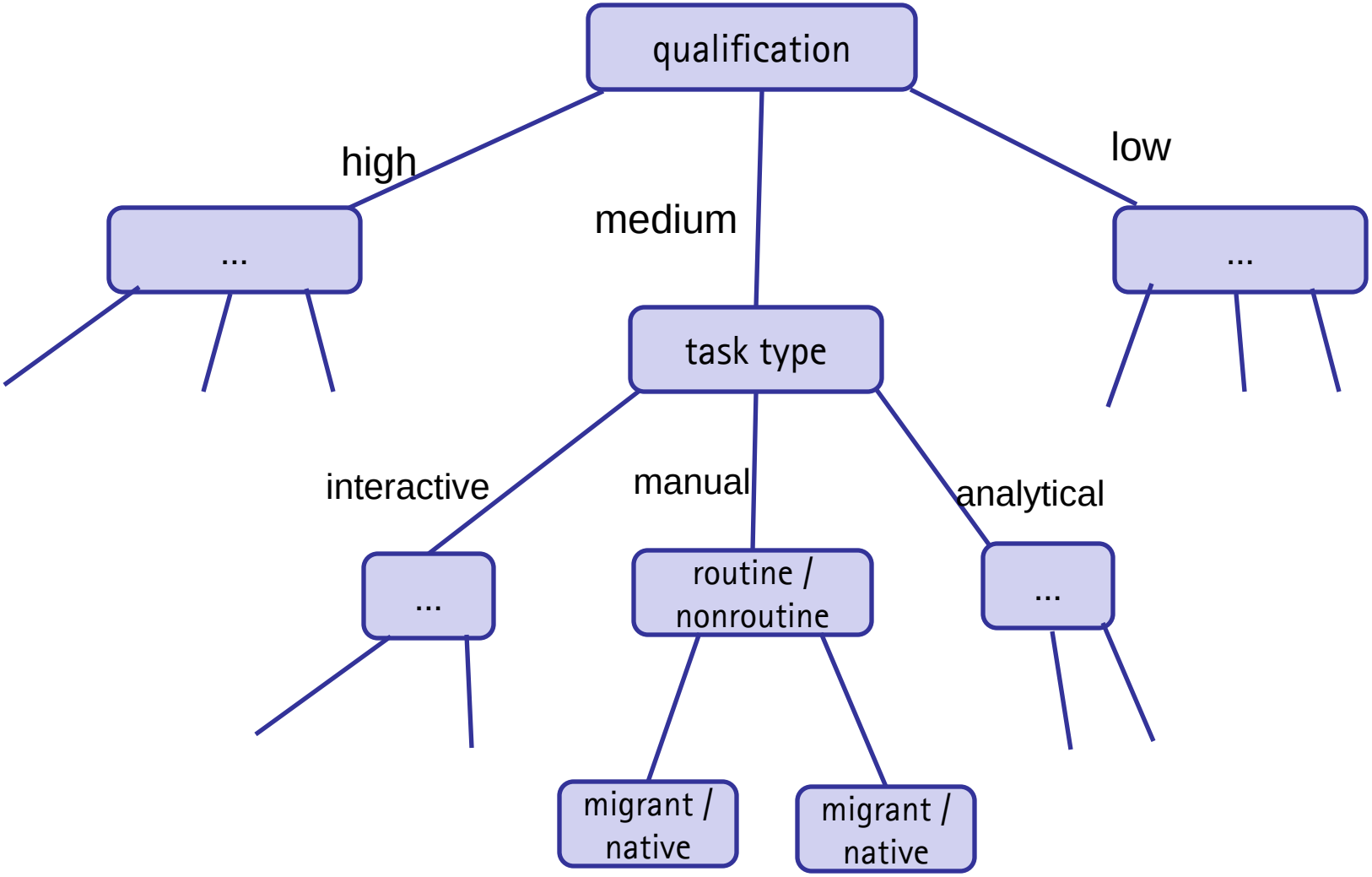
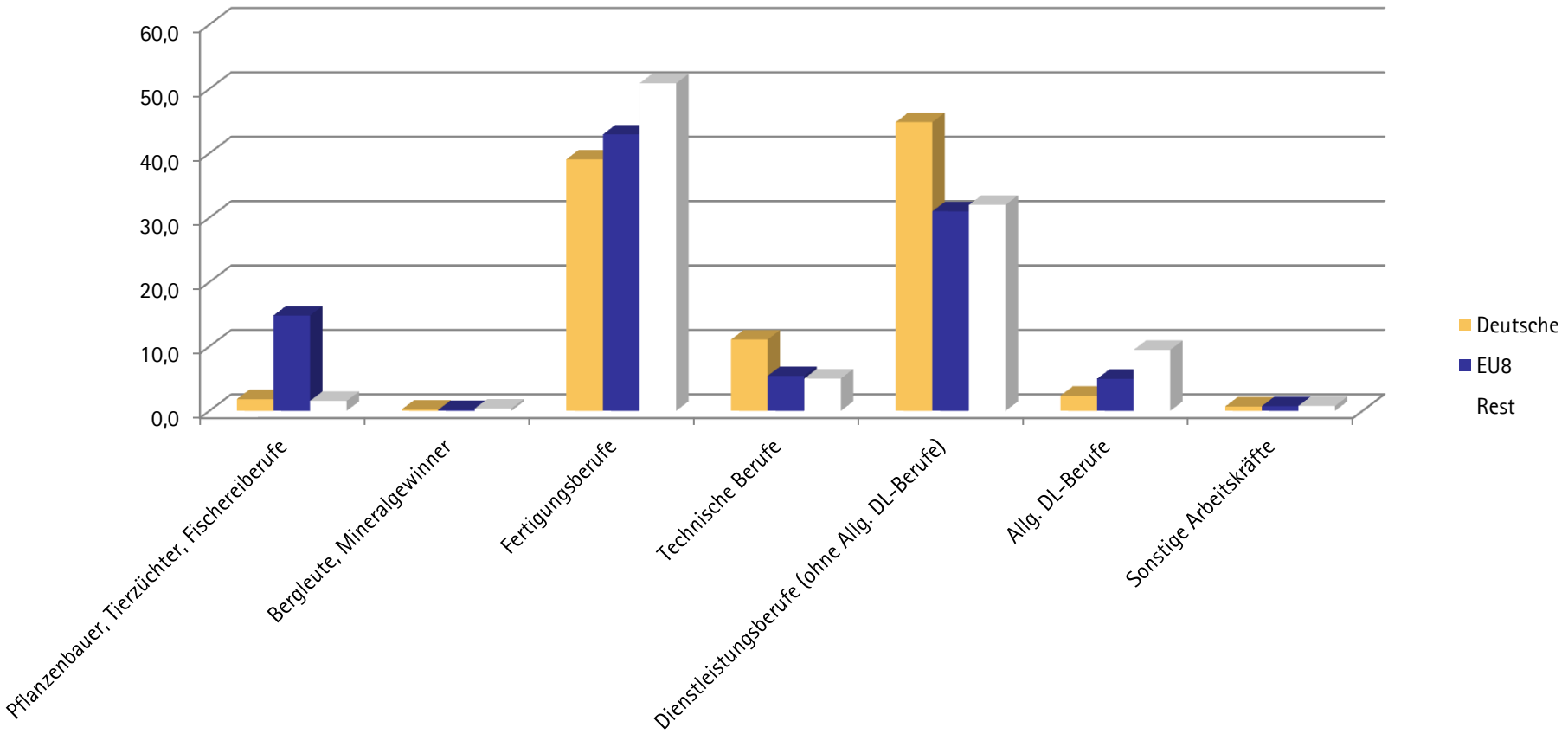
Nested CES-Production Function



Männer 2008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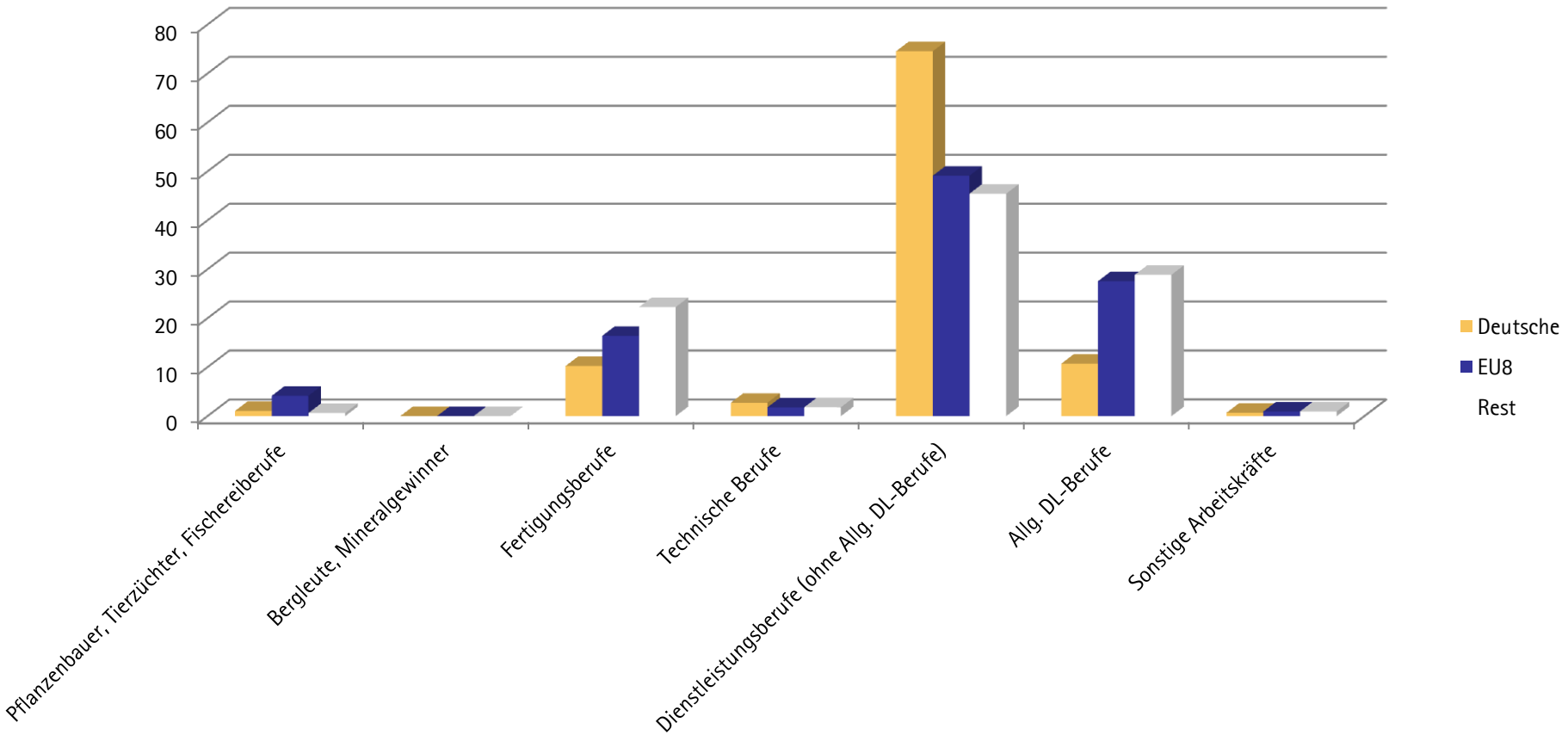
Pflanzenbauer, Tierzüchter, Fischereiberufe
Bergleute, Mineralgewinner
Fertigungsberufe
Technische Berufe
Dienstleistungsberufe (ohne Allg. DL-Berufe)
Allg. DL-Berufe
Sonstige Arbeitskräfte
Deutsche
EU8
Rest

Frauen 2008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Bergleute, Mineralgewinner
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Rest

Concluding Results from the Model

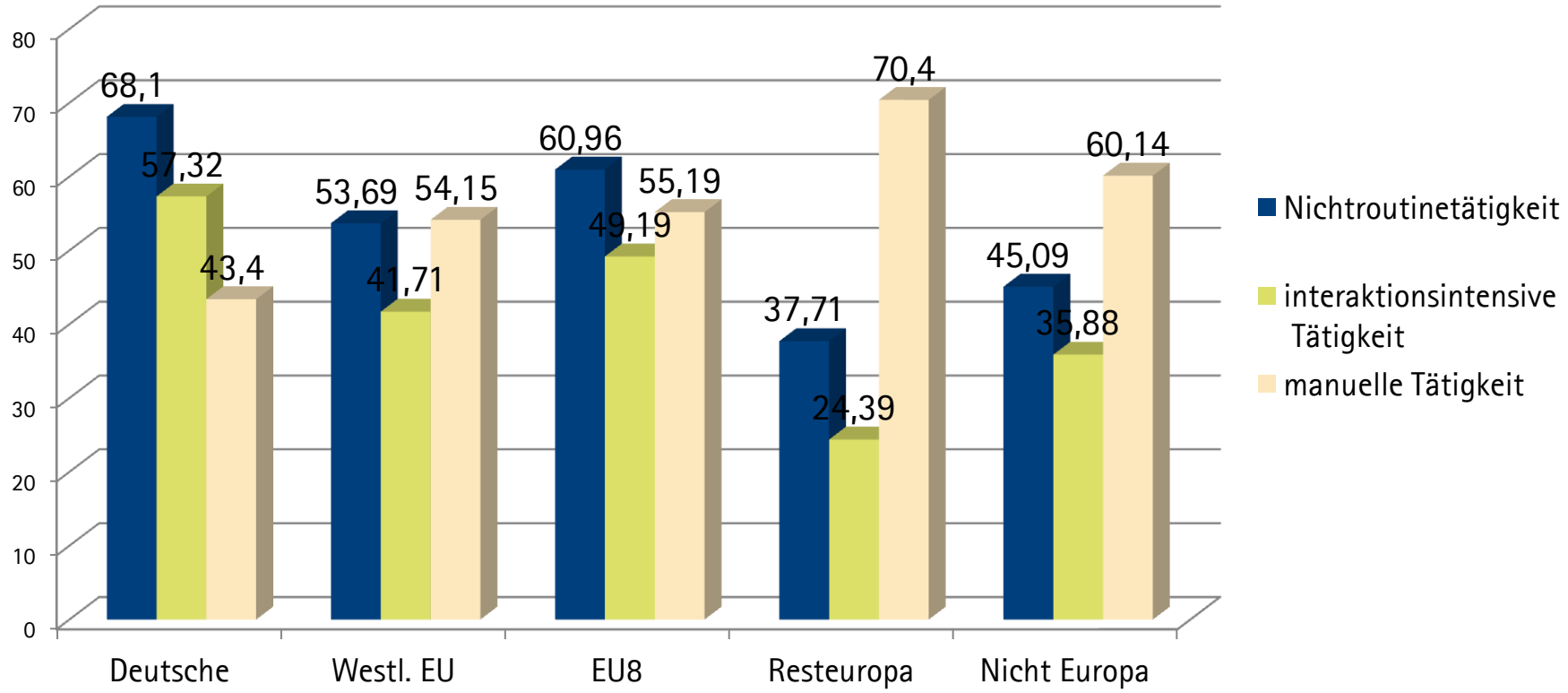
- A higher migrant share may lead to higher productivity
- The less productive a firm is, the more likely it is to employ a higher share of migrants
- Sociological aspects:
  - regional differences of workers perception of migrants
  - different market reaction on discrimination

Empirical adaption

- Main Question:

  What is the effect on wages if an migration shock occurs?
  - Estimation strategy:
    - define labor market regions
    - separate firms by branches
    - separate workers by skill and task groups
    - use nested CES-Production function

Main Tasks needed on the Job (2008)



Estimation strategy

- benchmark:
  - follow the approach of D'Amuri, Ottaviano and Peri (European Economic Review, 2010)
    - estimate parameters of the CES-production function with migrants as imperfect substitutes for natives
    - extended by task approach
    - simulate wage effects of a migration shock

Estimation strategy

- model approach
  - use the formula from the model to estimate the elasticity of substitution

$$\frac{L_m}{L_n} = \frac{\int_0^1 a\left(a + (1-a)\frac{w_2}{w_1}\right)^{-\sigma} g(a)da}{\int_0^1 (1-a)\left(a + (1-a)\frac{w_2}{w_1}\right)^{-\sigma} g(a)\,da}$$

  - Simulate a migration shock
  - calculate General equilibrium results using above formula **and** results from the estimated CES-parameters

- Compare both results

Estimating CES-Production-Function on Firm Level

Eine Firma maximiert den Gewinn:

$$\Pi = \left[\left(a_h L_h^{\frac{\sigma-1}{\sigma}} + a_l L_l^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}\right]^{\mu} - w_h L_h - w_l L_l; 0 < \mu < 1$$

Allerdings kann die Firma nur entweder keinen HQ einstellen [$L_h = 0$] oder muss ein gewisses Minimum erfüllen [$L_h > \tilde{L}_h$]. Falls solch ein $L_h > \tilde{L}_h$ ex. so dass

$$\frac{d\Pi}{\mathrm{dL_h}} = 0 \tag{1}$$

gilt, ist alles wie gewohnt. Falls nicht, gilt notwendigerweise

$$\frac{d\Pi}{\mathrm{dL_h}}\left(\tilde{\mathrm{L}}_{\mathrm{h}}\right) < 0 \tag{2}$$

Estimating CES-Production-Function on Firm Level

und die folgende Differenz ist entscheidend:

$$\Delta\Pi(0) = \Pi(\tilde{L}) - \Pi(0).$$

Wenn diese Positiv ist, ist es optimal $L_h = \tilde{L}_h$ zu wählen, sonst ist $L_h = 0$ optimal.

Für Schätzung folgendes Vorgehen:

1. Überall, wo eine Null auftaucht, ersetze den (nicht vorhandenen) Lohn durch den Durchschnitts(oder Minimal-) Lohn in der Region&Gruppe.
2. Ersetze die Nullen bei der Beschäftigung durch $\tilde{L}_h$.
3. Schätze Tobit mit (1) und (2):

$$\left\{\begin{array}{c} \ln(w_i) = \beta_1 + \beta_2 lnL_{hi} + \beta_3 x_i + \epsilon_i \; falls \; L_{hi} > \tilde{L}_i \\ \ln(w_i) > \beta_1 + \beta_2 lnL_{hi} + \beta_3 x_i + \epsilon_i \; falls \; L_{hi} = \tilde{L}_i oder \; L_{hi} = 0 \end{array}\right\}$$

Aggregation

- Let M be the long equilibrium number of firms and $\mu(a)$ the distribution of maximum migrant shares of firms in the market. Define a weighted average productivity:

$$\tilde{\phi} = \int_0^1 \phi(a)^{\sigma-1} \mu(a) da$$

- nice:

$$P = M^{\frac{1}{1-\sigma}} \cdot p(\tilde{\phi}) \; ; \; Q = M^{\frac{1}{\rho}} \cdot q(\tilde{\phi})$$

$$R = P \cdot Q = M \cdot r(\tilde{\phi}); \; \Pi = M \cdot \pi(\tilde{\phi})$$

- not so nice: labor demand
- Every firm that makes positive profit will try to stay in business. So define the minimum necessary productivity ϕ^* (and thus a minmax migrant share a^*) by:

$$\pi(\phi^*) = 0$$

Results

- A higher share of migrants lead to:
  - stronger relative difference in wages between natives and migrants
  - more competition in terms of firms exits
  - higher average productivity of firms
  - Clustering of migrants in certain jobs or tasks

Equilibrium

- The mean and the minimal productivity are related:

$$\tilde{\phi}(a^*) = \left[\frac{1}{1-G(a^*)}\int_{a^*}^{1}\phi(a)g(a)da\right]^{\frac{1}{\sigma-1}}$$

  - so the average profit level is determined by it too:

$$\bar{\pi} = w_2 F\left(\left(\frac{\tilde{\phi}(a^*)}{\phi^*(a^*)}\right)^{\sigma-1} - 1\right)$$

- The Free-Entry condition:

$$\bar{\pi} = \frac{\delta \cdot e \cdot w_2}{1-G(a^*)}$$

- Both conditions lead to:

$$\frac{\delta \cdot e}{F} = \int_{a^*}^{1}\left(\left(\frac{\phi(a)}{\phi^*(a^*)}\right)^{\sigma-1} - 1\right)g(a)da$$

- right side is decreasing monotonically in a^*.