Location Matters:
A spatial econometric analysis of post-crisis economic growth in EU regions

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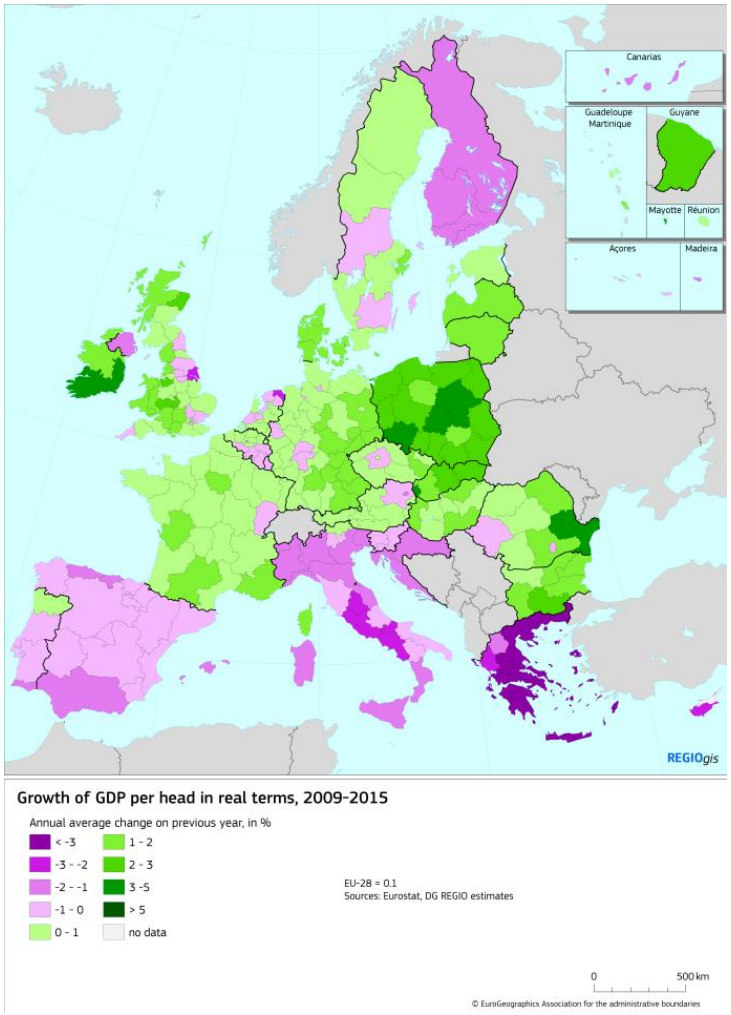
Purpose

Examining growth process in EU regions (NUTS2 and FUAs) by taking into account spatial heterogeneity and spatial dependence:

- Focus on post-crisis growth (2009-2015) to identify characteristics of resilient regions
- Empirical assessment of cross-regional spillovers
- Are there different spatial regimes?
  - If so: differentiated assessment of impacts (direct and indirect effects) for the different spatial regimes



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Our starting point

- Literature on club convergence (i.e. Durlauf and Johnson, 1995):
  - Presence of multiple, locally stable, steady state equilibria. When convergence clubs exist, one convergence equation should be estimated per club, corresponding to different regimes.

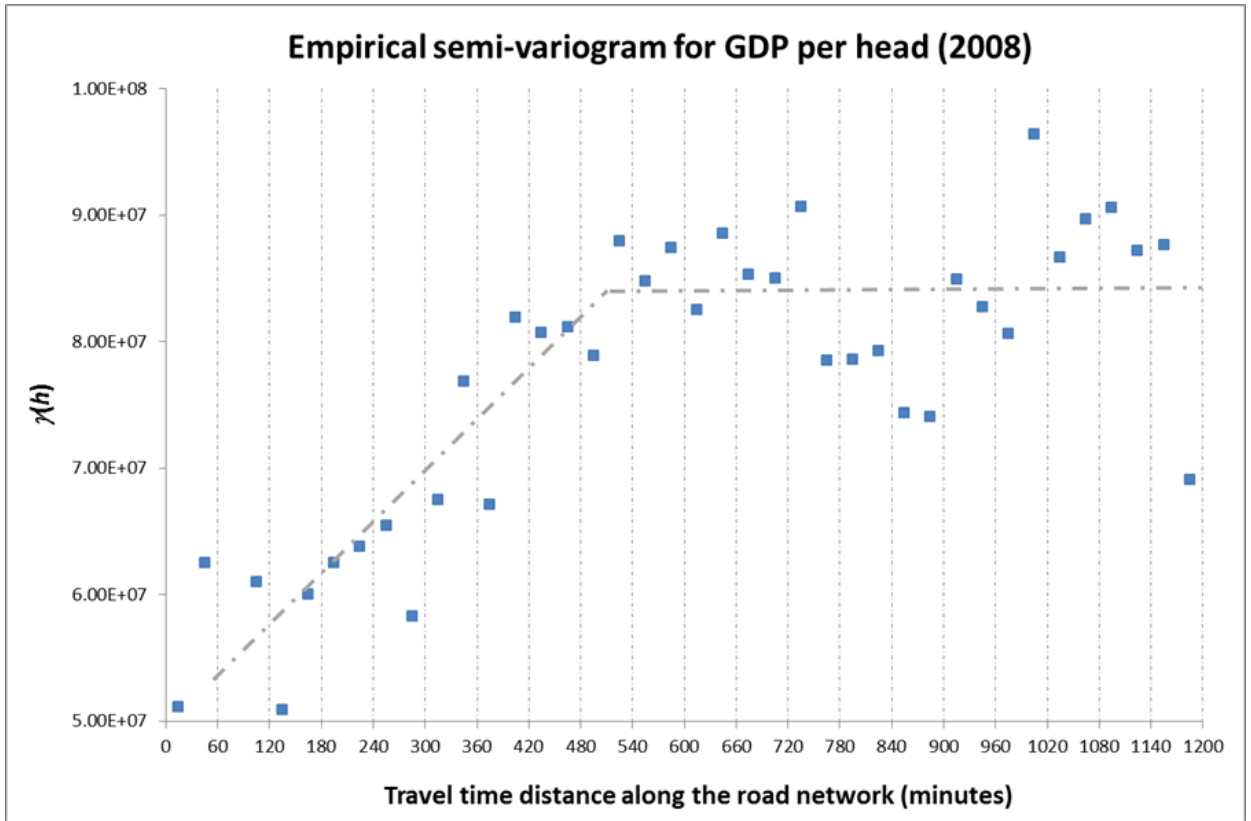
- Structural instability across spatial convergence clubs (i.e. Ertur et al., 2006 and Le Gallo and dall'Erba, 2006):
  - In both papers the authors show that the convergence process among EU regions is different across high and low income spatial regimes.

- Relevance of spatial spillovers across EU regions (i.e. Özyurt and Dess, 2015):
  - **A**nalyse economic performance across EU regions (2001-2008) and confirm the relevance of spatial spillovers, whereby strong indirect effects reinforce direct effects. They also find differences in the spillovers calculated over the whole sample of EU regions and regions in the Euro area.

Identification of spatial regimes – step 1

Choice of the *spatial weight matrix:*

- Travel time along the road/ferry network + variogram analysis on the initial GDP (2008) to identify the cut-off distance (500 minutes)



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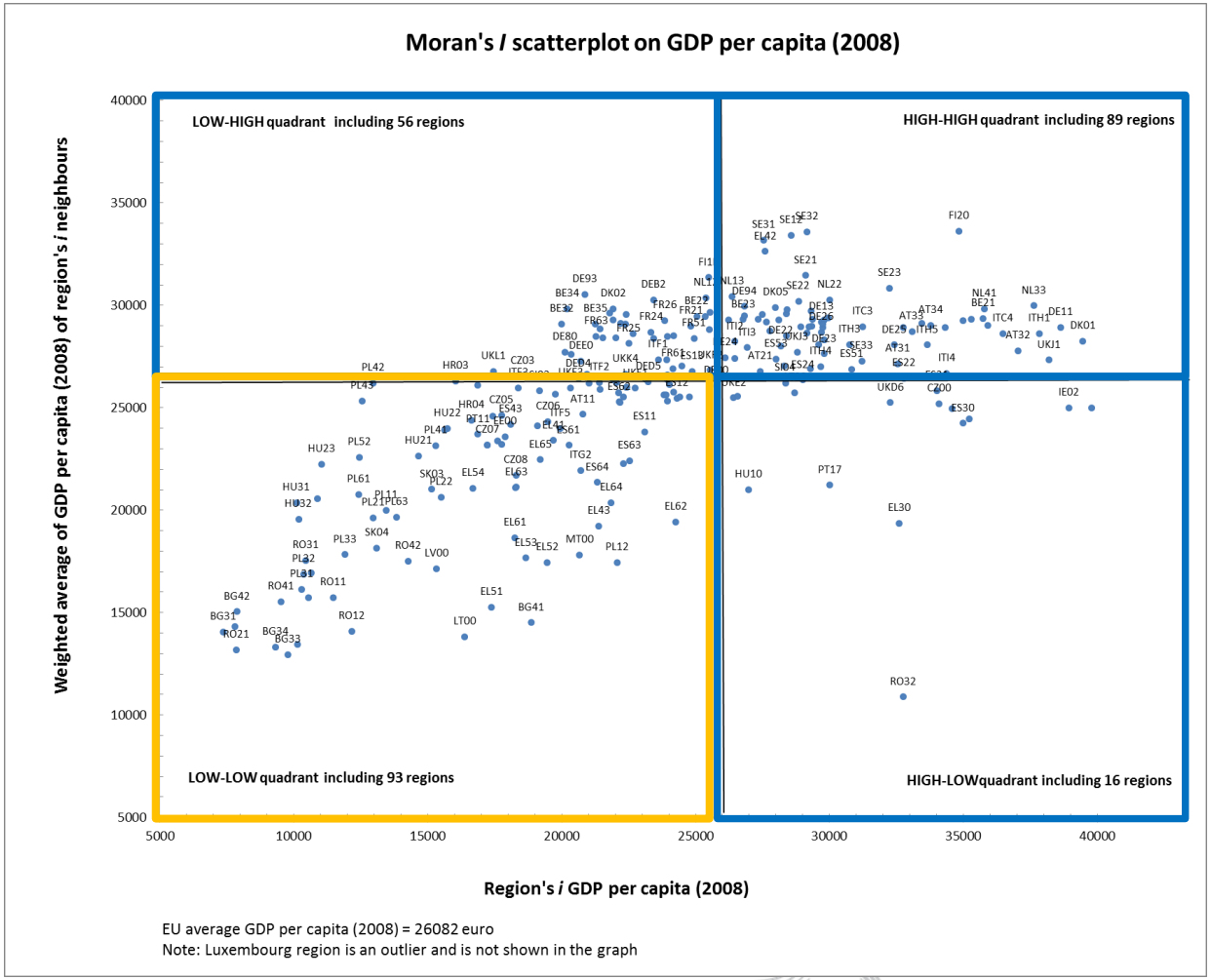
Identification of spatial regimes – step 2

- To go from 4 groups to 2, we carry out an ANOVA on all the explanatory variables to be tested by the spatial models.
- Each Moran's *I* group {HH}, {LH}, {HL}, {LL} is contrasted with the remaining three groups.
- {LL} contrasted to {HH,LH,HL} is the most polarizing configuration.



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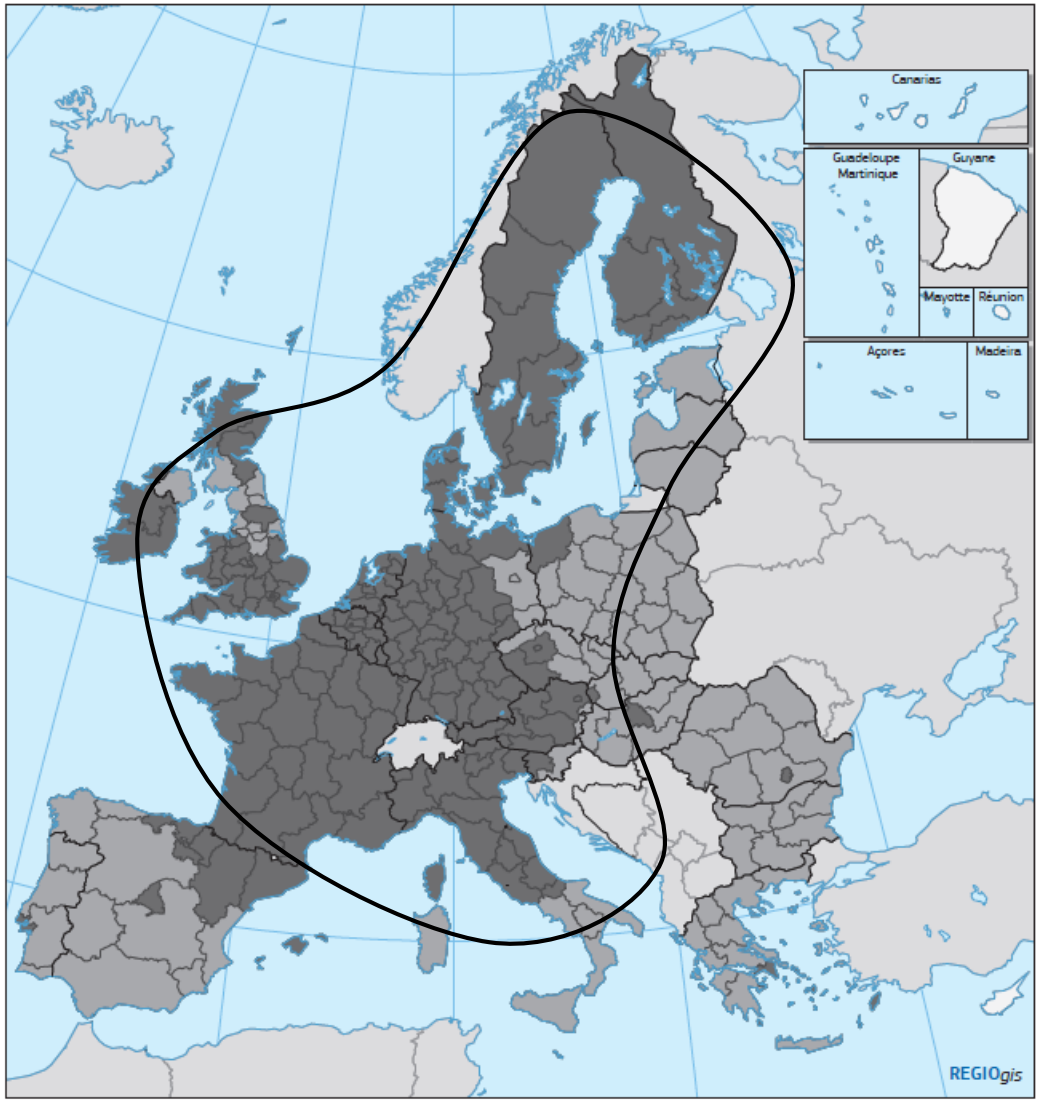
Identification of spatial regimes - final result

- A CORE-PERIPHERY structure (+ Nordic countries) is recognizable
- {HH,LH,HL} renamed HIGH income regime is the core + north
- {LL} renamed LOW income regime is the periphery



Spatial econometric model: formulation

- We start from the conditional growth model, à la *Mankiw et al.* (1992), and extend it to control for spatial dependence.

- We adopt the ***SPATIAL DURBIN MODEL,*** an extension of the Spatial Lag Model to capture spatial feedback effects from the neighbours through spatially lagged dependent (average growth of the neighbours) and independent variables (average determinants of growth of the neighbours)

- W = spatial weight matrix

Set of *k* regional explanatory variables

$$y_{nx1} = \rho W_{nxn} y_{nx1} + \alpha I_{nx1} + X_{nxk}\beta_{kx1} + W_{nxn} X_{nxk}\theta_{kx1} + \epsilon_{nx1}$$

Average real regional growth rate 2009-2015 across the *n* regions

Set of *k* explanatory variables in neighboring regions

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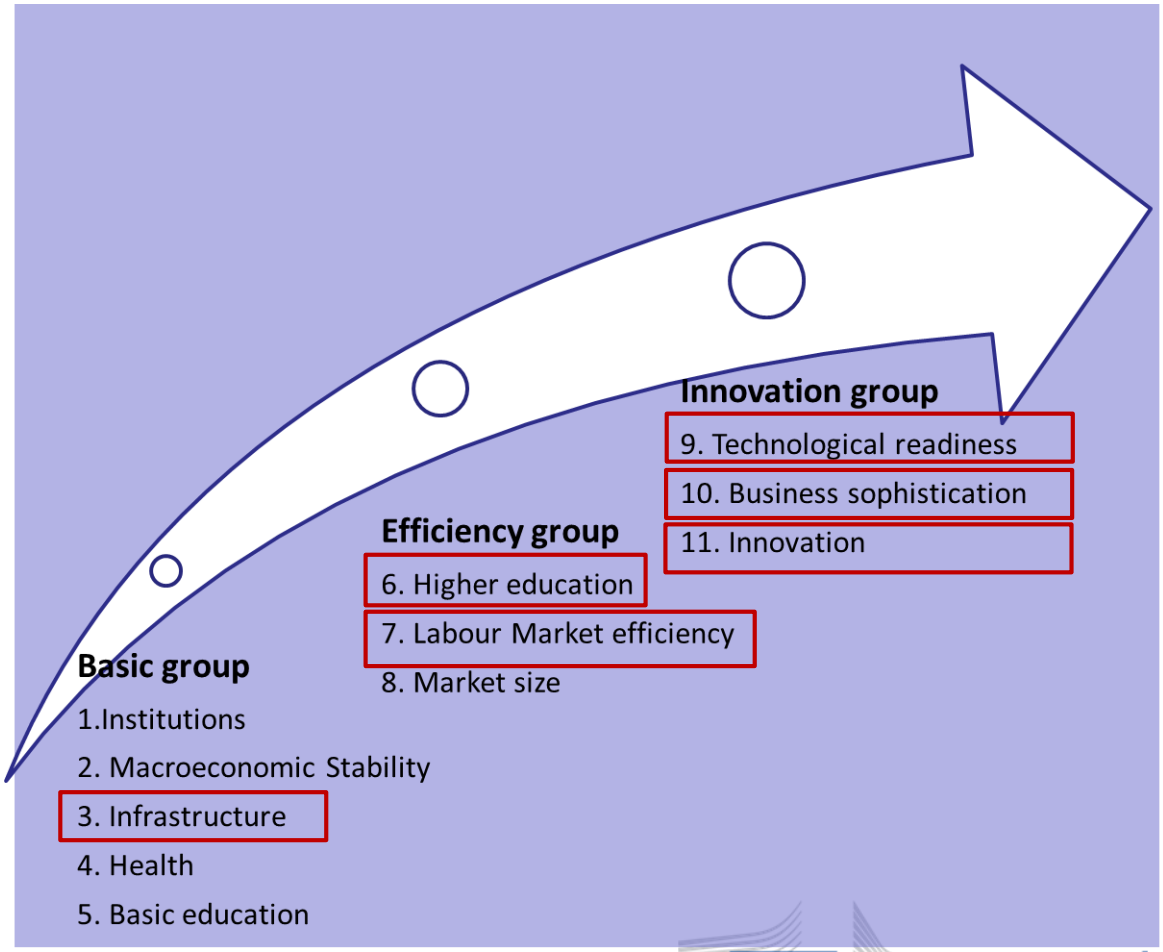
Spatial econometric model: ingredients

- The spatial weight matrix *W* is based on the inverse of travel time distances across the road network AND the cut-off distance of 500 minutes as suggested by the variogram analysis.
- A set of explanatory variables *X*, at the regional NUTS2 level, is tested:
  - Starting GDP per capita in PPS (2008) (EUROSTAT + REGIO GIS)
  - Share of population with at most lower secondary education (2006-2008 avg) (EUROSTAT)
  - Total investment measured by Gross Fixed Capital Formation/GDP (2008-2014 avg) (Cambridge Econometrics)
  - Average population growth (2008-2015) (EUROSTAT)
  - European Quality of Government Index (Gothenburg University, 2010 edition)
  - Selected components of the Regional Competitiveness Index (2010 edition)

The Regional Competitiveness Index - RCI

- What is the RCI? A comparable tool across the EU to measure regional competitiveness
- It is built on the Global Competitiveness Index of the World Economic Forum
- Based on more than 70 comparable indicators at the regional level sorted into 11 components and 3 groups
- Three points in time available so far: 2010, 2013 and 2016
- We use some components of the 2010 edition (raw indicators referring to 2007-2009 period)



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Spatial econometric model: inclusion of the regimes

- We 'extend' the Spatial Durbin Model to allow for different variable impacts in the two regimes identified by the Exploratory Spatial Data Analysis + ANOVA
- How?
  - By building a dummy for each regime (HIGH; LOW) and interacting each explanatory variable with both dummies
- Our assumption is that factors of growth, and resulting spillovers, differently affect the regions at different stages of economic development (LOW vs. HIGH regimes)
- We check for statistically significant differences between the estimated coefficients in the two groups (Spatial Chow test, *Anselin, 1988*):
  - Always significant

Results: modelling is an art …

- As expected, the three innovation-related RCI components (Technological Readiness, Business Sophistication and Innovation) present collinearity issues

- Innovation component tested extensively and almost never found significant but interacting with others components → *discarded* (too short time span and/or the so-called 'innovation puzzle', OECD 2012)

- Labour Market Efficiency component (and also simply Long-term unemployment) tested extensively and almost never found significant but interacting with others components → *discarded*

- Infrastructure component never found significant or, if so, it shows a weak, negative (!) causal effect → *discarded*

Results: SDM 2 regimes, IMPACTS

HIGH INCOME

LOW INCOME

Significant Direct Effects:

- Initial GDP per head (negative)
- Lowly Educated workforce (negative)
- Investment (positive)
- Quality of Government (positive)
- Business Sophistication (positive)

- Initial GDP per head (negative)
- Lowly Educated workforce (negative)
- Higher Education (positive)
- Technological Readiness (positive)

Significant Spillover (Indirect) Effects:

- Avg pop. Growth (negative)
- Investment (positive)

- Initial GDP per head (negative)
- Quality of Government (negative) ?
- Business Sophistication (negative)
- Lowly Educated workforce (positive)
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Concluding remarks:

- Significant and interesting differences between CORE and PERIPHERY of the EU
- Classical Solow growth model confirmed in both regimes (with low income regions converging at a faster pace)
- Investment levels counts in HIGH income group only (higher growth and positive spillovers)
- Institutions count more for HIGH income group. In LOW income negative spillover effects (fairer neighbours attract physical/human capital?)
- Lowly educated detrimental for both regimes. Positive spillover effects for LOW income regions (close to source of cheap labour?)

Concluding remarks (continued):

- Higher Education fosters growth in LOW income group only, with positive spillovers
- Technological Readiness important for LOW income group only, with positive spillovers (HIGH income group reached the frontier already?)
- Business Sophistication important in the HIGH income group (specialisation in higher value-added activities, see ***Smart Specialisation***). In the LOW income one, a negative, weak spillover effect only (neighbours with a more sophisticated business environment attract physical and human capital?)

Results: SDM 2 regimes, IMPACTS

Post estimations: Impacts for the spatial DURBIN model, 2 regimes

	High Income			Low Income		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Initial GDP (ln)	-1.72***	-6.27	-7.80	-2.01***	-13.09*	-15.10*
Investment	5.43**	73.59*	79.01**	1.89	-47.93	-45.60
Avg pop. growth	0.02	-0.51*	-0.50*	-0.01	0.17	0.16
Quality of Government	0.56***	1.02	1.58	-0.07	-4.01**	-4.08**
Share of Lowly Educated	-0.03***	0.02	-0.01	-0.03**	0.29**	0.26**
Higher Education (RCI component)	-0.19	-2.03	-2.22	0.68**	9.15*	9.83*
Technological readiness (RCI component)	0.01	0.70	0.71	0.46*	7.36**	7.82**
Business sophistication (RCI component)	0.51**	1.15	1.66	-0.26	-10.10*	-10.32*

Note: The statistical significance levels are labelled with ***, **, and * referring to the 1, 5 and 10 percent significance level, respectively.

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