Online Supporting Information

# School-to-Work Linkages, Educational Mismatches, and Labor Market Outcomes

Thijs Bol, Christina Ciocca Eller, Herman van de Werfhorst, and Tom Diprete

# Contents

# 1 Additional analyses and robustness checks

We have performed several robustness checks, mostly using different operationalizations or samples to re-estimate our results. In this section we mostly reproduce the two main tables for our earnings regressions (Tables 3 and 4).

## 1.1 Definition of a matched occupation

First, our results may vary depending upon the operationalization we use of a matched occupation. When we extend our definition of making match, the proportion of matched workers will grow. Table S1 shows the proportion of workers in a matched occupation for different definitions. France and Germany are very similar when we look at maximum 3 occupations, but when we take the four top occupations Germans with an upper secondary degree are more likely to be defined as "matched."

Table S1: Proportion matched with different definitions

| | **France** | | **Germany** | | **U.S.** |
|---|---|---|---|---|---|
| | Sec. | Tert. | Sec. | Tert. | Tert. |
| Top 1 occupation | 0.12 | 0.20 | 0.14 | 0.25 | 0.22 |
| Top 2 occupations | 0.23 | 0.34 | 0.23 | 0.40 | 0.30 |
| Top 3 occupations | 0.29 | 0.45 | 0.30 | 0.46 | 0.34 |
| Top 4 occupations | 0.34 | 0.52 | 0.41 | 0.52 | 0.42 |

If instead of using the top two matched occupations we use the top three for each field, the regression results change modestly although the qualitative pattern is still the same. Tables S2 and S3 show that the point estimates are slightly different when we use the top 3 occupations, but our findings do not depend on our decision to focus on the top two occupations. The positive interaction between the linkage strength of an educational credential and being in a matched occupation is found in exactly the same models when increasing the number of matched occupations from two to three. The only notable exception is that in the within-country comparison for secondary education in France (Table S2) we now find a small negative significant interaction instead of no (significant) effect. Tables S4 an d S5 show that by using the top 4 occupations the effect sizes of the interactions become slightly smaller, and in some cases lose significance. While the results remain qualitatively similar, it also becomes clear that using a more narrow definition of "match" (i.e., 2 or 3 occupations) seems slightly more predictive of labor market earnings.

Table S2: Within country, between field wage models using top 3 occupations

| | France | | Germany | | US | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Secondary | Tertiary | Secondary | Tertiary | 4 year | 4+ years |
| Local linkage. | -0.021** | 0.024** | -0.118** | -0.046** | -0.014 | -0.008 |
| | (-2.70) | (3.76) | (-13.63) | (-6.59) | (-1.72) | (-0.71) |
| In matched occ. | 0.031** | 0.004 | -0.147** | -0.033** | 0.028* | 0.041** |
| | (4.00) | (0.42) | (-14.67) | (-2.63) | (2.57) | (3.22) |
| Linkage * matched | -0.030** | 0.059** | 0.207** | 0.055** | 0.106** | 0.052** |
| | (-2.99) | (7.96) | (19.07) | (6.81) | (9.10) | (3.66) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 60503 | 41789 | 65640 | 42845 | 217237 | 223517 |
| $R^2$ | 0.24 | 0.34 | 0.17 | 0.27 | 0.18 | 0.21 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S3: Within level-field, between country wage models using top 3 occupations

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Fr-D, Secon. | Fr-D, Tert. | F-D-US, Tert. 4yr | F-D-US, Tert. 4+ |
| Linkage strength | 0.074** | 0.053** | 0.005 | 0.017 |
| | (4.99) | (5.41) | (0.61) | (1.62) |
| In matched occ. | -0.011 | -0.007 | 0.033** | 0.037** |
| | (-1.53) | (-0.75) | (4.70) | (4.09) |
| Linkage * matched | 0.039** | 0.039** | 0.036** | 0.025** |
| | (4.84) | (6.16) | (6.69) | (2.95) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 135052 | 75725 | 290642 | 299242 |
| $R^2$ | 0.35 | 0.45 | 0.29 | 0.32 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S4: Within country, between field wage models using top 4 occupations

| | France | | Germany | | US | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Secondary | Tertiary | Secondary | Tertiary | 4 year | 4+ years |
| Local linkage. | -0.016* | 0.012 | -0.107** | -0.047** | -0.003 | -0.007 |
| | (-2.08) | (1.78) | (-11.01) | (-6.36) | (-0.39) | (-0.59) |
| In matched occ. | 0.018* | -0.022* | -0.116** | -0.022 | 0.092** | 0.090** |
| | (2.42) | (-2.23) | (-11.53) | (-1.81) | (9.24) | (7.58) |
| Linkage * matched | -0.030** | 0.076** | 0.164** | 0.052** | 0.060** | 0.031* |
| | (-3.00) | (9.81) | (14.11) | (6.30) | (5.26) | (2.17) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 60503 | 41789 | 65640 | 42845 | 217237 | 223517 |
| $R^2$ | 0.24 | 0.34 | 0.17 | 0.27 | 0.18 | 0.21 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S5: Within level-field, between country wage models using top 4 occupations

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Fr-D, Secon. | Fr-D, Tert. | F-D-US, Tert. 4yr | F-D-US, Tert. 4+ |
| Linkage strength | 0.091** | 0.048** | 0.014 | 0.020 |
| | (6.12) | (4.78) | (1.78) | (1.91) |
| In matched occ. | 0.004 | -0.007 | 0.069** | 0.066** |
| | (0.55) | (-0.75) | (10.39) | (7.48) |
| Linkage * matched | 0.003 | 0.044** | 0.018** | 0.014 |
| | (0.42) | (6.90) | (3.29) | (1.68) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 135052 | 75725 | 290642 | 299242 |
| $R^2$ | 0.35 | 0.45 | 0.29 | 0.32 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

## 1.2 Part-time

Appendix Tables S6 and S7 show that our decision to focus on full-time workers did not affect our earnings results, and the regression analyses including all workers show predicted effect sizes that are similar as to the ones presented in the main text. The one major difference here is that when including all workers secondary education in France fits the pattern that we find in the other countries. A substantive interpretation of the presence of

an effect in France might be that workers that make the match end up working part-time, but obtain comparatively high wages. The results including parttime workers are uniform across the different countries and comparisons in both the within- and between-country design: making a match is beneficial, but particularly when there is a clear pathway from school to work.

Table S6: Within country, between field wage models including part time workers

| | France | | Germany | | US | |
|---|---|---|---|---|---|---|
| | (1) Secondary | (2) Tertiary | (3) Secondary | (4) Tertiary | (5) 4 year | (6) 4+ years |
| Local linkage. | -0.029** | 0.020** | -0.066** | -0.087** | -0.024** | -0.017 |
| | (-2.90) | (3.09) | (-8.80) | (-12.46) | (-2.69) | (-1.47) |
| In matched occ. | 0.036** | 0.087** | -0.055** | -0.032* | 0.049** | 0.092** |
| | (3.58) | (6.98) | (-5.72) | (-2.34) | (4.24) | (6.53) |
| Linkage * matched | 0.043** | 0.054** | 0.155** | 0.081** | 0.166** | 0.079** |
| | (3.33) | (6.38) | (15.60) | (9.74) | (13.49) | (5.15) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 74149 | 50047 | 82799 | 51726 | 248397 | 255316 |
| $R^2$ | 0.21 | 0.26 | 0.21 | 0.27 | 0.16 | 0.19 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S7: Within level-field, between country wage models including part time workers

| | (1) Fr-D, Secon. | (2) Fr-D, Tert. | (3) F-D-US, Tert. 4yr | (4) F-D-US, Tert. 4+ |
|---|---|---|---|---|
| Linkage strength | 0.077** | 0.045** | -0.023** | 0.000 |
| | (4.74) | (4.40) | (-2.87) | (0.01) |
| In matched occ. | 0.055** | 0.026* | 0.088** | 0.097** |
| | (7.47) | (2.41) | (11.25) | (9.17) |
| Linkage * matched | 0.027** | 0.054** | 0.050** | 0.034** |
| | (3.22) | (7.76) | (8.76) | (3.53) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 168162 | 90559 | 336392 | 345875 |
| $R^2$ | 0.31 | 0.40 | 0.24 | 0.27 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

## 1.3 Pre/post-crisis data for France and the USA

We use data from different years, and one might wonder to what extent the results hold when we use data before the financial crisis for all countries. The within-country results show no real differences with the main results: for France and the US the results do not change when we use data from respectively 2003-2008 or 2015 (Table S8). The estimates from the between-country model (Table S9) remain very similar. Of course the interpretation of this model might be more complex since we compare countries in very different periods (ranging from 2003-2015), but qualitatively the pattern is very similar to the results presented in the main text.

Table S8: Within country, between field wage models (Pre/post-crisis)

| | France (2003-2008) | | US (2015) | |
|---|---|---|---|---|
| | (1) Secondary | (2) Tertiary | (3) Secondary | (4) Tertiary |
| Local linkage. | -0.049** | 0.029** | -0.026** | -0.016 |
| | (-6.62) | (5.43) | (-3.15) | (-1.48) |
| In matched occ. | -0.013 | 0.027* | -0.013 | 0.007 |
| | (-1.45) | (2.30) | (-1.25) | (0.56) |
| Linkage * matched | 0.034** | 0.051** | 0.158** | 0.083** |
| | (3.01) | (6.81) | (13.31) | (5.68) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 43286 | 27889 | 228897 | 235177 |
| $R^2$ | 0.25 | 0.35 | 0.18 | 0.21 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S9: (Within level-field, between country wage models (Pre/post-crisis

| | (1) Fr-D, Secon. | (2) Fr-D, Tert. | (3) F-D-US, Tert. 4yr | (4) F-D-US, Tert. 4+ |
|---|---|---|---|---|
| Linkage strength | 0.105** | 0.050** | -0.010 | -0.006 |
| | (7.85) | (6.33) | (-1.23) | (-0.84) |
| In matched occ. | 0.022** | 0.006 | 0.030** | 0.040** |
| | (3.41) | (0.61) | (5.58) | (7.62) |
| Linkage * matched | 0.009 | 0.040** | 0.066** | 0.053** |
| | (1.32) | (6.72) | (13.26) | (11.40) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 117835 | 61825 | 288710 | 297002 |
| $R^2$ | 0.37 | 0.47 | 0.26 | 0.26 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

## 1.4 Multiple occupations

One might wonder how the results are affected by workers that work in multiple occupations. Maybe they end up in a non-matching job, and make a low wage, thereby confounding the effect between making the match and labor market earnings. Unfortunately the US data does not contain a variable that indicate if a respondent works in multiple jobs, so we can only test this for France and Germany. Working multiple jobs is coded as 1 if a worker has indicated that he or she has a second occupation and a 0 if a worker has indicated that he or she does not work in a second occupation. Table S10 shows the within-country results, Table S11 the between-country results for France and Germany only. The findings indicate that controlling for working multiple occupations does not affect the findings for France and Germany at all when we include this variable.

Table S10: Within country, between field wage models(multiple jobs)

| | France | | Germany | |
|---|---|---|---|---|
| | (1) Secondary | (2) Tertiary | (3) Secondary | (4) Tertiary |
| Local linkage. | -0.028** | 0.025** | -0.086** | -0.068** |
| | (-4.49) | (5.35) | (-12.77) | (-9.40) |
| In matched occ. | 0.006 | 0.033** | -0.152** | -0.072** |
| | (0.82) | (3.52) | (-16.00) | (-4.60) |
| Linkage * matched | 0.005 | 0.057** | 0.191** | 0.086** |
| | (0.54) | (8.75) | (20.70) | (9.46) |
| >1 job | -0.078** | -0.074** | 0.140** | 0.080** |
| | (-6.30) | (-5.15) | (14.55) | (5.96) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 60503 | 41789 | 74549 | 33936 |
| $R^2$ | 0.25 | 0.34 | 0.19 | 0.24 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S11: Within level-field, between country wage models (multiple jobs)

| | (1) Fr-D, Secon. | (2) Fr-D, Tert. |
|---|---|---|
| Linkage strength | 0.073** | 0.058** |
| | (5.02) | (6.07) |
| In matched occ. | -0.026** | 0.021* |
| | (-3.49) | (2.06) |
| Linkage * matched | 0.052** | 0.033** |
| | (6.34) | (4.96) |
| >1 job | 0.100** | 0.047** |
| | (12.13) | (4.27) |
| Controls | Yes | Yes |
| Observations | 135052 | 75725 |
| $R^2$ | 0.35 | 0.45 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

## 1.5 Different age groups for the analyses

In the analyses we use members of the age group 18-65 who are not in school, who are employed, and who have attained their final degree. One might wonder what happens when we restrict our sample to a more narrowly defined working age population. For this reason we investigate to what extent our findings hold up if we only look at the subgroup 22-55 olds for secondary degree-holders and 30-55 olds for tertiary degree holders. The results remain very similar if we use these subgroups (Table S12 and Table S13). Again, the pattern of effects that we have discovered in Table 3 and 4 in the main text remain robust to the use of different age groups.

Table S12: Within country, between field wage models(22-55/30-55 year olds)

| | France | | Germany | | USA | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Secondary | Tertiary | Secondary | Tertiary | 4yr | 4+ yr |
| Local linkage. | -0.033** | 0.026** | -0.085** | -0.067** | -0.038** | -0.043** |
| | (-4.44) | (4.80) | (-12.56) | (-9.29) | (-4.17) | (-3.63) |
| In matched occ. | 0.008 | 0.039** | -0.151** | -0.073** | -0.001 | 0.013 |
| | (1.00) | (3.62) | (-15.93) | (-4.64) | (-0.04) | (0.81) |
| Linkage * matched | 0.002 | 0.053** | 0.190** | 0.086** | 0.132** | 0.075** |
| | (0.15) | (7.21) | (20.61) | (9.46) | (10.25) | (4.50) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 60503 | 41789 | 74549 | 33936 | 146924 | 151581 |
| $R^2$ | 0.24 | 0.34 | 0.19 | 0.24 | 0.15 | 0.18 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S13: Within level-field, between country wage models (22-55/30-55 year olds)

| | (1) Fr-D, Secon. | (2) Fr-D, Tert. | (3) F-D-US, Tert. 4yr | (4) F-D-US, Tert. 4+ |
|---|---|---|---|---|
| Linkage strength | 0.087** | 0.045** | 0.029** | 0.029** |
| | (7.10) | (5.96) | (3.86) | (3.92) |
| In matched occ. | -0.017** | 0.020* | 0.017** | 0.027** |
| | (-2.87) | (2.33) | (2.97) | (4.79) |
| Linkage * matched | 0.040** | 0.039** | 0.058** | 0.047** |
| | (6.03) | (7.32) | (11.92) | (10.23) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 135052 | 75725 | 220329 | 227306 |
| $R^2$ | 0.37 | 0.46 | 0.29 | 0.29 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

## 1.6 PIAAC analyses

A potential worry is that there might be positive selection into strongly-linking fields of study. It is known that the cognitive ability of students varies across different fields of study (Arcidiacono, 2004). When especially high-ability sort into strongly linking fields, unmeasured ability might partially explain the pattern of results that we report in this paper. For this reason we have used the data from the Programme for the International Assessment of Adult Competencies (PIAAC).

PIAAC has a direct measure of cognitive ability – a detailed measure of numeracy. More information on the measure can be found in OECD (2013). but it is a measure based on a extensive numerical competency test that respondents had to take. However, using the PIAAC data produces some constraints on the analysis. First, there are only 9 fields available in the PIAAC, so the number of distinct combinations of level and fields decreases substantially. Second, because the sample sizes of the PIAAC are comparatively very small, we measure occupation at a more crude level: 2 digits. We use two-digit occupational destinations to define whether a worker is matched to the most common occupation. Finally, wages are defined by taking the midpoint for the decile groups. Hanushek et al. (2015) have shown that this method works very well. Given these data limitations, we do not necessarily expect to find exactly the same pattern of results: the underlying data is much less suited to test the hypotheses we are interested in. Nevertheless, it will indicate whether our results might change from the inclusion of a direct measure of workers' cognitive ability.

Table S14 shows the results for the within-country analyses. We find positive interactions for France (Tertiary) and the USA (Tertiary). For Germany there is no positive

interaction, but there is a strong main effect of making the match at the secondary level. We believe that the main take-away from these results is that adding a direct measure of numeracy skills does not change the pattern of results reported in the main text. This indicates that in the within-country models we find no evidence that an unobserved correlation between ability and the selection into strongly linking fields drives our findings.

Table S15 shows an even more consistent picture, this time using the between-country design. Here we find a positive interaction for all tertiary comparisons. Most importantly, the effects hardly change when we add information on individual cognitive skills, indicating again that selection based on "ability" is not likely to a major confounder in the analyses reported in the main article.

Table S14: Within country, between field wage models (PIAAC data)

| | France | | | | Germany | | | | USA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sec. | Sec. | Tert. | Tert. | Sec. | Sec. | Tert. | Tert. | Tert. | Tert. |
| Linkage strength | -0.01 | 0.01 | 0.02 | 0.02 | -0.01 | 0.01 | 0.01 | 0.02 | -0.02 | 0.01 |
| | (-0.20) | (0.45) | (0.97) | (1.07) | (-0.11) | (0.18) | (0.24) | (0.66) | (-0.30) | (0.11) |
| In matched occ. | -0.22 | -0.20 | -0.18** | -0.17** | 0.26** | 0.20** | 0.07 | 0.07 | -0.25* | -0.23 |
| | (-1.28) | (-1.21) | (-3.76) | (-3.40) | (5.35) | (4.10) | (0.59) | (0.65) | (-2.07) | (-1.92) |
| Linkage * Matched | 0.19 | 0.18 | 0.08** | 0.08** | -0.03 | 0.00 | -0.04 | -0.03 | 0.24* | 0.23* |
| | (1.01) | (1.00) | (2.90) | (2.88) | (-0.51) | (0.03) | (-0.48) | (-0.42) | (2.37) | (2.26) |
| Numeracy skills | | 0.13** | | 0.15** | | 0.21** | | 0.23** | | 0.21** |
| | | (5.99) | | (5.39) | | (8.52) | | (5.39) | | (4.64) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| $N$ | 1437 | 1436 | 1317 | 1317 | 1627 | 1627 | 1083 | 1083 | 1114 | 1114 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S15: Within level-field, between country wage models (PIAAC data)

| | Fr-De (Sec.) | | Fr-De (Tert.) | | Fr-De-US (Tert.) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| In matched occ. | 0.228** | 0.197** | -0.125* | -0.103 | -0.059 | -0.042 |
| | (5.55) | (4.85) | (-2.13) | (-1.78) | (-1.12) | (-0.82) |
| Linkage strength | 0.084 | 0.078 | 0.043 | 0.037 | 0.080* | 0.072* |
| | (1.18) | (1.12) | (1.10) | (0.94) | (2.25) | (2.04) |
| Linkage * Matched | -0.127* | -0.095 | 0.081* | 0.074* | 0.071* | 0.064 |
| | (-2.50) | (-1.89) | (2.18) | (2.01) | (2.04) | (1.86) |
| Numeracy skills | | 0.167** | | 0.171** | | 0.201** |
| | | (10.38) | | (7.12) | | (10.35) |
| Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 3064 | 3063 | 2400 | 2400 | 3514 | 3514 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

## 1.7 Changing the threshold

Finally, we analyzed the extent to which our results are dependent on the 100 observations threshold that we use by re-estimating our models using a threshold of 75 and then 50. The results of both within-country (Tables S16-S18) and between-country regressions (Tables S19 and S20) show that our findings are robust to using a different threshold. When setting the threshold lower, slighty more fields of study are included in the analysis, but the findings are not affected in a meaningful way. This conclusion holds both for the within- and between-country models.

Table S16: Within country, between field wage models for France (different thresholds)

| | TH=50 | | TH=75 | | TH=100 | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Secondary | Tertiary | Secondary | Tertiary | 4 year | 4+ years |
| Linkage strength | -0.033** | 0.029** | -0.033** | 0.026** | -0.033** | 0.026** |
| | (-4.48) | (5.33) | (-4.48) | (4.87) | (-4.44) | (4.80) |
| In matched occ. | 0.008 | 0.045** | 0.009 | 0.039** | 0.008 | 0.039** |
| | (1.03) | (4.24) | (1.04) | (3.69) | (1.00) | (3.62) |
| Linkage * matched | 0.001 | 0.047** | 0.001 | 0.052** | 0.002 | 0.053** |
| | (0.10) | (6.61) | (0.11) | (7.20) | (0.15) | (7.21) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 60926 | 42223 | 60741 | 41993 | 60503 | 41789 |
| $R^2$ | 0.24 | 0.34 | 0.24 | 0.34 | 0.24 | 0.34 |
| Categories | 81 | 81 | 73 | 73 | 66 | 66 |

$t$ statistics in parentheses

Control variables included in the model are age, age$^2$, sex, and educational level.

* $p < 0.05$, ** $p < 0.01$

Table S17: Within country, between field wage models for Germany (different thresholds)

| | TH=50 | | TH=75 | | TH=100 | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Secondary | Tertiary | Secondary | Tertiary | 4 year | 4+ years |
| Linkage strength | -0.106** | -0.052** | -0.109** | -0.053** | -0.109** | -0.054** |
| | (-13.96) | (-8.26) | (-14.15) | (-8.34) | (-14.09) | (-8.43) |
| In matched occ. | -0.181** | -0.051** | -0.184** | -0.051** | -0.184** | -0.052** |
| | (-17.45) | (-3.86) | (-17.61) | (-3.90) | (-17.59) | (-3.98) |
| Linkage * matched | 0.229** | 0.072** | 0.233** | 0.073** | 0.233** | 0.074** |
| | (22.00) | (9.16) | (22.12) | (9.14) | (22.11) | (9.26) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 65723 | 43302 | 65640 | 43000 | 65640 | 42845 |
| $R^2$ | 0.18 | 0.27 | 0.18 | 0.27 | 0.18 | 0.27 |
| Categories | 93 | 93 | 84 | 84 | 82 | 82 |

$t$ statistics in parentheses

Control variables included in the model are age, age$^2$, sex, and educational level.

* $p < 0.05$, ** $p < 0.01$

Table S18: Within country, between field wage models for the US (different thresholds)

| | TH=50 | | TH=75 | | TH=100 | |
|---|---|---|---|---|---|---|
| | (1) Secondary | (2) Tertiary | (3) Secondary | (4) Tertiary | (5) 4 year | (6) 4+ years |
| Linkage strength | -0.024** | -0.014 | -0.024** | -0.017 | -0.023** | -0.016 |
| | (-3.01) | (-1.41) | (-3.09) | (-1.66) | (-2.90) | (-1.58) |
| In matched occ. | -0.012 | 0.010 | -0.012 | 0.012 | -0.016 | 0.004 |
| | (-1.20) | (0.76) | (-1.23) | (0.91) | (-1.61) | (0.28) |
| Linkage * matched | 0.152** | 0.077** | 0.152** | 0.077** | 0.151** | 0.082** |
| | (13.78) | (5.49) | (13.79) | (5.44) | (13.76) | (5.79) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 221177 | 227877 | 221072 | 227598 | 217237 | 223517 |
| $R^2$ | 0.17 | 0.21 | 0.17 | 0.21 | 0.18 | 0.21 |
| Categories | 62 | 62 | 57 | 57 | 53 | 53 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S19: Within level-field, between country (using 50 as the threshold)

| | (1) Fr-D, Secon. | (2) Fr-D, Tert. | (3) F-D-US, Tert. 4yr | (4) F-D-US, Tert. 4+ |
|---|---|---|---|---|
| Linkage strength | 0.071** | 0.050** | -0.000 | 0.019 |
| | (5.26) | (5.47) | (-0.05) | (1.92) |
| In matched occ. | -0.029** | 0.023* | 0.027** | 0.036** |
| | (-3.95) | (2.26) | (4.02) | (3.94) |
| Linkage * matched | 0.056** | 0.032** | 0.051** | 0.033** |
| | (6.89) | (4.86) | (10.06) | (4.01) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 135601 | 76573 | 295038 | 304450 |
| $R^2$ | 0.35 | 0.45 | 0.28 | 0.31 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Table S20: Within level-field, between country (using 75 as the threshold)

| | (1) Fr-D, Secon. | (2) Fr-D, Tert. | (3) F-D-US, Tert. 4yr | (4) F-D-US, Tert. 4+ |
|---|---|---|---|---|
| Linkage strength | 0.074** | 0.056** | 0.000 | 0.017 |
| | (5.07) | (5.89) | (0.04) | (1.66) |
| In matched occ. | -0.026** | 0.020* | 0.027** | 0.037** |
| | (-3.48) | (2.00) | (4.00) | (4.08) |
| Linkage * matched | 0.052** | 0.034** | 0.051** | 0.031** |
| | (6.30) | (5.06) | (10.00) | (3.82) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 135290 | 76084 | 294629 | 303682 |
| $R^2$ | 0.35 | 0.45 | 0.28 | 0.31 |

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

# 2 Matched occupations

In Section 3.4 we detailed how we have calculated the two matched occupations for a given educational degree (a combination of a level and field of study). For each country we detail the list of these matched occupation in Tables S21, S22, and S23. We've calculated these occupations by taking the two occupations that are – compared to all occupational destinations in that educational level – most unique for that field. Imagine that we have occupations $j$, educational levels $g$, and educational fields within levels $h$. We then take the two occupations with the highest ratio of $\frac{p_{j|g}}{p_{j|gh}}$, where $p_{j|g}$ is the proportion of workers in occupation $j$ conditional on educational level $g$ and $p_{j|gh}$ is the proportion of workers in occupation $j$ conditional on both educational level $g$ and educational field $j$. For each level of field we take the two highest rations as the matched occupations, but in order to avoid strange matches, we only look at the 10 most common occupations for each field. If we would not condition on the ten largest occupations, some very uncommon occupations (i.e., there are just a few taxi-drivers with a PhD) could still be matched if all of them would cluster in one field of study (i.e., all taxi-drivers with a PhD graduated from social sciences).

Table S21: Matched occupations for France

| **Level** | **Field** | **Matched occ. 1** | **Matched occ. 2** |
|---|---|---|---|
| 3C | Arts | Artistic, entertainment and sports assoc. prof. | Writers and creative or performing artists |
| 3C | Buss&admin | Office clerks | Cashiers, tellers and related clerks |
| 3C | Eng | Electrical and electronic equipment mechanics and fitters | Machinery mechanics and fitters |
| 3C | Manuf | Other craft and related trades workers | Housekeeping and restaurant services workers |
| 3C | Archit | Painters, building structure cleaners and related trades workers | Building frame and related trades workers |
| 3C | Agri | Skilled agricultural and fishery workers | Crop and animal producers |
| 3C | Health | Health assoc. prof. (except nursing) | Personal care and related workers |
| 3C | Social serv | Nursing and midwifery assoc. prof. | Personal care and related workers |
| 3C | Pers serv | Other personal services workers | Other teaching assoc. prof. |
| 3C | Transport | Motor vehicle drivers | Material-recording and transport clerks |
| 3C | Environ | Domestic and related helpers, cleaners and launderers | Personal care and related workers |
| 3B | Buss&admin | Office clerks | Other office clerks |
| 3B | Eng | Electrical and electronic equipment mechanics and fitters | Machinery mechanics and fitters |

| | | | |
|---|---|---|---|
| 3B | Manuf | Other craft and related trades workers | Housekeeping and restaurant services workers |
| 3B | Archit | Painters, building structure cleaners and related trades workers | Building frame and related trades workers |
| 3B | Agri | Skilled agricultural and fishery workers | Animal producers and related workers |
| 3B | Social serv | Teaching assoc. prof. | Personal care and related workers |
| 3B | Pers serv | Other personal services workers | Housekeeping and restaurant services workers |
| 3B | Transport | Material-recording and transport clerks | Manufacturing labourers |
| 3A | No | Architects, engineers and related prof. | Primary and pre-primary education teaching prof. |
| 3A | Human. | Primary and pre-primary education teaching prof. | Domestic and related helpers, cleaners and launderers |
| 3A | Socsci | Production and operations managers | Administrative assoc. prof. |
| 3A | Buss&admin | Office clerks | Administrative assoc. prof. |
| 3A | Eng | Electrical and electronic equipment mechanics and fitters | Physical and engineering science technicians |
| 3A | Archit | Plant workers n.e.c. | Building finishers and related trades workers |
| 3A | Agri | Animal producers and related workers | Crop and animal producers |
| 3A | Health | Personal care and related workers | Health assoc. prof. (except nursing) |
| 5B | Arts | Optical and electronic equipment operators | Artistic, entertainment and sports assoc. prof. |
| 5B | Journ | Archivists, librarians and related information prof. | Artistic, entertainment and sports assoc. prof. |
| 5B | Buss&admin | Cashiers, tellers and related clerks | Office clerks |
| 5B | Law | Legal prof. | Protective services workers |
| 5B | Lifesci | Life science technicians and related assoc. professional | Chemical-products machine operators |
| 5B | Physsci | Physicists, chemists and related prof. | Food and related products machine operators |
| 5B | Comput | Computer assoc. prof. | Mathematicians, statisticians and related prof. |
| 5B | Eng | Electrical and electronic equipment mechanics and fitters | Machinery mechanics and fitters |
| 5B | Manuf | Textile-, fur- and leather-products machine operators | Food and related products machine operators |
| 5B | Archit | Building frame and related trades workers | Building finishers and related trades workers |
| 5B | Agri | Skilled agricultural and fishery workers | Crop and animal producers |

| | | | |
|---|---|---|---|
| 5B | Health | Nursing and midwifery assoc. prof. | Health assoc. prof. (except nursing) |
| 5B | Pers serv | Housekeeping and restaurant services workers | Domestic and related helpers, cleaners and launderers |
| 5B | Transport | Ship and aircraft controllers and technicians | Material-recording and transport clerks |
| 5A | No | Architects, engineers and related prof. | Physicists, chemists and related prof. |
| 5A | Teach | Primary and pre-primary education teaching prof. | College, university and higher education teaching prof. |
| 5A | Arts | Optical and electronic equipment operators | Artistic, entertainment and sports assoc. prof. |
| 5A | Human. | Secondary education teaching prof. | Primary and pre-primary education teaching prof. |
| 5A | Socsci | Social science and related prof. | Primary and pre-primary education teaching prof. |
| 5A | Journ | Archivists, librarians and related information prof. | Writers and creative or performing artists |
| 5A | Buss&admin | Other specialist managers | Production and operations managers |
| 5A | Law | Legal prof. | Religious prof. |
| 5A | Lifesci | Life science technicians and related assoc. professional | Physicists, chemists and related prof. |
| 5A | Physsci | Physicists, chemists and related prof. | Physical and engineering science technicians |
| 5A | Math | Secondary education teaching prof. | Armed forces |
| 5A | Comput | Computer assoc. prof. | Mathematicians, statisticians and related prof. |
| 5A | Eng | Architects, engineers and related prof. | Physical and engineering science technicians |
| 5A | Manuf | Food and related products machine operators | Architects, engineers and related prof. |
| 5A | Archit | Life science prof. | Architects, engineers and related prof. |
| 5A | Agri | Crop and animal producers | Life science prof. |
| 5A | Vet | Health prof. (except nursing) | Legislators and senior officials |
| 5A | Health | Health prof. (except nursing) | Nursing and midwifery assoc. prof. |
| 5A | Pers serv | Other teaching assoc. prof. | Teaching assoc. prof. |
| 5A | Transport | Ship and aircraft controllers and technicians | Material-recording and transport clerks |
| 5A | Environ | Life science prof. | Physical and engineering science technicians |
| 6A | Human. | Archivists, librarians and related information prof. | Armed forces |
| 6A | Socsci | Social science and related prof. | Legislators and senior officials |
| 6A | Lifesci | Health prof. (except nursing) | Finance and sales assoc. prof. |

| | | | |
|---|---|---|---|
| 6A | Physsci | Architects, engineers and related prof. | Primary and pre-primary education teaching prof. |

Table S22: Matched occupations for Germany

| **Level** | **Field** | **Matched occ. 1** | **Matched occ. 2** |
|---|---|---|---|
| 3B | No | Personal care and related workers | Other office clerks |
| 3B | Teach | Teaching assoc. prof. | Primary and pre-primary education teaching prof. |
| 3B | Arts | Craft printing and related trades workers | Artistic, entertainment and sports assoc. prof. |
| 3B | Human. | Office clerks | Client information clerks |
| 3B | Buss&admin | Numerical clerks | Office clerks |
| 3B | Physsci | Chemical-processing-plant operators | Chemical-products machine operators |
| 3B | Math | Mathematicians, statisticians and related prof. | Computer assoc. prof. |
| 3B | Comput | Computer assoc. prof. | Mathematicians, statisticians and related prof. |
| 3B | Eng | Machinery mechanics and fitters | Blacksmiths, tool-makers and related trades workers |
| 3B | Manuf | Other craft and related trades workers | Wood treaters, cabinet-makers and related trades workers |
| 3B | Archit | Building frame and related trades workers | Painters, building structure cleaners and related trades workers |
| 3B | Agri | Crop and animal producers | Animal producers and related workers |
| 3B | Health | Nursing and midwifery assoc. prof. | Health assoc. prof. (except nursing) |
| 3B | Social serv | Teaching assoc. prof. | Social science and related prof. |
| 3B | Pers serv | Other personal services workers | Housekeeping and restaurant services workers |
| 3B | Transport | Locomotive engine drivers and related workers | Library, mail and related clerks |
| 3B | Sec | Police inspectors and detectives | Protective services workers |
| 3A | No | Personal care and related workers | Armed forces |
| 4A | No | Personal care and related workers | Health assoc. prof. (except nursing) |
| 4A | Teach | Teaching assoc. prof. | Primary and pre-primary education teaching prof. |
| 4A | Arts | Craft printing and related trades workers | Artistic, entertainment and sports assoc. prof. |
| 4A | Human. | Office clerks | Personal and protective services workers |
| 4A | Buss&admin | Numerical clerks | Customs, tax and related government assoc. prof. |

| | | | |
|---|---|---|---|
| 4A | Math | Mathematicians, statisticians and related prof. | Computer assoc. prof. |
| 4A | Comput | Computer assoc. prof. | Mathematicians, statisticians and related prof. |
| 4A | Eng | Machinery mechanics and fitters | Blacksmiths, tool-makers and related trades workers |
| 4A | Manuf | Wood treaters, cabinet-makers and related trades workers | Textile, garment and related trades workers |
| 4A | Archit | Painters, building structure cleaners and related trades workers | Building frame and related trades workers |
| 4A | Agri | Crop and animal producers | Animal producers and related workers |
| 4A | Health | Nursing and midwifery assoc. prof. | Health assoc. prof. (except nursing) |
| 4A | Social serv | Social science and related prof. | Assemblers |
| 4A | Pers serv | Other personal services workers | Client information clerks |
| 4A | Transport | Locomotive engine drivers and related workers | Cashiers, tellers and related clerks |
| 4A | Sec | Police inspectors and detectives | Protective services workers |
| 5B | No | Metal, machinery and related trades workers | Other office clerks |
| 5B | Teach | Primary and pre-primary education teaching prof. | Teaching assoc. prof. |
| 5B | Arts | Craft printing and related trades workers | Artistic, entertainment and sports assoc. prof. |
| 5B | Human. | Religious assoc. prof. | Office clerks |
| 5B | Socsci | Administrative assoc. prof. | Customs, tax and related government assoc. prof. |
| 5B | Buss&admin | Numerical clerks | Religious prof. |
| 5B | Math | Mathematicians, statisticians and related prof. | Computer assoc. prof. |
| 5B | Eng | Machinery mechanics and fitters | Blacksmiths, tool-makers and related trades workers |
| 5B | Manuf | Other craft and related trades workers | Textile, garment and related trades workers |
| 5B | Archit | Building frame and related trades workers | Agricultural and other mobile plant operators |
| 5B | Agri | Life science prof. | Skilled agricultural and fishery workers |
| 5B | Health | Nursing and midwifery assoc. prof. | Health assoc. prof. (except nursing) |
| 5B | Social serv | Religious assoc. prof. | Social science and related prof. |
| 5B | Pers serv | Other personal services workers | Housekeeping and restaurant services workers |
| 5B | Transport | Locomotive engine drivers and related workers | Cashiers, tellers and related clerks |
| 5B | Sec | Police inspectors and detectives | Protective services workers |

| | | | |
|---|---|---|---|
| 5A | No | Models, salespersons and demonstrators | Other office clerks |
| 5A | Teach | Primary and pre-primary education teaching prof. | Secondary education teaching prof. |
| 5A | Arts | Artistic, entertainment and sports assoc. prof. | Optical and electronic equipment operators |
| 5A | Human. | Office clerks | Religious prof. |
| 5A | Socsci | Social science and related prof. | Writers and creative or performing artists |
| 5A | Journ | Archivists, librarians and related information prof. | Writers and creative or performing artists |
| 5A | Buss&admin | Numerical clerks | Business prof. |
| 5A | Law | Legal prof. | Religious prof. |
| 5A | Lifesci | Life science prof. | Life science technicians and related assoc. professional |
| 5A | Physsci | Physicists, chemists and related prof. | Physical and engineering science technicians |
| 5A | Math | Mathematicians, statisticians and related prof. | Computer assoc. prof. |
| 5A | Comput | Physicists, chemists and related prof. | Computer assoc. prof. |
| 5A | Eng | Architects, engineers and related prof. | Physical and engineering science technicians |
| 5A | Manuf | Housekeeping and restaurant services workers | Ship and aircraft controllers and technicians |
| 5A | Archit | Architects, engineers and related prof. | Physical and engineering science technicians |
| 5A | Agri | Life science prof. | Skilled agricultural and fishery workers |
| 5A | Vet | Food and related products machine operators | Health prof. (except nursing) |
| 5A | Health | Health prof. (except nursing) | Nursing and midwifery assoc. prof. |
| 5A | Social serv | Religious assoc. prof. | Social work assoc. prof. |
| 5A | Pers serv | Client information clerks | Health assoc. prof. (except nursing) |
| 5A | Transport | Ship and aircraft controllers and technicians | Material-recording and transport clerks |
| 5A | Sec | Police inspectors and detectives | Protective services workers |
| 6A | Teach | Secondary education teaching prof. | Other teaching prof. |
| 6A | Human. | Archivists, librarians and related information prof. | Social science and related prof. |
| 6A | Socsci | Social science and related prof. | Other teaching prof. |
| 6A | Buss&admin | Numerical clerks | Other office clerks |
| 6A | Law | Legal prof. | Managers of small enterprises |
| 6A | Lifesci | Life science prof. | Finance and sales assoc. prof. |

| | | | |
|---|---|---|---|
| 6A | Physsci | Physicists, chemists and related prof. | Finance and sales assoc. prof. |
| 6A | Comput | Computer assoc. prof. | Mathematicians, statisticians and related prof. |
| 6A | Eng | Architects, engineers and related prof. | Models, salespersons and demonstrators |
| 6A | Health | Health prof. (except nursing) | Writers and creative or performing artists |

Table S23: Matched occupations for the US

| **Level** | **Field** | **Matched occ. 1** | **Matched occ. 2** |
|---|---|---|---|
| 5B | Teach | Primary and pre-primary education teaching prof. | Teaching assoc. prof. |
| 5B | Human. | Models, salespersons and demonstrators | Finance and sales assoc. prof. |
| 5B | Socsci | Social science and related prof. | Teaching assoc. prof. |
| 5B | Buss&admin | Numerical clerks | Office clerks |
| 5B | Lifesci | Optical and electronic equipment operators | Physical and engineering science technicians |
| 5B | Comput | Mathematicians, statisticians and related prof. | Computer assoc. prof. |
| 5B | Eng | Machinery mechanics and fitters | Architects, engineers and related prof. |
| 5B | Manuf | Blacksmiths, tool-makers and related trades workers | Metal, machinery and related trades workers |
| 5B | Archit | Building frame and related trades workers | Agricultural, fishery and related labourers |
| 5B | Agri | Animal producers and related workers | Skilled agricultural and fishery workers |
| 5B | Health | Nursing and midwifery assoc. prof. | Health prof. (except nursing) |
| 5B | Pers serv | Other personal services workers | Housekeeping and restaurant services workers |
| 5B | Transport | Motor vehicle drivers | Agricultural and other mobile plant operators |
| 5B | Sec | Police inspectors and detectives | Protective services workers |
| 5B | Other | Housekeeping and restaurant services workers | Metal, machinery and related trades workers |
| 5A | Teach | Primary and pre-primary education teaching prof. | Secondary education teaching prof. |
| 5A | Arts | Artistic, entertainment and sports assoc. prof. | Writers and creative or performing artists |
| 5A | Human. | Writers and creative or performing artists | Office clerks |
| 5A | Socsci | Social science and related prof. | Protective services workers |

| | | | |
|---|---|---|---|
| 5A | Journ | Writers and creative or performing artists | Business services agents and trade brokers |
| 5A | Buss&admin | Business prof. | Finance and sales assoc. prof. |
| 5A | Law | Legal prof. | Administrative assoc. prof. |
| 5A | Lifesci | Life science prof. | Life science technicians and related assoc. professional |
| 5A | Physsci | Physicists, chemists and related prof. | Life science prof. |
| 5A | Math | Mathematicians, statisticians and related prof. | Secondary education teaching prof. |
| 5A | Comput | Mathematicians, statisticians and related prof. | Computer assoc. prof. |
| 5A | Eng | Architects, engineers and related prof. | Machinery mechanics and fitters |
| 5A | Archit | Managers of small enterprises | Architects, engineers and related prof. |
| 5A | Agri | Animal producers and related workers | Skilled agricultural and fishery workers |
| 5A | Health | Health prof. (except nursing) | Health assoc. prof. (except nursing) |
| 5A | Social serv | Social science and related prof. | Social work assoc. prof. |
| 5A | Pers serv | Health assoc. prof. (except nursing) | Housekeeping and restaurant services workers |
| 5A | Transport | Ship and aircraft controllers and technicians | Armed forces |
| 5A | Environ | Life science prof. | Physical and engineering science technicians |
| 5A | Sec | Protective services workers | Police inspectors and detectives |
| 5A | Other | Health assoc. prof. (except nursing) | Health prof. (except nursing) |
| 6B | Teach | Primary and pre-primary education teaching prof. | Other teaching assoc. prof. |
| 6B | Human. | Religious prof. | Writers and creative or performing artists |
| 6B | Socsci | Social science and related prof. | Social work assoc. prof. |
| 6B | Buss&admin | Numerical clerks | Legislators and senior officials |
| 6B | Lifesci | Physicists, chemists and related prof. | Life science prof. |
| 6B | Comput | Mathematicians, statisticians and related prof. | Archivists, librarians and related information prof. |
| 6B | Eng | Architects, engineers and related prof. | Building caretakers, window and related cleaners |
| 6B | Health | Health prof. (except nursing) | Life science technicians and related assoc. professional |
| 6B | Other | Archivists, librarians and related information prof. | Health assoc. prof. (except nursing) |

| | | | |
|---|---|---|---|
| 6A | Teach | Primary and pre-primary education teaching prof. | Other teaching prof. |
| 6A | Human. | Religious prof. | Archivists, librarians and related information prof. |
| 6A | Socsci | Social science and related prof. | Mathematicians, statisticians and related prof. |
| 6A | Law | Administrative assoc. prof. | Legal prof. |
| 6A | Lifesci | Life science prof. | Physicists, chemists and related prof. |
| 6A | Health | Health prof. (except nursing) | Personal care and related workers |
| 6A | Other | Physicists, chemists and related prof. | Health assoc. prof. (except nursing) |

# References

Arcidiacono, P. (2004). Ability sorting and the returns to college major. *Journal of Econometrics*, 121(1–2):343–375.

Hanushek, E. A., Schwerdt, G., Wiederhold, S., and Woessmann, L. (2015). Returns to skills around the world: Evidence from PIAAC. *European Economic Review*, 73:103–130.

OECD (2013). *Technical Report of the Survey of Adult Skills (PIAAC)*. OECD, Paris, France, 1 edition.