

# THE GROWING PAINS OF EDUCATION: EXPLORING EDUCATIONAL MISMATCH TRENDS

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## ABSTRACT

Since the 1990s, the Czech Republic has witnessed a significant increase in educational attainment, leading to a rise in educational mismatch. This study investigates the prevalence of vertical and horizontal educational mismatch using data from surveys conducted in 2011 and 2022 on Czech prime working-age employees. It provides insights into the evolving dynamics of educational mismatch, identifies the groups of employees most vulnerable to it, and offers suggestions to mitigate this phenomenon, improve labour market outcomes, and optimize the returns to educational investment. The analysis reveals a growing trend of overeducation over the past decade, particularly among women. In addition, substantial differences were found across fields of study. Fields such as the arts and humanities show high levels of both types of educational mismatch, while education and healthcare demonstrate better alignment. The findings – indicating that approximately half of the employee population experiences some form of educational mismatch – underscore persistent inefficiencies in the allocation of educational resources and highlight the private and societal costs associated with overeducation. Overeducated labour represents a strategic reserve of human capital that could facilitate the shift towards a digital and knowledge-driven economy – yet unlocking this potential will require targeted efforts to align qualifications with future labour market needs.

## KEY WORDS

educational mismatch, workforce allocation, overeducation, educational investments, labour market

## JEL CODES

J24, J21

## 1 INTRODUCTION

Since the 1990s, the Czech Republic has witnessed a trend of increasing educational attainment. Societal changes have enabled more individuals to achieve higher levels of education, leading to an increase in educational mismatch in various forms (Mysíková, 2016). When the growth in educational attainment is accompanied by a heightened demand for individuals with higher qualifications – or if this demand exceeds the available supply – we refer to this phenomenon as technological growth driven by skill development. This represents one of the primary features of

economic globalization experienced by all OECD countries in recent decades (Korpi and Tählin, 2009). However, if the supply of highly educated workers continues to grow and surpasses the demand for such positions, it results in what is known as overeducation – a condition characteristic of advanced Western economies. A less severe form of this so-called vertical mismatch is undereducation, which occurs when the demand for qualified workers exceeds their availability. Another type of educational mismatch is horizontal mismatch, which arises when workers are employed in a field different from their area of study. The emergence of educational mismatch can be attributed to various causes. The simplest explanation may be a long-term structural imbalance in the labour market. Among the theories explaining its origin is the job competition theory. Its proponent, Lester Thurow (1975), argues that worker productivity is not determined by marginal product, as posited by neoclassical human capital theory, but rather by the specific characteristics of the job. In contrast, Michael Sattinger's (1993) assignment theory explains the origins of educational mismatch through differing productivity levels between workers, which is influenced by both job characteristics and individual attributes. Additionally, historical theories such as the theory of differential overqualification, which explains mismatch from the perspective of individual and family decision-making (see Frank, 1978), or the theory of job match and worker turnover, which links educational mismatch to the natural life cycle of workers (see Jovanovic, 1979), also provide insights. An additional contribution is the theory of career mobility proposed by Sicherman and Galor (1990), who found that young workers tend to substitute a lack of experience in the labour market with excessive education. Regardless of the type of educational mismatch and its origins, all cases lead to inefficient allocation of labour, potentially incurring additional private and societal costs.

The most frequently discussed issue related to educational mismatch is overeducation, which is connected to the principle of opportunity costs. When a worker is employed in a position that does not require the level of education they have attained, there are effectively unnecessary costs associated with obtaining that additional education, borne by both the individual and the state (such as education costs and lost tax revenue). Richard Freeman first highlighted this in his 1976 publication, *The Overeducated American*. He was among the first to criticize Gary Becker's (1964) neoclassical economic model and the proportional growth of the marginal product of labour (resulting from the accumulation of human capital, particularly education) and wages. According to Freeman, the returns to education in the United States began to decline after World War II and were expected to continue this downward trend. Although later critiques softened the pessimistic forecasts, the study of the effects of surplus education and general educational mismatch has persisted. However, the issue of educational mismatch is not confined to North America. Despite Leuven and Oosterbeek's (2011) finding that overeducation in the United States and Canada is among the highest, European countries are not doing better. As illustrated in Tab. 1, nearly 22% of university graduates in the EU were employed in positions not requiring higher education in 2019. The Czech Republic has a relatively lower share, but considering the observed trend, this proportion has nearly doubled during the monitoring period. As this article will show, the share of overeducated employees is much higher when considering all workers, not just those with university education, and has been rising over time. This trend is also associated with significant individual wage losses among Czech employees, as one year of matched education brings a wage bonus of 7.2%, while one year of overeducation brings only 2.3% (Krejčí and Balcar, 2025).

The aim of this article is to quantify the incidence of educational mismatch among employees in the Czech labour market. This analysis will utilize data from two surveys conducted in 2011 and 2022. Descriptive analyses of vertical and horizontal mismatches will be used to examine differences by sex, age groups, educational attainment, and fields of study. The main contribution of this work is the assessment of the development and current state of educational mismatch in the Czech labour market, which indirectly reflects the effectiveness of educational expenditures

Tab. 1: Share of overeducated university graduates (in %)

|            | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------------|------|------|------|------|------|------|------|------|------|------|
| CR         | 8.3  | 12.7 | 12.5 | 13.4 | 13.3 | 13.4 | 13.7 | 14.5 | 14.6 | 15.1 |
| EU average | 20.3 | 19.6 | 20.7 | 21.0 | 21.7 | 21.8 | 21.7 | 22.1 | 22.1 | 21.9 |

Source: The conclusion of the audit action conducted by the Supreme Audit Office (NKÚ, 2020)

and the country's developmental potential. To date, no study has comprehensively addressed the Czech labour market in terms of the determinants of educational mismatch. The findings of this article could be used to prevent this phenomenon, optimize the educational system, and improve the efficiency of education.

The results confirm a trend of increasing educational mismatch. Between 2011 and 2022, there was an increase in the proportion of vertical mismatch, particularly in overeducation, with women being the most affected. The rise in overeducation was most pronounced among workers aged 25 to 44, while the oldest age group (45–54) experienced only a modest increase. For horizontal mismatch, no statistically significant change was observed between the two years; however, women consistently exhibited substantially higher levels of this type of mismatch. The greatest educational alignment is found in the fields of Education (ISCED 01) and Health and Welfare (ISCED 09), while the majority of workers who experience either type of educational mismatch have an educational background in Arts and Humanities (ISCED 02).

## 2 LITERATURE REVIEW

First, it is essential to consider the various methods available to measure educational mismatch, as the empirical literature identifies several distinct approaches. Three key methods are particularly prominent: normative, statistical, and subjective. The normative method (also known as the objective or job analysis approach) assesses mismatch by comparing an individual's actual level of education with the formal requirements for a given occupation. These requirements are typically defined in specialised databases, such as O\*Net in the USA or the National System of Occupations (NSO) in the Czech Republic. This method is valued for its high precision, objectivity, clearly defined job profiles, and standardised evaluation procedures. However, its limitations include the potential obsolescence of occupational databases and the time-intensive nature of their updates. Moreover, it cannot be assumed that all employers have identical expectations for a given position, which may lead to variation across firms. This is the method applied in the present article. An alternative approach is the statistical method (realised matches approach), which estimates the required level of education for each job based on the qualifications of individuals currently employed in that job, typically by identifying the average or modal level of education. The subjective approach, in contrast, relies on self-assessment: individuals evaluate for themselves whether their current job matches their level of education (McGuinness et al., 2018; Hartog, 2000).

In recent decades, numerous authors have highlighted the increasing emphasis on higher education. According to Freeman (1976), the rising number of graduates has led to a significant decline in the wage returns to higher education. The earnings premium of a university degree, compared to secondary education, decreased from 40% to 16% (Freeman, 1976), with the trend of oversupply of graduates relative to demand expected to continue. These pessimistic forecasts were later moderated by further analyses. However, concerns regarding the effectiveness of surplus education within the professional community persist. As Korpi and Tåhlin (2009) point out, it is crucial to view the general increase in educational attainment comprehensively, considering both supply and demand aspects. From this perspective, there are two possibilities: the first is

where the growth in the supply of highly qualified workers is accompanied by an increase in demand, which may often be even greater (the upgrading view). This scenario is common in economies experiencing growth, where new technologies, advanced production processes, and the development of the service sector are introduced. The second possibility represents the traditional view of educational mismatch, where the supply of education grows faster than demand, leading to overeducation in the labour market (the overeducation perspective). This latter view is most frequently associated with advanced economies.

The mismatch between labour market demand and supply, and the potential emergence of educational mismatch, may not be a universal phenomenon but could be influenced by regional (Cabus and Somers, 2018) or sectoral (Tijdens et al., 2015) factors. According to Cabus and Somers (2017), the supply of labour is exogenously determined and comprises all workers within a given territory or region, with employers accepting this supply as given. In contrast, employer demand is endogenous and depends on the specific internal requirements of particular positions. Although national data may indicate a relatively low level of educational mismatch, regional disparities can be substantial, as recruitment often occurs at a more local level. Tijdens et al. (2015) conducted an analysis of the alignment between available job vacancies and the qualifications of job applicants across 279 occupations in the Czech Republic. Their study found that 25% of the occupations exhibited an oversupply of workers, while 33% showed a shortage based on a comparison of educational attainment and job requirements. They also discovered that high (and unmet) demand in certain sectors correlates significantly with low educational requirements. The incidence of educational mismatch varies across time, countries, and genders. Leuven and Oosterbeek (2011), in their meta-analysis, used unweighted averages (and medians) from over 30 studies to examine the incidence of over- and undereducation by continent, decade, measurement method, and gender. On average, 26% (or 30%) of workers experience undereducation (or overeducation). Depending on the measurement method, results range from 10% to 32% for undereducation and from 14% to 37% for overeducation. The significant variation in results highlight the importance of distinguishing between measurement methods. Generally, the lowest incidence of undereducation and the highest incidence of overeducation are observed using subjective self-assessment methods. Additionally, variations across decades are notable. Undereducation has shown an upward trend, with 12% of workers being undereducated in the 1970s, rising to 50% in the early 2000s. The trend for overeducation is more complex, following a U-shaped pattern: the lowest incidence occurred in the 1990s, followed by a sharp increase. Leuven and Oosterbeek (2011) suggest that this recent increase may be due to differences in measurement methods used in studies from that period. These findings are consistent with an earlier meta-analysis by Hartog (2000), which reviewed results from over ten studies across five countries – the Netherlands, Spain, Portugal, the UK, and the USA. The average vertical mismatch was around 40%, with considerable variation depending on the method and country. Both studies highlight that the incidence of undereducation in the USA (or North America) is relatively low, while overeducation is the highest among the countries studied. According to Leuven and Oosterbeek (2011), this is surprising given that higher education in Europe is largely publicly funded, while US labour markets generally exhibit higher levels of market imperfection.

Educational mismatch has observable negative impacts at both the micro- and macrolevels. For workers, it primarily results in income penalties (e.g., Korpi and Tählin, 2009; Kleibrink, 2016; Artz and Welsch, 2020; Mysíková, 2016), reduces job satisfaction (e.g., Piper, 2015; Green and Zhu, 2010; Béduwé and Giret, 2011), increases career mobility (e.g., Wald, 2005), or leads to a decline in cognitive abilities due to overeducation (e.g., de Grip et al., 2008). Wage implications are the most commonly analysed aspect of educational mismatch. The results consistently indicate that education exceeding job requirements has a positive impact on wages, but this effect is smaller than if the worker were employed in a position matching their qualifications. Very few studies have

specifically addressed the Czech labour market. One notable exception is Mysíková (2016), who used various data sources, mismatch measurement approaches, and methods to investigate wage effects. Her findings support existing empirical evidence of the negative impact of educational mismatch on wages. Krejčí and Balcar (2025) used the same data from 2011 and 2022 as in this article to quantify the wage effects of educational mismatch in the Czech Republic. Their results indicate that matched workers receive the highest wage bonus, while mismatched workers face significant wage penalties compared to those with matched qualifications. They also showed that certain psychological traits, such as a sense of belonging and adaptability, can mitigate wage penalties associated with undereducation and horizontal mismatch. Galasi (2008) and Maršíková and Urbánek (2015) analysed cross-sectional data from several European countries, including the Czech Republic. According to Galasi (2008), the Czech Republic exhibits a higher wage bonus for overeducation and a lower wage penalty for undereducation compared to other countries. Maršíková and Urbánek (2015), using the same data source but more recent data, demonstrated a trend of increasing wage bonuses for overeducation and rising penalties for undereducation.

Wage effects are not the only negative consequences of educational mismatch for employees. For instance, its impact on job satisfaction is often less straightforward than its influence on wages. Piper (2015) reported a negative association between overeducation and job satisfaction. However, in many cases, the dissatisfaction experienced by overeducated workers is compensated by higher earnings. Green and Zhu (2010) found that overeducation significantly affected job satisfaction primarily when combined with skill mismatch. Conversely, Bédoué and Giret (2011) did not find a statistically significant relationship between vertical mismatch and job satisfaction; only horizontal mismatch was shown to have a negative impact. Additionally, Wald (2005) observed that overeducated workers are more likely to engage in job searching, while de Grip et al. (2008) analysed the cognitive skills of mismatched workers and found that such mismatches lead to a decline in cognitive abilities. Therefore, skill obsolescence can, over time, adversely affect an individual's actual level of capabilities.

Overall, the occurrence of educational mismatch does not merely reflect persistent inefficiencies within educational systems; it may also affect various dimensions of individuals' working lives, including income, job satisfaction, and labour mobility. In particular, findings on wage effects demonstrate that educational mismatch leads to wage penalties compared to workers whose qualifications align with their job roles. Evidence from previous studies further suggests that not all population groups are affected equally. For instance, women tend to experience a higher incidence of mismatch. Furthermore, geographic differences may significantly influence its prevalence. Although most research has focused on developed Western countries, only a limited number of studies have specifically examined the Czech Republic. The following analysis aims to provide a comprehensive view of the prevalence of educational mismatch in the Czech Republic, as well as potential explanations for its distribution across different population groups.

### 3 EMPIRICAL STRATEGY

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#### 3.1 Data

The data utilised in this analysis are derived from two waves of questionnaire surveys of Czech employees in their prime working years (25–54 years), focusing on wage conditions and conducted in 2011 and 2022. The 2011 survey provides data on a representative sample of 1,984 employees, gathered through face-to-face interviews. Quota sampling was used to ensure that the structure of respondents aged 25 to 54 corresponded to that of the employee population in the Czech Republic, as published by the Czech Statistical Office (CZSO), based on sex, age, education, region, and size of municipality. In addition, the job categories of the National System of Occupations (NSO)

were matched with the job titles reported by the respondents. This enriched the dataset with characteristics of the respective NSO occupations, particularly the required educational level – that is, the level of education deemed necessary for a given job. By comparing the educational attainment of workers with the required education level for their jobs, it is possible to determine whether a worker is undereducated, overeducated, or adequately matched in terms of education. To assess horizontal mismatch, the declared job titles were again matched to the NSO classification to determine the most appropriate field(s) of study for each occupation. It is important to note that only the fields of education deemed “most suitable” by the NSO were considered, representing a more stringent criterion. The CZ-ISCED-F 2013 classification was used to identify potential horizontal mismatches, applying 12 categories (detailed in Tab. 2). The ‘Business and Law’ category was further divided into two separate groups due to the large number of observations. The classification of the most suitable field of education for a given job was then compared with the respondent’s highest completed field of study to identify horizontal mismatch. Six respondents were excluded from the analysis because their declared job titles could not be matched to the NSO. To restore the representativeness of the sample, weights based on the 2010 CZSO census were applied, resulting in a final sample of 1,978 employees.

More recent data, comprising a representative sample of 2,251 Czech residents aged 25 to 54 (of whom 1,620 were employees), were collected in January 2022. This constitutes the second wave of a survey on wage conditions in the Czech Republic, following the 2011 questionnaire. In this wave, additional population groups were included; however, for the purposes of examining educational mismatch, only the responses of individuals who identified as employees were retained, enabling comparison of trends over time. Further data reduction was performed in cases where missing information was identified or where job descriptions were too vague to allow for linkage with NSO data. As in the previous wave, the NSO job categories corresponding to the respondents’ reported occupations were manually assigned. Information on the required educational level and the most suitable field of education was then appended to each job category for the analysis of vertical and horizontal mismatch. The final sample used for the mismatch analysis comprised 1,516 employees. To restore the representativeness of the dataset, weights derived from the 2020 CZSO Census were again applied, based on the combination of sex, age, education, and size of municipality.

### 3.2 Methodology

The results section of this article presents descriptive statistics on both vertical and horizontal educational mismatches, with a particular focus on sex, age, and educational attainment. To measure educational mismatch, an objective (also called normative) approach is employed. This method involves identifying mismatch by comparing the required level of education for a given job, as specified in the NSO database, with the respondent’s reported level of educational attainment.

The descriptive analysis is complemented by the results of a multinomial logistic regression for vertical mismatch (reflecting the three categories: undereducated, matched, and overeducated) and a binomial logistic regression for horizontal mismatch. These regressions, presented in Tab. 2, serve to confirm the statistical significance of the patterns observed in the graphical analysis. The explanatory variables are based on supply-side factors that may influence the likelihood of educational mismatch among workers. As noted by Leuven and Oosterbeek (2011), there is no unified framework for the determinants of educational mismatch. Therefore, this analysis draws primarily on existing research discussed in the theoretical section and on the available data. In the regression model, the explanatory variables include sex, age, years of education (required to attain the reported level), field of study (ISCED-F categories), and regional dummies as control variables. The model specification is outlined in Equation 1 (Long and Freese, 2014), where

$Y$  is the dependent variable with  $k = 1, \dots, K-1$  categories, and  $X_i$  is the vector of explanatory variables.

$$\ln \left( \frac{\Pr(Y = k | X)}{\Pr(Y = K | X)} \right) = \beta_{k0} + \beta_{K-1}X \quad (1)$$

In the case of horizontal mismatch, binomial logistic regression is applied, as shown in Equation 2. This model uses the same explanatory variables as in the case of vertical mismatch. The dependent variable is binary, where 1 denotes the presence of horizontal mismatch and 0 indicates a match. The vector of explanatory variables  $X$  includes sex, age, years of education, ISCED-F categories, and regional dummies.

$$\ln \left( \frac{\Pr(Y = 1 | X)}{\Pr(Y = 0 | X)} \right) = \beta_0 + \beta X \quad (2)$$

## 4 RESULTS

### 4.1 Development of Educational Mismatch and Its Sex Differences

In Fig. 1A, we observe a substantial and statistically significant increase in the number of overeducated employees in the labour market between 2011 and 2022, amounting to nearly 10 percentage points. This finding suggests a potential issue with the effective allocation of highly educated employees to suitable positions. Although the share of undereducated employees has decreased, the overall level of vertical mismatch in the Czech labour market has increased by approximately 5 percentage points. These findings are further supported by the results of the logistic regression analysis. In the case of Model 1 (see results in Tab. 2), no statistically significant differences were found between the two observed years in terms of undereducation. Similarly, no notable statistical change was observed in the matching rate in Model 2. However, there was a significant increase in the probability of employees being overeducated (Model 3). This indicates that an increasing number of employees hold educational qualifications that exceed the requirements of their positions. Compared to the findings of Mysíková (2016), who used three data sources from the period 2011–2013, the vertical match in her study was higher, ranging from 60% to 73%, depending on the data source and the measurement method used. On the other hand, according to Galasi's (2008) data, vertical matching in 2006 was only 12.6%. As can be seen, the results of various studies on this topic can differ significantly. By contrast, the incidence of horizontal mismatch remains relatively stable, as shown in Fig. 1B and in Model 4. Horizontal mismatch in our case is relatively high compared to the findings of Sedláček and Zelenka (2021). This may be due to the use of a stricter criterion for determining horizontal mismatch, where we consider only the most suitable fields of study.

Women exhibit higher levels of vertical mismatch, particularly in 2022. As Frank (1978) highlights in his theory of differential overqualification, women often have fewer employment options due to family relocation being more frequently based on the man's employment as the primary income earner. As a result, women may face limited local job opportunities, increasing the risk of educational mismatch. Models 5 to 7 show no statistically significant sex differences in vertical mismatch in 2011, suggesting that men and women had comparable probabilities of being undereducated, matched, or overeducated. In contrast, the situation changes in 2022. While Model 9 shows no significant sex difference in the probability of being undereducated, Model 10 indicates a significantly lower probability of vertical matching among women, and Model 11 reveals that the probability of overeducation was 7 percentage points higher for women. In this regard, the

Tab. 2: Estimates from Logistic Regression for Vertical and Horizontal Mismatch (average marginal effects reported)

|                              | (1)                    | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                | (11)                 | (12)                 |
|------------------------------|------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|
|                              | Yearly dummy variables |                      |                      | Year 2011            |                      |                      | Year 2022            |                      |                      |                     |                      |                      |
|                              | Under-education        | Matched              | Over-education       | Horizontal mismatch  | Under-education      | Matched              | Over-education       | Horizontal mismatch  | Under-education      | Matched             | Over-education       | Horizontal mismatch  |
| Women                        | 0.004<br>(0.016)       | -0.051**<br>(0.022)  | 0.047**<br>(0.019)   | 0.085***<br>(0.020)  | 0.003<br>(0.022)     | -0.034<br>(0.029)    | 0.031<br>(0.026)     | 0.065**<br>(0.027)   | -0.004<br>(0.022)    | -0.065**<br>(0.031) | 0.070**<br>(0.028)   | 0.114***<br>(0.030)  |
| Age                          | baseline               | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline            | baseline             | baseline             |
| 25-34 years                  | -0.023<br>(0.016)      | 0.033<br>(0.023)     | -0.010<br>(0.020)    | -0.006<br>(0.020)    | -0.021<br>(0.021)    | 0.035<br>(0.030)     | -0.013<br>(0.026)    | -0.026<br>(0.026)    | -0.025<br>(0.026)    | 0.032<br>(0.035)    | -0.007<br>(0.030)    | 0.020<br>(0.031)     |
| 35-44 years                  | -0.017<br>(0.017)      | 0.050**<br>(0.024)   | -0.033<br>(0.020)    | 0.014<br>(0.021)     | -0.021<br>(0.022)    | 0.035<br>(0.031)     | -0.014<br>(0.026)    | 0.014<br>(0.026)     | -0.013<br>(0.027)    | 0.072**<br>(0.036)  | -0.059*<br>(0.031)   | 0.026<br>(0.034)     |
| 45-54 years                  | -0.069***<br>(0.005)   | -0.001<br>(0.006)    | 0.070***<br>(0.004)  | 0.005<br>(0.005)     | -0.074***<br>(0.006) | 0.008<br>(0.007)     | 0.066***<br>(0.005)  | 0.007<br>(0.006)     | -0.061***<br>(0.007) | -0.017**<br>(0.008) | 0.078***<br>(0.005)  | 0.006<br>(0.006)     |
| Years of education           | baseline               | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline            | baseline             | baseline             |
| ISCED                        | baseline               | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline            | baseline             | baseline             |
| 00 - Generic programmes      | baseline               | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline             | baseline            | baseline             | baseline             |
| 01 - Education               | 0.308***<br>(0.058)    | -0.006<br>(0.062)    | -0.302***<br>(0.032) | -0.622***<br>(0.046) | 0.335***<br>(0.066)  | -0.037<br>(0.073)    | -0.298***<br>(0.043) | -0.706***<br>(0.054) | 0.259**<br>(0.106)   | 0.057<br>(0.109)    | -0.316***<br>(0.048) | -0.516***<br>(0.075) |
| 02 - Arts & Humanities       | 0.221***<br>(0.086)    | -0.178**<br>(0.081)  | 0.043<br>(0.059)     | 0.083**<br>(0.035)   | 0.383***<br>(0.151)  | -0.368***<br>(0.124) | -0.015<br>(0.113)    | —                    | 0.168*<br>(0.086)    | -0.108<br>(0.090)   | -0.059<br>(0.070)    | 0.129***<br>(0.046)  |
| 03 - Social Sciences & Info  | 0.089*<br>(0.046)      | 0.016<br>(0.056)     | -0.106**<br>(0.042)  | -0.175***<br>(0.047) | 0.099*<br>(0.059)    | 0.024<br>(0.073)     | -0.123**<br>(0.055)  | -0.300***<br>(0.060) | 0.044<br>(0.069)     | 0.042<br>(0.083)    | -0.085<br>(0.064)    | -0.001<br>(0.057)    |
| 041 - Business               | 0.006<br>(0.025)       | 0.016<br>(0.039)     | -0.022<br>(0.035)    | -0.444***<br>(0.034) | -0.015<br>(0.036)    | 0.026<br>(0.058)     | -0.011<br>(0.052)    | -0.350***<br>(0.046) | 0.030<br>(0.034)     | 0.019<br>(0.051)    | -0.049<br>(0.047)    | -0.527***<br>(0.046) |
| 042 - Administration & Law   | 0.126***<br>(0.035)    | -0.019<br>(0.046)    | -0.106***<br>(0.038) | -0.487***<br>(0.039) | 0.150***<br>(0.045)  | -0.056<br>(0.059)    | -0.094*<br>(0.048)   | -0.625***<br>(0.043) | 0.070<br>(0.058)     | 0.108<br>(0.077)    | -0.178***<br>(0.061) | -0.168***<br>(0.067) |
| 05 - Natural Sciences & Math | 0.034<br>(0.041)       | 0.100*<br>(0.060)    | -0.134**<br>(0.053)  | -0.034<br>(0.037)    | 0.038<br>(0.050)     | 0.110<br>(0.077)     | -0.149**<br>(0.068)  | -0.093**<br>(0.043)  | 0.028<br>(0.087)     | 0.107<br>(0.095)    | -0.134*<br>(0.074)   | 0.009<br>(0.062)     |
| 06 - ICTs                    | 0.198***<br>(0.068)    | -0.113<br>(0.072)    | -0.085*<br>(0.051)   | -0.332***<br>(0.071) | 0.390**<br>(0.183)   | -0.327**<br>(0.162)  | -0.063<br>(0.102)    | -0.145<br>(0.185)    | 0.160**<br>(0.067)   | -0.065<br>(0.078)   | -0.095<br>(0.062)    | -0.314***<br>(0.080) |
| 07 - Engin. & Manufacturing  | 0.017<br>(0.021)       | 0.009<br>(0.034)     | -0.026<br>(0.032)    | -0.465***<br>(0.028) | 0.004<br>(0.031)     | 0.042<br>(0.048)     | -0.046<br>(0.044)    | -0.540***<br>(0.031) | 0.025<br>(0.029)     | -0.012<br>(0.047)   | -0.013<br>(0.045)    | -0.380***<br>(0.045) |
| 08 - Agriculture & Vet.      | -0.033<br>(0.032)      | -0.040<br>(0.053)    | 0.072<br>(0.048)     | -0.035<br>(0.039)    | -0.018<br>(0.045)    | -0.111<br>(0.069)    | 0.129*<br>(0.066)    | -0.106**<br>(0.042)  | -0.055<br>(0.039)    | 0.071<br>(0.075)    | -0.016<br>(0.069)    | 0.043<br>(0.064)     |
| 09 - Health & Welfare        | 0.374***<br>(0.040)    | -0.187***<br>(0.046) | -0.187***<br>(0.038) | -0.681***<br>(0.037) | 0.427***<br>(0.052)  | -0.257***<br>(0.061) | -0.170***<br>(0.056) | -0.726***<br>(0.051) | 0.292***<br>(0.062)  | -0.075<br>(0.070)   | -0.217***<br>(0.050) | -0.665***<br>(0.050) |
| 10 - Services                | -0.042*<br>(0.022)     | 0.053<br>(0.038)     | -0.011<br>(0.036)    | -0.287***<br>(0.033) | -0.061*<br>(0.031)   | 0.107**<br>(0.054)   | -0.047<br>(0.049)    | -0.303***<br>(0.038) | -0.014<br>(0.030)    | -0.018<br>(0.055)   | 0.032<br>(0.051)     | -0.274***<br>(0.055) |
| Region of residence          | YES                    | YES                  | YES                  | YES                  | YES                  | YES                  | YES                  | YES                  | YES                  | YES                 | YES                  | YES                  |
| Year dummies (base 2011)     | -0.023<br>(0.015)      | -0.032<br>(0.020)    | 0.055***<br>(0.017)  | -0.017<br>(0.018)    | -0.061*<br>(0.031)   | 0.107**<br>(0.054)   | -0.047<br>(0.049)    | -0.303***<br>(0.038) | -0.014<br>(0.030)    | -0.018<br>(0.055)   | 0.032<br>(0.051)     | -0.274***<br>(0.055) |
| Adj. McFadden $R^2$          | 0.092                  | 0.092                | 0.092                | 0.143                | 0.088                | 0.088                | 0.088                | 0.152                | 0.071                | 0.071               | 0.071                | 0.150                |
| Observations                 | 3,394                  | 3,394                | 3,394                | 3,394                | 1,978                | 1,978                | 1,978                | 1,978                | 1,516                | 1,516               | 1,516                | 1,516                |

Notes: Robust standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

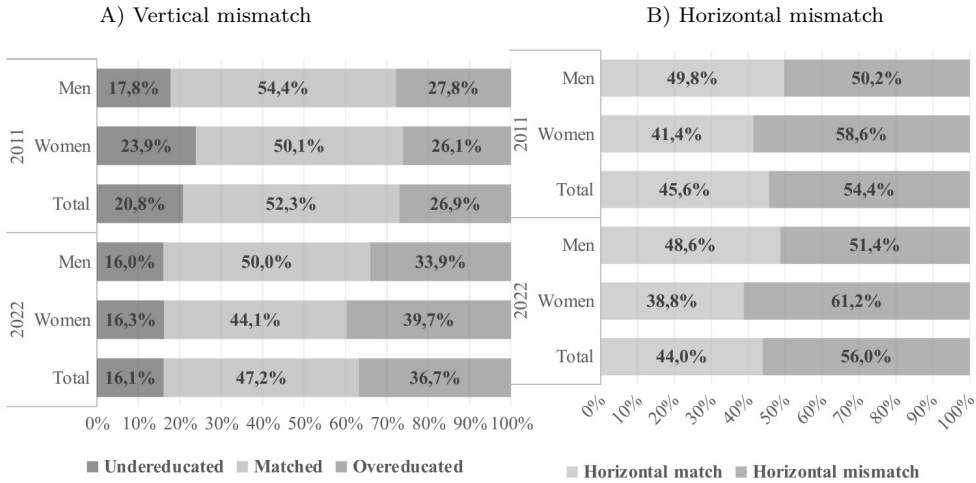


Fig. 1: Educational Mismatch by Sex

situation has worsened over time. The results of the models, together with the observed relative frequencies in Fig. 1A, indicate not only significant sex differences in 2022 but also a general shift for both sexes toward lower matching and higher overeducation. Women are disproportionately affected by this development, which may have implications for awareness campaigns addressing the risks of educational mismatch, as well as for understanding persistent sex wage disparities.

Regarding horizontal mismatch, Fig. 1B illustrates that men display relatively balanced rates of horizontal match and mismatch in both observed years, whereas women predominantly exhibit horizontal mismatch. This indicates that women are more often employed outside the field of education they studied. Such a pattern may again be interpreted in light of Frank's (1978) theory of differential overqualification, whereby men are more likely to secure employment first, and their partners subsequently adapt to a narrower range of local job opportunities. The regression results confirm statistically significant sex differences in both 2011 and 2022 (Models 8 and 12, respectively). In both years, women show a higher probability of being horizontally mismatched than men – 6.5 percentage points higher in 2011 and 11.4 percentage points higher in 2022.

## 4.2 Educational Mismatch Across Age Groups

As noted by Sicherman and Galor (1990), who formulated the theory of career mobility, younger employees are expected to experience vertical mismatch more frequently than older employees. Due to their limited work experience, younger individuals often accept jobs that require lower levels of education in order to gain experience, with the expectation of transitioning later into positions more closely aligned with their qualifications. Fig. 2A, however, does not provide clear support for this assumption. While the oldest age group in 2022 shows a statistically significantly higher probability of educational matching and lower overeducation (see Models 10 and 11), the absence of statistically significant effects among the youngest and mid-aged employees suggests that the theory of career mobility is not supported in our data. Moreover, since in 2011 no statistically significant association was found between age and overeducation, the subsequent rise in overeducation among younger cohorts can likely be attributed to the broader expansion of education during that period. Between 2011 and 2022, the share of overeducated employees rose from 30.5% among the youngest cohort (25–34) and 25.6% among the mid-aged group (35–44) to nearly 41% in both groups. This trend indicates that new labour market entrants increasingly attain higher levels of education, yet often find employment in positions for which they are

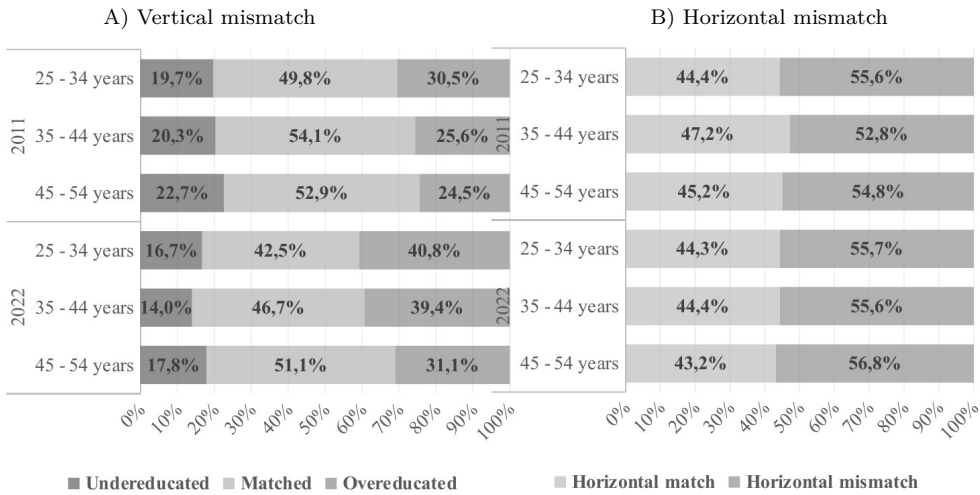


Fig. 2: Education Mismatch by Age Categories

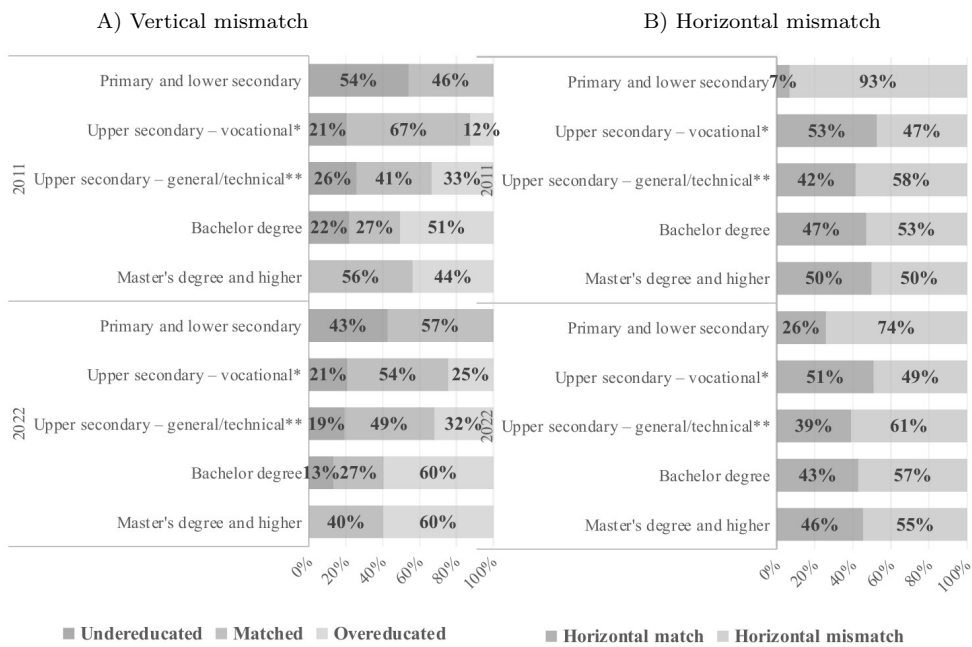
overqualified. At the same time, the incidence of undereducation has slightly declined across all age categories.

Regarding horizontal mismatch, no significant change was observed between 2011 and 2022, nor were there any statistically significant differences between age groups, as shown in Fig. 2B and the results from Models 8 and 12. These findings suggest that the theory of career mobility is more closely associated with vertical mismatch, while horizontal mismatch appears to be relatively stable across age cohorts and time.

4.3 Educational Mismatch by Highest Level of Education and Field of Study

Fig. 3A categorises employees by their highest level of education. The lowest proportion of well-matched employees is found among those with a bachelor’s degree (ISCED 6), with only about 27% working in suitable positions in both years. In general, overeducation prevails among higher education graduates. For example, among master’s degree holders (ISCED 7), the incidence of overeducation increased by 16 percentage points between 2011 and 2022. Conversely, undereducation shows a declining trend across all education levels, with the share of undereducated employees decreasing in every category. The only stable group, where no decrease was observed, consists of employees with secondary vocational education with apprentice certificate (ISCED 3). This overall pattern – a drop in undereducation and a rise in overeducation – reflects the increasing educational attainment in Czech society, with more job seekers now holding higher qualifications than a decade ago. These results are also supported by our regression models (Models 5–7 and 9–11), which show that the number of years of education is a key determinant of undereducation, overeducation, and education match. As the number of years of schooling increases, the probability of overeducation increases, while the probability of undereducation decreases.

Regarding horizontal mismatch, Fig. 3B shows that the highest proportion of horizontally mismatched employees is consistently found among those whose highest level of education is *basic school*, i.e., lower secondary education (ISCED 2). This is understandable, as jobs available at this education level tend not to require field-specific qualifications, which are usually acquired at higher levels of education. Among the other education levels, the distribution between matched and mismatched employees is more balanced, with the proportion of horizontal mismatch in 2022 ranging from 49% to 61%. As for the differences between the two observed years, apart from a



Notes: \*) Upper secondary vocational education (with apprenticeship certificate); \*\*) Upper secondary general/technical education (with Matura certificate).

Fig. 3: Development of Educational Mismatch by Highest Degree of Education

decrease in mismatch among employees with basic education, no substantial shifts are observed across other educational groups. Overall, horizontal mismatch appears relatively stable over time. This is also supported by the results of the logistic regression, which show that the number of years of education does not have a statistically significant linear effect on the probability of horizontal mismatch (see Model 12).

Subsequently, we focus on educational mismatch by the field of study corresponding to the highest level of education attained. For clarity, the results discussed refer to the year 2022; the corresponding results for 2011 are presented in the Annex. Before interpreting the findings, it is important to note that although the sample is representative in both years with respect to sex, age, education level, and size of municipality, the field of study was not among the stratification criteria. As a result, the distribution of study fields in the sample may not correspond to that of the general population, and the results should therefore be interpreted with appropriate caution.

As shown in Fig. 4A, the highest proportion of horizontally well-matched employees are those educated in Education (ISCED 01) and Services (ISCED 10). In contrast, the highest shares of undereducated employees are observed among those with qualifications in Health and Welfare (ISCED 09), followed by Information and Communication Technologies (ICTs; ISCED 06). This may be due to a shortage of qualified professionals in these fields, requiring the recruitment of less educated and qualified employees to meet demand. Both education fields with the highest share of undereducation have long experienced shortages in the Czech labour market (ČTK, 2023). These results align with our model findings, indicating that employees educated in fields with current labour shortages (e.g., healthcare, ICTs, and education) are more likely to be undereducated compared to those with a general education background (Model 9).

Regarding overeducation, the highest levels are observed among employees educated in Arts and Humanities (ISCED 02), followed by Agriculture, Forestry, Fisheries and Veterinary (ISCED 08), and Information and Communication Technologies (ISCED 06). These graduates often struggle

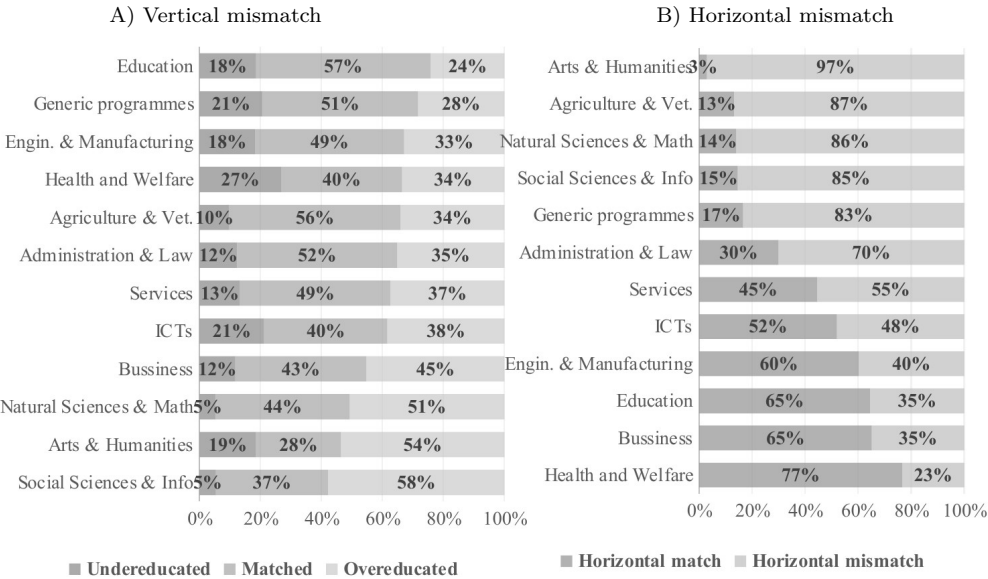


Fig. 4: Share of Education Mismatch by Study Field in 2022

to find employment within their field of study and are more likely to take up positions that require lower levels of education. Conversely, both observed years show the lowest rates of overeducation among those educated in Education (ISCED 01) and Health and Welfare (ISCED 09). This is unsurprising, as these fields comprise relatively homogeneous occupational groups – such as pedagogical and non-pedagogical staff – whose positions are regulated by qualification standards tied to specific higher education credentials. A similarly low incidence of overeducation is found among those with qualifications in Generic programmes and qualifications (ISCED 00), a residual category encompassing graduates without a specialised field of study. As indicated by the regression results – particularly Model 11 for 2022 – employees educated in fields such as Education (ISCED 01), Administration and Law (ISCED 042), and Health and Welfare (ISCED 09) display a lower probability of overeducation compared to the reference category. A common factor explaining these findings is the legal requirement for specific educational attainment in these professions.

Fig. 4B illustrates the uneven distribution of horizontal mismatch across different fields. The highest horizontal mismatch rate is found in Arts and Humanities (ISCED 02), with 97% of employees working outside their field of study. Conversely, the lowest rate is among those with education in Healthcare and Welfare (ISCED 09), where only 23% are employed outside their field of study. Interestingly, when comparing these results with those for vertical mismatch (see Fig. 4A), the same fields appear at similar positions in the rankings for both types of mismatch. This may suggest an overlap between vertical and horizontal educational mismatches, which will be explored further in the next section of this article. The findings are supported by the logistic regression results for 2022, particularly Model 12 in Tab. 1. The lowest probability of horizontal mismatch is found in Healthcare and Welfare (ISCED 09), which is 66.5 percentage points lower compared to Generic programmes and qualifications (ISCED 00). The highest probability of horizontal mismatch is observed in Arts and Humanities (ISCED 02), which is 12.9 percentage points higher compared to Generic programmes.

4.4 Combination of Vertical and Horizontal Mismatch on the Czech Labour Market

Previous findings have indicated a partial overlap between vertical and horizontal mismatch. As shown in Fig. 5, only 23.3% of employees (or 26.8% in 2011) show full alignment between both the level and field of their education and the requirements of their job. However, the majority of cases exhibit at least one form of educational mismatch. Notably, the largest proportion in both years comprises employees who experience both vertical and horizontal mismatch – a share that has slightly increased over time. This points to a growing segment of the labour market made up of individuals who not only work in fields unrelated to their studies but are also either overeducated or undereducated for their positions. This dual mismatch reflects not only wasted educational potential but also substantial costs associated with acquiring qualifications that are subsequently not utilised. In 2022, such employees accounted for one-third of the total workforce.

As we observe a growing proportion of employees experiencing at least one type of educational mismatch, Fig. 6 expands on the previous graph by detailing the fields of study of these employees. For clarity, only data from 2022 is used here; the Fig. 8 for 2011 can be found in the Annex. The fields with the highest overall alignment include Education (ISCED 01) with 41% match, Engineering, Manufacturing and Construction (ISCED 07) with 34% match, and Health and Welfare (ISCED 09) with 33% match. All these fields are characterised by high demands for expertise, making it generally necessary for employees to have education that meets the required standards for these positions. In contrast, the field of Arts and Humanities (ISCED 02) shows the highest incidence of combined vertical and horizontal mismatch – as many as 72% of employees with education in this field are employed in positions that do not align with either their field of study or educational level. Only 3% of individuals with this educational background are fully matched. Fields such as Social Sciences, Journalism and Information (ISCED 03) and Natural Sciences, Mathematics and Statistics (ISCED 05) also report high levels of combined mismatch – second and third highest respectively – with alignment rates of just 8% and 10%. By contrast, Health and Welfare (ISCED 09) and Information and Communication Technologies (ISCED 06) exhibit the lowest levels of combined mismatch among all fields, with only 17% and 18% of employees in these areas experiencing both vertical and horizontal mismatch.

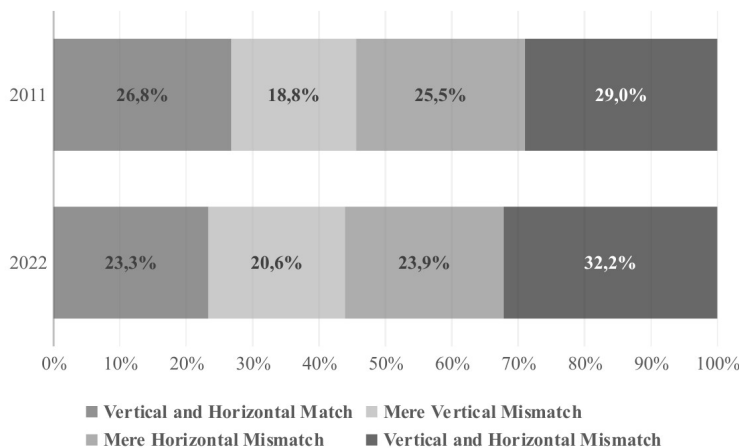


Fig. 5: Share of Different Types of Education Mismatches

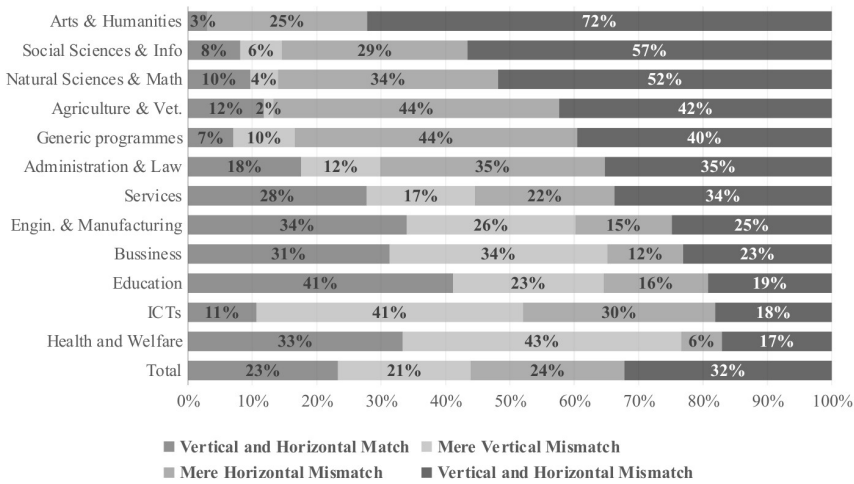


Fig. 6: Share of Workers by Education Mismatch and Field of Study in 2022

## 5 CONCLUSIONS

The mere occurrence of educational mismatch does not necessarily indicate deep structural problems in the labour market. Nevertheless, its widespread or persistent presence may reduce overall labour market efficiency and increase the societal costs of education. The presence of educational mismatch carries various drawbacks, which McGuinness (2006) categorises into micro- and macro-level effects. From the perspective of employees, two main consequences are frequently discussed – income penalties and lower job satisfaction. As noted by Nordin et al. (2010), employees experiencing educational mismatch are significantly more likely to earn lower wages compared to those whose job aligns with their qualifications. Specifically, overeducation has the most adverse effect on wages, with overeducated employees earning, on average, 15.3% less than matched employees, based on a synthesis of 21 prior studies (McGuinness, 2006). Furthermore, Battu and Bender (2020) argue that educational mismatch negatively impacts job satisfaction, as affected employees may feel a sense of inadequacy and unrealised potential. Overeducated employees are also more likely to change jobs frequently and may negatively affect the work environment. Burris (1983) additionally notes that overeducation can provoke societal discontent among certain social groups, potentially leading to negative social phenomena and radicalisation.

From a societal standpoint, education is an expensive process. When the costs of education exceed what is necessary to perform a particular job role, it represents an inefficient allocation of resources and a form of waste. These costs are borne by both individuals and the state, whether in the form of direct and indirect educational expenses (see Becker, 1964) or foregone tax revenues due to underutilised qualifications (McGuinness, 2006). According to Battu and Bender (2020), overeducation can also negatively affect a country's overall economic growth. For companies employing workers with educational mismatches, McGuinness (2006) notes that overeducated employees may display lower motivation and job satisfaction, potentially resulting in reduced productivity. Conversely, undereducated employees and those experiencing horizontal mismatch may require longer periods of adjustment, which can lead to additional training costs and reduced initial efficiency.

This article aims to address a gap in research on educational mismatch in the Czech labour market, examining its potential causes and determinants, as well as its development over the past decade. Although highly relevant, this topic remains understudied in the context of the Czech

labour market. To this end, we utilise data from two waves of the Wage Conditions Survey, conducted in 2011 and 2022, comprising 1,978 and 1,516 observations, respectively. The analysis reveals that educational mismatch – particularly overeducation – is a widespread phenomenon in the Czech labour market and has exhibited an upward trend over the past decade. In 2022, both vertical and horizontal mismatches exceeded the share of employees whose education matched the requirements of their jobs. Specifically, 52.8% of employees were vertically mismatched – either undereducated or overeducated – while 56.0% experienced horizontal mismatch, meaning they worked outside their field of study. Overall, only 23.3% of employees in 2022 did not exhibit any form of educational mismatch. Generally, women exhibit higher levels of educational mismatch compared to men, both in terms of overeducation and horizontal mismatch, which lends support to Frank's (1978) theory of differential overqualification. Older employees (aged 45–54) tend to have higher levels of vertical alignment, while younger employees (aged 25–44) are more likely to be overeducated. However, this finding applies only to the year 2022 and may reflect the increasing accessibility of education rather than supporting the theory of career mobility. In terms of horizontal mismatch, no statistically significant differences were found between younger and older employees. Taken together, a more comprehensive view reveals that only 23.3% of employees experience no educational mismatch at all, whereas nearly one-third (32.2%) face both vertical and horizontal mismatches simultaneously.

Interesting results were also observed across various fields of study. The highest proportion of overeducated employees is found among those with an educational background in Arts and Humanities (ISCED 02), where overeducation reaches 74%, followed by Agriculture, Forestry, Fishery and Veterinary (ISCED 08) with 48%. Conversely, the lowest rates of overeducation are observed among employees educated in Education (ISCED 01) and Health and Welfare (ISCED 09), at 14% and 20%, respectively. This suggests that fields with stricter professional regulations and qualification requirements – such as Education (ISCED 01) and Health and Welfare (ISCED 09) – tend to exhibit lower levels of vertical mismatch compared to broader academic disciplines such as Arts and Humanities or Social Sciences, where such formal requirements are typically absent. In terms of horizontal mismatch, employees with education in less specialised or broader fields – particularly Arts and Humanities (ISCED 02) – show the highest probability of mismatch, with over 97% working in jobs unrelated to their field of study. Similarly, high horizontal mismatch rates are found among those educated in Agriculture, Forestry, Fishery and Veterinary (ISCED 08) and Natural Sciences, Mathematics and Statistics (ISCED 05). In contrast, the highest proportion of employees whose current job corresponds to their field of education is observed among those educated in Health and Welfare (ISCED 09), where 77% are horizontally matched. This is followed by employees with an educational background in Business (ISCED 041) and Education (ISCED 01), both with a horizontal match rate of 65

At this stage, it is also necessary to consider the limitations and constraints of this study, as well as the data employed. The available data do not allow for the inclusion of all potential determinants of educational mismatch. For example, Leuven and Oosterbeek (2011) point out that individual ability may represent an important factor, highlighting a negative correlation between ability and overeducation. Due to this, the model may be affected by unobserved heterogeneity (see, e.g., Bauer, 2002). Additionally, other relevant determinants might have been omitted because of the structural limitations of the dataset. Moreover, the analysis is based on two separate cross-sectional waves (2011 and 2022), rather than longitudinal panel data. This limits the ability to assess the dynamics of mismatch at the individual level and to determine whether mismatch tends to persist over time or is typically temporary. Future research should aim to address these limitations. It should also place greater emphasis on other dimensions of educational mismatch. While this study has focused on the individual perspective, further investigation is needed to explore the consequences of mismatch for employers and the state. In particular, attention should

be paid to the quality of education and whether higher-quality education reduces the likelihood of mismatch. Finally, future studies should consider the role of economic policy in reducing educational mismatch and mitigating its negative impacts.

Given the extent of the observed phenomenon on the Czech labour market, it is essential to consider measures that could reduce educational mismatch. Potential solutions include systematic career guidance for students in primary and secondary schools, involving regular consultations to evaluate future development options and recommend further study or career paths. Enhancing the existing network of career advisors could facilitate a better alignment between the qualifications of school leavers and the needs of the labour market. Another approach might involve limiting publicly funded higher education. For example, introducing tuition fees at public universities, with interest-free state loans, could help reduce overeducation and horizontal mismatch and improve educational quality. This measure would encourage students to rationalise their choice of higher education institutions and fields of study, minimising the tendency to extend their educational period. Additional funds could also enhance the effectiveness of teaching at universities. This approach is not unprecedented; for instance, the National Economic Council of the Government of the Czech Republic (NERV, 2022) mentions tuition fees as a potential solution to the growing budget deficit. Another related issue is the growing number of private secondary and higher education institutions, often characterised by less demanding academic standards. This may be reflected in the skills and knowledge of their graduates, who may then struggle to secure appropriate job positions. Finally, the government should also focus on creating an environment that actively supports companies in adopting the principles of Industry 4.0, technological innovation, and the knowledge-based economy. By supporting sectors with high added value and fostering innovation, the surplus of education – currently reflected in overeducation – can be transformed from a structural inefficiency into a driver of long-term economic growth. In this way, highly educated individuals will not be underutilised, but instead become a key resource for advancing productivity, competitiveness, and sustainable development.

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7 ANNEX

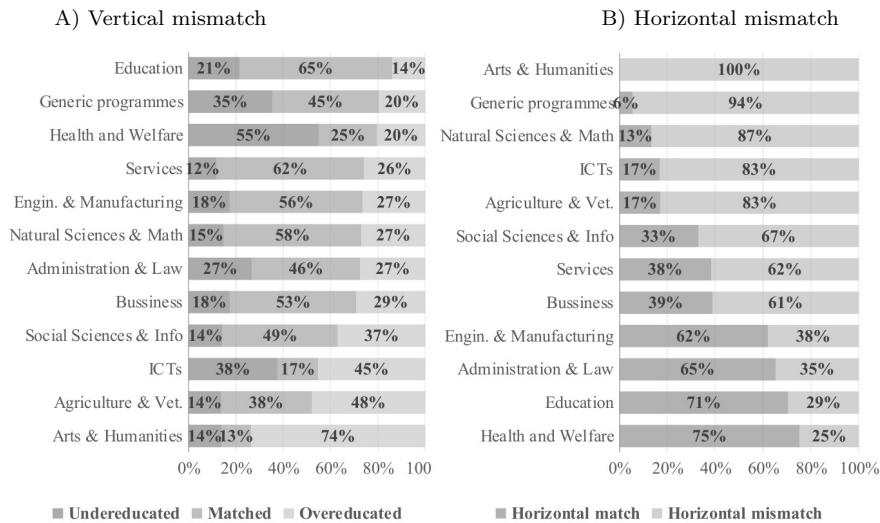


Fig. 7: Share of Education Mismatch by Study Field in 2011

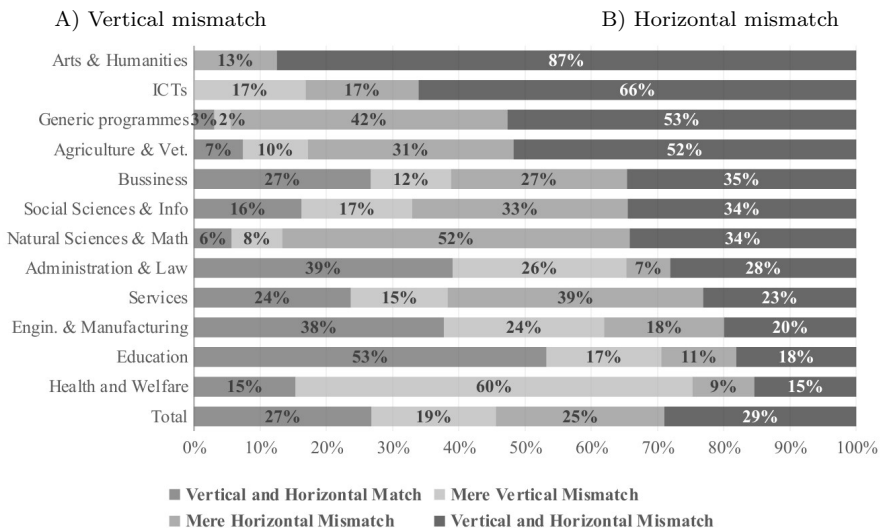


Fig. 8: Share of Workers by Education Mismatch and Field of Study in 2011

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