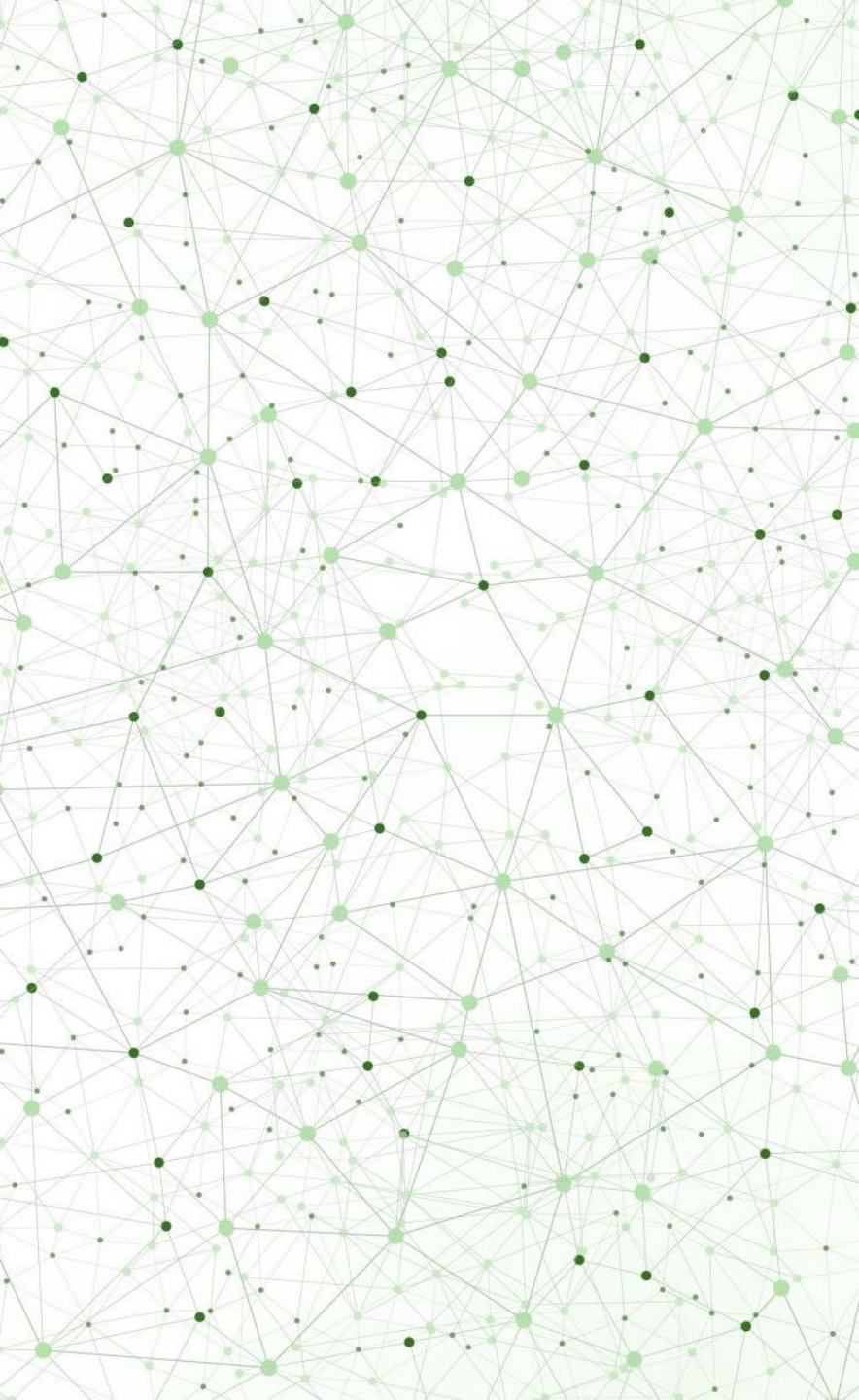




IDENTIFYING JOB SATISFACTION FACTORS ACROSS EUROPE: A MACHINE LEARNING APPROACH USING OECD PIAAC DATA

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Nordic-Baltic PIAAC Conference 2026
26–27 August 2026, Jyväskylä, Finland

Europe's Human Capital Challenges

76%

People aged 20–64 in employment in 2025

Europe's challenge is shifting from “more jobs” towards “better and more sustainable jobs”

~35%

Of workers are qualification mismatched

Skills and qualifications are not always effectively matched to jobs

33%

Workers would prefer to work fewer hours

Job quality extends beyond employment and pay.

53%

Of European SMEs find it difficult to retain skilled workers

Worker retention is already a major business challenge

In a context of high employment, persistent labour shortages and demographic challenges, understanding job satisfaction becomes economically relevant because Europe increasingly needs not only to mobilise human capital, but also to allocate, utilise and retain it effectively.

Skills
development

Skills
matching

Skills
utilisation

Job quality &
satisfaction

Retention &
performance

What makes workers satisfied with their jobs — and do the same factors matter across European labour markets?

What Explains Job Satisfaction?

No single theory captures the full set of mechanisms. Evidence points to a multidimensional explanation of the possible factors of job satisfaction and important trade-offs between them:

MATCH

Education–job and skills match matter beyond education level itself. Over-education may lower satisfaction through unmet expectations; poor match is not always compensated by higher pay.

Lee & Sabharwal, 2016; Verhofstadt et al., 2007

CONTENT, AUTONOMY & FLEXIBILITY

Autonomy repeatedly emerges as a strong correlate of satisfaction and can dominate income effects in empirical models. Higher FWAs were positively correlated with job satisfaction

Nguyen, Taylor & Bradley, 2003; Mostafa & Jaafar, 2024
Harrop et al. 2026

COMPENSATION

Absolute and relative earnings matter, but comparison income effects may be modest and depend on sector, job type and non-monetary attributes.

Nguyen et al., 2003; Lee & Sabharwal, 2016

DEVELOPMENT

Training and professional developmentt, and promotional opportunities are associated with achievement, growth and higher satisfaction.

Bindhu et al., 2024

EMPLOYMENT CONTEXT

Firm policies, firm size and sector can condition how individual factors translate into satisfaction.

Artz, 2008; Lee & Sabharwal, 2016

INDIVIDUAL & DISPOSITIONAL HETEROGENEITY

Social and emotional skills matter for job satisfaction at least as much as literacy skills. Openness is positively associated with job satisfaction in Latvia and Poland.

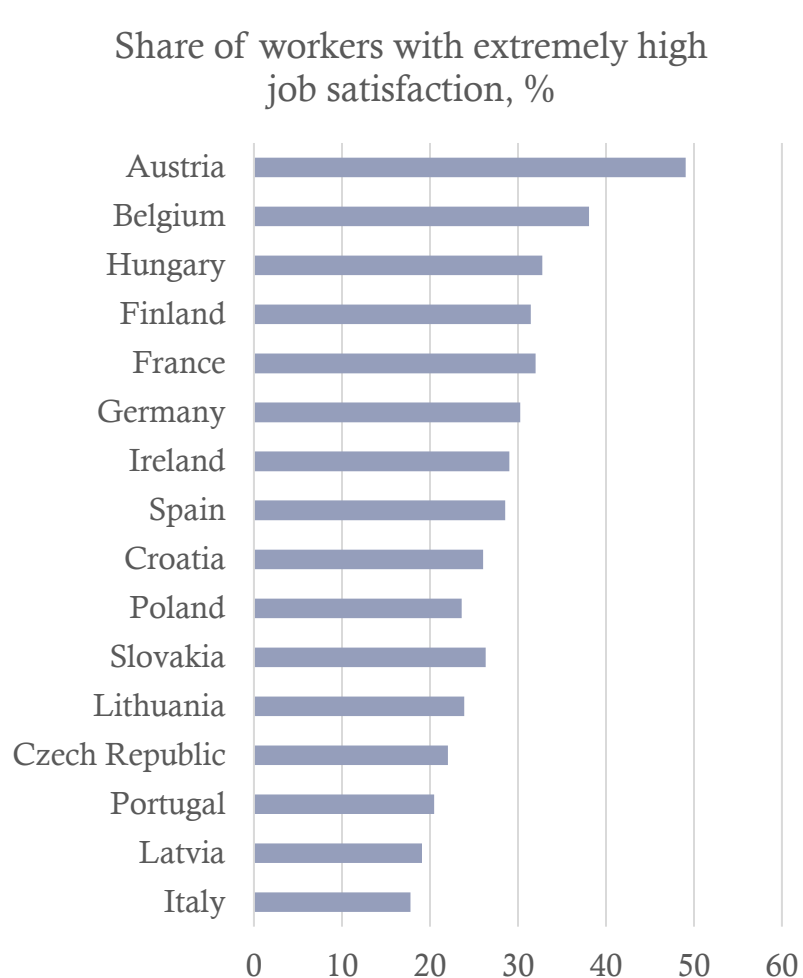
OECD, 2025

Implication: job satisfaction should be modelled as the outcome of interacting human-capital, job, organisational and individual factors. This motivates to apply flexible models that can capture non-linearities and interactions.

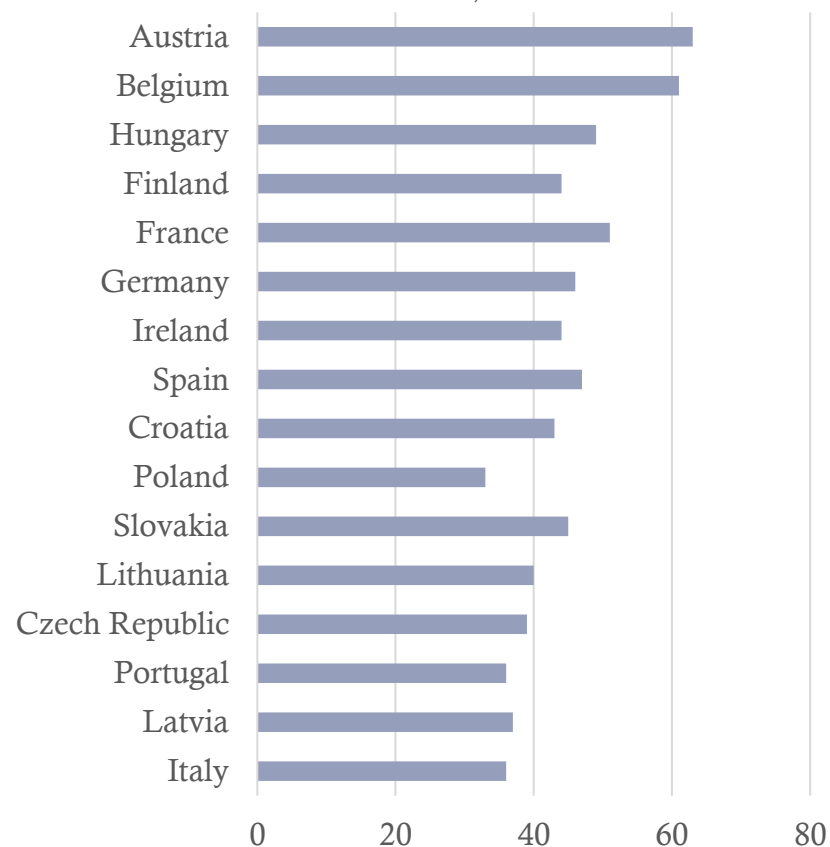
PIAAC variables grouped according to the analytical framework

0	SATISFACTION	• Job satisfaction	• 1 – Extremely satisfied; 0 – Other	• d2_q13
1	MATCH	• Field mismatch • Education-level mismatch • Self-reported skills mismatch	• 1 – Match between occupations and education field defined by the OECD; 0 – Other. • 1 – Underqualified; 2 – Match; 3 – Overqualified. • 1 – Skills higher then required; 2 – Match; 3 – Lower.	• edfield, isco2c • edcat6, d2_q12a • h2_q19a
2	DEVELOPMENT	• Training participation • Training usefulness • Changed position/tasks	• 1 – Participation in training – YES; 0 – No. • 1 – Very useful; 0 – other. • 1 – Yes; 0 – No. (Moved to a different position or changed tasks or new unit)	• b2_q08a • b2_q17 • d2_q06a, d2_q06b, d2_q06c
3	JOB CONTENT AUTONOMY & FLEXIBILITY	• Computer • Physical work • Flexibility • Tight deadlines • Supervision	• 1 – Create / Edit e-doc every day and at least once a week – software; 0 – Other. • 1 – Working physically for long period every day. • 1 – To a very high extent can choose working h, speed and how to. • 1 – More than half of the time work with tight deadlines; 0 – Other. • 1 – You are supervising others; 0 – No.	• f2_q05d, f2_q05e • h2_q07a • h2_q08a, h2_q08b, h2_q08d • h2_q12 • d2_q09a
4	COMPENSATION & EMPLOYMENT CONTEXT	• Wage-income decile • Relative earnings vs similar occupation /industry • Firm size	• 10 groups • 9 groups • 7 groups	• earnhrbonus2 • earnhrbonus2 • d2_q07a
5	INDIVIDUAL & DISPOSITIONAL HETEROGENEITY	• Health • Partner • Children • Age • Gender • Big Five traits	• 5 groups (self assessment) • 1 – Yes, 0 – Other. • 1 – Has kids, 0 – Other; 1 – Child age below 7, 0 – Other. • 10 years interval • 1 – Male, 2 – Female • Emotional stability, agreeableness, consciousness, extraversion, open mindedness	• i2_q03 • j2_q02a • j2_q03a, j2_q03d1 • age10lfs • gender_r • remos, agre, cons, extr, opem

Job satisfaction



Share of people from those with extremely high job satisfaction who are also showing very high life satisfaction, %



- The share of workers with extremely high job satisfaction vary between 18% in Italy to 49% in Austria.
- To avoid multicollinearity we do not include life satisfaction into set of explanatory variables, since many explanatory variables affect both job and life satisfaction. And the share of people who are very satisfied with job and life at the same time is very high.

Research Gap and Contribution

WHAT WE KNOW

Job satisfaction is associated with:

- pay and relative pay
- intrinsic job characteristics
- person–job fit
- qualification / skills mismatch
- personality
- workplace characteristics

THE GAP

Do the same factors have the same relative importance across European countries?

Cross-country heterogeneity may involve non-linearities and interactions that are difficult to pre-specify.

OUR CONTRIBUTION

PIAAC + tree-based ML

Boosted Forest

- capture non-linear relationships
- accommodate complex interactions
- rank relative predictive importance
- apply a harmonised framework country by country

Research questions

- RQ1 What are the most important predictors?**
RQ2 How does importance vary across countries?
RQ3 Which factors are consistently important?

Boosted forest

Classification problem: 1 – extreme job satisfaction; 0 - otherwise

Sample restrictions: employed or self-employed

Subgroup of countries including all variables: Italy, Spain, Latvia, Poland, Czech Republic

Restricted access variables: compensation, education field and level mismatch, age of children, year of starting work for current employer

Larger set of countries (excluding restricted access variables): Italy, Latvia, Portugal, Czech Republic, Lithuania, Slovakia, Poland, Croatia, Spain, Ireland, Germany, France, Finland, Hungary, Belgium, Austria

Model tuning:

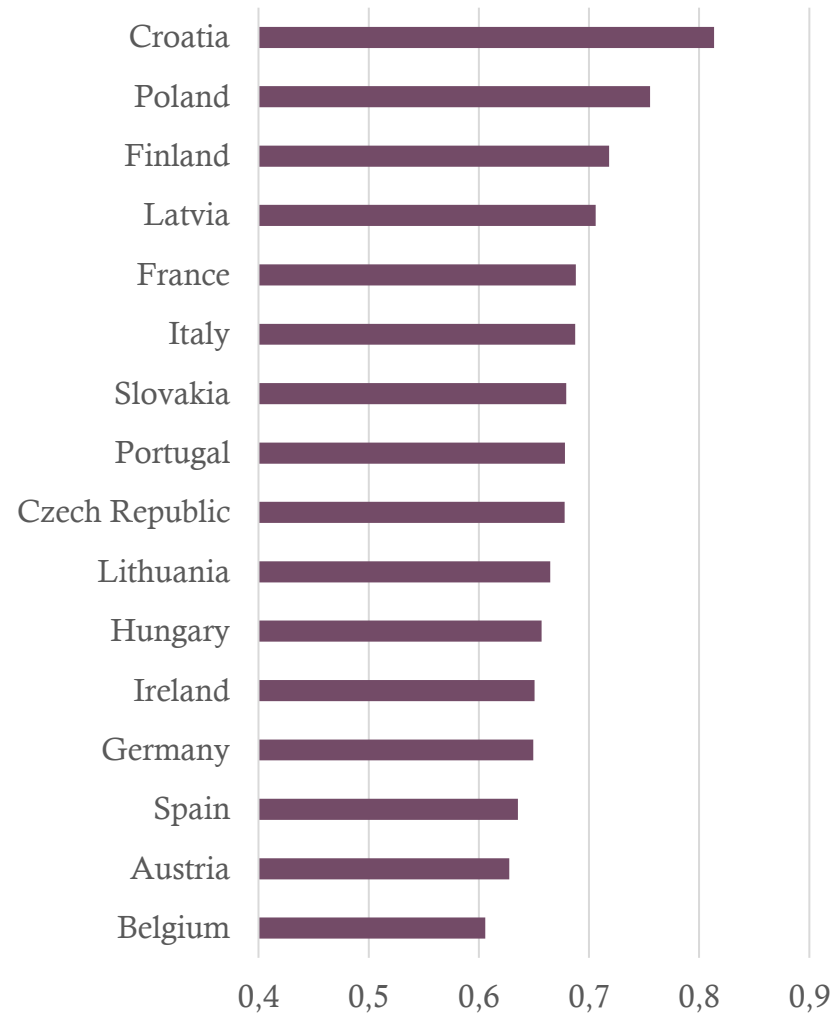
Training sample: 80% of the original data is used for model development. Within that 80%, the data are split into 5 folds.

Tuning parameters: number of trees, maximum tree depth, minimum node size, learning rate, loss reduction parameter (gamma), and row subsampling proportion.

The optimal parameter specification was selected according to the highest mean cross-validated ROC-AUC (ability of the model to distinguish satisfied from dissatisfied workers across all possible classification thresholds).

After tuning, the model was re-estimated using the full training sample and evaluated on an independent 20% test sample.

Goodness of model fit



ROC-AUC measures the probability that a randomly selected satisfied worker receives a higher predicted probability than a randomly selected other less satisfied worker.

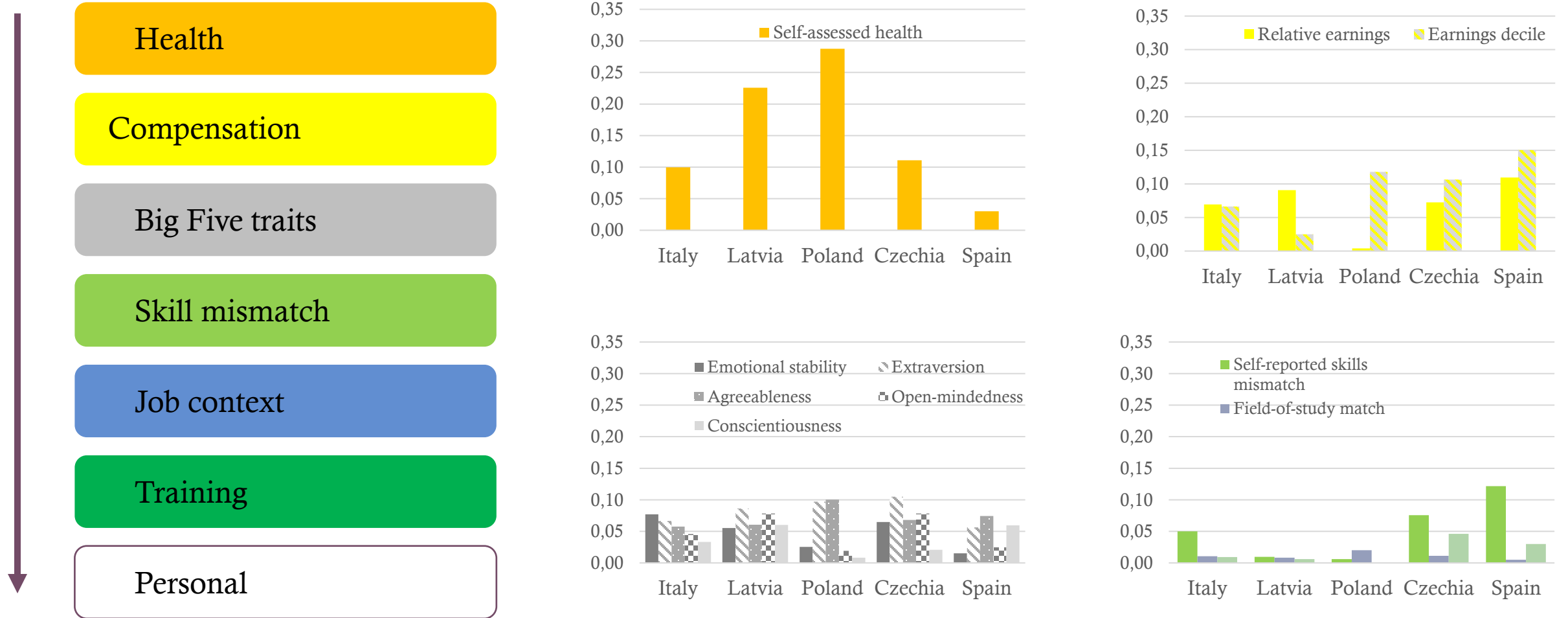
A value of:

0.50 corresponds to random guessing;
0.60–0.69 indicates acceptable discrimination;
0.70+ indicates good discrimination.

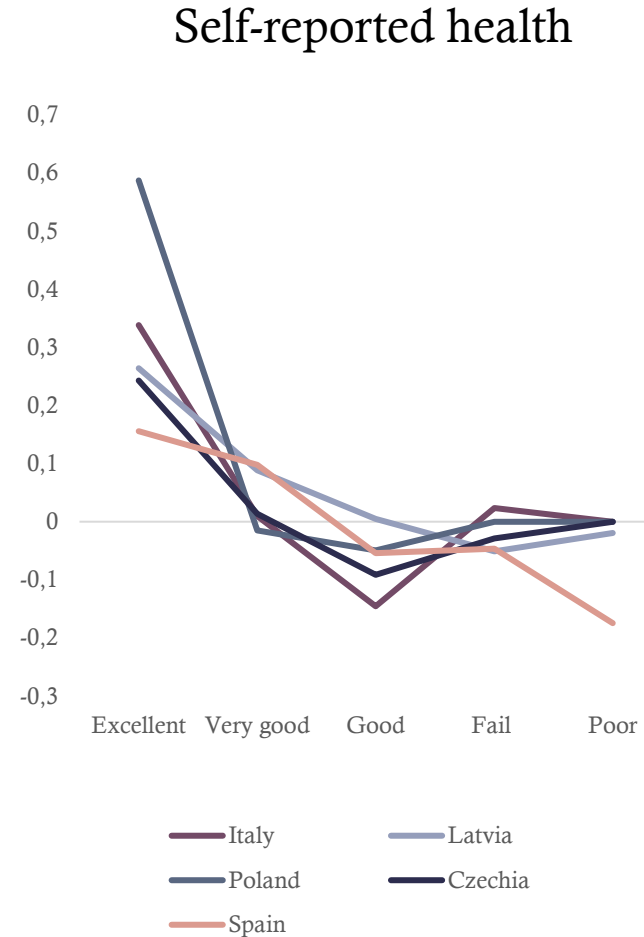
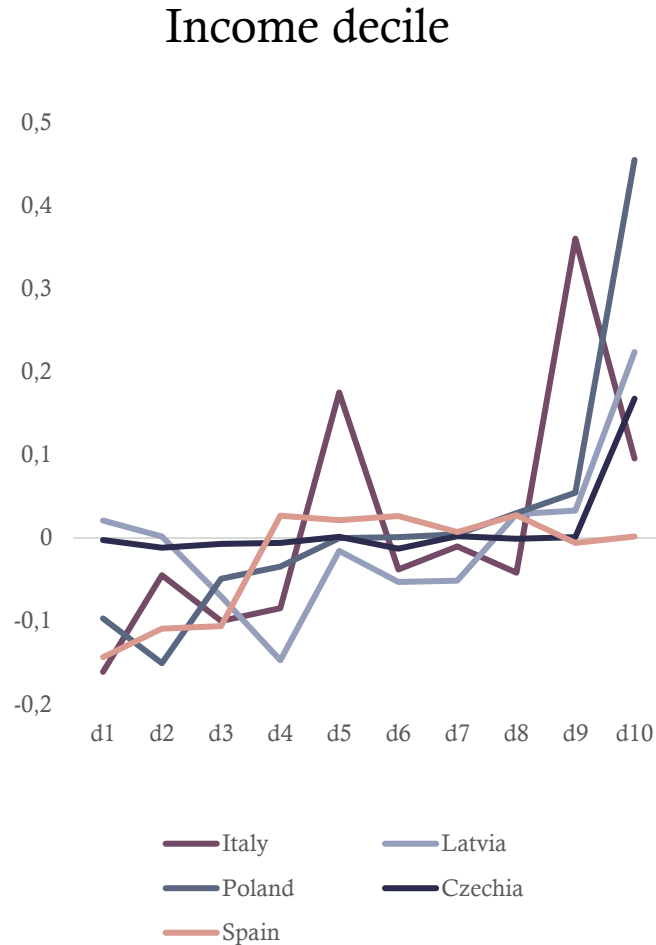
All country models show acceptable performance.

Results – 5 countries (full set of explanatory variables)

Relative mean absolute SHAP importance ranking of factors to predict extreme job satisfaction



The role of income and health in job satisfaction



SHAP values

- Higher income level and excellent health is associated with higher probability to report extreme satisfaction with job.

Results – 16 countries (smaller set of explanatory variables)

Relative mean absolute SHAP values

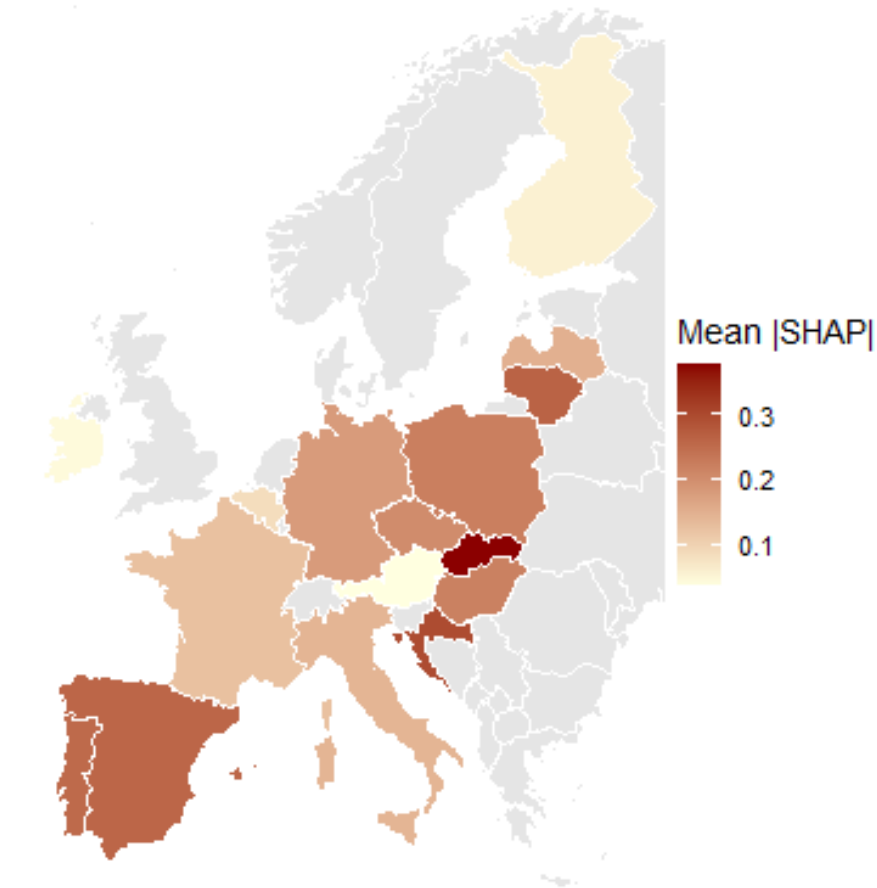
5 countries		16 countries	
Self-assessed health	0.15	Self-assessed health	0.18
Earnings decile	0.09	Emotional stability	0.09
Extraversion	0.08	Work autonomy/flexibility	0.09
Agreeableness	0.07	Extraversion	0.09
Relative earnings	0.07	Agreeableness	0.08
Work autonomy/flexibility	0.05	Conscientiousness	0.06
Self-reported skills mismatch	0.05	Firm size	0.06
Open-mindedness	0.05	Open-mindedness	0.04
Emotional stability	0.05	Age	0.03
Usefulness of training	0.04	Usefulness of training	0.03
Conscientiousness	0.04	Self-reported skills mismatch	0.03
Age	0.03	Tight deadlines	0.03
Manual tasks	0.03	Change in position/tasks	0.03
Partner	0.02	Manual tasks	0.03
Firm size	0.02	Managerial responsibility	0.02
Repetitive tasks	0.02	Repetitive tasks	0.02
Education level mismatch	0.02	Partner	0.02
Has children	0.02	Has children	0.02
Managerial responsibility	0.02	Computer tasks	0.02
Change in position/tasks	0.01	Gender	0.01
Participation in training	0.01	Participation in training	0.01
Tight deadlines	0.01		
Gender	0.01		
Computer tasks	0.01		
Field-of-study match	0.01		
Child below age 7	0.00		

- Relative position of factors remain similar even using a smaller set of variables (available for all countries).
- Health remains the strongest predictor. People with excellent health often report extreme job satisfaction.
- Higher work autonomy/flexibility is associated with high job satisfaction.
- Self-reported skill mismatch is a strong indicator of being less satisfied with job.
- Participation in training is not as important for job satisfaction as usefulness of training.

Heterogeneity of factor importance: health

Self-assessed health

Relative mean absolute SHAP importance



- Health remains the strongest predictor overall, but its importance varies substantially across countries.

- Health is particularly important in **Hungary and Portugal**, while its predictive importance is considerably lower in **Finland and Ireland**.

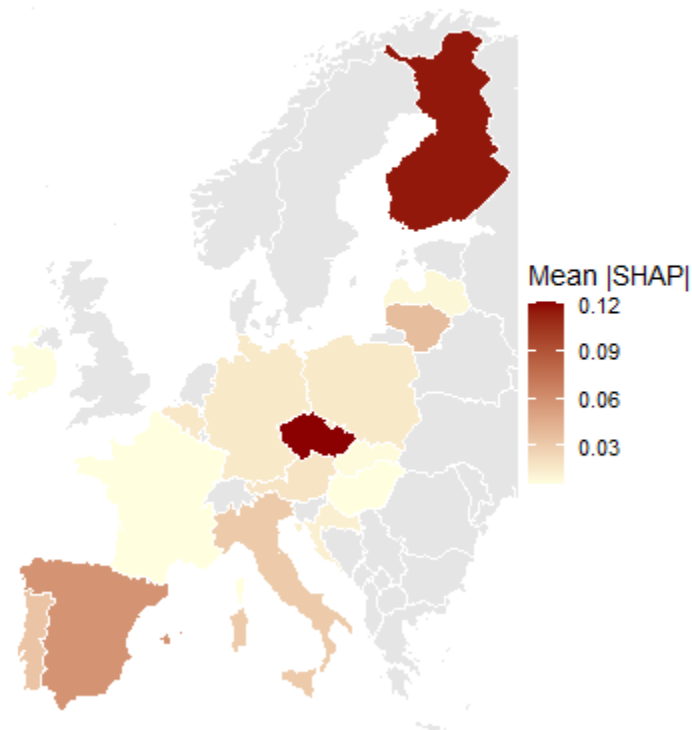
- The map shows the importance of health for prediction, not the direction of its effect.

- Excellent health contributes strongly to extreme job satisfaction, while differences between other health categories are much smaller.

- Even the strongest predictor is context-dependent — country-level analysis reveals heterogeneity hidden by European averages.

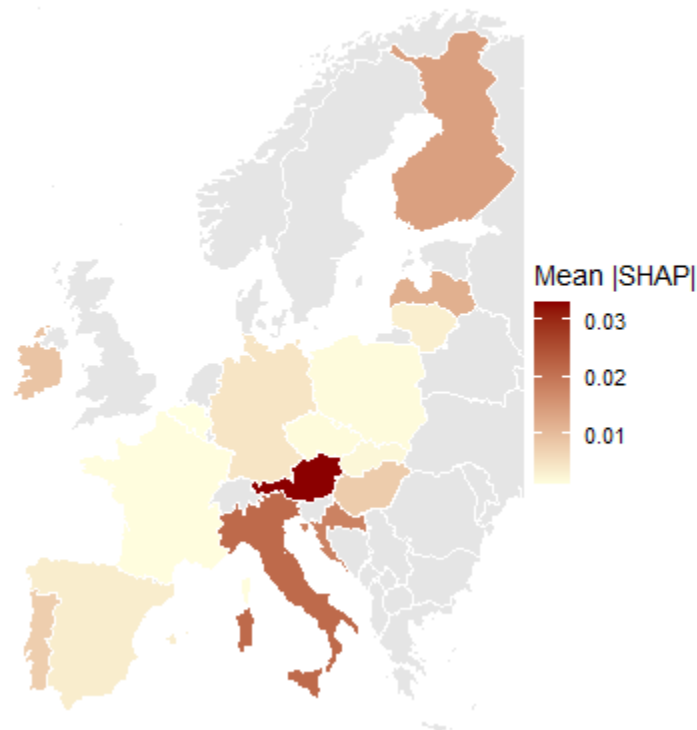
Heterogeneity of factor importance: skills match and training

Self-reported skills mismatch
Relative mean absolute SHAP importance



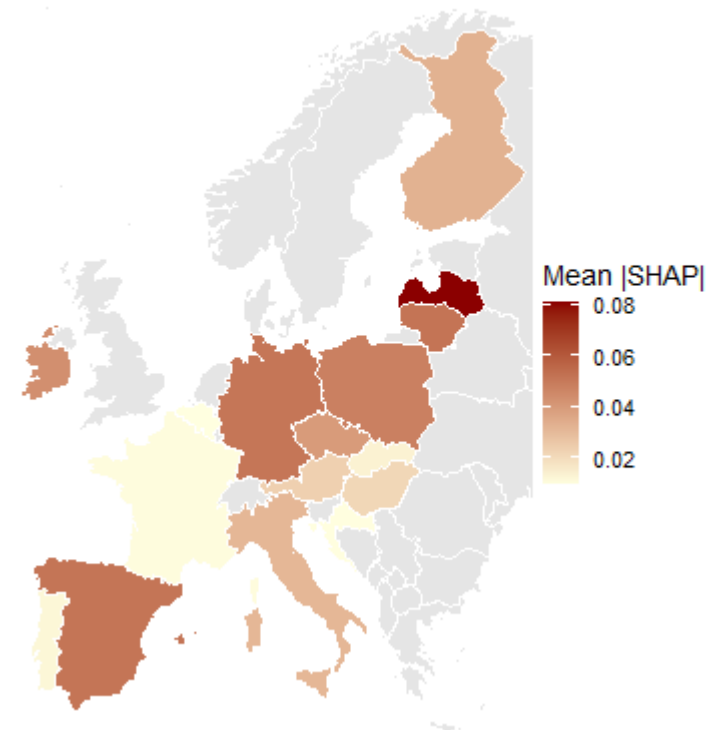
Self-reported skills mismatch is particularly important in **Finland** and **Czechia**, but much less important in several other countries.

Participation in training
Relative mean absolute SHAP importance



Participation in training is particularly important in **Austria**, **Croatia** and **Italy**, while its predictive importance remains relatively low across most other countries

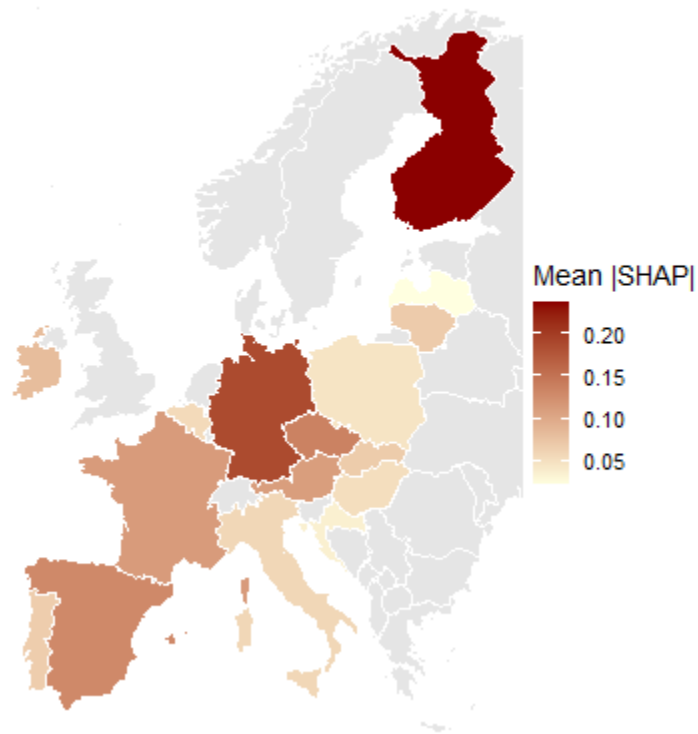
Usefulness of training
Relative mean absolute SHAP importance



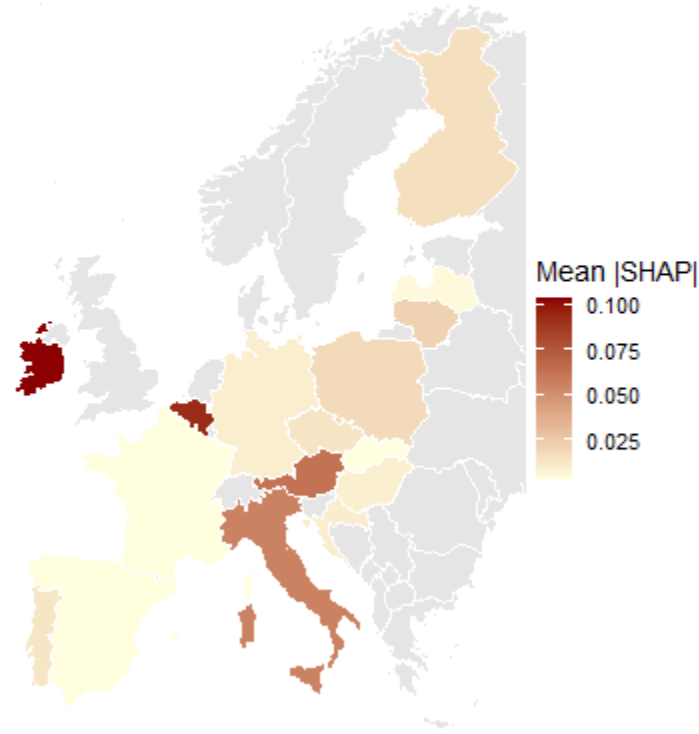
The usefulness of training matters considerably more than participation itself, particularly in **Latvia** and several **Central European** countries.

Heterogeneity of factor importance: work related factors

Work autonomy/flexibility
Relative mean absolute SHAP importance



Change in position/tasks
Relative mean absolute SHAP importance



- Work autonomy/flexibility is particularly important in **Finland** and **Germany**, and relatively important in several Western and Central European countries.

- Changes in position/tasks are particularly important in **Ireland** and **Belgium**, with some relevance in Southern and Central Europe.

- Overall, day-to-day work organisation appears more important for job satisfaction than changes in workers' roles or tasks.

Data: PIAAC, N=11 292

* - Relative mean absolute SHAP importance is adjusted so that sum is equal to 1 for each country and can be compared between countries

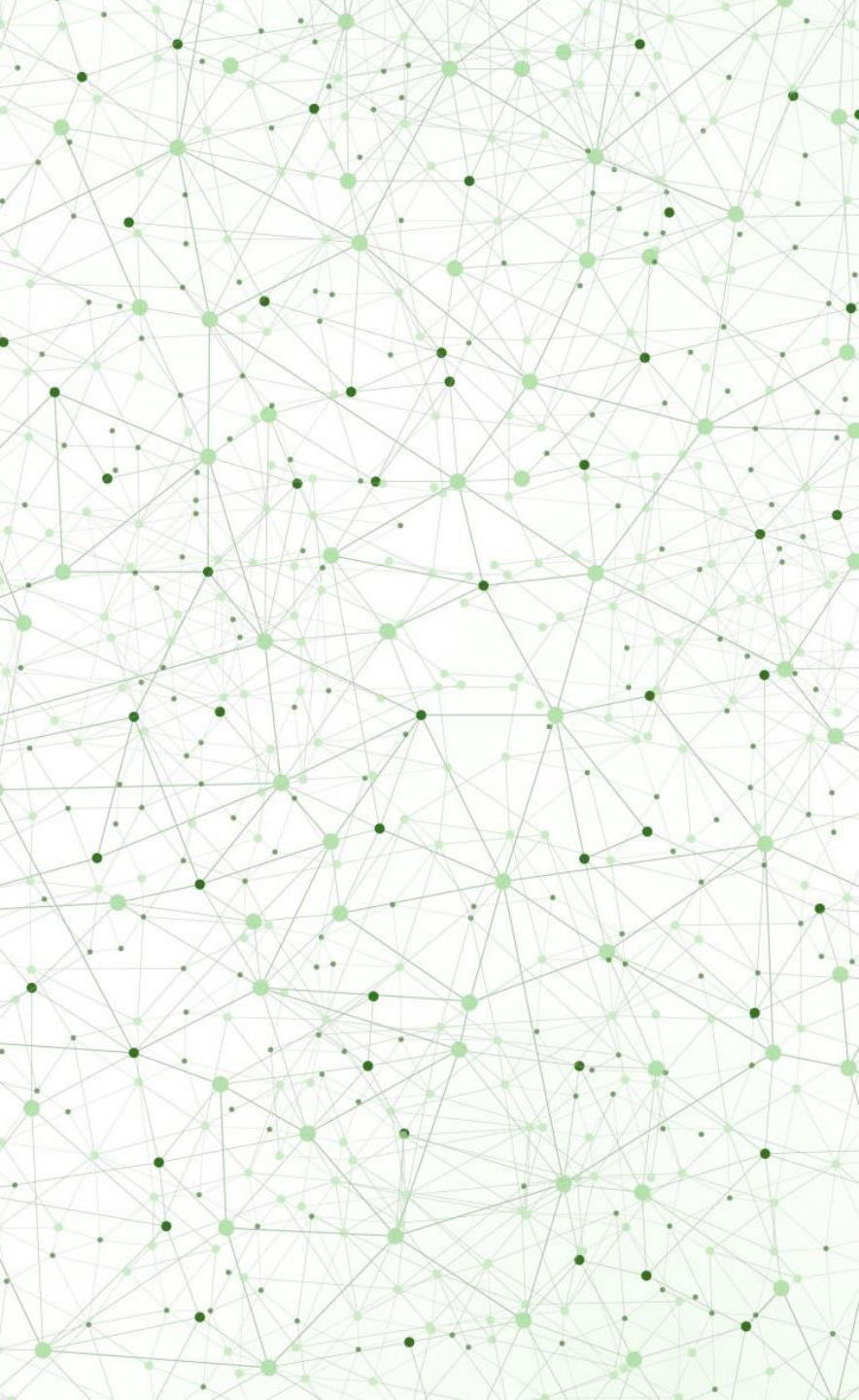
Conclusions & Future steps

Conclusions:

1. No single factor explains extreme job satisfaction. Health, personality, job characteristics, skills match, and compensation all contribute to prediction. However, the relative importance of predictors varies substantially across countries.
2. Self-assessed health is the strongest overall predictor, with excellent health particularly distinguishing workers with extreme job satisfaction.
3. Work content, autonomy and flexibility emerge among the strongest job-related predictors.
4. Perceived skills mismatch is more informative than formal education–job mismatch in the broader country analysis.
5. For training, usefulness matters more than participation itself.
6. SHAP patterns show that average importance can hide important differences within variables. For example, excellent health stands out, rather than there being a simple health gradient.
7. The findings point towards the importance of job quality, autonomy, skills utilisation and meaningful development opportunities alongside pay and formal qualifications.
8. Therefore, policies aimed at labour supply and skills should increasingly consider the conditions under which people are willing and able to remain in their jobs.

Future steps:

1. Try different explanatory variable specification – use maximum available groups without re-working them into binary variables.
 2. Compare random and boosted forest results.
 3. Clarify if income variables are available for research purposes from wider set of countries.
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THANK YOU!

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Why Job Satisfaction Matters

RETENTION

Poor job attitudes and dissatisfaction translate into withdrawal from work – lower performance, lateness, absence and turnover.

Harrison, Newman & Roth, 2006

PERFORMANCE

A clear, positive and statistically-significant relationship between the average level of job satisfaction at the workplace and workplace performance. +12% productivity.

Bryson, Forth & Stokes, 2017
Oswald, Proto & Sgroi, 2015

PERSON-JOB FIT

Fit is systematically related to work attitudes, performance, withdrawal behaviour and tenure.

Kristof-Brown et al., 2005

MISMATCH

PIAAC literature links qualification and skills mismatch with lower wages and lower job satisfaction.

OECD, 2024

Job satisfaction links employees' subjective experiences with outcomes that are important to individuals, companies, and labor markets.
