Task Specialization and the Native-Foreign Wage Gap: Evidence from Worker-level Data

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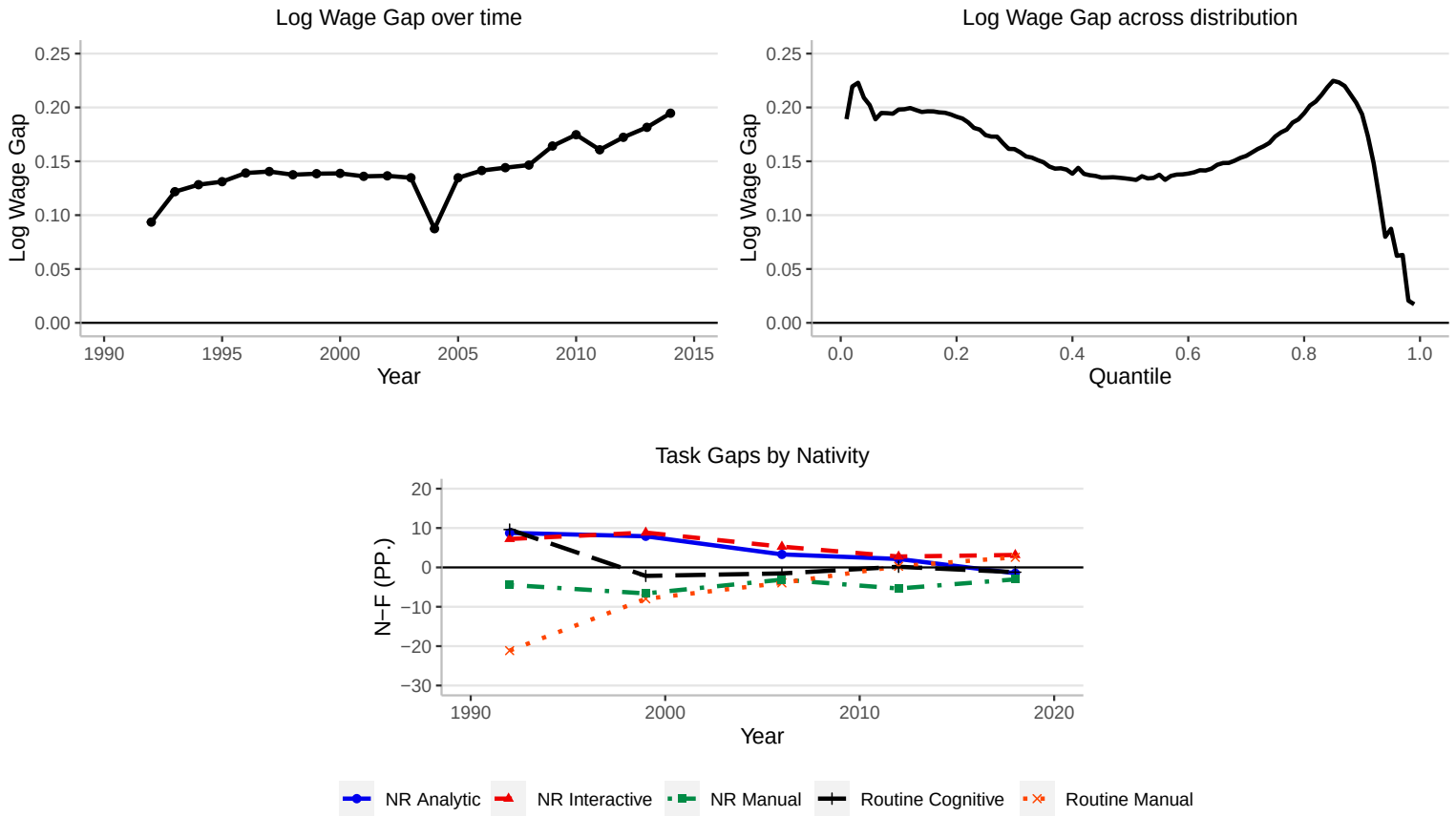
Motivation



NOTE. —"NR" stands for Non-Routine Activities. NR Analytic and NR Interactive can be subsumed under *Abstract* tasks, involving lots of problem-solving skills. Routine Cognitive and Routine Manual can be subsumed under *Routine* tasks, characterized by various repetitive steps. NR *Manual* involves activities requiring hand-eye coordination, which are difficult to automate.

Figure 1: Native-Foreign (NF) Wage & Task Gap in Germany, 1992-2018

Source: SIAB-R 7514, BIBB/IAB/BAuA

Motivation

- If F workers assimilate in terms of educational outcomes[1] and tasks, then why do we not observe a convergence in wages?

[1] Omitted in this presentation, see paper for details.

Contributions

1. **Variation in Tasks at worker-level predictive of the NF Wage Gap**
   - Robust to inclusion of Education and Experience measures

   $\Rightarrow$ Challenges identifying assumptions in structural models in which N & F with similar education-experience profile are assumed to be perfect substitutes (e.g., *D'Amuri, Ottaviano & Peri 2010*)

2. **RIF Decomposition applied to Migration Context**
   - Idiosyncratic differences pronounced among high-wage earners
   - Contribute up to 25% to explained wage gap

   $\Rightarrow$ Conventional decomposition methods such as Oaxaca-Blinder (OB) understate the impact of tasks on wage gaps

3. **Between-Occupation vs Within-Occupation Contributions**
   - Occupational segregation: $\geq 70\%$
   - Within-Occupation specialization: $\geq 10\%$

   $\Rightarrow$ Focus on occupational segregation alone understates degree of task specialization between N & F (e.g., *Peri & Sparber 2009, 2011*)

Data

- German employment surveys provided by BIBB/IAB/BAuA[2]
  - Key: Information on *self-reported* tasks by workers (1992 - 2018)

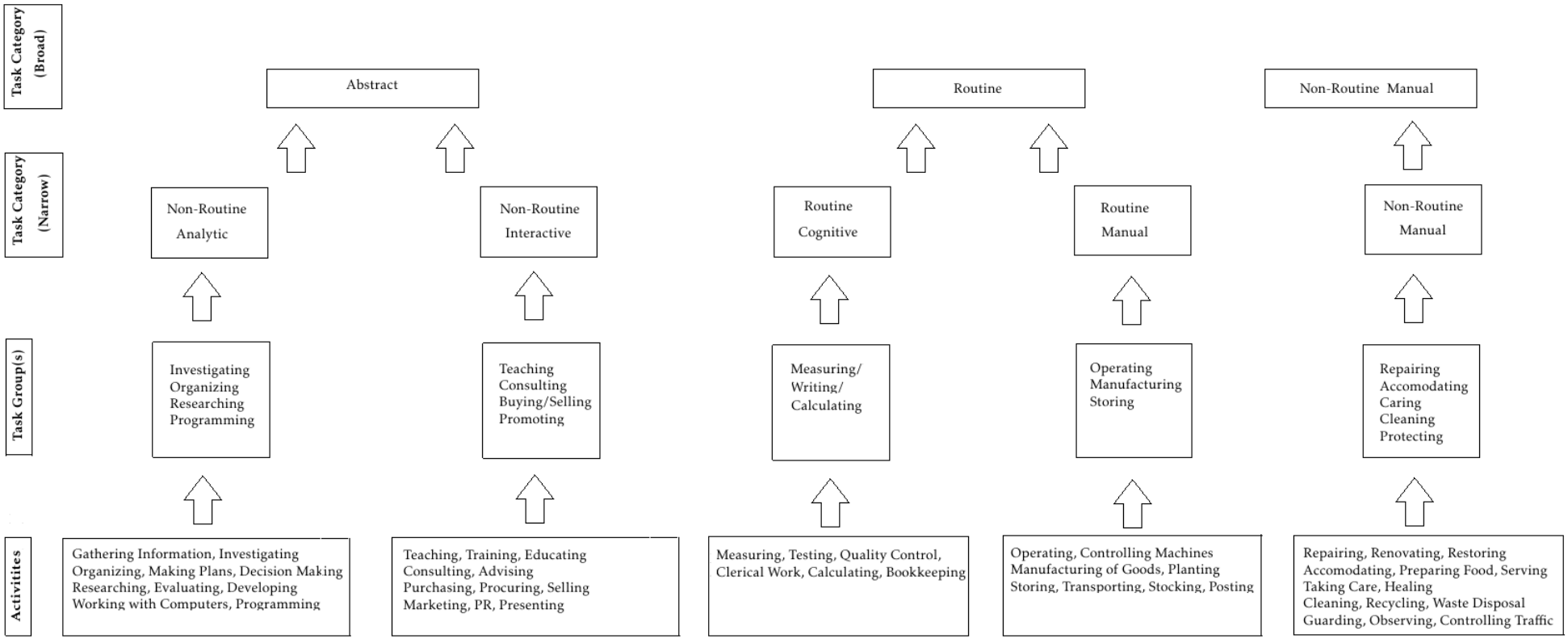


Figure 2: From Activities to Tasks: Construction of the Task Content

[2]BIBB = Federal Institute for Vocational Education, IAB = Institute of Employment Research, BAuA = Federal Institute of Occupational Safety and Health

Data

- **Measuring individual task content**: Compute relative importance of task category j for individual i at time t[3]

$$T_{ijt} = \frac{\text{No. of activities performed by i in task category j at time t}}{\text{Total no. of activitites by i across } \textit{all} \text{ j's at time t}} \tag{1}$$

Note:

- $T_{ijt} \in [0, 1] \; \forall j$
- $\sum_J T_{ijt} = 1$

[3] following *Antonczyk, Fitzenberger, and Leuschner (2009)*

Data

- **Measuring occupational task content**: Collect T_{ijt} for all N_o workers employed in occupation o at time t

$$T_{jot} = \frac{1}{N_{ot}} \sum_i T_{ijt_{o_{sub}}} \tag{2}$$

– $sub \in (o_{90}, o_{00})$
  - o_{90} = sub-sample 1992-99
  - o_{00} = sub-sample 2006-18

Note:

- $T_{jo} \in [0, 1]\ \forall j$
- $\sum_J T_{jo} = 1$

Methodology

Main Analysis: Recentered Influence Function (RIF) Decomposition

- Conventional Oaxaca-Blinder (OB) Decomposition for groups $g = N, F$:

$$\implies \overline{w}_N - \overline{w}_F = \underbrace{(\overline{X}_F - \overline{X}_N)\hat{\beta}_N}_{\text{Explained Part}} + \underbrace{\overline{X}_F(\hat{\beta}_N - \hat{\beta}_F)}_{\text{Unexplained Part}} \tag{3}$$

- **What I do:** Generalize OB by applying it along the wage distribution and replace mean wages with corresponding RIF by $g = N, F$ at decile τ:

$$\implies RIF^N_\tau - RIF^F_\tau = \underbrace{(\overline{X}^F_\tau - \overline{X}^N_\tau)\hat{\beta}^N_\tau}_{\text{Explained Wage Gap}} + \underbrace{\overline{X}^F_\tau(\hat{\beta}^N_\tau - \hat{\beta}^F_\tau)}_{\text{Unexplained Wage Gap}} \tag{4}$$

Methodology: Recentered Influence Function (RIF) Decomposition

- Following *Firpo, Fortin & Lemieux (2009)*, construct an RIF based on:

$$RIF_g(w_g, p_\tau) = \underbrace{\frac{\tau - I(w_g \leq p_\tau)}{f_{w_g}(p_\tau)}}_{\text{Influence Function (IF)}} + \underbrace{p_\tau}_{\text{Recentered (R)}} \tag{5}$$

  - $g = N, F$
  - p_τ: Log Hourly Real Wage at decile $\tau = 0.1, ..., 0.9$
  - $I(w_g \leq p_\tau)$: Indicator suggesting if observed wage for $g = N, F$ falls below decile p_τ
  - $f_{w_g}(p_\tau)$: Marginal density of w_g associated with p_τ

Methodology

- Perform quantile regressions by replacing the original dependent variable ($ln\ w_{it}$) with its corresponding RIF:

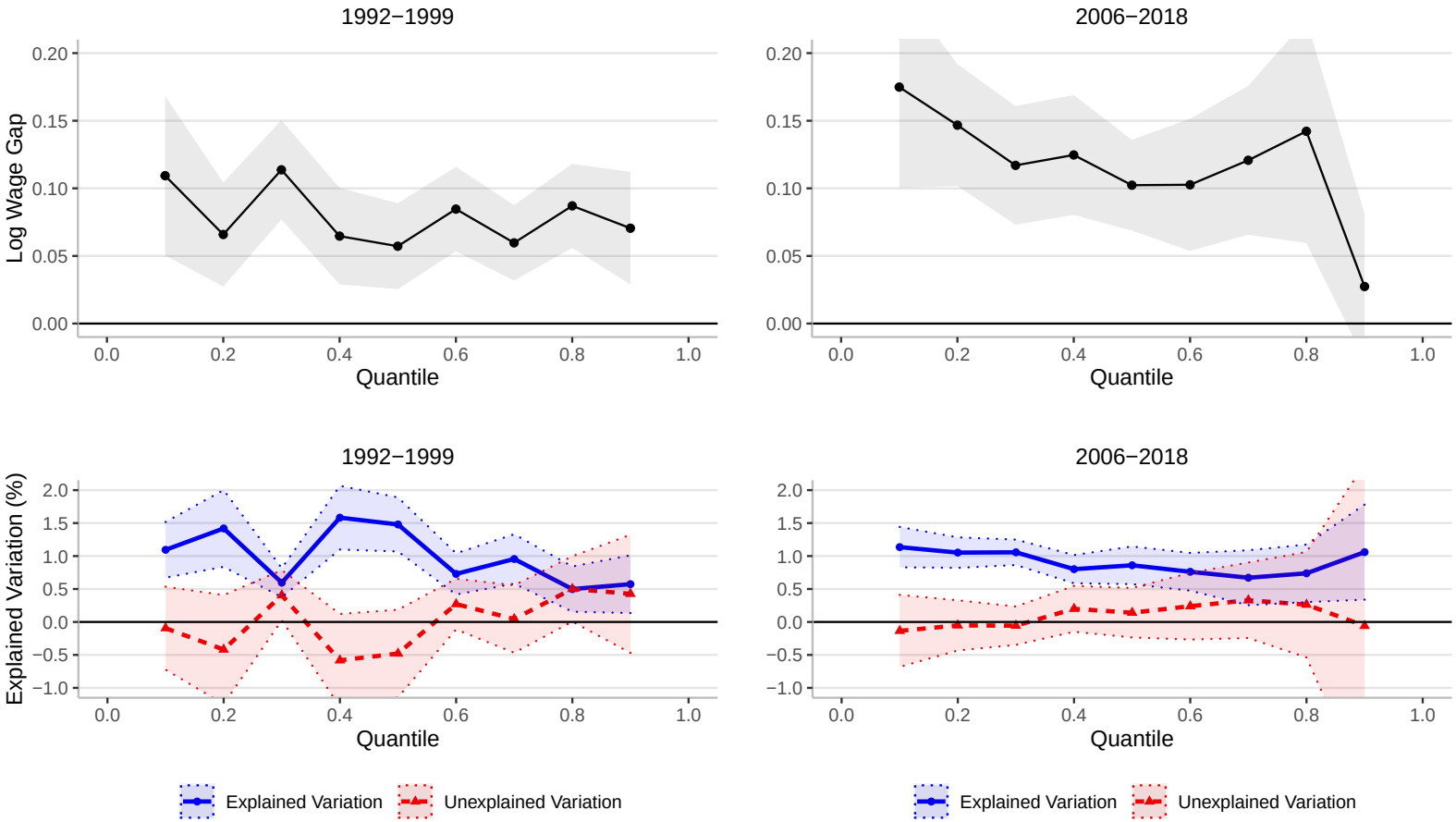
$$RIF_g(ln\ \widehat{w_{it}, p_\tau} | \boldsymbol{T}, \boldsymbol{X}) = \alpha + \beta_1 \boldsymbol{T_{it}} + \beta_2 \boldsymbol{T_{ot}} + \gamma \boldsymbol{X_{it}} + \delta_t + \lambda_r + \eta_s + \epsilon_{it} \quad (6)$$

- $\boldsymbol{T_{it}} = \left(T_{i1t}, T_{i2t}, ..., T_{iJt}\right)$: Task category j performed by i at time t
- $\boldsymbol{T_{ot}} = \left(T_{1o}, T_{2ot}, ..., T_{Jot}\right)$: Task category j performed in occupation o
- $\mathbf{X}_{it}$: Controls
- δ_t, λ_r, η_s: Time, Region, Sector dummies

▸ Occupational Segregation

▸ Within-Occupation Specialization

Key Results RIF Decomposition: Explained Wage Gap



NOTE. —Point estimates are displayed with a 95% Confidence Interval.

Figure 3: German Native-Foreign Wage Gap by sub-samples, 1992-2018

Assessment of Relative Importance of Task Measures

Visual evidence from Figure (3) combined with eq. (4) implies for most τ:

$$
\begin{aligned}
RIF_{\tau}^{N} - RIF_{\tau}^{F} &= \underbrace{(\overline{X}_{\tau}^{F} - \overline{X}_{\tau}^{N})\hat{\beta}_{\tau}^{N}}_{\text{Explained Wage Gap}} + \underbrace{\overline{X}_{\tau}^{F}(\hat{\beta}_{\tau}^{N} - \hat{\beta}_{\tau}^{F})}_{\text{Unexplained Wage Gap}} \\
&\approx \underbrace{(\overline{X}_{\tau}^{F} - \overline{X}_{\tau}^{N})\hat{\beta}_{\tau}^{N}}_{\text{Explained Wage Gap}}
\end{aligned} \tag{7}
$$

Split covariates included in X:

- $\Delta T_{j,\tau} = \overline{T}_{j,\tau}^{F} - \overline{T}_{j,\tau}^{N}$: Difference in the total task content for j at decile τ between F and N
- $\Delta X_{\tau}^{'} = \overline{X}_{\tau}^{F'} - \overline{X}_{\tau}^{N'}$: Difference in the remaining covariates at τ between F and N

Assessment of Relative Importance of Task Measures

Expanding on eq. (7), the explained wage gap can then be represented as follows:

$$
\begin{aligned}
\underbrace{RIF_{\tau}^{N} - RIF_{\tau}^{F}}_{\text{Explained Wage Gap}} &= \sum_{j=1}^{J} \underbrace{\Delta T_{j,\tau} \hat{\beta}_{j,\tau}^{N}}_{\text{Total Task Variation}} + \underbrace{\Delta X_{\tau}^{'} \hat{\beta}_{\tau}^{N}}_{\text{Controls}} \\
&= \sum_{j=1}^{J} \underbrace{\left[(\overline{T}_{ij,\tau}^{F} - \overline{T}_{ij,\tau}^{N}) \hat{\beta}_{j(i),\tau}^{N} \right.}_{\text{Individual-level Tasks}} + \underbrace{\left. (\overline{T}_{jo,\tau}^{F} - \overline{T}_{jo,\tau}^{N}) \hat{\beta}_{j(o),\tau}^{N} \right]}_{\text{Occupation-level Tasks}} + \Delta X_{\tau}^{'} \hat{\beta}_{\tau}^{N} \\
&\equiv \sum_{j=1}^{J} \left[\Delta T_{j,\tau}^{I} \hat{\beta}_{j(i),\tau}^{N} + \Delta T_{j,\tau}^{O} \hat{\beta}_{j(o),\tau}^{N} \right] + \Delta X_{\tau}^{'} \hat{\beta}_{\tau}^{N}
\end{aligned}
\tag{8}
$$

- $\Delta T_{j,\tau}^{I}$: Task Variation between N & F for j at τ (*individual* level)
- $\Delta T_{j,\tau}^{O}$: Task Variation between N & F for j at τ (*occupational* level)

Assessment of Relative Importance of Task Measures

Note:

- $\Delta T_{j,\tau} = \Delta T^{I}_{j,\tau} + \Delta T^{O}_{j,\tau}$

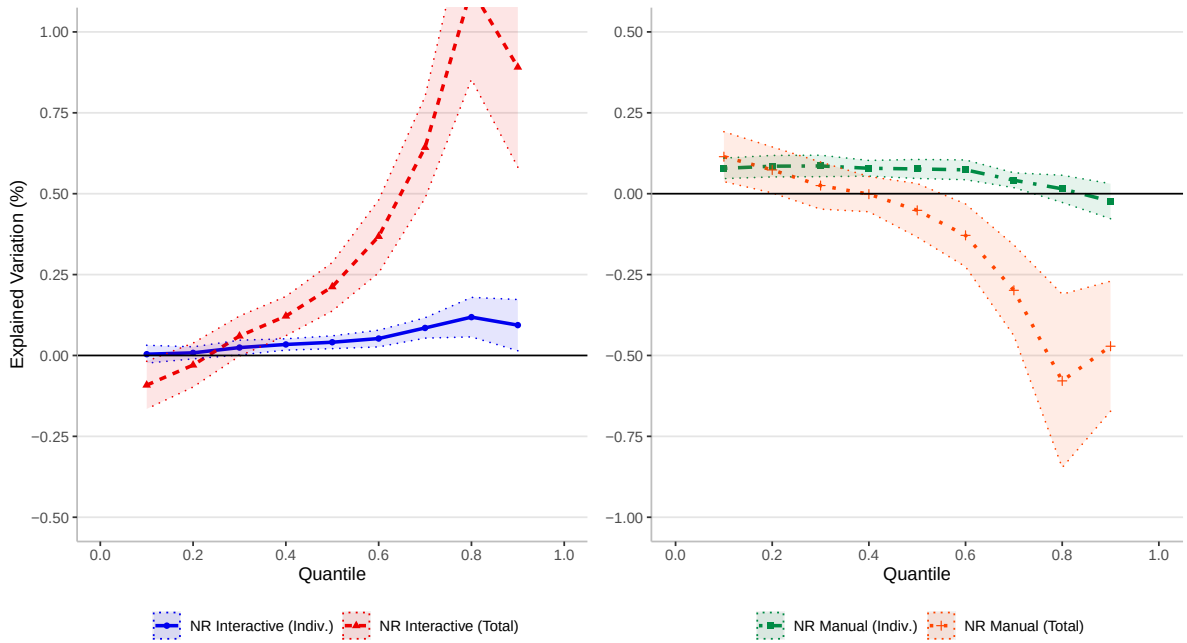
Compare the ratio of individual- to occupation-level variation (IOV) in j at τ:

$$IOV^{\tau}_{j} = \frac{\Delta T^{I}_{j,\tau}}{\Delta T^{O}_{j,\tau}} = \frac{\Delta T^{I}_{j,\tau}}{(\Delta T_{j,\tau} - \Delta T^{I}_{j,\tau})} \tag{9}$$

Example: $IOV^{0.9}_{NRI} = 1$

$\Longrightarrow$ Individual- and occupational variation in NR Interactive tasks are equally important in explaining the NF Wage Gap evaluated at the $9th$ decile

Key Results RIF Decomposition: Long-term Trends



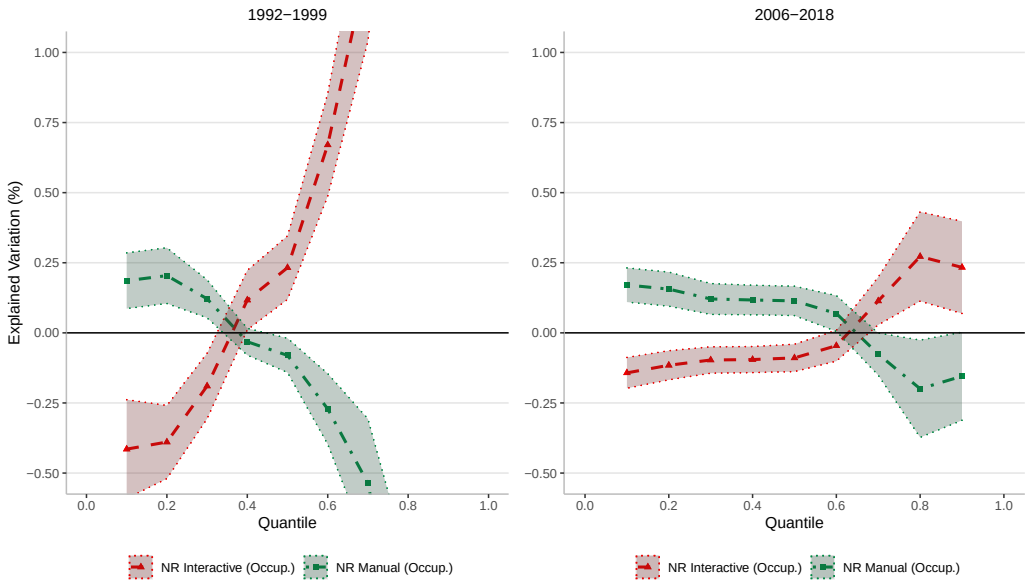
NOTE. —The decomposition results are top-censored for clarity, i.e. cut off at contributions of (+-) 100% to the explained wage gap. Point estimates are displayed with a 95% Confidence Interval.

Figure 4: Contributions of Individual-level variation in Tasks to the explained Native-Foreign Wage Gap, 1992-2018

- $IOV^{0.9}_{NRI} = 0.12$
- $IOV^{0.1}_{NRM} = 2.2$

▶ Regression

Key Results RIF Decomposition: Trends in Occupational Segregation



NOTE. —The decomposition results are top-censored for clarity, i.e. cut off at contributions of 100% & -50% to the explained wage gap. Point estimates are displayed with a 95% Confidence Interval.

Figure 5: Contributions of Occup.-level variation in Tasks to the Wage Gap, 1992-2018

- Decline of economic significance of occupational segregation

▶ Regression

Assessment of Relative Importance of Within-Occupation Task Specialization

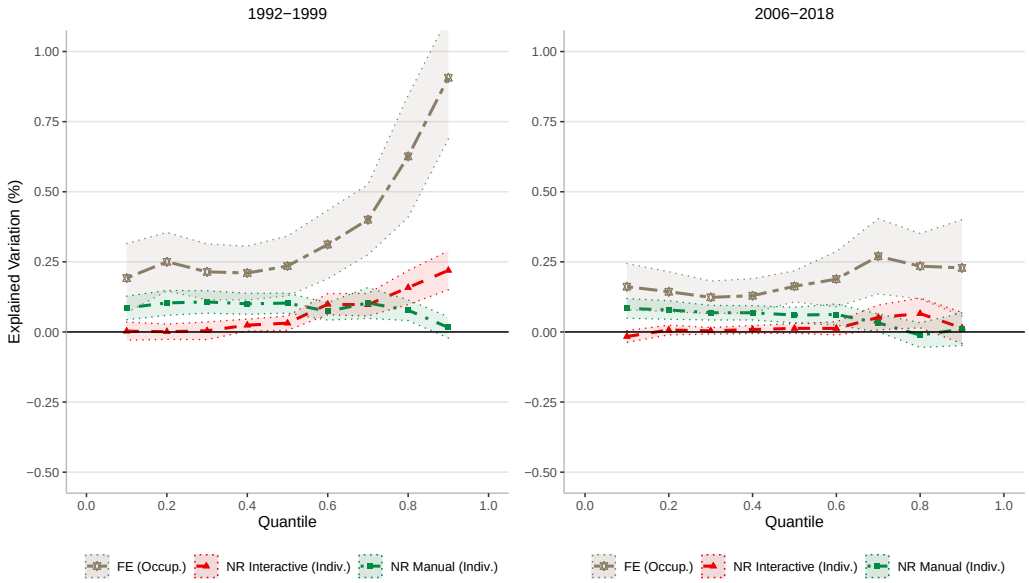
Compare the ratio of individual task variation relative to occupational FE ($IFEV$) in j at τ:

$$IFEV_j^{\tau} = \frac{\Delta T^I_{j,\tau}}{\Delta FE_{j,\tau}} \tag{10}$$

Example: $IFEV^{0.8}_{NRI} = 1$

$\Longrightarrow$ Individual variation in tasks equally important to occupational characteristics

Key Results RIF Decomposition: Trends in Within-Occupation Task Specialization



NOTE. —Point estimates are displayed with a 95% Confidence Interval.

Figure 6: Contributions of Individual-level variation in Tasks to the explained Wage Gap conditional on Occupational FE, 1992-2018

- $IOV^{0.8}_{NRI,92-99} = 0.25$ $\quad IOV^{0.8}_{NRI,06-18} = 0.3$
- $IOV^{0.1}_{NRM,92-99} = 0.45$ $\quad IOV^{0.1}_{NRM,06-18} = 0.55$

Conclusions

1. **Task Specialization extends beyond occupational borders**
   - Reinforces comparative advantage in interactive tasks among skilled labor, thus contributing to rising wage gap between N and F workers
   - Structural models may understate LR wage *gains* from immigration

2. **Implications on Immigration Policy**
   - Federal Recognition Act (2012) & Skilled Immigration Act (2020) aim at improving recognition of foreign qualifications
   - Findings suggest Policy Challenges with respect to
     - (i) Attraction &
     - (ii) Retention of skilled immigrant workers