

Trajectories in the Czech Labour Market: The Role of Information-processing Skills and Education¹

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Abstract

The article assesses the role of information-processing skills and education in people's labour market trajectories in the Czech Republic in the period of economic recovery from 2011/2012 to 2015. We examine the extent to which literacy and numeracy and formal and informal education influenced changes in the stability of individuals' employment and their income mobility, incorporating polarisation and segmentation perspectives. The analysis is conducted using a unique combination of Czech PIAAC data and a follow-up survey. The findings show that formal education compared to information-processing skills and further education is by far the most important factor of change in a person's position in the labour market while the role of skills is only limited.

Keywords: labour market, information-processing skills, mobility, polarization, segmentation, wage dynamics

JEL Classification: J24, J31

Introduction

Alongside the accelerating digitalisation of societies and economies, labour markets in developed countries are changing fast in many respects. One is the composition of skills individuals need to find and maintain a sufficiently paid and meaningful job. In light of the emergence of ever new technologies and of the consequent rapid creation and destruction of jobs, the market environment increasingly requires people to be able to improve and change their qualification more often than before. At the same time, the growth of intellectually demanding

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jobs, as an underlying trend, prevents us from seeing the changes in skill requirements as mere chaos. Individuals are consequently more often required to be able to absorb and use information in a variety of forms and, in particular, through digital channels.

These observations formed a good part of the rationale (OECD, 2013, p. 23; Straková and Veselý, 2013, p. 19) behind the implementation of the Programme for the International Assessment of Adult Competencies (PIAAC) starting in 2008. The survey included testing of large representative adult population samples in *information-processing skills* (in the text below these are also referred to as cognitive skills, competencies, or just skills), specified as literacy, numeracy, and problem-solving skills in a digital environment (OECD, 2013; OECD, 2016), and a questionnaire dealing with a number of aspects of work, education, and the personal circumstances of respondents. In this way, empirically grounded conclusions could be drawn about skill levels in participating countries and about their impact on people's working lives. It has been found that literacy and numeracy correlate strongly with education level but do not overlap with it. The effect of these skills on success in the labour market is significant in terms of, among other aspects, avoiding long-term unemployment and attaining higher income. While the skills are to some extent obtained and signalled through formal education, they also have their own independent effect (OECD, 2016).

In this paper, we use the unique combination of PIAAC data and a follow-up survey to assess the role of information-processing skills and education in people's labour market trajectories in the Czech Republic in the period of economic recovery from 2011/2012 to 2015. We examine the extent to which skills and formal and informal education influenced changes in the stability of individuals' employment and their wage mobility. Given that the labour market has come to be polarised in developed countries and that this is likely to continue as a result of digitisation being a driving force behind it, we will also deal with the different impact that the studied factors have on people with lower and higher income. Thus, taking advantage of PIAAC test results in skills and data on subsequent labour market trajectories of PIAAC respondents and incorporating polarisation and segmentation perspectives, in this paper we seek to innovatively contribute to explaining the dynamics in people's working lives in the Czech Republic in recent years.

The article begins with an overview of what recent scholarship and literature has found on the role of cognitive skills in careers and on labour market segmentation and polarisation. Further on, we will explain our approach to measuring individual trajectories in the labour market, state our hypotheses, and specify our use of data. To close, we will present and discuss the results of our empirical analysis.

The Impact of Skills on Success in the Labour Market

The technological revolution combined with social and economic transformations has accelerated the pace of changes in current labour markets and especially in the kinds of skills that are in demand. The need for routine cognitive and craft skills is declining due to increasing automation, while the demand for information-processing skills and other high-level cognitive and interpersonal skills is growing (OECD, 2013; de la Rica and Goltazar, 2015). Policy-makers often see skills as drivers of overall economic development or, as the European Commission (2012, p. 7) puts it, ‘a real “win-win” for all – for the economy, for society, for employers and, of course, for individuals themselves’. The OECD *Skills Strategy* is formulated as an ‘integrated, cross-government and interdisciplinary strategic framework to help countries understand more about how to invest in skills in a way that will transform lives and drive economies’ (OECD, 2012, p. 3).

Conceptual approaches to the classification of skills and their measurement include a wide range of approaches derived from many disciplines. The definition of information-processing skills and related concepts also varies in the literature (for an overview, see Kearns, 2001). For the purposes of this article we use the OECD’s (2013) definition of *key information-processing competencies*, which are the skills that are an integral part of generic skills and serve as the basis for developing higher cognitive skills (e.g. analytical thinking) and that are also necessary for acquiring expert knowledge, and these are: numeracy, literacy, and problem-solving in technology-rich environments. ‘These skills are relevant for adults in many social contexts and work situations, and necessary for fully integrating and participating in the labour market, education and training, and social and civic life’ (OECD, 2013, p. 25).

Empirical analysis has for a long time focused on years of school education as a necessarily imperfect proxy for a worker’s human capital. In the analysis of the relationship between knowledge and economic product, Hanushek and Woessmann (2012) stress that the number of years of education, usually used as a measure of human capital, neglects qualitative differences in the resulting knowledge. As the authors demonstrate on international data, cognitive skills are more important for economic growth than is education itself. Nevertheless, both characteristics are mutually related, because it’s the education system in which competencies are developed and structured, but also verified, tested, and certified (Hanushek and Woessmann, 2012).

Already a number of years ago, researchers attempted to quantify what share of the wage benefits of education could be explained by cognitive skills. Green and Riddell (2001) found that including skills of this kind reduces the effect of educational attainment on wages by one-third, and according to Osberg (2000)

by even more, by 40 – 45%. Even so, formal education remains the most important factor. In fact, the level of education is a proxy for other unmeasured and immeasurable skills, such as occupation-specific skills, the ability to learn, and other skills. Education also has a signalling function, as employers use it as information about a worker's level of productivity (e.g. Arrow, 1973; Spence, 1973).

A more direct way of measuring human capital compared to schooling was made possible with the first direct testing of adult competencies in the *International Adult Literacy Survey* (IALS) conducted in the 1990s, which was followed by the more extensive *Programme for International Assessment of Adult Competencies* (PIAAC), conducted in the Czech Republic in 2011 – 2012. Still, only some types of cognitive skills can be measured in tests. Testing methods were developed for literacy and numeracy and also for problem-solving in technologically rich environments.

Literature based on these surveys usually confirms that a higher level of skills increases the probability of having a better job. The increase in wages associated with one standard deviation rise in literacy proficiency ranges from less than 5% in Denmark, Finland, and Italy, to more than 10% in the United States, while the effect of years of education on wages is on average larger, ranging from 7% in Sweden to more than 25% in Poland and the Slovak Republic (OECD, 2013, p. 232). The effect of skill proficiency on wages doesn't seem to change over the lifespan (OECD, 2013, p. 233). There is also a relationship between cognitive skills and the quality of jobs. An OECD study based on the results of IALS shows that the likelihood of people with secondary education working in manual jobs ('blue-collar' occupations in ISCO classes 6 – 9) decreases with the increasing level of cognitive skills. Conversely, the likelihood of their working in high-skilled occupations (ISCO classes 1 – 3) grows with their increasing level of cognitive skills (OECD, 2000).

In the Czech Republic, previous research has found that information-processing skills have a relatively low impact on having a paid job at a given moment, while their effect is stronger in preventing long-term unemployment (Bakule, Matoušková and Vavřinová, 2013, pp. 134 – 138; OECD, 2016, pp. 122 – 123). The role of cognitive skills in the work success of Czech graduates is also rather low compared to formal education and to the increasing influence of socio-economic family background (Koucký and Zelenka, 2013, pp. 217 – 219). The relationship between competencies and earnings is complex. While these two are strongly associated, the effect of competencies on wages in the Czech Republic nearly disappears when education, gender, and some characteristics of a job are taken into account (Matějíř, Anýžová, 2015; Večerník, Mysíková and Matějíř, 2013). The Czech labour market poorly financially rewards competencies when

compared to formal education, as opposed to countries with larger innovation potential (Anýžová, 2017). It also has to be noted that returns to formal education were rising in the Czech Republic from 1990 up to at least 2010, which was the last year observed by Večerník, Mysíková and Matějů (2013, pp. 164 – 165). Out of the not very sizeable academic literature dealing with the effect of further education on work success in the Czech Republic, let us mention the paper by Simonová and Hamplová (2016) that found a significant impact on upward mobility but not on preventing downward mobility.

Labour Market Segmentation and Polarisation

Besides personal characteristics, skills, knowledge, and institutional context, people's work trajectories are, influenced by the overall structure of the labour market and trends in its development. There is a large body of literature that sees increasing disintegrative processes in the labour markets of developed countries, conceptualised as segmentation and polarisation. We will proceed here to present the main features of these concepts and the empirical evidence found in the recent literature and will then incorporate these concepts into our data analysis.

Theories of a segmented labour market postulate the existence of several separate labour markets instead of just one as otherwise assumed. This perspective sees the labour market as divided into primary and secondary, internal and external, or core and peripheral (Doeringer and Piore, 1980; Cappelli and Neumark, 2004) and more recently there has been growing use of the term *precarious work* occurring in the disadvantaged segment (e.g. Benach and Muntaner, 2007). The primary, internal, or core labour market consists of more secure jobs, usually on indefinite contracts. The employees get higher wages, better working conditions, and more opportunities for self-development and for influencing the way they work. On the contrary, jobs on the secondary, external, or peripheral labour market, or precarious jobs, are insecure and worse paid. Employees have worse working conditions and treatment, get quickly hired and dismissed in times of demand-induced fluctuation (Pfeifer, 2009), and, in addition, receive less on-the-job training (Cabreres, Dolano and Mora, 2014). Besides the negative consequences for a person's career, insecure jobs also significantly heighten the risk of the deterioration of a person's mental and physical health (Aronsson, 2005; Waenerlund et al., 2011; Quinlan, Mahew and Bohle, 2001).

As Pfeifer (2009, p. 92) points out, the core-periphery hypothesis is not supported by very strong empirical evidence. Nevertheless, almost two decades ago Quinlan, Mahew and Bohle (2001) were already able to observe a high degree of consensus in the literature that peripheral employment was increasing. This trend

then accelerated during the global economic crisis, as manifested by the expansion of temporary contracts and involuntary part-time jobs throughout Europe, including the Czech Republic (Eurofound, 2015; Piasna, 2015; Křížková and Formánková, 2014). Although evidence on peripheral and precarious employment in the Czech Republic has not been elaborated beyond description of the aforementioned indicators, some authors view the Czech labour market as segmented (Trbola and Rákoczyová, 2010; Sirovátka, 2002).

Compared to segmentation, polarisation of the labour market can be measured in a more straightforward way, as it refers to growing employment in high-skilled and low-skilled occupations at the expense of the middle categories. At the same time, wages increase at the top while decreasing in the middle and at the bottom, which results in widening wage gaps among employees (Michaels, Natraj and van Reenen, 2014; van den Berge, Kuijpers and Ter Weel, 2015) and thereby in a ‘hollowing-out’ of the skill and income structure of employment (Frey and Osborne, 2013). This trend has been observed in Europe and the United States since the early 1990s (Pertold-Gebicka, 2014, p. 133) or even since a decade before that (Michaels, Natraj and van Reenen, 2014, p. 60). There seems to be a consensus that job polarisation is largely caused by routine middle jobs being supplanted by new technologies (e.g. de la Rica and Gortazar, 2015; Michaels, Natraj and van Reenen, 2014; Pertold-Gebicka, 2014; Frey and Osborne, 2013) and some scholars, but not all, see the relocation of some middle jobs to low-wage countries as a factor (Pertold-Gebicka, 2014). Not only workers get more concentrated at the opposite poles of the wage structure, but these poles also grow further apart from each other because of the continuously rising income inequalities (for empirical evidence, see, e.g., in OECD, 2015a; Večerník, 2013).

Although employment polarisation, labour market segmentation, and growing income inequality are differently defined processes, the link between them is more than evident because peripheral jobs are usually also low-skilled and low-paid. A substantial body of literature has noted the interconnection of these trends, be it explicitly or implicitly. Halleröd, Ekbrand and Bengtsson (2015, p. 476) directly ascribes the rise of the precariat to the growth of employment in low-skilled occupations occurring as part of job polarisation in Europe. A cross-country analysis by Eurofound (2015) on data from 2006 – 2010 found significantly lower wages among employees with temporary contracts (which is one of the indicators of peripheral employment) compared to those with permanent contracts. This wage gap in the Czech Republic was 27% or 10% after controlling for potentially interfering variables, and both numbers had risen since 2006. Atypical work contracts were also found by the OECD to be one of the causes of long-term low wages (OECD, 2015b, pp. 186 – 187). Pinkston (2009, p. 369) acknowledges the findings of previous literature that ‘bidding wars’ between

firms for potential employees may be a constitutive element of the highly productive part of the dual labour market as opposed to low productive firms, and in line with that Oesch and Rodriguez Menes (2010, p. 29) assume negative implications of job polarisation for the upward mobility of the low-paid, thus their increasing segregation at the bottom. The growing disintegration of the labour market leads us to expect that different mechanisms play role in individual work trajectories in the advantaged and disadvantaged segments, which is why we will consider this issue in the data analysis.

Conceptualising Trajectories in the Labour Market

We proceed by explaining what we will mean by trajectories in the labour market. The most obvious manifestation of a person's labour market position is having a paid job. While those who are employed can enjoy access to a regular income, to a network of social contacts, and to the feeling of being involved in more or less useful activities, unemployed adults have, generally speaking and with the exceptions of some specific groups, more limited possibilities to use all these resources. Being in paid employment is therefore an indicator widely present in literature dealing with predictors of labour market success (OECD, 2015b; Halleröd, Ekbrand and Bengtsson, 2015; Křížková and Formánková, 2014). Besides a person's current status, recent experience with unemployment and inactivity also distinguishes a stable position in the labour market from a more vulnerable one (Halleröd, Ekbrand and Bengtsson, 2015) with important consequences for a person's needs being addressed. When mutually comparing different jobs, it is common to use wage as a measure of job quality (e.g. McIntosh and Vignoles, 2000; Chiswick, Lee and Miller, 2002; Green and Riddell, 2012), assuming that the primary motivation to work is to earn one's living and that a better-paid job is more desirable. These two dimensions will be at the core of our interest. At the same time, we do not include the option of examining mobility between ISCO job levels. The impact of education level on the qualification intensity of a job might, justifiably, be regarded as self-evident, which is why we don't expect this potential to offer much added value compared to a model of earnings.

We have the unique opportunity to compare the respondents' labour market position in PIAAC (2011/2012) and in a follow-up survey from 2015 on the education and working careers of PIAAC respondents and monitor the trajectories in the labour market. In 2012, the economic crisis manifested itself as a second peak of the unemployment rate, reaching 7% (by Eurostat methodology), while the situation improved later on and unemployment dropped to 5.1% in 2015. Our analysis thus covers the period of emerging better times in the labour market

after years of pessimism. Yet, far from everyone was affected by the positive changes. The data from the follow-up survey allow us to shed some light on the unequal access to the gains brought by the economic recovery.

Research Questions and Hypotheses

We will examine the importance of factors of individual trajectories in the labour market over the specified period and we can group these factors into the following categories:

- individual factors, associated with human capital: education level, skills, participation in non-formal education;
- socio-demographic characteristics represented by age and gender;
- recent experience with unemployment or inactivity and change of employer (for the wage mobility model only, as specified below).

Bearing in mind the above-described trends of segmentation and polarisation of the labour market and growing income inequalities, first we explore how much the role of the studied factors varies in the wage change of employees with initially lower or higher earnings, and second we define stable and unstable positions in the labour market in a manner similar to the way in which core and periphery workforces have been operationalised in other research.

We shall now present the hypotheses for the data analysis. First, we expect numeracy and literacy skills to play a greater role in earnings change than in employment stability (H1). Skills will have a greater impact on improving the earnings of employees with higher initial earnings (H2). We base this assumption on Pinkston's (2009) conclusion that an employer gains more information on the skills of an employee as time passes, that the transmission of this information happens when a person moves to another employer without falling into unemployment in the meantime, and that employers project this information into an employee's wage. Pinkston, however, believes that this transmission only applies to highly productive firms, in other words in the case of 'good' jobs or the primary labour market. Bearing in mind the failure of non-formal education to prevent downward mobility, as Simonová and Hamplová observed (2016) we expect no significant effect of literacy and numeracy skills on preventing the loss of a stable position in the labour market (H3).

Data, Key Variables and Methodology

We use merged data from PIAAC and from a follow-up survey conducted among Czech PIAAC respondents in the project '*SKILLS CLOSE – Links between skills, education and results on the labour market: a longitudinal study*'

(referred to here and below as ‘SKILLS’). The follow-up survey aimed at exploring relations between skills of adults, measured in PIAAC, and individual labour market trajectories. Out of the initial 6,102 Czech respondents of PIAAC, 2,425 remained in the panel until the completion of the SKILLS questionnaire, while the rest quit participation in various phases of the process. The large majority of the data for SKILLS were collected through an online questionnaire (CAWI method) and in a small number of cases (6%) through phone interviews (CATI). Women, younger people, and people with higher education were over-represented in the SKILLS survey sample, so a post-stratification weight was applied to the variables. The data for PIAAC were collected between August 2011 and April 2012 and for SKILLS between July and September 2015.

Below we will statistically assess the predictors of movement between a stable and unstable employment position (Model 1) and change in earnings (Model 2). The indicators were constructed with identically worded questions in both the PIAAC and the SKILLS questionnaires. Both regression analyses are performed using sampling weights in Stata 9.

The indicator of moving between a stable and unstable employment position is inspired by labour market trajectories between the core and periphery workforce as defined by Halleröd, Ekbrand and Bengtsson (2015).² We understand people in an unstable position in the labour market to be those who either:

- Are employed and have recent experience of unemployment or inactivity longer than three months, or
- Are unemployed or in retirement or on disability leave at the moment of the survey.

The status of an unstable position does not apply to students or to people on parental leave as these situations are common during certain periods in life. Following the same logic, the status of stable position includes people who have a paid job and have not recently experienced unemployment or inactivity excluding study and parental leave periods. We use respondents’ subjective perception of their current status consistently with the subjective assessment of recent unemployment or inactivity. Employment stability is represented by one variable for PIAAC and one for SKILLS. The resulting variable indicates whether the respondent’s situation changed between the two surveys.

For earnings (Model 2), respondents could choose between stating exact monthly or hourly earnings and classing themselves into one of the six ordered categories. Median-adjusted monthly earnings were assigned to the minority of

² We decided to speak of a stable and unstable position rather than a core and periphery workforce as used in the referenced article because of the possible inaccuracy of the term ‘periphery’ for people with the presented features.

respondents who chose class themselves in a category.³ Hourly earnings were recalculated based on the stated number of hours worked and, finally, the first and the last percentile were considered outliers and excluded. The final variable was constructed by subtracting the wage in PIAAC from the wage in SKILLS, adding up a constant in order to move into positive numbers and calculating a decadic logarithm of the result.

The analysis of earnings change is restricted only to full-time employees. The regression is done separately on two groups of respondents: people with originally lower monthly earnings (up to 21,000 CZK, an amount very close to the median gross wage in the Czech Republic in 2012) and people with originally higher monthly earnings (more than 21,000 CZK). In splitting our survey sample by income rather than by core-peripheral status, we believe that the low-income group will cover a large segment of the people on the peripheral labour market because of the close link between the polarisation and segmentation of the labour market described above. The income-based approach also eliminates the risk of the questionable inclusion of high-skilled employees working on temporary projects in the periphery, as they differ significantly from low-end employees in a number of important characteristics (Aronsson, Gustafsson and Dallner, 2002, pp. 170 – 171). As the dependent variable is a *change* in earnings and not the *final level* of earnings, splitting the sample according to the *initial level* of earnings does not create a potentially problematic autocorrelation between the dependent variable and the variable according to which the sample is divided.

As for independent variables, information-processing skills will be represented by the first plausible value of literacy skills and, in an alternative version, of numeracy skills, derived from the PIAAC survey assessment.⁴ This approach is common in current PIAAC-related research (e.g. Hanuschek et al., 2014; Levels, van der Velden and Allen, 2013; Pellizzari and Fichen, 2017) because it results in nearly identical estimates, as though the entire set of other plausible values had been used (Broecke, 2015, p. 142; Pellizzari and Fichen, 2017, p. 28) and because of the very high correlation between literacy and numeracy that prevents them from being included simultaneously. For literacy and numeracy in Model 1, apart from a continuous variable, we use also a categorised variable to test for possible non-linear relations. The categories are: level 0 – 2 (up to 275 points in

³ Within the pooled dataset, 7% of employees chose to rank themselves in a category in PIAAC and 12% in the follow-up. We consider the resulting imprecision of the results to be of an acceptable magnitude.

⁴ The third type of skills tested, problem-solving in a technology-rich environment, did not cover the part of the sample that had relatively weak computer skills. A significant non-random non-response would have emerged that would negatively impact the validity of the results if this type of skills would be included in the analysis.

the test), level 3 (276 – 325 points), and level 4 – 5 (more than 325 points), reflecting the OECD conceptualisation (OECD, 2013). The variable representing formal qualifications is the level of formal education, based on 3 categories ranging from elementary and secondary education without '*maturita*',⁵ secondary education with '*maturita*' up to tertiary education. Non-formal education is represented by a question from PIAAC covering the respondent's participation in informal educational activities during the preceding year. It was specified in the questionnaire as online or distance education, on the job training, seminars or workshops, private lessons and other courses.

The wage change model (Model 2) contains a variable indicating whether a person had been unemployed or inactive for more than three months during the five years preceding PIAAC, (excluding formal education and paid leaves – parental and sickness) and a variable indicating whether or not the individual changed employer between the two surveys. We also used some other characteristics of work in the first year and their change between the first and second year of panel data analysed in order to estimate their impact on individuals' wage change (organisation size, economic sector, duration of the job with the same employer). Neither of them, however, proved significant.

Gender and age are the control predictors in our models. The relation between age and employment stability is supposed to be nonlinear. In our survey sample, a persistently stable position in the labour market is most common in the 31 – 45 age group (74%), less in the 46 – 60 age group (62%, presumably influenced by the higher unemployment of older people and by early retirement, often used as a strategy to escape from unemployment) and least among young people aged 18 to 30 years (51%). We therefore use age as a categorised variable in Model 1. We exclude people over the age of 60 from the analysis in both models. In much current research experience with unemployment, economic inactivity has been found to be a significant obstacle to earnings improvement, which is why it is included in model 2.

Results

Model 1: Stable Position in the Labour Market

Model 1 is the result of multinomial logistic regression with movement (or its absence) between a stable and unstable position in the labour market as a dependent variable. We use the most numerous group of respondents in a stable position in both surveys as the reference category. Literacy represents information-processing

⁵ A school-leaving exam that is part of secondary educational programmes that allows the graduates to apply for higher education.

skills in this model. Replacing literacy with numeric skills leads to nearly identical results, the effects of numeracy being only very slightly weaker. Cases were deleted listwise. See Appendix 1 for descriptive statistics of the included variables. The assumptions of multinomial logistic regression were met.⁶

The model can in a general form be expressed as follows:

$$\begin{aligned}
 Y = & \alpha_1 + \beta_{11} \textit{literacy / numeracy} + \beta_{12} \textit{secondary_educ_maturita} \\
 & + \beta_{13} \textit{tertiary_educ} + \beta_{14} \textit{nonformal_1activity} \\
 & + \beta_{15} \textit{nonformal_more_activities} + \beta_{16} \textit{woman} \\
 & + \beta_{17} \textit{age31to45} + \beta_{18} \textit{age46to60} + \varepsilon_1
 \end{aligned}$$

where Y stands for possible movement between a stable and unstable position in the labour market. The model is significant on the 5% level, with the McFadden's pseudo R² of 0.08.

The results (Table 1)⁷ show that information-processing skills were only of limited importance for movement between a stable and unstable position in past years. When included as an interval variable, literacy skills can only be considered statistically significant (just above the level of 5%) in the category of people in a continuously unstable position, where each additional point of the test result slightly reduces the chance of remaining in this situation rather than a continuously stable position. By contrast, skills has no significant effect in the groups of respondents who either were in an unstable position before PIAAC or who are now. This means that better information-processing skills to a certain extent do keep people from being left in an unstable position for a long time, but do not help people avoid such a situation from time to time. When literacy is split into different levels, we find that only the top literacy skills, levels 4 and 5, significantly and greatly improve the chances of not remaining in an unstable position in the long-term, whereas none of the categories of numeracy have significant results. People with the middle-level literacy skills, level 3, are somewhat less likely to see their position improve as opposed to people whose skills are higher or lower than theirs, indicating a 'hollowing out' of the demand for skills in the polarised labour market. Numeracy has the same pattern, although without statistical significance (see Appendix 2).

⁶ The number of cases included in each category of the dependent variable per independent variable is sufficient (see the descriptive statistics in Appendix 1), and the multicollinearity of each variable (recoded as dummies when needed) doesn't exceed the conventional level of 4 in VIF in the case of either variable.

⁷ The coefficients Exp(B) in the table indicate the respondents' 'relative risks' appearing in the given category of stability in the labour market as compared to being the reference category, which is a stable position in both surveys (stated in a note under the table).

Table 1

Modelling Movement between a Stable and Unstable Position in the Labour Market (Model 1)

	Model 1a			Model 1b		
	Exp(B)	95% confidence interval		Exp(B)	95% confidence interval	
<i>PIAAC unstable – SKILLS unstable</i>						
Literacy skills (interval)	0.99+	0.99	1.00			
Literacy skills – level 3				0.90	0.56	1.44
Literacy skills – level 4 – 5				0.19*	0.05	0.73
Secondary education with ‘maturita’ (ISCED 344, 354)	0.58*	0.36	0.93	0.56*	0.35	0.89
Tertiary education (ISCED 5 – 8)	0.37*	0.19	0.72	0.37*	0.20	0.72
Non-formal education 1 year before PIAAC: one activity	0.47*	0.25	0.91	0.48*	0.25	0.92
Non-formal education 1 year before PIAAC: two or more activities	0.27***	0.16	0.45	0.27***	0.16	0.45
Women	1.86*	1.17	2.94	1.80*	1.13	2.88
Age 31 – 45 years	0.24***	0.12	0.49	0.24***	0.12	0.50
Age 46 – 60 years	0.72	0.37	1.39	0.73	0.37	1.41
Constant	3.15	0.56	17.85	0.73	0.35	1.50
<i>PIAAC unstable – SKILLS stable</i>						
Literacy skills (interval)	1.00	0.99	1.00			
Literacy skills – level 3				0.67+	0.43	1.05
Literacy skills – level 4 – 5				0.96	0.52	1.79
Secondary education with ‘maturita’ (ISCED 344, 354)	0.91	0.58	1.45	0.99	0.62	1.56
Tertiary education (ISCED 5 – 8)	0.72	0.41	1.26	0.75	0.44	1.30
Non-formal education 1 year before PIAAC: one activity	0.58+	0.33	1.01	0.58+	0.33	1.00
Non-formal education 1 year before PIAAC: two or more activities	0.32***	0.21	0.49	0.33***	0.21	0.50
Women	1.33	0.89	1.99	1.31	0.87	1.95
Age 31 – 45 years	0.32***	0.19	0.54	0.32***	0.19	0.54
Age 46 – 60 years	0.26***	0.15	0.47	0.26***	0.15	0.46
Constant	1.25	0.24	6.64	1.08	0.59	2.00
<i>PIAAC stable – SKILLS unstable</i>						
Literacy skills (interval)	1.00	1.00	1.01			
Literacy skills – level 3				0.92	0.57	1.46
Literacy skills – level 4 – 5				1.16	0.59	2.27
Secondary education with ‘maturita’ (ISCED 344, 354)	0.60*	0.37	0.97	0.63+	0.39	1.01
Tertiary education (ISCED 5 – 8)	0.31***	0.16	0.59	0.33***	0.18	0.60
Non-formal education 1 year before PIAAC: one activity	1.15	0.61	2.16	1.14	0.61	2.14
Non-formal education 1 year before PIAAC: two or more activities	0.77	0.46	1.29	0.78	0.47	1.30
Women	1.67*	1.08	2.58	1.65*	1.07	2.55
Age 31 – 45 years	0.64	0.31	1.30	0.64	0.32	1.32
Age 46 – 60 years	1.17	0.59	2.34	1.17	0.58	2.34
Constant	0.12*	0.02	0.76	0.20***	0.09	0.43

Notes: N (unweighted) = 1 374; The reference category of the dependent variable is PIAAC stable – SKILLS stable; The reference categories of the predictors are: Literacy skills – level 0 – 2; Elementary and secondary education without ‘maturita’ (ISCED 0 – 2, 353); No participation in non-formal education 1 year before PIAAC; Men, Age 18 – 30 years; McFadden R squared is 0.080 for Model 1a and 0.083 for Model 1b; Significance notation: + at 10% level, * at 5% level, *** at 0.1% level.

Source: PIAAC and SKILLS datasets; authors’ calculations.

Formal education proved to be a stronger predictor of a person's stability in the Czech labour market. The higher the level of education, the lower the likelihood of remaining trapped in an unstable position (0.58 for people with secondary education, 0.37 for tertiary educated compared to people with only elementary or secondary education without '*maturita*'). This also applies, and in a similar magnitude, to the possibility of losing an initially stable position, while the effect on improving an unstable position is not significant in relation to those in a permanently stable position, which means that formal education is also a factor that helps people remain in core employment. These results imply that higher formal education has been a strong factor influencing people's chances of being steadily employed and protected them from falling into an unstable situation during the recent years of economic improvement and it also helped the initially peripherally positioned people to move closer to the core labour market.

Non-formal education obtained before PIAAC doesn't play an important role. Its strongly significant 'effect' on being in a continuously unstable position merely reflects the fact that most further education is job-related, while more interesting results can be found among the people whose situation changed. The coefficient estimates and confidence intervals of non-formal education in the category of people who shifted into a stable position are very similar to those who did not, which means that there is no evidence of non-formal education helping people to obtain stability in working life.⁸ Among those whose position worsened, there is no significant effect of prior non-formal education compared to people who remained stable. Therefore, in general, we cannot conclude that participating in further education had an impact either on upward or on downward mobility in terms of a stable position in the labour market in recent years.

An expected age pattern was found confirming that the middle age group of people 31 – 45 years old are more likely to stay in stable employment than younger and older people and that the stabilising trajectory most likely forms up to the age of 30. The significantly negative coefficient for the highest age category with respect to the effect of older age on the chances of moving out of an unstable position, as opposed to its insignificant effect on remaining long-term in an unstable position, shows that the chances of entering the more secure segment of (stable) employment indeed diminish with age.

Women's odds of facing continuous instability were almost twice as great as those of men. The odds of women seeing their position worsen recently and not improve are significantly higher. As the analysis includes women who had a baby since PIAAC and does not include women who were on parental leave during

⁸ This conclusion was confirmed by using the category *unstable in PIAAC – unstable in SKILLS* as a reference in an otherwise identical model, where the effect of non-formal education in the group *unstable in PIAAC – stable in SKILLS* isn't significant.

PIAAC, we can't interpret this result as indicating a deteriorating of the (employment) situation of women in the Czech labour market. However, our data confirm that women keep facing more difficulties than men in getting into and remaining in employment.

Recent movement between a stable and unstable position in the labour market, or the absence of such movement, was found to depend heavily on formal education even after taking into account information-processing skills and further education. In particular, higher formal education largely improves a person's chances of long-term continuous employment and also of attaining a more stable situation, whereas a long-term unstable position and having recently fallen into such a situation are strongly linked to lower education. Information-processing skills beyond education level are a factor that is protective against long-term but not temporary instability. People in a particularly safe situation are those with the top levels of literacy skills, while, paradoxically, people with middle-level skills probably have smaller chances of improving their position than people with low-level literacy skills, which can be seen as a signal of labour market polarisation. Enrolment in further education, generally speaking, is not found to be either a factor in consolidating people's working lives or a factor that protects against loss of a stable position. On the contrary, gender has strong explanatory power, as can be seen by long-term instability being a more common situation for women than for men, and age plays an important role, too. Education that is mainly obtained in the early period of people's lives, timely entry into the sphere of secure employment, and even gender, therefore, seem to have a strong impact on long-term employment prospects and (on determining) potential long-term placement in either the core or the periphery of the labour market. Beyond that, a very high level of literacy skills helps avoid the risk of being trapped in the periphery, whereas people with middle-level skills might face a growing risk of getting into such a situation in the near future.

Model 2: Individual Wage Mobility

Model 2 is the result of linear regression with a logarithm of wage change as a dependent variable. Two versions of the regression were performed – one with literacy and the other with numeracy skills among independent variables. For the model's descriptive statistics, see Appendix 1. The assumptions of a multiple linear regression are met in the models for both income subgroups,⁹ while the

⁹ Based on the Durbin-Watson test, the model doesn't show excessive autocorrelation of residuals. Also, the association between the dependent variable and the interval independent variables (age and literacy/numeracy skills) follows a linear pattern and the assumption of homoscedasticity is met. Finally, none of the independent variables score very high in multicollinearity as the VIF is always less than 4.

power of the statistical analysis is limited by the relatively small number of cases. The model can be expressed as follows, with Y representing the decadic logarithm of wage change:

$$\begin{aligned}
 Y = & \alpha_2 + \beta_{21} \textit{literacy} / \textit{numeracy} + \beta_{22} \textit{secondary_educ_maturita} \\
 & + \beta_{23} \textit{tertiary_educ} + \beta_{24} \textit{nonformal_1activity} \\
 & + \beta_{25} \textit{nonformal_more_activities} + \beta_{26} \textit{age} + \beta_{27} \textit{woman} \\
 & + \beta_{28} \textit{change_employer} + \beta_{29} \textit{unemployment_experience} + \varepsilon_2
 \end{aligned}$$

The model for both subgroups is significant at the 5% level, with the adjusted R^2 of 0.21 for the low-income subgroup and 0.11 for the high-income subgroup. Information-processing skills proved to be weak predictors of a person's chances of a wage increase. Only numeracy has a significant effect at the 10% level in the low-income group (owing to lower variability), while in the case of literacy the effects did not reach conventional significance levels. However, the coefficients of both literacy and numeracy in both income groups are positive and are greater in the group with higher initial earnings. The consistency of the coefficients with each other and with theoretical expectations leads us, albeit cautiously, to conclude that higher information-processing skills have had a certain positive effect on individual wage mobility in recent years.

An important predictor of wage change for both income groups is the level of formal education. Tertiary education is positively related to wage increase in both income groups. In the group of people with higher initial earnings, even secondary education with '*maturita*' positively influences the wage change. Similarly to what we found in studying individual employment stability, in wage mobility also we observed that it was people with higher qualifications who gained the most from the recent economic recovery. Interestingly, formal education is a somewhat weaker predictor of wage mobility for people with lower initial earnings.

As regards non-formal education obtained before PIAAC, the model shows that participation activities in further education did not play any role in individual wage change for both initial income groups. This can be concluded on the basis of the lack of significance of our dummy variables representing prior non-formal learning and of their negligible coefficients.

Age proved to be a predictor that differentiates chances of wage mobility between the two initial income groups of our analysis. While the relationship between age and wage increase is negative in the category of people with lower initial earnings, there is no significant age effect in the category of people with initial earnings higher than 21,000 CZK per month. This finding implies that whereas the chances of high-paid people getting a wage increase do not

systematically change over a lifetime, the prospects of low-paid people are determined rather early and later it becomes more difficult to move into the higher (-paid) segment of employment.

Table 2

Modelling Individual Wage Change (Model 2)

	Model 2A – lower initial earnings (up to 21,000 CZK)			Model 2B – higher initial earnings (more than 21,000 CZK)		
	B	SE B	β	B	SE B	β
Model with literacy skills						
Constant	4.42	.06		4.27	.11	
Secondary education with ‘ <i>maturita</i> ’ (ISCED 344, 354)	.02	.01	.09	.03	.02	.14 +
Tertiary education (ISCED 5 – 8)	.06	.02	.17 ***	.06	.02	.25 **
Non-formal education 1 year before PIAAC: one activity	.01	.01	.03	-.01	.02	-.02
Non-formal education 1 year before PIAAC: two or more activities	.01	.01	.04	.01	.02	.03
Change of employer	.04	.01	.22 ***	.03	.02	.08
Literacy skills	.00	.00	.06	.00	.00	.12
Women	-.04	.01	-.23 ***	-.05	.02	-.17 **
Age	-.00	.00	-.18 *	-.00	.00	-.02
Unemployment experience	-.00	.01	-.01	.00	.02	.00
R ²			0.202			0.105
Cases included (unweighted)			332			330
Model with numeracy skills						
Constant	4.39	.05		4.28	.09	
Secondary education with ‘ <i>maturita</i> ’	.01	.01	.09	.03	.02	.14 +
Tertiary education	.05	.02	.17 ***	.06	.02	.26 **
Non-formal education 1 year before PIAAC: one activity	.01	.01	.03	.01	.01	.03
Non-formal education 1 year before PIAAC: two or more activities	.01	.01	.04	.01	.01	.03
Change of employer	.04	.01	.23 ***	.03	.02	.08
Numeracy skills	.00	.00	.06 +	.00	.00	.12
Women	-.04	.01	-.23 ***	-.05	.02	-.18 **
Age	-.00	.00	-.19 **	-.00	.00	-.02
Unemployment experience	-.00	.01	-.01	.00	.02	.00
R ²			0.208			0.105
Cases included (unweighted) ¹⁰			332			330

Notes: The reference categories of the predictors: Elementary and secondary education without ‘*maturita*’ (ISCED 0 – 2, 353); No participation in non-formal education 1 year before PIAAC; No change of employer between 2011 and 2015; Men; No experience with unemployment for more than 3 months. Significance: + at 10% level, * at 5% level, ** at 1% level, *** at 0.1% level.

Source: PIAAC and SKILLS datasets, authors’ calculations.

Women face a disadvantage in the labour market in that they have significantly and greatly lower odds of a wage increase in both categories of initial earnings. Thus, individuals’ recent movement along the wage ladder has been largely gendered at the cost of women. It’s worth noting that the analysis was conducted on a sample of people who were employed full-time in both surveys, meaning that women on maternity and parental leaves were excluded from the analysis.

¹⁰ The smaller number of respondents included in Model 2 than in Model 1 is due to the PIAAC’s and follow-up survey’s restriction to narrower focus on full-time employees.

Although we expected unemployment experience to have a negative impact on the prospect of wage mobility, this effect turned out to be insignificant. A change of employer between the PIAAC and the SKILLS surveys had a significant effect on wage change for people in the category of lower initial earnings. This result indicates that while higher-income workers can build up their careers gradually and move up the wage ladder in one job, people in the low-income category more often have to search for a new employer to increase their wages. We also controlled for the organisation size and the economic sector the respondents worked in and for the duration of employment (in the same job) with the same employer. Neither of these effects was significant for either group of respondents.

Recent individual wage change has positively depended, as in the case of moving between stable and unstable position, on formal education, even after taking into account information-processing skills and further education. Skills have proved to be a weak, though not completely negligible factor of individual wage development and probably more affect people in the higher-income segment of employment. For both income groups we can conclude that higher formal education impacts not only wages as such but also their recent changes, that it is used by employers as the dominant signal of workers' competencies and productivity, and therefore that it places Czech employees in a favourable position regarding their further income prospects during their career. Enrolment in further education was not found to be a factor of wage mobility. It is worth pointing out that lower-paid employees are disadvantaged in their chances of getting a wage increase in the case where they remain long-term with the same employer and also in older age.

Discussion and Conclusion

The aim of this paper was to examine the movement of individuals up and down the Czech labour market ladder in recent years, focusing primarily on the effects of information-processing skills and education. As measures of work success we took the (in)stability of a person's employment and change in employees' wages.

Accepting the importance of different types of disintegration of the labour markets, as analysed in a large body of current literature, we looked at the Czech labour market as segmented and potentially polarised. We performed two regression models, the first of which studied movement between the segments of stable and unstable employment, and the second of which studied the mechanisms operating within the low-paid and high-paid segments.

Our first hypothesis (H1) expected information-processing skills to have a stronger influence on wage mobility than on employment stability. Within the stability analysis, the results showed that information-processing skills play a role only in the case of avoiding permanent instability and only in the top-skilled category, and for wage mobility we obtained positive though mostly insignificant coefficients for the effect of information-processing skills. The overall impact of skills on mobility turned out to be limited in the case of both examined indicators without a clear difference between the results in the two dimensions. We expected skills to have more of an influence on wage change among people with higher initial earnings (H2). Although skills were not found to be a factor of individual wage change in either category at the 5% significance level, the coefficients do indicate they have a stronger effect among the high-paid. Previous non-formal education has no impact on preventing the loss of a stable labour market position, thus verifying our third hypothesis (H3). Non-formal education does not play a role in this type of upward mobility either.

When comparing the importance formal education on the one hand and information-processing skills and further education on the other have on the changes in individuals' position in the labour market, the role of formal education has proved to be much more important in the Czech Republic. A degree, mostly obtained in the early part of a person's life, and undoubtedly the competencies acquired by the preceding education increase the chances of avoiding long and recurring episodes of unemployment, for retaining a stable position once it is acquired, and also for improving wages, especially in the already better paid segment. While the effect of education on a person's stability in employment comes as no surprise, its role in wage mobility is not as expected, especially with unemployment experience among the controls. The fact that wage dynamics are more favourable for people with higher formal education may indicate that the importance of this factor in the Czech labour market is still growing.

High literacy and numeracy skills beyond those manifested by formal education help people to avoid long-term employment instability, but they are not a protective factor from temporary instability. Although we were unable to solidly prove the impact of these skills on wage change, the results nevertheless revealed a pattern where skills somewhat raise the chances of getting a wage increase, and this is more pronounced in the higher, more knowledge-intensive job segment. We believe that the small numbers of respondents included in the model proved to be a limiting factor in this case. Previous non-formal education does not influence the risk of temporary or long-term instability. It must be stressed, however, that this variable was included in our analysis without a detailed breakdown according to the different forms and content of non-formal education.

There are insufficient grounds for drawing optimistic conclusions about the permeability of the current Czech labour market. Not only does non-formal education *per se* not impact the chances of rising up the wage ladder, but it does not help people to avoid ending up in the peripheral workforce either, while skills do so only in the case of the highest skill levels, which is the skill level of currently just a small share of people, and the effect concerns only avoidance of long-term peripheral position. A particular reason for concern is that with increasing age the low-paid gradually lose chances for wage improvement, unlike the better-paid. This can mean that shifting into the higher segment gets more and more difficult with age, while, within the higher-paid segment the prospects of wage improvement remain more open throughout productive life. This finding, along with the one about the negative effect of staying with the same employer among the initially low-paid, suggests the hypothesis that upward wage mobility within the high-paid segment is to a large extent positionally conditioned. Finally, we would like to point out that the higher odds we observed of women (not just those with small kids) becoming trapped in the periphery of the labour market and their lower chances of seeing their wages rise in comparison with men show that women's disadvantage stretches along longer spans of their careers and thus is not limited to just a static gender wage gap.

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Appendix 1

Descriptive Statistics of Variables in Model 1

Value	N (weighted)	Percentage
<i>Transition between stable and unstable position in the labour market</i>		
PIAAC stable – SKILLS stable	974	66
PIAAC unstable – SKILLS unstable	172	12
PIAAC unstable – SKILLS stable	198	13
PIAAC stable – SKILLS unstable	139	9
<i>Literacy skills</i>		
Level 0 – 2	659	44
Level 3	674	45
Level 4 – 5	151	10
<i>Formal education</i>		
Elementary/secondary without 'maturita' (ISCED 0 – 2, 353)	717	48
Secondary with 'maturita' (ISCED 344, 354)	518	35
Tertiary (ISCED 5 – 8)	248	17
<i>Participation in non-formal education 1 year before PIAAC</i>		
No activity	568	38
One activity	246	17
More than one activity	669	45
<i>Age in 2015</i>		
18 – 30 years	202	14
31 – 45 years	648	44
46 – 60 years	634	43
<i>Gender</i>		
Male	852	57
Female	631	43

Source: PIAAC and SKILLS datasets; authors' calculations.

Descriptive Statistics of Variables in Model 2

Variable	Low initial earnings				High initial earnings			
	N (weighted)	Percentage	Mean	St. Deviation	N (weighted)	Percentage	Mean	St. Deviation
Change of wage (decadic logarithm)	395		4.4	0.1	320		4.3	0.1
Literacy skills	395		275.0	36.3	320		290.4	34.8
Numeracy skills	395		277.3	36.7	320		294.0	40.1
Age	395		43.1	11.1	320		43.9	9.5
Formal education								
Elementary/secondary without 'maturita' (ISCED 0 – 2, 353)	230	58			96	30		
Secondary with 'maturita' (ISCED 344, 354)	137	35			142	44		
Tertiary (ISCED 5 – 8)	28	7			82	26		
Participation in non-formal education 1 year before PIAAC								
No activity	181	46			61	19		
One activity	63	16			59	19		
More than one activity	151	38			199	62		
Change of employer								
Change	104	26			46	14		
No change	292	74			273	86		
Experience with unemployment								
Yes	82	21			25	8		
No	313	79			294	92		
Gender								
Male	188	47			245	77		
Female	208	53			75	23		

Source: PIAAC and SKILLS datasets; authors' calculations.

Appendix 2

Results of Model 1, Version with Numeracy Skills

(moving between a stable and unstable position in the labour market)

	Model 1a			Model 1b		
	Exp(B)	95% confidence interval		Exp(B) A	95% confidence interval	
PIAAC unstable – SKILLS unstable						
Numeracy skills (interval)	0.99	0.99	1.00			
Numeracy skills – level 3				0.69	0.42	1.12
Numeracy skills – level 4 – 5				0.46	0.17	1.24
Secondary education with ‘ <i>maturita</i> ’ (ISCED 344, 354)	0.58 *	0.36	0.94	0.59 *	0.36	0.95
Tertiary education (ISCED 5 – 8)	0.37 *	0.18	0.74	0.38 *	0.19	0.78
Non-formal education 1 year before PIAAC: one activity	0.47 *	0.25	0.91	0.47 *	0.25	0.90
Non-formal education 1 year before PIAAC: two or more activities	0.27 ***	0.16	0.45	0.27 ***	0.16	0.45
Women	1.82 *	1.14	2.89	1.78 *	1.12	2.84
Age 31 – 45 years	0.24 ***	0.11	0.49	0.23 ***	0.11	0.48
Age 46 – 60 years	0.73	0.38	1.41	0.70	0.36	1.37
Constant	2.55	0.41	15.91	0.81	0.39	1.70
Cases included (unweighted): 130						
PIAAC unstable – SKILLS stable						
Numeracy skills (interval)	1.00	1.00	1.01			
Numeracy skills – level 3				0.83	0.51	1.34
Numeracy skills – level 4 – 5				1.19	0.64	2.22
Secondary education with ‘ <i>maturita</i> ’ (ISCED 344, 354)	0.86	0.53	1.37	0.91	0.57	1.46
Tertiary education (ISCED 5 – 8)	0.64	0.36	1.13	0.67	0.38	1.19
Non-formal education 1 year before PIAAC: one activity	0.58 +	0.34	1.02	0.58 +	0.33	1.01
Non-formal education 1 year before PIAAC: two or more activities	0.32 ***	0.21	0.49	0.32 ***	0.21	0.49
Women	1.36	0.90	2.05	1.36	0.90	2.05
Age 31 – 45 years	0.32 ***	0.19	0.54	0.31 ***	0.19	0.53
Age 46 – 60 years	0.26 ***	0.15	0.47	0.26 ***	0.14	0.46
Constant	0.65	0.12	3.46	1.02	0.55	1.88
Cases included (unweighted): 174						
PIAAC stable – SKILLS unstable						
Numeracy skills (interval)	1.00	0.99	1.00			
Numeracy skills – level 3				0.77	0.47	1.25
Numeracy skills – level 4 – 5				1.32	0.65	2.67
Secondary education with ‘ <i>maturita</i> ’ (ISCED 344, 354)	0.67	0.41	1.09	0.65 +	0.40	1.06
Tertiary education (ISCED 5 – 8)	0.38 *	0.20	0.74	0.32 ***	0.17	0.61
Non-formal education 1 year before PIAAC: one activity	1.12	0.60	2.11	1.14	0.61	2.13
Non-formal education 1 year before PIAAC: two or more activities	0.77	0.46	1.28	0.77	0.46	1.28
Women	1.60 *	1.03	2.48	1.69 *	1.08	2.62
Age 31 – 45 years	0.66	0.32	1.35	0.63	0.31	1.28
Age 46 – 60 years	1.17	0.58	2.36	1.14	0.57	2.26
Constant	0.38	0.06	2.58	0.21 ***	0.10	0.45
Cases included (unweighted): 123						

Note: N (unweighted) = 1 374; Reference category of the dependent variable is PIAAC stable – SKILLS stable; Reference categories of predictors: Numeracy skills – level 0 – 2, Elementary and secondary education without ‘*maturita*’; No participation in non-formal education 1 year before PIAAC, Men, Age in 2015: 18 – 30 years; McFadden R squared 0,080 for Model 1a and 0,082 for Model 1b; Significance notation: + at 10% level, * at 5% level, *** at 0.1% level.

Source: PIAAC and SKILLS datasets; authors’ calculations.