Are skill deficits always bad? Towards a learning perspective on skill mismatches.

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Introduction

The explicit assumption in most literature on educational and skill mismatches is that these mismatches are inherently costly (Quintini, 2011). Allocation on the labor market is considered optimal if people end up in jobs for which they were trained and which require the skills that they possess. The empirical literature has indeed consistently shown that the premium for years of overschooling is lower than the premium of required years of schooling. Moreover overqualified/overskilled workers have a lower job satisfaction (Hersch, 1991; Hartog, 2000; Allen and van der Velden, 2001). It is usually assumed that the reverse situation, i.e. the situation in which workers are underqualified or underskilled, is also not optimal. Pellizari and Fichen (2013) for example argue that underskilled workers are better off and reach a higher productivity in jobs that would better match their skills level. The results on the effects of underqualification or underskilling only partly support these hypotheses. Underqualified workers are usually found to receive a wage penalty for the number of years that they are underqualified, although this penalty is small and does not offset the premium for required years of schooling (Hartog, 2000). While this may be explained by some unobserved characteristic (e.g. specific experience that might compensate the effect of lacking qualifications), even studies that account for this usually do not find evidence for a strong wage penalty to underqualification (e.g. Korpi and Tåhlin, 2009). Also some authors find a positive effect of being underqualified or underskilled on job satisfaction, although this is less strong than the negative effects of being overqualified/overskilled (Garcia-Aracil and Van der Velden, 2008; Verhaest and Omey, 2009). These more ambiguous results for underqualified/underskilled workers are often ignored by putting them in the same category as the well-matched workers and by concentrating on the overqualified/overskilled.

Rather than assuming that all types of mismatches are inherently costly, we interpret the mixed findings for the underqualified/underskilled workers by taking a learning perspective on skill mismatches. As argued by De Grip et al. (2008), overqualified workers may face cognitive decline because they are unable to apply all their skills (i.e. the 'use-it-or-lose-it hypothesis'). Underqualified workers, on the other hand, may be challenged, resulting in more skill development (i.e. the 'intellectual challenge hypothesis'). We build further on this idea, but formulate a more nuanced hypothesis on the learning effects of skill deficits. Following the theory of the Russian psychologist Vygotski on the so-called 'zone of proximal development' (Vygotski, 1978), we argue that the most optimal learning situation for workers is in situations where the required skills are on a somewhat higher level than their own acquired skills, but not too high. From this perspective some underskilling is the optimal situation in which workers can find themselves. However too much underskilling may have a negative effect on skill development as these tasks are too complex for the worker to handle on their own.

In line with the idea that skill deficits are not always bad, some studies indeed found that under-educated workers may participate more in training (Büchel and Mertens, 2004) or may have more learning opportunities

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(Korpi and Tåhlin, 2009) than adequately educated workers with a similar educational background. Conversely, overqualified workers are usually found to participate less in training and report to have acquired fewer additional skills (e.g. Hersch, 1991; Verhaest and Omey, 2013). However, these studies are characterized by several drawbacks. First of all, they rely on educational mismatch indicators, which are known to be rather poorly correlated with skill mismatches (Allen and Van der Velden, 2001; Green and McIntosh, 2007). Second, none of these studies differentiate between slight underskilling and more serious underskilling, which is a crucial distinction in our theoretical framework. Third, skill development is either measured in an indirect way through participation in training or based on rather crude indicators of skill acquisition and learning. But participation in training can also be regarded as a measure an employer needs to take in order to 'repair' a skill deficit and does not automatically imply that this skill deficit is good. From a learning perspective one would rather look at more 'spontaneous' forms of learning that might take place. Unfortunately, most studies lack this information on spontaneous learning.

In this paper we will use a new dataset, European Centre for the Development of Vocational Training CEDEFOP's European Skill Survey, which provides an excellent opportunity to overcome these problems. The results show that workers who start their current job with a small skill deficit indeed show the largest increase in skill development. The mechanism involved is that working in an environment which demands some more (but not too much more) skills positively affects the spontaneous learning opportunities. We conclude that skill match is good, but some skill deficit is better.

Theory and hypotheses

Following the Russian psychologist Vygotski, many educationalists and learning psychologists have argued that optimal learning takes place when learning tasks are in the so-called 'zone of proximal development' (Vygotski, 1978). In simple terms, think of learning as climbing a ladder. Children (but also adults) learn best when the tasks they are confronted with are one rung away from where they stand. If the tasks are too complex (too far away from their own rung) children will get frustrated and learn nothing. Likewise they will learn nothing from tasks that are too simple (on the rungs below them). And even the tasks at the same rung as where they are standing are not the ones from which they will learn most.

If we apply this principle to a working situation, we can assume that workers who indicate that their job requires somewhat more skills than they actually have, find themselves in this zone of proximal development and will demonstrate the highest skill gain in that work as expressed in the following hypothesis:

> *Hypothesis 1:* Workers who have a small skill deficit when starting their job, will show more skill development than workers who start in a matching job and also more than workers who have a serious skill deficit at the start of their job. We expect the least skill gain for workers who started with a skill surplus.

Of course skill deficits also pose a problem to employers. When workers have less skills than required on the job (either because these skills are simply not trained in education or because the demand for such skills is higher than the supply), employers will send workers to training courses or have them trained on-the-job by co-workers or supervisors in order to repair these deficits. Such participation in training (whether non-formal or on-the-job) is often initiated by the employer and changes the skill level of the worker not as a result of the mismatch situation but as a result of the training itself. These are not the effects of skill deficits we are interested in. Instead we want to find out whether a situation of skill deficit invokes a learning environment that enables workers to learn more spontaneously. This is not to say that this spontaneous learning does not

involve other people. Just like the optimal learning environment for children requires a teacher or competent peers who stimulate their development, so do workers need a stimulating environment, including supervisors and co-workers from which they can learn. However this learning has a more spontaneous form and is not forced upon by the employer. We formulate the following hypothesis:

> *Hypothesis 2:* Workers who have a small skill deficit when starting their job, will engage more often in 'spontaneous' forms of learning than workers who start in a matching job and also more than workers who have a serious skill deficit at the start of their job. We expect the least participation in spontaneous learning for workers who started with a skill surplus.

Finally, we expect that the 'zone of proximal development' also provides an intellectual challenging environment that satisfies worker's intrinsic needs. The opposite situation is the case of skill surplus that negatively affects job satisfaction. But we can also expect a low job satisfaction in the case of a high skill deficit. A large gap between the skills required and the skills possessed can lead to stress and thus lead to less job satisfaction (De Jonge et al., 2000). We formulate the following hypothesis:

> *Hypothesis 3:* Workers who have a small skill deficit when starting their job, will have a higher job satisfaction than workers who start in a matching job and also more than workers who have a serious skill deficit at the start of their job. We expect the lowest job satisfaction for workers who started with a skill surplus.

Data and methodology

Our hypotheses are tested using the European Skills Survey. CEDEFOP commissioned this survey with the aim to assess the level of skill mismatch and skill obsolescence in Europe. The survey was conducted in 2014 among 48,676 respondents from the 28 EU Member States using both online and telephone interviewing. All respondents were employees between 24 and 65 years old. Quota sampling was used to achieve representativeness.

All our analyses are carried out separately for the full sample and for those who were in their job for less than one year (5092 respondents). The reasons to focus on workers that started more recently in their current job are threefold. First of all we expect that most of the learning in the job will occur in the first year, so the effects should be strongest for workers who more recently started their current job. Second, workers who started in a job in which they experienced a large skill mismatch (deficit or surplus) but nevertheless stay in that job for a long time may be a selective group, who might compensate their initial mismatch with other qualities. Also in that case, we expect the 'purest' effects for the group who is less than one year in their current job. And thirdly, if people have been in their job for a long time, they may have a recall bias. This would again point to stronger effects for those who started their current job less than one year ago. For a number of analyses, we also report separate results depending on the educational level[3].

The main independent variable in our analysis is skill mismatch at the start of the job. Its measurement is based on the question "When you started your job with your current employer, overall, how would you best describe your skills in relation to what was required to do your job at that time?" with answer categories ranging from 0 ("My skills were a lot lower than required") to 10 ("My skills were a lot higher than required") and category 5

[3] We distinguish the following categories: lower educated (ISCED 1 and 2), medium educated (ISCED 3 and 4) and higher educated (ISCED 5 and 6).

denoting the situation in which skills were matched to what was required. For the full sample, about 50% reports a skill match at the start of their job (see Appendix, Table A1). Among those having a mismatch, about 26% reports a skill surplus and 23% reports a skill deficit. While more strong surpluses seem more usual than more moderate surpluses, the opposite is true regarding deficits with moderate deficits being much more frequent than severe deficits. Regarding the subsamples, figures are comparable.

The dependent variable for the first hypothesis is skill change. This variable is measured on the basis of the question "Compared to when you started your job with your current employer, would you say your skills have now improved, worsened or stayed the same?" Respondents answered on a 0-10 scale with 0 "My skills have worsened a lot", 5 "My skills have stayed the same" and 10 "My skills have improved a lot".[4] Along with skill change (range 0-10), we also conduct additional analyses for skill growth (range 0-5 with respondents with no change or a skill decline being coded 0) and skill decline (range 0-5 with respondents with no change or a skill decline being coded 0).[5]

For the second hypothesis, we rely on two different survey questions regarding training and learning activities. The first question (definition A) is as follows: "Since you started your job with your current employer, have you done any of the following to improve or acquire new skills?" Respondents could select the following activities: (1) "you attended training courses (work-based, classroom based and online)", (2) "your supervisor taught you on-the-job", (3) "you learned by interacting with colleagues at work", (4) "you learned at work through trial and error", and (5) "you learned by yourself (e.g. with the aid of manuals, books, videos or on-line materials)". We conduct analyses for each activity separately and consider the latter three activities (named "learning by interaction", "learning by doing" and "learning by yourself" hereafter) to be more "spontaneous" than the former two activities (named "training courses" and "supervisor training" hereafter). The aforementioned question has only been posed to those who indicated an improvement of their skills since the start of the job. While this is the case for most of the workers, it may nevertheless generate some selection bias. Hence, we also rely on a second question (definition B), which has been posed to all respondents, and which is formulated as follows: "In the last 12 months (replaced with 'Since you started your job' if less than 12 months in current position), have you undergone any of the following types of training for your current job?" Respondents could select the following activities: (1) "training courses attended mostly or only during work hours", (2) "training courses attended mostly or only outside of work hours", and (3) "training whilst performing your regular job (e.g. instruction by a supervisor/coworker using your normal tools of work; job rotation; peer support, participation in learning or quality circles)". Only the latter category is considered to be more "spontaneous". Since the question refers to activities during the last 12 months, we only conduct analyses for this question relying on the restricted sample of those being less than one year in the job.

Finally, the dependent variable for the third hypothesis is job satisfaction, measured by the question "On a scale from 0 to 10, where 0 means very dissatisfied, 5 means neither satisfied nor dissatisfied and 10 means very satisfied, how satisfied are you with your job?"

For our multivariate analyses, we rely on linear regression, tobit regression or binary logistic regression. To account for confounding factors, a large range of control variables are included. Firstly, skill growth may not only be affected by skill mismatches, but also by initial skill levels. Therefore, we control for the educational

[4] Apart from responding to the scale, respondents also had the opportunity to choose the following option (value 88): "The skills I have now cannot be compared to those I had when I started my job". Only a small number of individuals (1.6%) provided this answer. We recoded this answer as a missing value.

[5] For a full overview of the dependent variables and their distributions, see Table A2 in Appendix.

level (6 dummies) and ascribed characteristics such as age, gender and country of residence (27 dummies). Secondly, since realized skill growth is likely to be higher for those already being longer in their job, we also control for the time elapsed since the start with the current employer (both linear and squared term). Finally, the degree of skill mismatch in a job may not only change because of skill growth or depreciation, but also because of changes in skill requirements. Therefore, we also control for a number of changes that may have taken place since the start of the employment relationship. We control for the extent to which, according to the respondent, changes in variety and in difficulty of the tasks have taken place. Both changes are measured using a scale from 0 to 10. The answer categories are: (0) "decreased a lot", (5) "stayed the same" and (10) "increased a lot". To account for nonlinearities, we also include the squared term. Finally, we include four dummy variables measuring whether, according to the respondent, there has been a promotion to a higher level position, a movement to a different department, a change in tasks and responsibilities without promotion or department move and/or a change to a lower level position.

We also conducted a number of sensitivity analyses with a large number of additional control variables being included. These additional controls are dummies for occupational groups (9 dummies), industry (15 dummies), firm size (7 dummies), the main activity before the current job (4 dummies), the length of joblessness before the current job (3 dummies) and the similarity between the current occupation and the occupation in the previous job (3 dummies). However, this did not affect the coefficients substantially and had no influence on the general conclusions of this study.[6]

Results

All the analyses have been carried out separately for the full sample and for those who were in their job for less than one year. The results for the full sample and the restricted sample (less than 1 year in current job) are usually more or less the same, but as expected the results are indeed in most cases somewhat stronger for respondents who more recently started in their current job. We will discuss the results for the latter group, and only point out differences with the full sample when relevant.

Skill growth and decline

Table 1 presents the bivariate relation between skill mismatch at the start of the job and the skills change since that start. Skills change is transformed into three categories: skill decline (answers 0-4), no change (answer 5) and skill growth (answers 6-10).

<here Table 1>

The results show that the vast majority of respondents experience an increase in their skill level. This is true for all workers regardless of the mismatch situation at the start of their job. Of course, respondents who indicated that they had less skills than required at the start, experience more skill growth than respondents who indicated that they had more skills than required. Respondents that started in a situation in which they experienced a deficit indicate in some 80-95% of the cases that they have increased their skill level. But also when respondents started in a job for which they indicated that they had more skills than required, they still state in some 55-75% of the cases that they have increased their skill level. This indicates that people learn in all sorts of situations, even when the job requires less skills than workers actually have. However the extent to

[6] These results are available upon request.

which skill growth takes place does depend on the skill mismatch situation at the start. In Table 2, we show the results of the multivariate analysis relating skill mismatch at the start of the job to the extent of skill change.

<here Table 2>

The first column provides the results when applying a simple OLS to the skills change variable (range 0-10). The table shows the effect of the 10 skill mismatch dummies with a matching job at the start as the reference category and controlling for several background characteristics (control variables not shown). The upper panel shows the estimates for the full sample, the lower panel shows the results for those who were in their job for less than one year. Both analyses show more or less similar results, but as expected the results are somewhat stronger for workers who more recently started in their job.

Starting in a job for which one has a surplus of skills, does not improve the skills level as much as starting in a matching job. Compared to the reference group, the respondents who start with a skill surplus have about 0.5 points less gain. This is not true for workers who started with a skill deficit. They gain more skills than the respondents in the reference group, and – more important – this gain is highest for the ones with a small skill deficit ('deficit 1': +0.708; significant at 1% level) and lowest for the ones with a high skill deficit ('deficit 4': +0.138; not significant). The only anomaly are the workers with the highest skill deficit ('deficit 5': +0.579; significant at 5% level) who show a higher skill gain than the ones with 'deficit 4', although still lower than the ones with a small skill deficit ('deficit 1'). However, we must take into account that the number of respondents in the highest skill deficit category is very small (1% of all respondents, Appendix table A1) and the result is mainly driven by the higher educated. The last three columns of Table 2 show the results separately for the lower, medium and higher educated. Only for the higher educated we see a strong positive result for the highest skill deficit category. We assume that respondents in this category are working in jobs that are extremely challenging and require skills that are probably more firm-specific. This would be typical for higher-level entry jobs in firm internal labor markets in which workers are recruited for a career rather than for a specific job. This is confirmed by the fact that in these jobs the task variety and task difficulty has grown considerably, despite the fact that the respondents started in a situation in which they already had a very large skill deficit (see Tables A3 and A4 in Appendix).

Column 2 presents the result for a Tobit regression with skill growth as dependent variable (all respondents with no change or a skill decline have been coded 0). The results show that respondents who started their job with a surplus of skills, generally experience much less skill growth than their peers who started in a job that fully matched their skills. The skill growth is even higher for those who started their job with a skill deficit, with the highest growth for those who only have a small skill deficit. The situation is reversed when we look at the effects on skill decline. Column three provides the result of a Tobit regression with skill decline as dependent variable (all respondents with no change or a skill growth coded as 0). We look at the full sample here, as the number of observations for those who started working in their current job less than one year ago is too small to obtain robust results. The results show that respondents who started their job with a surplus of skills, have a high chance of experiencing a skill decline. The absolute effect sizes are even bigger than was the case in the analysis on skill growth (column 2), indicating that starting with a surplus of skills may seriously affect subsequent skill loss. Conversely, starting with a small skill deficit offers the highest protection against skill decline (- 1,204).

Both results confirm our hypothesis on how people may learn. As indicated in the hypothesis on the 'zone of proximal development' the most optimal learning situation for workers is in situations where the required skills are on a somewhat higher level than their own acquired skills, but not too high. This is confirmed by the fact

that we find the largest skill growth and smallest skill decline in a situation where workers started in a job for which they have a small skill deficit.

Training and learning activities

If this is true this should also be reflected in the way workers have learned in their job. As outlined in the theory section, we expect most of the 'spontaneous learning' to occur in a situation where there is a small skill deficit. Table 3 presents descriptive results of the relation between skill mismatch at the start of the job and subsequent training and learning activities. The results are in line with our hypothesis, with the highest participation in "spontaneous" learning activities among those with small skill deficits. Moreover, this is the case relying on both definitions of training and learning activities. Using definition (A), we note that the participation in 'learning by interaction', 'learning by doing" and 'learning by yourself' is highest among the workers with a small or moderate skill deficit (deficit 1 or 2). Similarly, when using definition (B), we find those having a small or moderate skill deficit to be more likely to participate in training whilst performing the job in comparison to those with a surplus and, to a lesser extent, those with more severe skill deficits. A similar pattern does not show up with respect to more formal training activities, such as training courses outside working hours.

<here Table 3>

Tables 4 and 5 present the results of a series of logistic regressions with different training and learning activities as dependent variables, controlled for various job and background characteristics. We first concentrate on the results using definition A. Column 4 in Table 4 shows that in the case of 'learning by doing' the results are in line with the hypothesis on 'spontaneous learning'. The incidence of 'learning by doing' is highest in the case of a small skill deficit and then gradually declines with increasing skill deficits (with the exception again of the highest skill deficit level), and turns into a negative effect for those workers who have a major skill surplus (surplus 4 or 5).

The situation is a bit less clear in the case of 'learning yourself'. Here workers with a skill deficit 2 are even more inclined to participate in 'learning yourself' although the difference with the workers with skill deficit 1 is not significant.[7] But there are also some anomalies regarding workers who started their job with more skills than required. In the case of surplus 1 and 3 we find an unexpected positive effect on the participation in 'learning by doing' and only in the case of the most severe skill surplus (surplus 5) we find the expected negative sign.

The third more or less 'spontaneous' learning situation is 'learning by interaction'. Here we see the same results as for 'learning yourself' when it comes to workers with an initial skill deficit. Workers with a skill deficit 2 have the highest chance to participate in this form of learning, followed by workers with the smallest skill deficit (1) and then workers with a medium skill deficit (3). Workers with a high initial skill surplus have significantly less chance to participate in this form of learning.

We find similar results in the case of participation in 'training courses'. Here we did not expect any theoretical relation between the degree of skill deficit at the start of the job and the incidence of training. One can argue that both workers with a small and a large skill deficit may be send to a training course by their employers to

[7] In the full sample we do find the expected linear trend with the highest participation for the smallest skill deficit and then increasing lower participation rates the higher the initial skill deficit (again with the exception of workers with the highest initial skill deficit 5).

'repair' these deficits. Again workers with a skill deficit 2 have the highest chance to participate in non-formal learning, followed by workers with the smallest skill deficit (1) and then workers with a medium skill deficit (3). Workers who started their job with a surplus of skills have a similar chance to participate in non-formal training as workers who started in a job that well-matched their skills.

Finally we look at the results regarding supervisor training. Here we can see that workers with a skill deficit at the start of their job are significantly more subject to supervisory training than workers who started in a matching job, regardless of the magnitude of their skill deficit. The only exception are workers with a very high skill deficit, which – again – highlights the specific situation of this small group.

<here Table 4>

The analysis using definition B (Table 5) provides further support for our hypothesis. The incidence of 'training whilst performing the job', which is considered to be the most spontaneous learning method, is the highest in the case of a small skill deficit and then gradually declines with increasing skill deficits. Remarkably, those with a small skill surplus also have a higher chance to participate in this type of training, compared to workers who started in a well-matched job. But the workers with serious skill surpluses (surplus 4 or 5) have a lower chance to participate, as we expected. Further, regarding training courses during working hours, in particular those with medium skill deficits (deficit 2 or 3) have a higher participation rate. Finally, regarding the incidence of training courses outside working hours, which is likely to be the most formalized type of training, no clear relation can be detected with the extent of skill mismatch at the start of the job.

<here Table 5>

Job Satisfaction

Does a small skill deficit have a positive effect on job satisfaction? As indicated earlier, previous research could not well distinguish between the effects of small skill deficits and large skill deficits. Table 6 reports the results of the OLS regression of skill mismatch at the start of the job on current job satisfaction. The results for the workers with medium to serious initial skill surpluses (3-5) are in line with previous findings (Allen and Van der Velden, 2001; Mavromaras et al., 2013): being overskilled has a negative effect on job satisfaction. But our hypothesis that a small skill deficit should be associated with a higher job satisfaction level compared to well-matched workers is refuted. The difference between well-matched workers and workers who have a small (1) to medium (3) skill deficit at the start of their work, is not significantly different. Workers who started their job with a high (4) skill deficit are significantly less satisfied with their job. But the workers who started their job with the highest skill deficit (5) show no less satisfaction with their current job than workers who started in a job that matched their initial skills well. This is probably related to the same explanation as we offered before for the skill growth in this group. The workers with a very high skill deficit probably enter high-level entry jobs in a firm internal labor market. These jobs are highly challenging but also rewarding in terms of career prospects. The results are more clear if we focus on the full sample. Here we find a negative effect for all workers with an initial skill surplus as well as a negative effect for workers who started their job with a medium (3) to very high (5) skill deficit. It thus seems that a situation of continued high skill deficit invokes stress and less job satisfaction than a situation in which workers start in a job that matches their skills well or for which they have a smaller skill deficit (1 or 2).

<here Table 6>

Conclusion and discussion

The term skill mismatch has the inherent connotation of a situation that needs to be avoided, both from the perspective of individuals as from the perspective of society at large. Green (2013) in his book on skills and skilled work remarks that the "potential consequences of mismatch are lost productivity, lower pay and reduced well-being (o.c. p. 31). Quintini (2011) in her review on the mismatch literature argues that ensuring a good match between supply and demand of skills is "essential to make the most of investments in human capital and promote strong and inclusive growth" (o.c. p. 4). In their paper on the development of a skill mismatch indicator for the PIAAC data, Pellizari and Fichen (2013) argue that underskilled workers may deploy more skills than their endowment allows, but this has a cost in terms of negative output. This is echoed in policy publications. The EU New Skills for New Jobs Strategy aims to develop a better matching between skills and labour market needs (EC, 2015). The OECD (2011) announced a skills strategy aimed at developing policies that enhance skill matching and a better use of skills. And national policymakers in the western world are concerned about skill mismatches on the labor market and develop strategies to bring supply and demand for skills in balance.

This suggest that all skill mismatch, whether skill surplus or skill deficit, has a similar negative outcome. The empirical evidence however is more ambiguous. The absolute effect of underqualification on earnings is usually smaller than the absolute effect of overqualification (Hartog, 2000) which already suggests that both types of – in this case educational – mismatch are not the same. And some researchers have found positive effects of a skill deficit on job satisfaction (Garcia-Aracil and Van der Velden, 2008; Verhaest and Omey, 2009).

These results suggest that the situation of a skill deficit is much more difficult to understand than the situation of a skill surplus. In the case of a skill surplus, it is easy to see that workers sometimes bring more skills to the job than are actually required to perform the job tasks adequately. Employers are not or only partly willing to pay for these extra skills, resulting in a negative wage effect for the overskilled. And because these workers also see less opportunity to deploy the skills they have, they are less satisfied than in a situation where their skills are fully utilized. But the opposite situation is less straightforward. Why would an employer hire an underskilled worker in the first place? One can imagine that when supply of certain skills is lacking, employers are forced to hire workers who lack those skills. This could be because the education system does not produce enough workers with that type of skill or because the skills are too firm-specific to be produced in the education system. But even in that case, the skill deficit must not be too large, especially in a situation of a large damage potential in the case of underperformance (Sitkin and Roth, 1993). Still, we see that a situation of a skill deficit is not uncommon. In our sample 23% of workers report that they had a skill deficit at the start of their job. This seems hardly in line with the above assertion that employers will only hire workers who are underskilled in a situation of serious shortages on the labor market and only if that skill deficit is not too large. But apparently, employers hire such workers more often and we need an explanation for that. We also need an explanation for the fact that workers with a skill deficit sometimes report a higher job satisfaction. Based on stress theory (De Jonge et al, 2000) one could argue that a skill deficit poses a situation for a worker that is stressful and is therefore associated with a lower job satisfaction, increased absenteeism et cetera. But apparently this is not always the case.

In this paper we try to explain these anomalies in the empirical findings, by proposing a learning perspective on skill deficit. The basic idea originates in the works of the Russian learning psychologist Vygotski, who argues that children learn best when learning tasks are in the so-called 'zone of proximal development'. The underlying idea is simple: learning tasks should be a bit more difficult than the tasks that children already master, but not too difficult. Translated to the situation of workers, one would expect that workers who start

their job with a small skill deficit, show more skill growth than workers who start in a matching job or workers who start in a job for which they have a serious skill deficit. We tested this hypothesis using the CEDEFOP European Skill Survey and the results confirm these expectations. Workers learn more from job tasks that are more demanding than if they would work in a job that completely matches their initial skill level and this skill gain is largest for those who start with a small skill deficit. This result holds for workers of all educational levels, except for workers with a higher education degree who also report a large skill growth in a job in which they had the largest skill deficit. We argue that this does not refute our hypothesis since these jobs typically represent higher-level entry jobs in firm internal labor markets. Workers recruited for such jobs face a steep career and have to acquire a lot of firm-specific skills in order to function well in the organization and are thus confronted with large skill deficits at the start of their job. With the exception of such jobs, the data clearly confirm our hypothesis: a small skill deficit provides a better learning environment than a situation in which the required skills exactly match the worker's skills or a situation in which workers face serious skill deficits. The learning opportunities are worst when workers start in a job for which they have a skill surplus.

This is reflected in the type of learning activities that workers take up. Workers with a small skill deficit are more often engaged in 'spontaneous' informal learning activities, such as learning by interaction with colleagues, learning by doing, or learning yourself. They are also more engaged in informal learning-on-the-job activities (instruction by supervisor/coworkers, job rotation, quality circles et cetera). This is exactly what the theory of proximal development would predict. Having a small skill deficit invokes more spontaneous learning from the job environment.

Finally our hypothesis that workers who started their job with a small skill deficit would also show a higher job satisfaction is not confirmed. Instead we find no significant difference between workers who started in a well-matched job and workers who started with a small skill deficit. The results confirm previous results indicating lower job satisfaction levels for workers who started their job with a medium to severe skill surplus. And we also find a negative effect for workers who started their job with a large skill surplus, indicating that indeed large skill deficits can involve stress. The only exception – again – is found among workers with the largest skill deficit whose job satisfaction level is not significantly different from the level of well-matched workers. As indicated above, this situation probably applies to workers who start at a high-level entry job in a firm internal labor market.

We conclude that a skill match is good, but a small skill deficit is even better. This puts some responsibility on employers to keep job tasks and responsibilities at a challenging level for an employee. This may be easier at the start of the job when new hires will almost always have a steep learning curve (even in the case of an initial skill surplus). The real challenge in terms of human resource management is to keep the job challenging for existing workers, e.g. by job rotation, increased autonomy and increasing complexity of the job tasks.

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Table 1: Change in skills depending on the degree of skill mismatch at the start of the job

	Skill change		
	Skill decline	No change	Skill growth
Full sample (N=46,820)			
Skill surplus 5	6.4%	23.1%	70.5%
Skill surplus 4	5.4%	16.4%	78.2%
Skill surplus 3	6.2%	17.6%	76.3%
Skill surplus 2	6.6%	15.3%	78.1%
Skill surplus 1	6.6%	10.5%	82.9%
Skill match	1.9%	10.0%	88.1%
Skill deficit 1	0.8%	3.2%	96.0%
Skill deficit 2	1.1%	2.8%	96.2%
Skill deficit 3	1.4%	3.1%	95.5%
Skill deficit 4	1.8%	5.5%	92.7%
Skill deficit 5	1.7%	4.9%	93.4%
< 1 year in job (N=4,882)			
Skill surplus 5	4.9%	39.3%	55.8%
Skill surplus 4	3.6%	31.7%	64.7%
Skill surplus 3	4.6%	36.3%	59.1%
Skill surplus 2	9.7%	29.0%	61.4%
Skill surplus 1	0.0%	23.7%	76.3%
Skill match	2.2%	20.1%	77.8%
Skill deficit 1	0.7%	5.9%	93.4%
Skill deficit 2	1.3%	7.6%	91.1%
Skill deficit 3	1.7%	8.5%	89.8%
Skill deficit 4	5.0%	13.8%	81.3%
Skill deficit 5	2.1%	8.5%	89.4%

Notes. Data source: Cedefop European Skills survey, own calculations.

Table 2: The relationship between skill mismatches at the start of the job and skill change – linear regression and tobit regression coefficients and standard errors

	Skill change Linear regression All educational levels			Skill growth Tobit regression All educational levels			Skill decline Tobit regression All educational levels			Skill change Linear regression Lower educated			Skill change Linear regression Medium educated			Skill change Linear regression Higher educated		
Full sample																		
Skill surplus 5	-0.406	***	(0.025)	-0.479	***	(0.027)	1.556	***	(0.161)	-0.302	***	(0.088)	-0.406	***	(0.040)	-0.473	***	(0.036)
Skill surplus 4	-0.447	***	(0.025)	-0.480	***	(0.026)	1.516	***	(0.162)	-0.508	***	(0.083)	-0.411	***	(0.040)	-0.478	***	(0.035)
Skill surplus 3	-0.482	***	(0.032)	-0.513	***	(0.034)	1.671	***	(0.194)	-0.602	***	(0.105)	-0.504	***	(0.050)	-0.466	***	(0.046)
Skill surplus 2	-0.478	***	(0.052)	-0.493	***	(0.055)	1.743	***	(0.303)	-0.804	***	(0.191)	-0.381	***	(0.085)	-0.479	***	(0.071)
Skill surplus 1	-0.030		(0.077)	0.033		(0.081)	1.418	***	(0.447)	-0.202		(0.252)	0.164		(0.136)	-0.012		(0.102)
Skill match (ref.)																		
Skill deficit 1	0.472	***	(0.029)	0.499	***	(0.030)	-1.204	***	(0.331)	0.744	***	(0.094)	0.484	***	(0.045)	0.417	***	(0.040)
Skill deficit 2	0.393	***	(0.029)	0.422	***	(0.030)	-0.762	**	(0.298)	0.498	***	(0.097)	0.372	***	(0.046)	0.415	***	(0.041)
Skill deficit 3	0.358	***	(0.029)	0.384	***	(0.030)	-0.307		(0.272)	0.435	***	(0.087)	0.316	***	(0.044)	0.376	***	(0.042)
Skill deficit 4	0.295	***	(0.046)	0.315	***	(0.048)	0.166		(0.392)	0.001		(0.139)	0.320	***	(0.070)	0.345	***	(0.067)
Skill deficit 5	0.572	***	(0.063)	0.596	***	(0.065)	-0.179		(0.580)	0.767	***	(0.172)	0.569	***	(0.088)	0.483	***	(0.106)
N	46,413			46,413			46,413			5,526			19,479			21,408		
< 1 year in job																		
Skill surplus 5	-0.507	***	(0.071)	-0.746	***	(0.090)	-			-0.375	*	(0.224)	-0.584	***	(0.111)	-0.436	***	(0.101)
Skill surplus 4	-0.494	***	(0.073)	-0.671	***	(0.092)	-			-0.555	**	(0.231)	-0.483	***	(0.120)	-0.463	***	(0.100)
Skill surplus 3	-0.615	***	(0.099)	-0.826	***	(0.125)	-			-0.738	**	(0.293)	-0.392	**	(0.160)	-0.720	***	(0.139)
Skill surplus 2	-0.457	***	(0.150)	-0.554	***	(0.189)	-			-1.342	**	(0.617)	-0.373		(0.250)	-0.378	*	(0.193)
Skill surplus 1	0.014		(0.259)	-0.045		(0.318)	-			-1.044		(1.186)	0.198		(0.412)	-0.029		(0.342)
Skill match (ref.)																		
Skill deficit 1	0.708	***	(0.098)	0.829	***	(0.118)	-			0.985	***	(0.316)	0.511	***	(0.160)	0.734	***	(0.134)
Skill deficit 2	0.382	***	(0.109)	0.489	***	(0.132)	-			1.115	***	(0.376)	0.360	**	(0.174)	0.298	**	(0.152)
Skill deficit 3	0.352	***	(0.107)	0.434	***	(0.129)	-			0.240		(0.389)	0.395	**	(0.171)	0.354	**	(0.146)
Skill deficit 4	0.138		(0.177)	0.246		(0.215)	-			0.122		(0.659)	-0.010		(0.286)	0.249		(0.237)
Skill deficit 5	0.579	**	(0.232)	0.628	**	(0.278)	-			0.484		(0.614)	0.230		(0.342)	1.073	***	(0.383)
N	4,867			4,867						586			2,099			2,182		

Notes. ***(**)((*)) indicates significance at the 1%(5%)((10%)) significance level. Standard errors are in parentheses. Included control variables are: educational level (6 dummies), age, gender (1 dummy), country of residence (27 dummies), time elapsed since the start with current employer and the square value of this duration, changes in variety of tasks since start job and the square value of this change, changes in difficulty of the tasks since start job and the square value of this change, promotion to a higher level position since start job (1 dummy), movement to a different department since start job (1 dummy), change in tasks and responsibilities without promotion or department move since start job (1 dummy) and movement to a lower level position since start job (1 dummy). Data source: Cedefop European Skills survey, own calculations.

Table 3: Training participation or informal learning depending on the degree of skill mismatch at the start of the job

	(A) Training and learning activities to improve or acquire new skills					(B) Training activities in last 12 months		
	Training courses	Supervisor Training	Learning by Interaction	Learning by doing	Learning by yourself	Training courses during working hours	Training courses outside working hours	Training whilst performing job
Full sample								
Skill surplus 5	59.6%	34.4%	53.6%	50.7%	48.8%	-	-	-
Skill surplus 4	62.9%	35.1%	62.2%	55.2%	52.2%	-	-	-
Skill surplus 3	63.3%	38.2%	68.8%	58.9%	56.3%	-	-	-
Skill surplus 2	68.9%	38.6%	73.5%	67.5%	59.7%	-	-	-
Skill surplus 1	64.5%	44.0%	69.4%	67.0%	56.0%	-	-	-
Skill match	62.8%	38.5%	65.5%	55.8%	49.8%	-	-	-
Skill deficit 1	70.9%	50.7%	79.4%	70.7%	65.1%	-	-	-
Skill deficit 2	72.1%	51.1%	81.1%	70.2%	62.8%	-	-	-
Skill deficit 3	70.4%	51.2%	76.9%	67.9%	59.4%	-	-	-
Skill deficit 4	66.7%	50.8%	74.4%	67.4%	55.1%	-	-	-
Skill deficit 5	60.3%	54.1%	71.5%	64.4%	56.7%	-	-	-
N			41,221					
< 1 year in job								
Skill surplus 5	39.2%	34.5%	47.6%	41.3%	35.0%	25.3%	16.8%	27.1%
Skill surplus 4	42.1%	41.3%	60.5%	43.6%	42.4%	32.8%	23.6%	34.5%
Skill surplus 3	39.5%	44.8%	62.2%	47.1%	50.0%	32.6%	18.4%	40.6%
Skill surplus 2	44.3%	50.0%	72.9%	62.9%	44.3%	33.9%	15.7%	42.6%
Skill surplus 1	51.6%	45.2%	58.1%	51.6%	58.1%	33.3%	23.8%	50.0%
Skill match	37.3%	42.6%	63.5%	49.5%	40.9%	30.6%	20.3%	37.4%
Skill deficit 1	44.7%	53.5%	77.8%	70.9%	59.6%	36.1%	16.7%	60.9%
Skill deficit 2	45.7%	53.9%	80.8%	65.9%	59.1%	38.8%	17.2%	56.0%
Skill deficit 3	45.1%	57.7%	71.6%	62.3%	51.6%	41.7%	16.7%	54.6%
Skill deficit 4	37.3%	55.2%	70.2%	59.7%	49.3%	34.2%	26.8%	51.2%
Skill deficit 5	27.9%	41.9%	55.8%	62.8%	48.8%	35.4%	12.5%	45.8%
N			3,701				4,995	

Notes. Data source: Cedefop European Skills survey, own calculations.

Table 4: The relationship between skill mismatches at the start of the job and training participation or informal learning (definition A) – logit coefficients and standard errors

	Training Courses			Supervisor training			Learning by Interaction			Learning by doing			Learning by yourself		
Full sample (N=40,887)															
Skill surplus 5	-0.169	***	(0.043)	-0.182	***	(0.042)	-0.510	***	(0.041)	-0.245	***	(0.041)	-0.064		(0.041)
Skill surplus 4	-0.022		(0.041)	-0.118	***	(0.040)	-0.184	***	(0.040)	-0.073	*	(0.039)	0.089	**	(0.039)
Skill surplus 3	0.019		(0.054)	-0.008		(0.051)	0.125	**	(0.053)	0.123	**	(0.051)	0.263	***	(0.051)
Skill surplus 2	0.286	***	(0.090)	0.008		(0.084)	0.286	***	(0.092)	0.403	***	(0.087)	0.333	***	(0.084)
Skill surplus 1	0.061		(0.125)	0.172		(0.116)	0.157		(0.125)	0.470	***	(0.124)	0.237	**	(0.118)
Skill match (ref.)															
Skill deficit 1	0.294	***	(0.046)	0.428	***	(0.040)	0.654	***	(0.048)	0.623	***	(0.044)	0.541	***	(0.042)
Skill deficit 2	0.318	***	(0.047)	0.466	***	(0.041)	0.764	***	(0.051)	0.622	***	(0.045)	0.489	***	(0.043)
Skill deficit 3	0.250	***	(0.046)	0.459	***	(0.041)	0.546	***	(0.047)	0.539	***	(0.044)	0.348	***	(0.042)
Skill deficit 4	0.087		(0.072)	0.440	***	(0.065)	0.420	***	(0.074)	0.486	***	(0.070)	0.185	***	(0.067)
Skill deficit 5	-0.201	**	(0.096)	0.514	***	(0.089)	0.368	***	(0.098)	0.451	***	(0.094)	0.274	***	(0.091)
< 1 year in job (N=3,690)															
Skill surplus 5	-0.025		(0.122)	-0.306	**	(0.123)	-0.599	***	(0.120)	-0.334	***	(0.121)	-0.215	*	(0.125)
Skill surplus 4	0.016		(0.120)	-0.104		(0.119)	-0.133		(0.121)	-0.262	**	(0.119)	0.067		(0.121)
Skill surplus 3	0.088		(0.169)	0.123		(0.166)	-0.036		(0.171)	-0.115		(0.166)	0.408	**	(0.169)
Skill surplus 2	0.298		(0.253)	0.294		(0.253)	0.350		(0.282)	0.399		(0.262)	-0.053		(0.256)
Skill surplus 1	0.528		(0.378)	0.068		(0.385)	-0.066		(0.382)	0.110		(0.380)	0.779	**	(0.385)
Skill match (ref.)															
Skill deficit 1	0.302	**	(0.136)	0.393	***	(0.135)	0.592	***	(0.158)	0.899	***	(0.149)	0.659	***	(0.139)
Skill deficit 2	0.339	**	(0.153)	0.406	***	(0.152)	0.878	***	(0.188)	0.704	***	(0.161)	0.699	***	(0.155)
Skill deficit 3	0.261	*	(0.151)	0.554	***	(0.151)	0.365	**	(0.165)	0.568	***	(0.155)	0.358	**	(0.152)
Skill deficit 4	-0.051		(0.265)	0.424	*	(0.258)	0.374		(0.281)	0.393		(0.264)	0.371		(0.260)
Skill deficit 5	-0.543		(0.361)	-0.050		(0.324)	-0.282		(0.323)	0.712	**	(0.342)	0.410		(0.327)

Notes. ***(**)((*)) indicates significance at the 1%(5%)((10%)) significance level. Standard errors are in parentheses. Included control variables are: educational level (6 dummies), age, gender (1 dummy), country of residence (27 dummies), time elapsed since the start with current employer and the square value of this duration, changes in variety of tasks since start job and the square value of this change, changes in difficulty of the tasks since start job and the square value of this change, promotion to a higher level position since start job (1 dummy), movement to a different department since start job (1 dummy), change in tasks and responsibilities without promotion or department move since start job (1 dummy) and movement to a lower level position since start job (1 dummy). Data source: Cedefop European Skills survey, own calculations.

Table 5: The relationship between skill mismatches at the start of the job and training participation or informal learning (definition B) – logit coefficients and standard errors (< 1 year in job; N = 4,972)

	Training courses during working hours			Training courses outside working hours			Training whilst performing job		
Skill surplus 5	-0.265	**	(0.106)	-0.334	***	(0.122)	-0.473	***	(0.101)
Skill surplus 4	0.002		(0.104)	0.068		(0.115)	-0.187	*	(0.100)
Skill surplus 3	0.102		(0.139)	-0.132		(0.166)	0.184		(0.131)
Skill surplus 2	0.170		(0.210)	-0.336		(0.268)	0.285		(0.199)
Skill surplus 1	0.043		(0.355)	0.142		(0.384)	0.628	*	(0.330)
Skill match (ref.)									
Skill deficit 1	0.138		(0.136)	-0.182		(0.170)	0.935	***	(0.131)
Skill deficit 2	0.260	*	(0.148)	-0.191		(0.186)	0.740	***	(0.143)
Skill deficit 3	0.328	**	(0.145)	-0.303		(0.188)	0.671	***	(0.141)
Skill deficit 4	0.052		(0.245)	0.263		(0.262)	0.501	**	(0.230)
Skill deficit 5	0.104		(0.327)	-0.779	*	(0.450)	0.251		(0.304)

Notes. ***(**)((*)) indicates significance at the 1%(5%)((10%)) significance level. Standard errors are in parentheses. Included control variables are: educational level (6 dummies), age, gender (1 dummy), country of residence (27 dummies), time elapsed since the start with current employer and the square value of this duration, changes in variety of tasks since start job and the square value of this change, changes in difficulty of the tasks since start job and the square value of this change, promotion to a higher level position since start job (1 dummy), movement to a different department since start job (1 dummy), change in tasks and responsibilities without promotion or department move since start job (1 dummy) and movement to a lower level position since start job (1 dummy). Data source: Cedefop European Skills survey, own calculations.

Table 6: The relationship between skill mismatches at the start of the job and job satisfaction at time of survey – linear regression coefficients and standard errors

	Full sample			< 1 year in job		
Skill surplus 5	-0.765	***	(0.036)	-0.942	***	(0.098)
Skill surplus 4	-0.505	***	(0.035)	-0.585	***	(0.101)
Skill surplus 3	-0.393	***	(0.045)	-0.543	***	(0.136)
Skill surplus 2	-0.328	***	(0.073)	-0.219		(0.208)
Skill surplus 1	-0.501	***	(0.107)	-0.441		(0.348)
Skill match (ref.)						
Skill deficit 1	-0.050		(0.040)	-0.207		(0.135)
Skill deficit 2	0.006		(0.041)	-0.124		(0.150)
Skill deficit 3	-0.113	***	(0.040)	-0.231		(0.148)
Skill deficit 4	-0.124	*	(0.064)	-0.770	***	(0.244)
Skill deficit 5	-0.174	**	(0.087)	-0.187		(0.320)
N	47,214			4,958		

Notes. ***(**)((*)) indicates significance at the 1%(5%)((10%)) significance level. Standard errors are in parentheses. Included control variables are: educational level (6 dummies), age, gender (1 dummy), country of residence (27 dummies), time elapsed since the start with current employer and the square value of this duration, changes in variety of tasks since start job and the square value of this change, changes in difficulty of the tasks since start job and the square value of this change, promotion to a higher level position since start job (1 dummy), movement to a different department since start job (1 dummy), change in tasks and responsibilities without promotion or department move since start job (1 dummy) and movement to a lower level position since start job (1 dummy). Data source: Cedefop European Skills survey, own calculations.

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Appendix

Table A1: The degree of skill mismatch at the start of the job - descriptives

	Full sample	< 1 year in job	Lower educated	Medium educated	Higher educated
Skill surplus 5	9.1%	13.4%	7.2%	8.9%	9.9%
Skill surplus 4	9.2%	12.1%	7.8%	8.5%	10.3%
Skill surplus 3	5.2%	5.8%	4.6%	5.0%	5.5%
Skill surplus 2	1.8%	2.3%	1.3%	1.6%	2.1%
Skill surplus 1	0.8%	0.8%	0.8%	0.7%	1.0%
Skill match	50.6%	47.7%	55.7%	52.2%	47.8%
Skill deficit 1	6.7%	5.9%	5.9%	6.4%	7.2%
Skill deficit 2	6.4%	4.6%	5.6%	6.0%	6.8%
Skill deficit 3	6.5%	4.8%	7.1%	6.6%	6.3%
Skill deficit 4	2.4%	1.6%	2.6%	2.5%	2.3%
Skill deficit 5	1.3%	1.0%	1.7%	1.6%	0.9%
N	47,718	4,995	5,711	20,050	21,957

Notes. Data source: Cedefop European Skills survey, own calculations.

Table A2: Dependent variables - descriptives

	Min-Max	Full Sample		< 1 year in job	
		Mean	Std. dev.	Mean	Std. dev.
Skill change					
Skill Change	[0-10]	7.774	1.768	7.081	1.807
Skill Growth	[0-5]	2.832	1.625	2.140	1.693
Skill Decline	[0-5]	0.058	0.392	0.059	0.383
Training & learning (Definition A)					
Training Courses	[0-1]	0.644	-	0.394	-
Supervisor training	[0-1]	0.411	-	0.442	-
Learning by Interaction	[0-1]	0.677	-	0.638	-
Learning by doing	[0-1]	0.591	-	0.516	-
Learning by yourself	[0-1]	0.532	-	0.440	-
Training & learning (Definition B)					
Training courses during working hours	[0-1]	0.421	-	0.314	-
Training courses outside working hours	[0-1]	0.217	-	0.193	-
Training whilst performing job	[0-1]	0.347	-	0.391	-
Job Satisfaction	[0-10]	6.999	2.217	6.944	2.306

Notes. Data source: Cedefop European Skills survey, own calculations.

Table A3: Change in variety of tasks[($)] depending on the degree of skill mismatch at the start of the job

	Change in variety of tasks		
	Variety decreased	Variety stayed the same	Variety increased
Skill surplus 5	8.0%	25.7%	66.3%
Skill surplus 4	6.2%	19.7%	74.1%
Skill surplus 3	7.5%	22.9%	69.6%
Skill surplus 2	7.7%	22.0%	70.3%
Skill surplus 1	8.6%	23.6%	67.8%
Skill match	3.6%	18.0%	78.4%
Skill deficit 1	2.7%	14.0%	83.3%
Skill deficit 2	3.7%	11.0%	85.4%
Skill deficit 3	3.6%	12.3%	84.2%
Skill deficit 4	3.4%	11.9%	84.7%
Skill deficit 5	4.5%	13.8%	81.8%

Notes. [($)]Based on following survey question: "Have the following increased, decreased or remained the same since you started your job with your current employer? The variety of tasks. Please use a scale of 0 to 10 where 0 means it has decreased a lot, 5 means it has stayed the same and 10 means it has increased a lot.". Data source: Cedefop European Skills survey, own calculations. N = 47657.

Table A4: Change in difficulty of tasks[($)] depending on the degree of skill mismatch at the start of the job

	Change in difficulty of tasks		
	Difficulty decreased	Difficulty stayed the same	Difficulty increased
Skill surplus 5	8.9%	29.7%	61.3%
Skill surplus 4	6.7%	22.6%	70.7%
Skill surplus 3	8.4%	25.9%	65.7%
Skill surplus 2	8.4%	25.5%	66.1%
Skill surplus 1	9.3%	25.3%	65.4%
Skill match	3.3%	20.5%	76.2%
Skill deficit 1	2.2%	18.0%	79.8%
Skill deficit 2	3.3%	12.4%	84.4%
Skill deficit 3	2.7%	14.0%	83.3%
Skill deficit 4	2.5%	12.4%	85.2%
Skill deficit 5	3.8%	17.8%	78.4%

Notes. [($)]Based on following survey question: "Have the following increased, decreased or remained the same since you started your job with your current employer? The difficulty of the tasks. Please use a scale of 0 to 10 where 0 means it has decreased a lot, 5 means it has stayed the same and 10 means it has increased a lot.". Data source: Cedefop European Skills survey, own calculations. N = 47629.