Assessing cross-border impacts of gas infrastructure investment expenditure across Europe with MRIO

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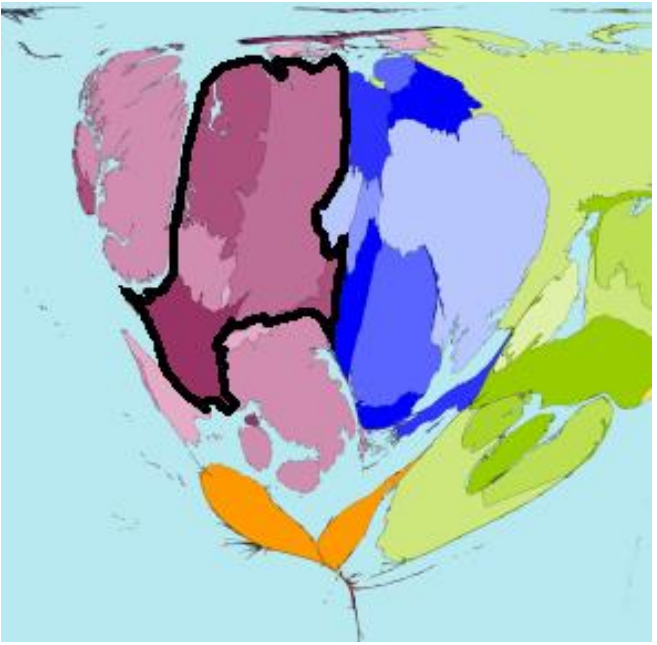
Research question and motivation

- Research question
  - What is the extent and distribution of cross-border spill-overs of gas infrastructure investment expenditure?
- Motivation
  - At the moment an EU-wide cost-benefit methodology is developed to assess gas infrastructure impacts.
  - Investment plans need to be assessed in an international setting.
  - Cross-border spill-over effects are expected to be an important dimension of large-scale investment projects.

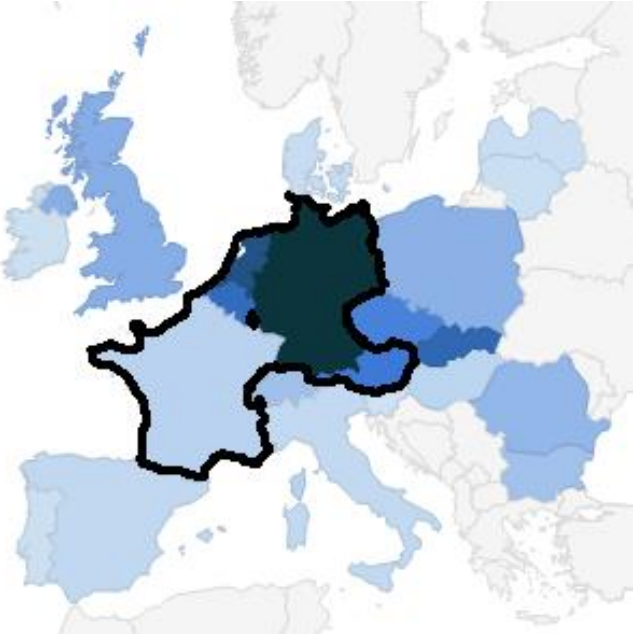
EU gas consumption



Source: www.worldmapper.org;
BP statistical review of world energy

entry capacity

exit capacity



Legend: Dark(er): high(er) capacity, light(er): low(er) capacity
Source: ENTSOG cross-border transmission capacity (among EU, excl. LNG)

Methodology: multi-regional input-output model

- Standard input-output model $\mathbf{x} = \mathbf{Ax} + \mathbf{f}$,
  - $\mathbf{x}$ is a vector of outputs related to *R* regions and *I* industries
  - $\mathbf{A}$ is a matrix of input coefficients representing how much of each input is required to produce one unit of output
  - $\mathbf{f}$ is a vector of final demand
- Solve for $\mathbf{x}$: $\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}$
- The matrix $(\mathbf{I} - \mathbf{A})^{-1}$ represents, for each pair of industries *i* and *j*, how much additional output (direct and indirect) of *i* is required to produce one unit of output of industry *j*.
- A multi-regional model represent multiple countries
  - An element of A is in this case characterized by four dimensions: industry *i* and industry *j*, and country of origin *r* and country of destination *s.*
  - includes all international indirect effects

Methodology: impact analysis

- Define an impact vector $\mathbf{c}$ which represents gas infrastructure investment
  - assume all investment is in the country under consideration
- Translate additional output to value added impact and employment impact
  - Define value added coefficients: employment compensation ($\mathbf{w}$) and operating profits ($\mathbf{v}$)
  - Define employment coefficients: hours of employment required per unit of output
- Calculate impacts, for example: $w = \mathbf{w}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{c}$
- For different vectors $\mathbf{c}$, the distribution of the impacts on value added and employment is analyzed

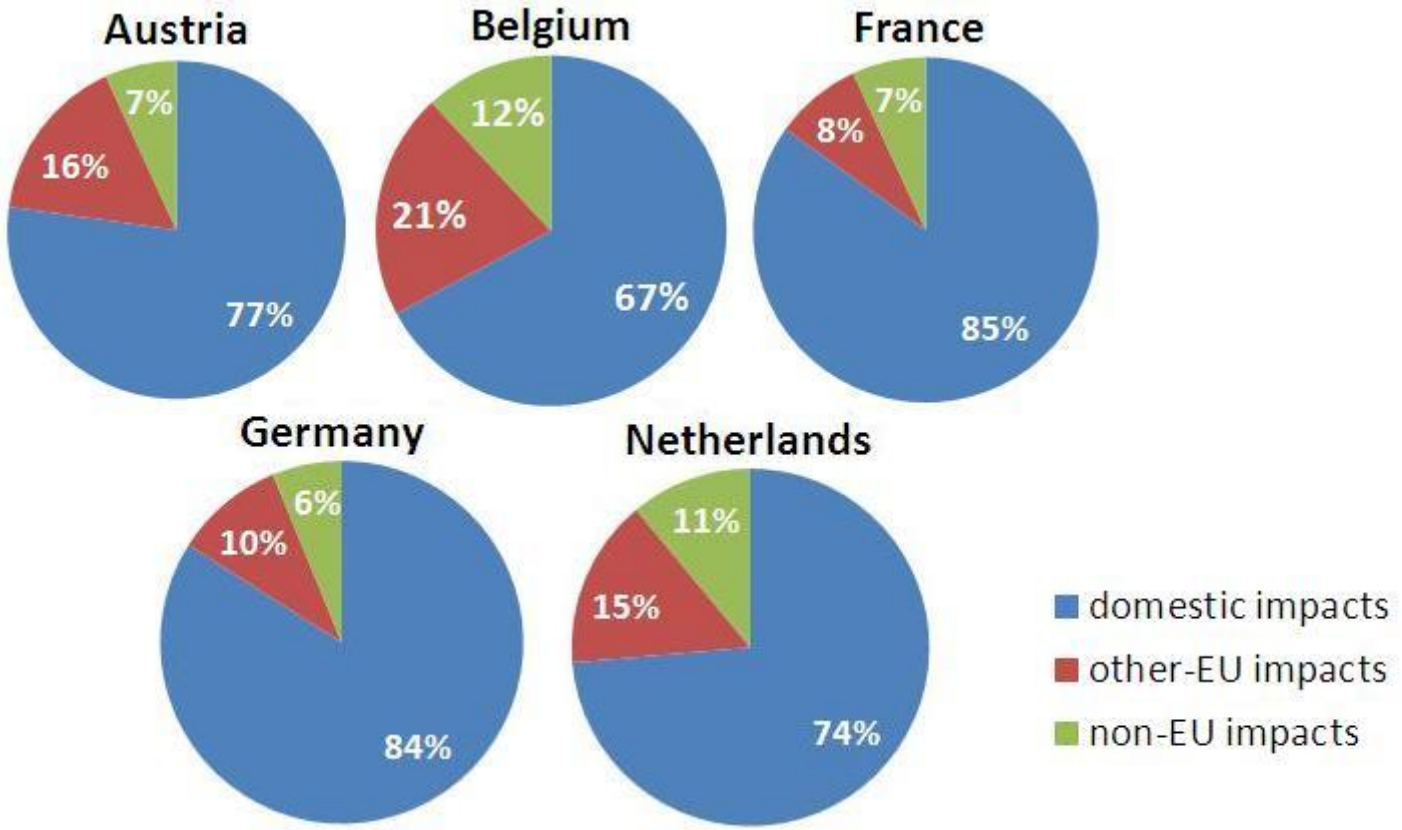
Data: MRIO table and investments

- Multi-regional input-output table (EXIOPOL database)
  - Year: 2000, 43 countries + RoW, 129 sectors
  - Value added matrices distinguishing between employment compensation and operating surplus
  - Satellite accounts on hours of employment
- Investment expenditure by country and sector
  - Based on Ten Year Network Development Plans
  - Estimate investment expenditure using a mix of sources

Estimating investment data: main steps

- Assign TYNDP projects to countries
- Estimating unit cost per type of investment
  - Pipelines (unit: kilometer): a linear relationship between diameter and unit cost has been estimated from a set of unit cost estimates
  - Compression power (unit: MWh): simple average of two unit cost estimates
  - LNG (unit: storage capacity): estimates based on investment numbers
  - Underground storage (unit: working volume): differentiate between salt cavern and depleted gas field
- Calculate total investment cost per country
- Allocate investment values to the supplying industries
  - I.e. materials, equipment, construction, real estate etc.
  - Assume all expenditure is in sectors in the country under consideration

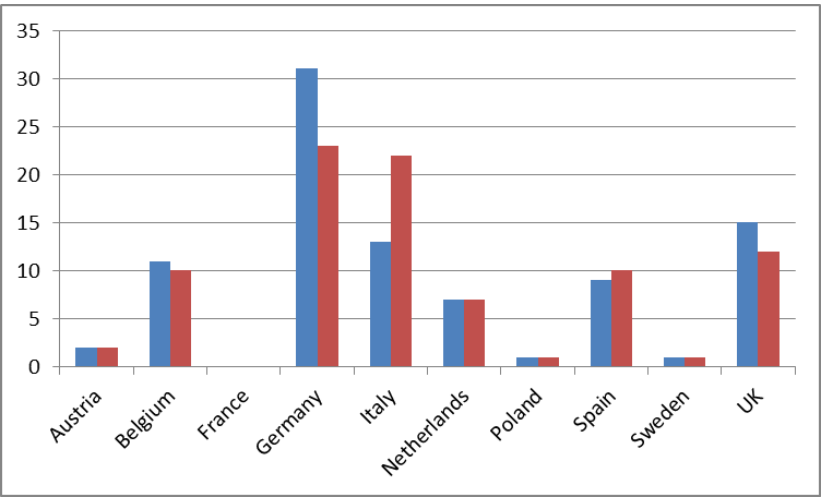
Results I: shares of value added impacts



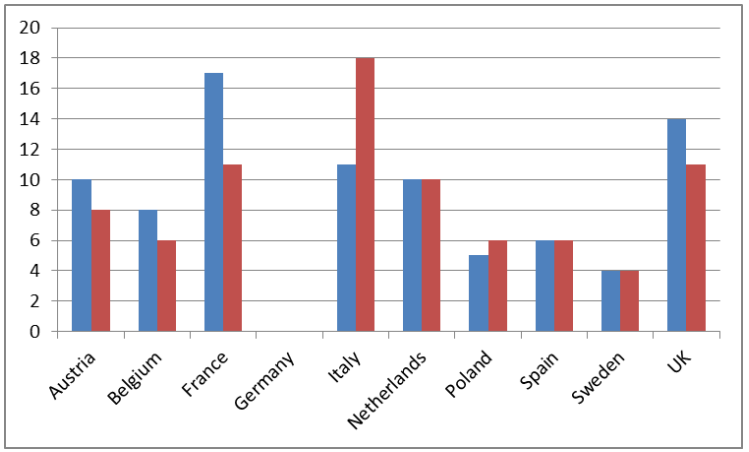
Results II: value added spill-overs

Cross-border value added spill-overs by country where they are generated as percentages of total cross-border value added spill-overs due to investment in:

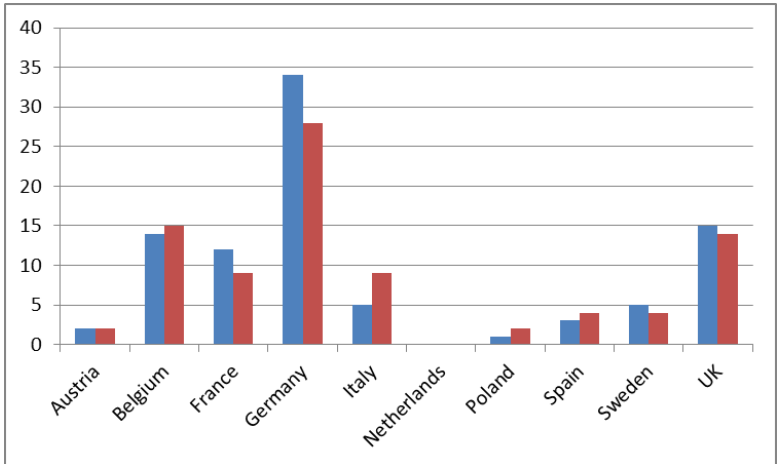
France



Germany



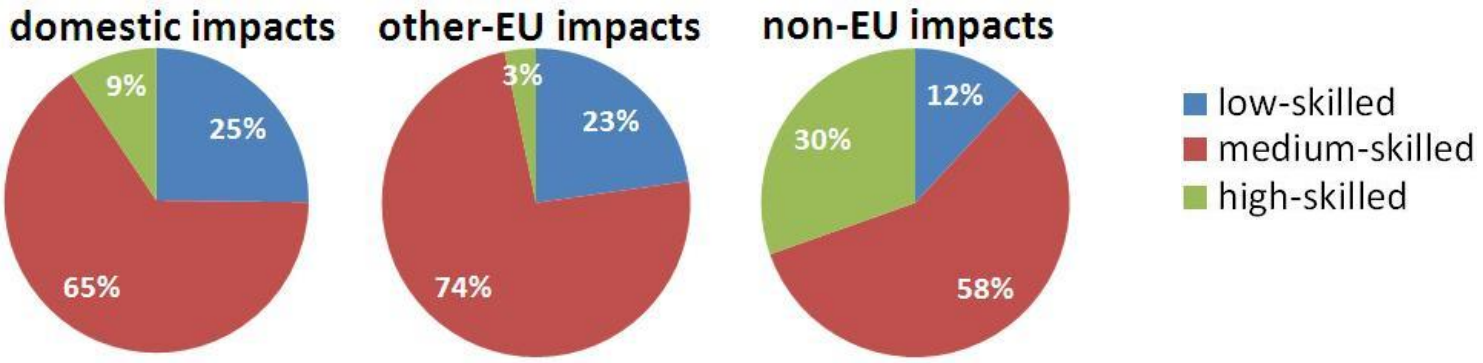
Netherlands



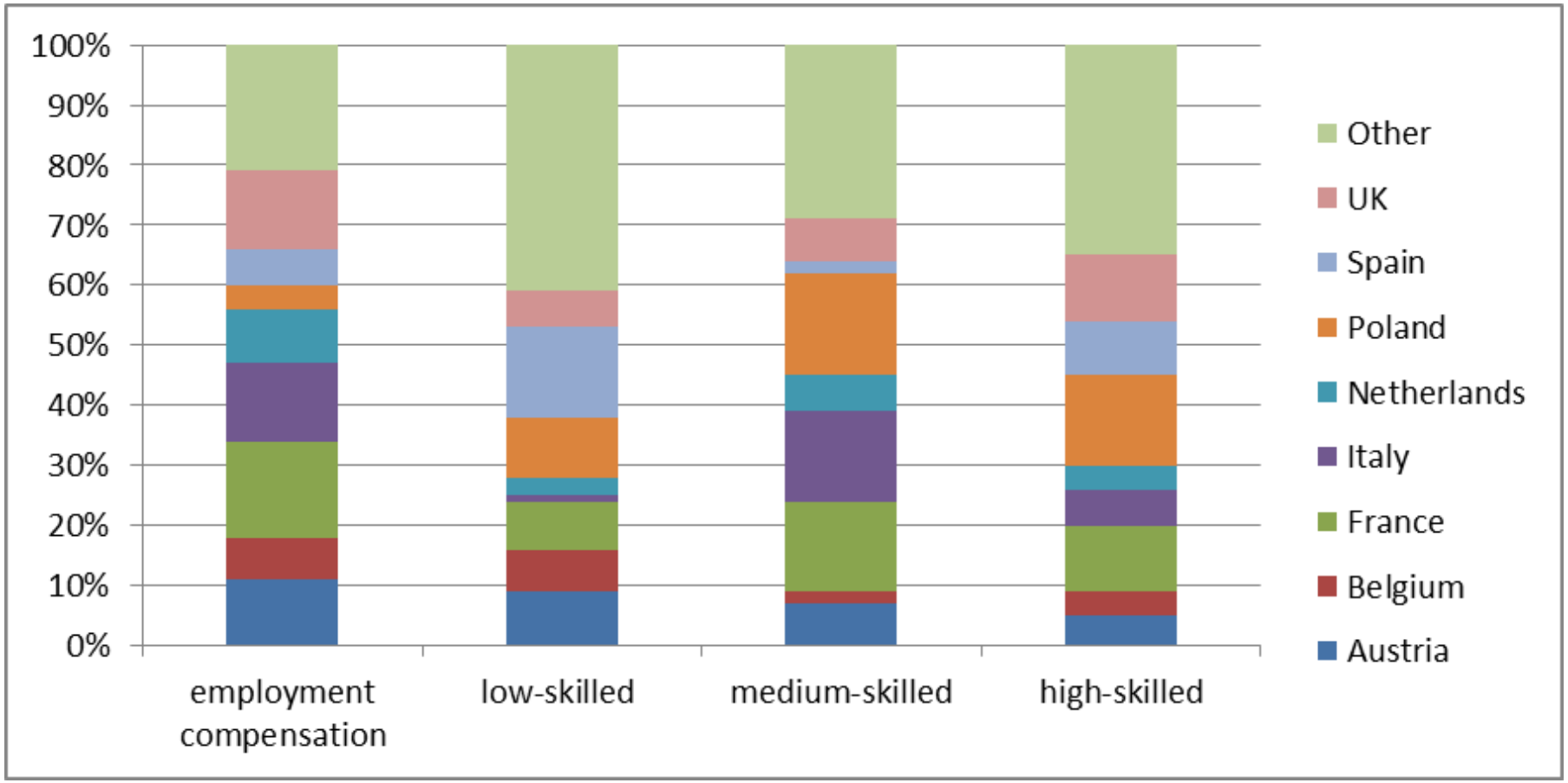
Results III: employment impacts

	employment compensation			employment hours		
	domestic	other EU	non-EU	domestic	other EU	non-EU
Austria	**79%**	**15%**	**5%**	**77%**	**21%**	**2%**
Belgium	**69%**	**21%**	**10%**	**66%**	**27%**	**7%**
France	**86%**	**9%**	**5%**	**85%**	**13%**	**2%**
Germany	**87%**	**7%**	**5%**	**86%**	**12%**	**2%**
Netherlands	**77%**	**14%**	**8%**	**79%**	**17%**	**4%**
Total	**85%**	**9%**	**5%**	**84%**	**13%**	**3%**

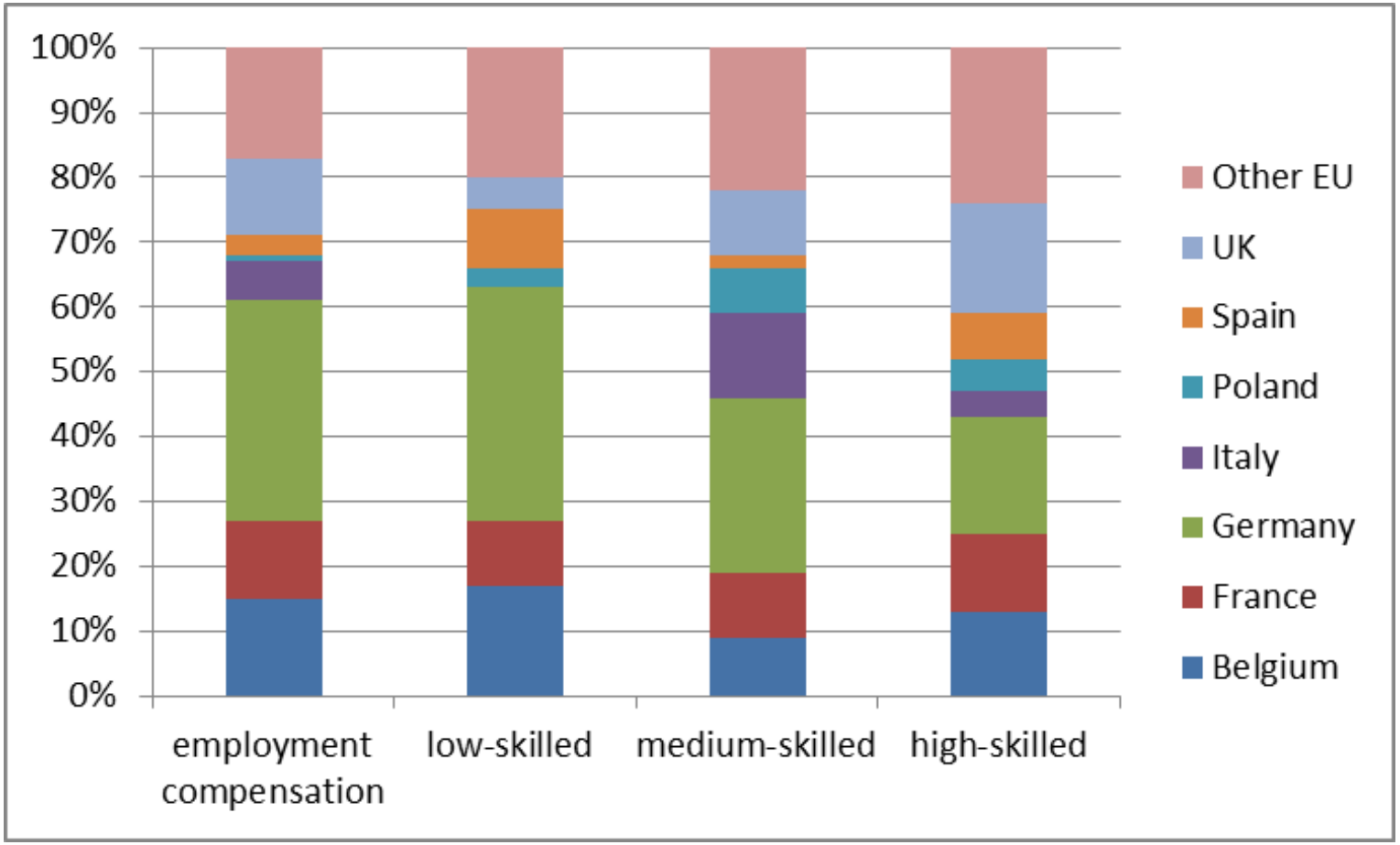
employment hours



Results IV: other-EU impacts in more detail: German spill-overs by country impacted



Results IV: other-EU impacts in more detail: Dutch spill-overs by country impacted



Discussion and conclusion

- Economy-wide impacts of investment, and cross-border spill-overs can conveniently be calculated within an MRIO framework
- We have shown that the cross-border spill-overs are sizeable, and that the distribution of the effects differs depending on the country where the investment takes place.
- Cross-border spill-over impacts should be included in a methodology that covers projects of EU-wide importance

Thank you

Comments, questions, ideas?

Nederlands

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English

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