Supplementary Material:

High-skilled labour mobility in Europe before and after the 2004 enlargement

Figures S1-S4 and Tables S1-S2

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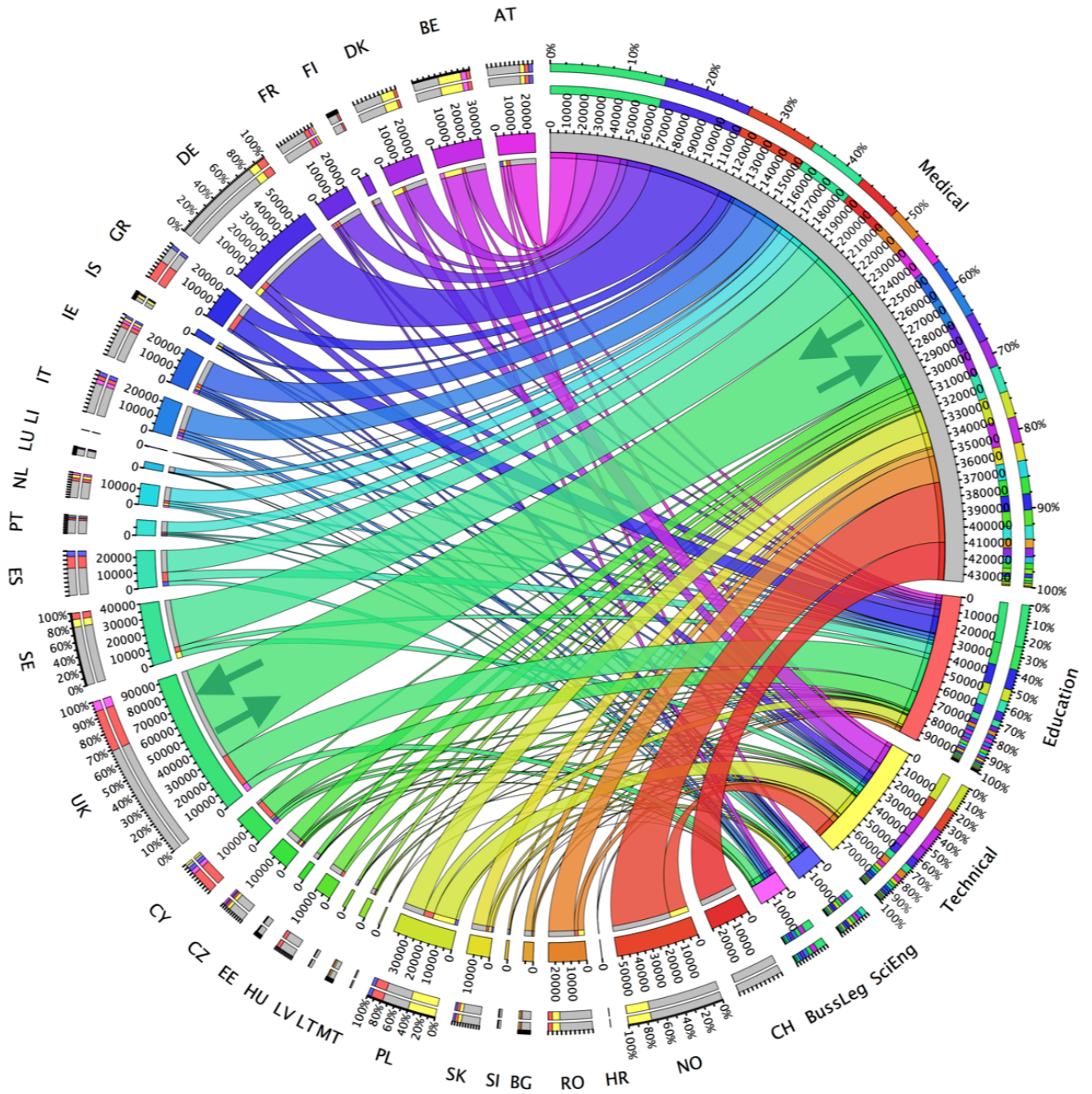*E-mail*: apetersen3@ucmerced.edu

FIG. S1: **High-skilled mobility by country and profession.** Bi-partite projection of the network between country mobility and profession type following the 2004 EU enlargement (2005-2014). Each link shows the total amount of mobility by country i in profession p. Outer rings show the distribution of the total mobility, either by country or by profession; because this is a bipartite projection both outer rings are redundant. Countries are ordered according to 2004 EU membership status.
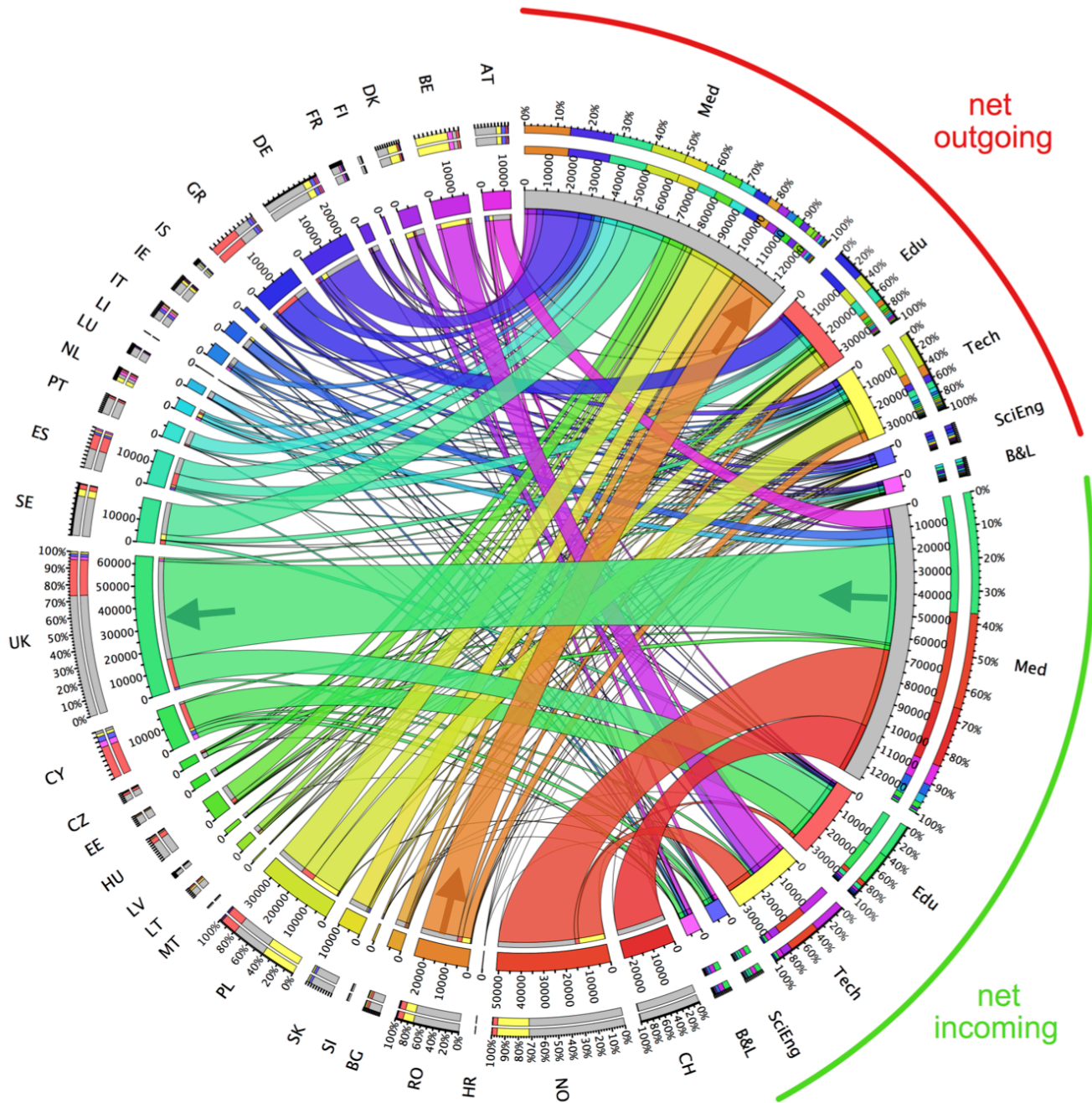
FIG. S2: **Brain drain and brain gain by country and profession.** Bi-partite projection of the brain-drain network illustrating the net incoming or outgoing mobility by country for each profession following the 2004 EU enlargement (2005-2014). Outer ring show the distribution across the total net flow, either by country or by profession; because this is a bipartite projection both outer rings are redundant. Countries are ordered according to 2004 EU membership status.
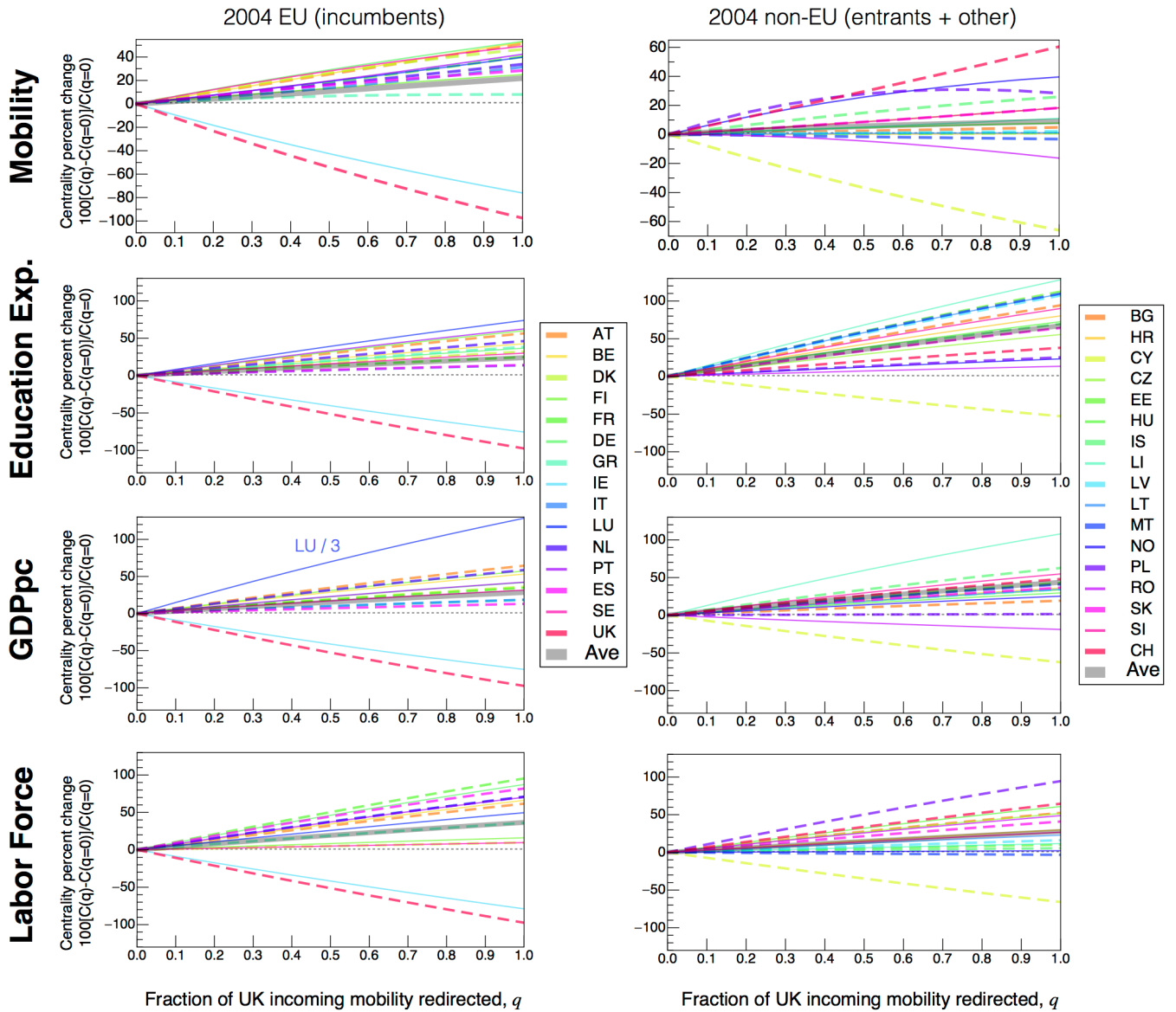
FIG. S3: **Robustness check of redirection model using additional World Bank country variables to estimate redirection weights.** Comparison of the percent change in network centrality estimated in our redirection model as a function of q – the fraction of redirected incoming UK mobility – using 3 different economic variables to define the redirection weight $F_{j,t,k}$. In the main manuscript Fig. 5(f,g) we use $F_{j,t,k} \equiv M_{ij,t}$; we reproduce these results in the first row to facilitate cross-comparison. In the remaining three rows we show additional estimates from the redirection model using the three most-positive push-pull factors in our panel regression model to define $F_{j,t,k}$: (i) the total expenditure on education as a percentage of government expenditure on all sectors, (ii) GDP per capita, and (iii) the total labour force size, reported as the economically active population size including individuals 15 years or older. It is worth mentioning that this generic redirection scheme still conserves the total observed mobility, i.e. $M_t = \sum_{i,j} M_{ij,t} = 338,747$ for all q over the period 2005–2014. (Left column) Percent change $\%(q)$ in the PageRank centrality of 2004 incumbent EU members as a function of q; (Right column) Percent change $\%(q)$ in the PageRank centrality of 2004 entrant and non-EU members as a function of q. The $q = 1$ values in each panel represent the percent change corresponding to the most extreme 'hard Brexit'. Within each panel, the average $\%(q)$ value is indicated by the opaque grey curve. The panel in the first column and third row shows the time series for LU divided by a factor of 3 so that it fits on the common scale.
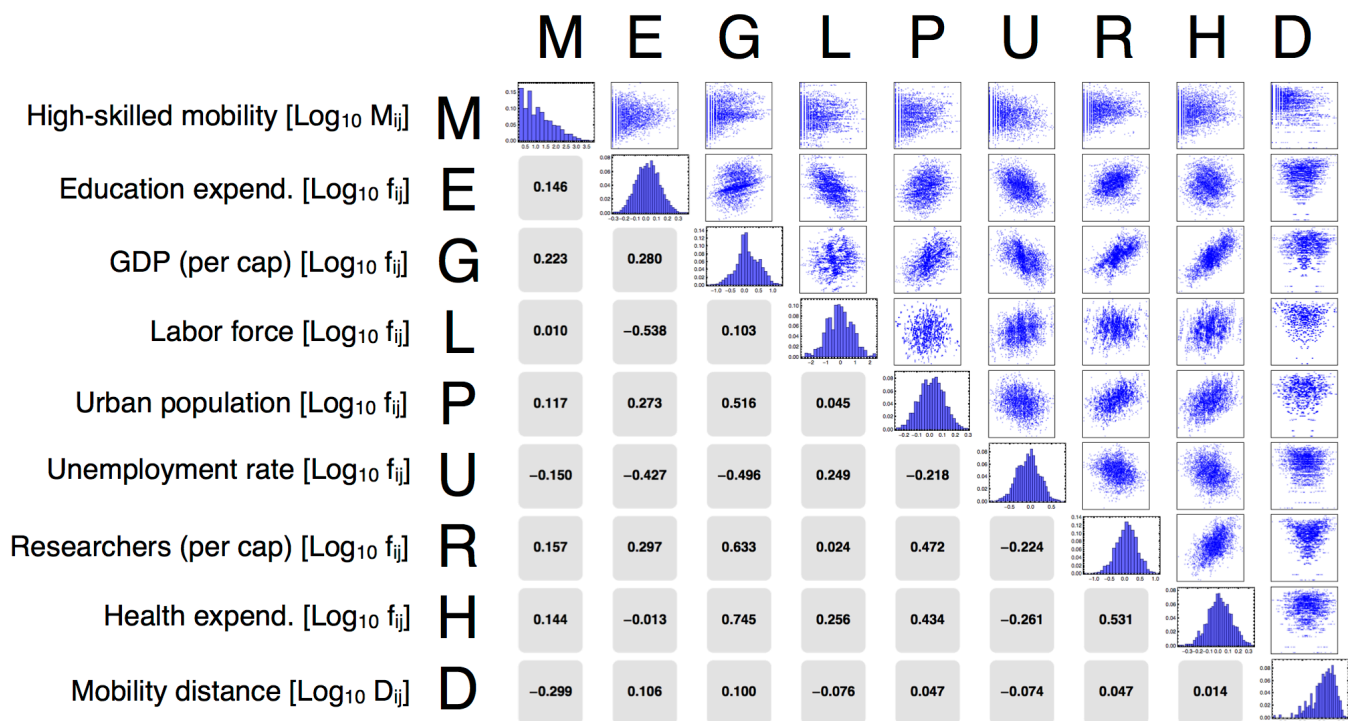
FIG. S4: **Model parameter probability distributions and cross-correlations.** The cells in the upper quadrant show the scatter plot of pairwise combinations of model covariates; the corresponding lower-quadrant cells contain the corresponding Pearson correlation coefficient. The cells along the diagonal show the probability distribution of the individual economic variables. For the scatter plots, the row variable is plotted on the x-axis while the column variable is plotted on the y-axis. To be concise, we only show the matrix using the mobility data for all professions pooled together, as the analogous cross-correlation results calculated using mobility data for just Medical or Sci.&Eng.+Tech. professions are consistent in sign and magnitude with the pooled data.

TABLE S1: **Mobility data for Medical professions.** Results of a basic (1) and fixed-effects (2) model, for which the dependent variable is the logarithm of the mobility from country i to country j, $\log_{10} M_{ij}$. Model-2 parameters estimated using year and source-country (i) fixed-effects. Only observations with $M_{ij} > 0$ are analyzed; see Eq. (7) for the full model specification. Estimates calculated using robust standard errors. Since World Bank data for 2013 and 2014 is not yet available for several of the variables, only observations thru 2012 are used.

	Basic model (1) Mobility, $\log_{10} M_{ij}$		Fixed-effects model (2) Mobility, $\log_{10} M_{ij}$	
Education expenditure (% of gvt. exp.), β_E	0.954***	(0.000)	2.332***	(0.000)
GDP (per cap.), β_G	0.523***	(0.000)	0.272	(0.071)
Country neighbors, β_N	0.482***	(0.000)	0.476***	(0.000)
labour force (total), β_L	0.0666***	(0.000)	0.383***	(0.000)
Urban population (% of total), β_P	-0.0759	(0.598)	0.369	(0.143)
Unemployment rate (% of labour force), β_U	-0.00779	(0.889)	-0.172	(0.052)
Researchers in R&D (per cap.), β_R	-0.121*	(0.016)	-0.438***	(0.000)
Health expenditure (% GDP), β_H	-0.294	(0.079)	-1.516***	(0.000)
Distance between capitals, β_D	-0.534***	(0.000)	-0.630***	(0.000)
$D_{1997/1998}$	-0.0811	(0.316)	-0.136*	(0.027)
$D_{1999/2000}$	(omitted)	(.)	(omitted)	(.)
$D_{2001/2002}$	-0.0554	(0.431)	-0.0119	(0.794)
$D_{2003/2004}$	0.192**	(0.004)	0.260***	(0.000)
$D_{2005/2006}$	0.187**	(0.004)	0.213**	(0.001)
D_{2007}	0.276***	(0.000)	0.309***	(0.000)
D_{2008}	0.285***	(0.000)	0.340***	(0.000)
D_{2009}	0.313***	(0.000)	0.315***	(0.000)
D_{2010}	0.389***	(0.000)	0.391***	(0.000)
D_{2011}	0.308***	(0.000)	0.326***	(0.000)
$D_{W \to W}$	0.233***	(0.000)	0.727***	(0.000)
$D_{W \to E}$	-0.229*	(0.013)	(omitted)	(.)
$D_{E \to E}$	-0.567***	(0.000)	-0.797***	(0.000)
$D_{E \to W}$	(omitted)	(.)	(omitted)	(.)
Constant	2.225***	(0.000)	2.273***	(0.000)
N	2737		2737	
adj. R^2	0.300		0.408	
F	56.71		154.3	
Prob. $>$ F	0.0000		0.0000	
df_m	21		19	
df_r	2715		29	

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE S2: **Mobility data for Science & Engineering + Technical professions.** Results of a basic (1) and fixed-effects (2) model, for which the dependent variable is the logarithm of the mobility from country i to country j, $\log_{10} M_{ij}$. Model-2 parameters estimated using year and source-country (i) fixed-effects. Only observations with $M_{ij} > 0$ are analyzed; see Eq. (7) for the full model specification. Estimates calculated using robust standard errors. Since World Bank data for 2013 and 2014 is not yet available for several of the variables, only observations thru 2012 are used.

	Basic model (1) Mobility, $\log_{10} M_{ij}$		Fixed-effects model (2) Mobility, $\log_{10} M_{ij}$	
Education expenditure (% of gvt. exp.), β_E	0.286	(0.110)	1.496***	(0.000)
GDP (per cap.), β_G	0.328***	(0.000)	0.223	(0.313)
Country neighbors, β_N	0.263***	(0.000)	0.331***	(0.001)
labour force (total), β_L	-0.0634**	(0.002)	0.137*	(0.014)
Urban population (% of total), β_P	0.876***	(0.000)	1.073*	(0.042)
Unemployment rate (% of labour force), β_U	-0.115	(0.086)	-0.232	(0.083)
Researchers in R&D (per cap.), β_R	0.00201	(0.974)	-0.236	(0.054)
Health expenditure (% GDP), β_H	-0.0359	(0.867)	-0.983**	(0.002)
Distance between capitals, β_D	-0.371***	(0.000)	-0.498***	(0.000)
$D_{1997/1998}$	-0.108	(0.289)	(omitted)	(.)
$D_{1999/2000}$	(omitted)	(.)	0.150	(0.081)
$D_{2001/2002}$	-0.0374	(0.679)	0.161	(0.057)
$D_{2003/2004}$	0.0779	(0.378)	0.291**	(0.002)
$D_{2005/2006}$	0.0616	(0.478)	0.237**	(0.007)
D_{2007}	-0.0237	(0.782)	0.151	(0.089)
D_{2008}	-0.00522	(0.951)	0.181*	(0.022)
D_{2009}	0.0597	(0.488)	0.216*	(0.023)
D_{2010}	0.0163	(0.850)	0.184*	(0.028)
D_{2011}	0.0595	(0.496)	0.213**	(0.010)
$D_{W \to W}$	0.0424	(0.478)	0.187	(0.114)
$D_{W \to E}$	(omitted)	(.)	(omitted)	(.)
$D_{E \to E}$	-0.252**	(0.001)	-0.225	(0.089)
$D_{E \to W}$	-0.210*	(0.048)	(omitted)	(.)
Constant	1.915***	(0.000)	1.988***	(0.000)
N	1692		1692	
adj. R^2	0.184		0.238	
F	19.19		29.06	
Prob. > F	0.0000		0.0000	
df_m	21		19	
df_r	1670		28	

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$