

Telework Disruption and Digital Skills: Evidence from 700,000 Job Postings during COVID-19 Pandemic in Slovakia

Evidence from Job Postings during COVID-19 in Slovakia

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Harnessing web data for next-generation skills intelligence

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Introduction & Context

- ▶ **The COVID-19 Pandemic as an Exogenous Shock:** Acted as a massive, sudden disruption to the global labour market, serving as a unique **natural experiment** for studying rapid technological adoption.
- ▶ **Forced vs. Evolutionary Change:** Unlike prior waves of automation that replaced routine tasks gradually over decades, the pandemic triggered a compressed wave of forced digitisation within just a few weeks (February–March 2020).
- ▶ **Slovakia as a Case Study:** A small, open European economy deeply integrated into global production chains, making it highly sensitive to organizational and operational shifts.
- ▶ **Mechanism:** The crisis mandated the immediate deployment of existing tools (video conferencing, remote workflow systems) for all tasks where physical presence was non-essential.

Research Objectives & Core Questions

Primary Goal

To evaluate how a macro-level crisis-driven shock of forced digitisation reshaped the fine-grained organisation of work and employer demand for specific digital skills.

Key Research Questions:

1. **Structural Change:** Did the pandemic shock lead to a temporary spike or a permanent, structural upward shift in digital requirements across occupations?
2. **Occupational Heterogeneity:** How did the timing, pace, and magnitude of this digital skill upgrading differ across white-collar occupational groups with varying baseline readiness?

Data & Methodology: The Power of Big Data

- ▶ **Dataset:** Analysing **694,188 unique job advertisements** posted on *Profesia.sk* (Slovakia's largest vacancy portal) during 2020–2021.
- ▶ **Granular Market Representation:** Covers an estimated **70–80%** of all publicly advertised vacancies in Slovakia.
- ▶ **Advantages of Online Job Vacancy (OJV) Data over Surveys:**
 - ▶ **Instantaneous:** Reflects real-time, current employer needs on a weekly basis.
 - ▶ **Highly Granular:** Captures specific technical and operational skills embedded within text.
- ▶ **Classification Approach:**
 - ▶ Portal's internal taxonomy (736 categories) harmonized to the **ISCO-08** 1-digit structure.
 - ▶ Dual expert-LLM classification procedure to map 1,787 unique skill tags and flag digital competencies.

Conceptual Framework: Telework Disruption

- ▶ Developed on the foundational **Task-Based Framework** (Acemoglu & Autor, 2011) where occupations are bundles of cognitive vs. manual and routine vs. non-routine tasks.
- ▶ We introduce the concept of **Telework Disruption**, driven by the interaction of two distinct factors:

1. Task Disturbance

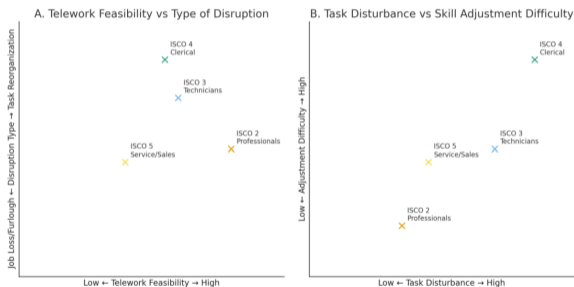
The operational push to reorganize tasks for remote execution, driven by:

- ▶ **Remote-shift intensity:** Moving from on-site to remote.
- ▶ **Digital-tool change:** Sudden requirement for workflow platforms.

2. Skill-Adjustment Difficulty

The structural resistance or friction faced by the existing workforce in adapting to these digital processes based on prior IT exposure and role characteristics.

Conceptual Dimensions of Telework Disruption



Panel A: Feasibility vs. Disruption Type

- ▶ ISCO 4 (Clerical) & ISCO 3 (Technicians) face high remote potential but intense operational task reorganization.
- ▶ ISCO 5 (Service/Sales) leans toward job loss/furlough threats due to physical constraints.

Panel B: Disturbance vs. Adjustment Friction

- ▶ ISCO 2 (Professionals): Minimal friction; changes are evolutionary.
- ▶ ISCO 4 (Clerical): Extreme vulnerability due to the combination of high operational shift and low baseline digital exposure.

Occupational Hypotheses

The magnitude of the "skill spike" is a function of **Task Disturbance** × **Skill-Adjustment Difficulty**:

▶ **ISCO 2: High-Level Professionals**

High telework feasibility + Low adjustment difficulty → **Evolutionary transition**. Work was already digital; change is gradual and steady.

▶ **ISCO 4: Clerical Support Workers**

Canonical routine cognitive labor, heavily anchored in analogue procedures and physical offices → **Canonical Disruption**. Sharpest initial screening spike expected.

▶ **ISCO 3: Technicians & Associate Professionals**

Strong task disturbance combined with narrower prior ICT exposure → **Early, sharp increase**.

▶ **ISCO 5: Service & Sales Workers**

Intermediate position; highly heterogeneous effects based on sub-sectors moving online.

Pre-Pandemic Occupational Breakdown (2020–2021)

| ISCO | Occupational Group | Observations (N) | Share of Total | Baseline IT Skill % |
|--------------|--|------------------|----------------|---------------------|
| 1 | Managers | 5,640 | 0.81% | 34.82% |
| 2 | Professionals (Ref. Group) | 57,979 | 8.35% | 30.61% |
| 3 | Technicians & Assoc. Prof. | 181,357 | 26.12% | 33.59% |
| 4 | Clerical Support Workers | 115,865 | 16.69% | 42.68% |
| 5 | Service and Sales Workers | 144,235 | 20.77% | 30.00% |
| 6–9 | Blue-Collar (Excl. from main analysis) | 189,112 | 27.26% | 5.0%–29.2% |
| Total | All Occupations | 694,188 | 100% | 27.85% |

Table: Source: Own calculations using Profesia data. Analysis focuses on white-collar roles (ISCO 2–5) where telework reorganisability was viable.

Empirical Design: Econometric Specification

To isolate the true forced-digitisation effect, we estimate logistic regression models:

$$\Pr(\text{Digital_skills} = 1 \mid X) = \Lambda\left(\beta_0 + \beta_1\text{COVID_Period} + \beta_2\text{ISCO} + \beta_3(\text{COVID_Period} \times \text{ISCO}) + \text{Controls}\right)$$

- ▶ **Dependent Variable:** Binary indicator equal to 1 if the job advertisement explicitly screens for any digital competency (office suites, CRM, digital workflow platforms).
- ▶ **Core Identification:** The interaction term β_3 captures the varying shift across occupations during the lockdown phases relative to Professionals (ISCO 2).
- ▶ **Controls:** Bratislava regional dummy, university degree requirement, sector fixed effects, and **firm fixed effects** (clustering standard errors at the firm level).

Regression Results: The Role of Firm Fixed Effects

- ▶ **Explanatory Power Doubles:** Moving from baseline models to a specification containing **Firm Fixed Effects** nearly doubles the Pseudo- R^2 (from 0.016 to 0.100).
- ▶ **Insight:** Idiosyncratic, company-level screening and operational adaptation strategies are the dominant drivers of changing digital skill requirements.

Key Interaction Coefficients (Preferred Firm-FE Specification)

- ▶ **ISCO 2 (Professionals) × First Lockdown:** No statistically significant increase. This confirms the evolutionary hypothesis—tools were already integrated.
- ▶ **ISCO 4 (Clerical) × First Lockdown:** 0.308*** – Strongest immediate upward surge, reflecting a severe forced-digitisation shock.
- ▶ **ISCO 3 (Technicians) × First Lockdown:** 0.206*** – Significant, immediate spike in employer requirements.

Logistic regression: the lockdown interactions

| Variable | (1) Baseline | (2) + Sector FE | (3) + Firm FE |
|--|-------------------|-------------------|-------------------------|
| <i>Main effects (ref.: ISCO 2 Professionals)</i> | | | |
| ISCO 3 — Technicians | 0.054* (0.026) | 0.127*** (0.026) | 0.153*** (0.027) |
| ISCO 4 — Clerical | 0.319*** (0.026) | 0.358*** (0.027) | 0.394*** (0.028) |
| ISCO 5 — Service / Sales | -0.244*** (0.026) | -0.266*** (0.027) | -0.290*** (0.027) |
| <i>Interactions with first lockdown</i> | | | |
| ISCO 3 × First lockdown | 0.186*** (0.040) | 0.192*** (0.041) | 0.206*** (0.041) |
| ISCO 4 × First lockdown | 0.289*** (0.042) | 0.296*** (0.042) | 0.308*** (0.043) |
| Bratislava + college controls | Yes | Yes | Yes |
| Sector FE | — | Yes | Yes |
| Firm FE | — | — | Yes |
| Observations | 498,689 | 498,689 | 498,689 |
| Pseudo- R^2 | 0.016 | 0.055 | 0.100 |

Standard errors clustered at the firm level. Significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Population-Average Requirements & Structural Shift

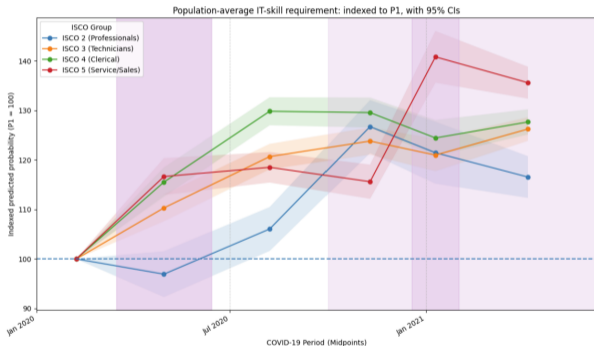


Figure 3: Population-average IT-skill requirement: indexed to P1, with 95% CIs

Key Dynamic Insights:

- ▶ **Immediate Spikes (P2):** Clerical and technical support show immediate surges of 25–30% relative to baseline.
- ▶ **The Service Surge (P4):** ISCO 5 (Service/Sales) undergoes a delayed, massive escalation (> 40%) by early 2021 as standard operating frameworks moved online.
- ▶ **Permanent Upgrading:** Post-lockdown levels do not return to baseline, marking a permanent structural shift.

Discussion: Macro-Level Labor Market Friction

- ▶ **The Post-COVID Puzzle:** Post-pandemic recoveries across advanced economies showed an outward shift of the **Beveridge Curve** (high vacancies alongside sticky unemployment).
- ▶ **Microeconomic Explanation:** This study provides direct empirical evidence of a widening **skills mismatch**.
- ▶ **The Skill Wedge:** Forced digitalisation created an overnight gap between the newly upgraded digital expectations of employers and the pre-existing skill bundles of the incumbent workforce.
- ▶ Middle-skill, routine cognitive workers bore the steepest adaptation costs and faced immediate displacement risks if unable to up-skill rapidly.

Implications for Corporate Strategy & Businesses

- ▶ **Limits of External Sourcing:** In a hyper-disrupted market, relying entirely on reactive external recruitment to fill sudden digital competency gaps leads to prolonged vacancy durations and high costs.
- ▶ **Internal Up-Skilling as Core Resilience:** Firms that implemented proactive, internal digital training programmes preserved institutional knowledge and adapted smoothly.
- ▶ **Strategic Takeaway:** Corporate training must be reframed from an adjustable operational expense to a core pillar of **strategic organizational resilience** against external shocks.

Policy Recommendations & Industrial Relations

- ▶ **Inadequacy of Furloughs Alone:** While short-time work and furlough schemes successfully cushioned immediate employment losses, they did not address underlying structural skill upgrading.
- ▶ **Active Labour Market Policies (ALMPs):**
 - ▶ Implementation of targeted, subsidized **digital training vouchers** for workers in vulnerable roles.
 - ▶ Expanded public-private adult education frameworks aligned with real-time OJV data signals.
- ▶ **The Role of Collective Bargaining:**
 - ▶ Trade unions and employers should explicitly negotiate frameworks where **expanded remote-work rights are directly linked to employer-funded training obligations**.
 - ▶ Anticipatory workforce planning must protect demographic groups (by age, gender) concentrated in highly disrupted clerical roles.

Conclusion & Future Horizons

- ▶ **Summary:** The pandemic acted as a powerful accelerator of structural technological change, permanently formalizing digital screening standard requirements across mid-level white-collar roles.
- ▶ **Future Research Agenda:**
 1. **Wage Premia vs. Credential Inflation:** Do these newly listed digital requirements translate into real wage growth or simply reflect standard inflation of job credentials?
 2. **Hiring Outcomes:** Tracking actual placement and tenure rates to see if firms successfully filled these upgraded roles.
 3. **Cross-Institutional Comparisons:** Comparing Slovakia's experience with countries that had different baseline digital infrastructures or lockdown stringencies.

Thank you! Questions & Discussion