Trade status, innovation activities and skill structure of firms

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Outline

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- Methodology
- Data
- Descriptive statistics
- Results
- Conclusion

Innovation

Innovation is the central issue in economic prosperity.
(Michael Porter)

- Importance of innovation
- Types of innovation:
  - product innovation (goods and services);
  - process innovation;
  - organisational innovation; and
  - marketing innovation.
- Positive impact of firms' R&D activities on their exports (Vogel & Wagner, 2012).

Trade

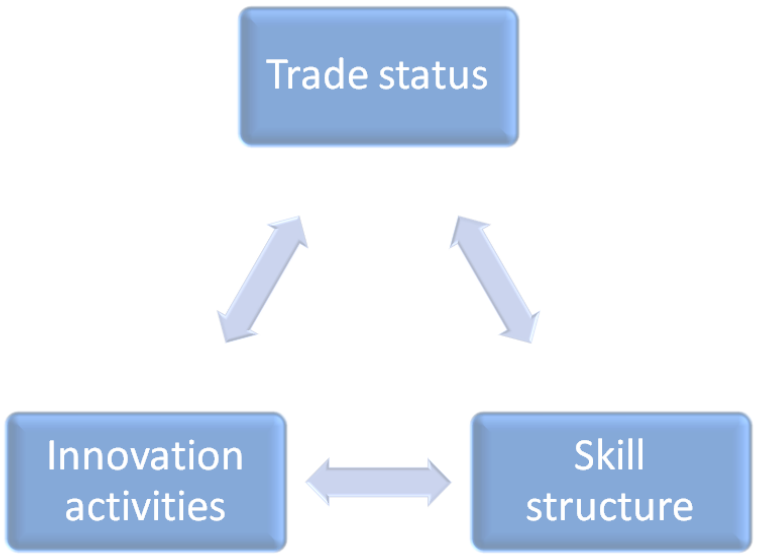
- Importance of trade
- Theoretical models: Bustos (2011)
- Positive impact of trade status on innovation activities of firms (Kiriyama, 2012; Bustos, 2011a; and Damijan & Kostevc, 2010).
- Impact of trade on innovation (Kiriyama, 2012):
  - technology diffusion;
  - increased competition; and
  - learning opportunities.
- Positive impact of trade on skill structure of firms (Bloom, Draca & Van Reenen, 2011; Crino, 2011; Brambilla, Lederman & Porto, 2010; and Meschi, Taymaz & Vivarelli, 2008).

Skill structure of firms

- Importance of the skill structure of firms
- Increasing demand and supply of more educated labour:
  - Share of employees with attained tertiary education:
    - EU: ↑by 8.3 ppt
    - Slovenia: ↑by 15.2 ppt
  - Employment rates of persons with attained tertiary education:
    - EU: 81.8 % (average: 64.2 %)
    - Slovenia: 84.2 % (average: 64.1 %)
- Reasons: greater trade openness and/or more sophisticated technology (Meschi, Taymaz & Vivarelli, 2008; Attanasio, Goldberg & Pavcnik, 2003; Tokarick, 2002; Muendler, 2001; Feenstra & Hanson, 1998).

Motivation and aim

- Motivation: studying the causalities and links between all three factors that influence firms'performance – trade status, skill structure and innovation activities – and the order of their appearance has not been studied thoroughly yet.
- Aim: test empirically correlations and causalities between firms' trading activities, their skill structure and innovation performance.



The Model

$$P(Trade_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, trade_{it-s}, skill_{it-s}, innovator_{it-s}, \mathbf{X}_{it-s}, time_t, ind_t) \quad (1)$$

$$P(Skill\_d_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, trade_{it-s}, skill_{it-s}, innovator_{it-s}, \mathbf{Y}_{it-s}, time_t, ind_t) \quad (2)$$

$$P(Innov_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, trade_{it-s}, skill_{it-s}, innovator_{it-s}, \mathbf{Z}_{it-s}, time_t, ind_t) \quad (3)$$

- Method of estimation: propensity score matching

The Model - sequencing

$$P(imp_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, rimsh_{it-s}, time_t, ind_t) \quad (4)$$

$$P(\exp_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, rexsh_{it-s}, time_t, ind_t) \quad (5)$$

$$P(skill\_d_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, time_t, ind_t) \quad (6)$$

$$P(innov_{it} = 1) = f(size_{it-s}, lvae_{it-s}, lke_{it-s}, time_t, ind_t) \quad (7)$$

- Method of estimation: propensity score matching

Databases

- Income tax data,
- Firm-level data on exports and imports of goods,
- Statistical register of employment,
- Annual balance sheets of firms,
- Industrial production, and
- Community Innovation Survey (CIS).

Description of the dataset

- Information on firms' balance sheets and income statements, their export and import activities, innovation activities, and characteristics of employees.
- Matched employer-employee panel dataset, disaggregated on a product level for Slovenian manufacturing firms.
- Observation period: 1996-2010.

Data sources

Data was provided by:

- Statistical office of the Republic of Slovenia (SORS); and
- Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES).

Descriptive statistics

Table 1: Characteristics of Slovenian manufacturing firms by the type of trading activities (period 2003-2010, mean values, only CIS data)

		2003	2004	2005	2006	2007	2008	2009	2010
No trade	emp	34.2	42.5	34.6	36.3	9.1	10.2	9.4	8.9
	emp_skill	4.3	5.1	9.1	9.1	1.1	1.8	1.9	1.9
	age	39.0	39.7	39.8	40.5	38.7	39.4	40.2	41.0
	gw	7,944	8,932	10,053	10,732	13,817	15,083	14,482	15,005
	gw_skilled	19,895	18,314	17,771	18,288	23,193	25,147	24,507	24,167
Trade	emp	184.0	188.8	156.2	152.3	131.8	131.6	149.9	152.0
	emp_skill	21.4	21.1	19.6	21.1	17.9	17.6	20.3	22.3
	age	39.4	40.0	40.0	40.1	40.4	40.9	41.5	41.9
	gw	9,427	10,117	10,724	11,617	13,195	14,298	14,106	14,558
	gw_skilled	19,314	20,209	20,861	21,805	23,662	25,986	25,128	25,128

Notes: emp: mean number of employees; emp_skill: mean number of skilled employees; age: average age of employees; gw: average gross wage in €; gw_skill: average gross wage of skilled employees in €. Source: SORS, own calculations

Descriptive statistics

Table 2: Characteristics of Slovenian manufacturing firms by the type of innovation (period 2003-2010, mean values)

		2003	2004	2005	2006	2007	2008	2009	2010
No innov	emp	88.1	89.7	74.2	73.8	91.6	87.6	99.4	94.0
	emp_skill	11.6	11.6	8.8	10.5	9.8	8.4	10.0	10.2
	age	39.1	39.4	39.4	39.6	39.1	39.7	40.6	41.1
	gw	9,426	9,819	10,153	10,885	12,833	13,727	13,274	13,477
	gw_skilled	19,154	19,513	18,714	19,358	22,493	24,651	23,775	23,108
Innov	emp	226.5	232.4	176.0	178.1	100.6	99.5	110.8	111.8
	emp_skill	25.8	25.1	24.0	25.4	15.4	15.7	17.8	19.4
	age	39.6	40.3	40.3	40.5	40.4	41.0	41.4	42.0
	gw	9,262	10,146	10,921	11,895	13,746	15,094	14,885	15,609
	gw_skilled	19,466	20,410	21,472	22,667	24,143	26,343	25,650	25,940

Notes: emp: mean number of employees; emp_skill: mean number of skilled employees; age: average age of employees; gw: average gross wage in €; gw_skill: average gross wage of skilled employees in €. Source: SORS, own calculations

Descriptive statistics

- Sequencing of the events was tracked and registered for every firm – i.e. when a firm starts importing, exporting, innovating and employing skilled workers.

Table 3: Sequencing of events, descriptive statistics

Sequencing with two events	**%**
Start IMP —> Start EXP	25.4
Start EXP —> Start IMP	14.6
Start IMP —> Start EMP Skill	12.4
Other combinations	47.6
Sequencing with three events	**%**
Start IMP —> Start EXP —> Start EMP Skill	33.4
Start EXP —> Start IMP —> Start EMP Skill	12.2
Start EMP Skill —> Start IMP —> Start EXP	8.7
Other combinations	45.7

Source: SORS, own calculations

- The majority of firms start importing first, then they start exporting and later upgrade their skill structure.

Base results - nearest neighbour matching

Table 4: Tripartite causalities between trade status, innovation activities and skill structure of firms (period 1996-2010)

Treatment = Trade					
	No treat.	No contr.	ATT	s.e.	t-stat
Innovation	9,949	1,094	0.20	0.019***	10.27
Emp_skill	17,641	9,757	6.94	0.432***	16.08
Treatment = Skills					
	No treat.	No contr.	ATT	s.e.	t-stat
Trade	1,925	3,503	0.02	0.004***	4.28
Innovation	1,925	3,243	22.42	1.862***	12.04
Treatment = Innovation					
	No treat.	No contr.	ATT	s.e.	t-stat
Trade	7,823	5,985	0.04	0.005***	7.73
Emp_skill	4,173	4,689	0.07	0.011***	6.58

Notes: ATT stands for average treatment effects obtained with nearest neighbour matching after propensity score. Variables: Innovation: innovation activities of firms, measured as the number of added products; Emp_skill: number of skilled employees, Trade: dummy variable, controlling whether a firm was exporter or importer. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Base results - nearest neighbour matching

Table 5: Tripartite causalities between trade status, innovation activities and skill structure of firms (period 1996-2010)

Treatment = Imports					
	No treat.	No contr.	ATT	s.e.	t-stat
Innovation	9,649	1,384	0.20	0.017***	11.72
Emp_skill	15,908	11,477	7.84	0.405***	19.36
Treatment = Exports					
	No treat.	No contr.	ATT	s.e.	t-stat
Trade	8,916	1,998	0.21	0.014***	14.80
Emp_skill	13,844	13,298	8.50	0.386***	22.02

Notes: ATT stands for average treatment effects obtained with nearest neighbour matching after propensity score. Variables: Innovation: innovation activities of firms, measured as the number of added products; Emp_skill: number of skilled employees, Trade: dummy variable, controlling whether a firm was exporter or importer. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Base results - sequencing, nearest neighbour matching

Table 6: Type 1 sequencing; starting point = imports (period 1996-2010, nearest neighbour matching)

			Lag = 2		
	No. treat.	No. contr.	ATT	Std. Err.	t
Start_exp	622	41300	0.01	0.005*	1.979
Start_innov	64	3186	0.042	0.033	1.275
Start_skill	534	18537	0.022	0.007***	3.064
			Lag = 4		
	No. treat.	No. contr.	ATT	Std. Err.	t
Start_exp	525	32022	0.021	0.007***	3.048
Start_innov	44	1681	0.14	0.048***	2.882
Start_skill	401	14563	0.016	0.007**	2.401

Notes: ATT stands for average treatment effects obtained with nearest neighbour matching after propensity score. Variables: Start_exp: start of exporting activities; Start_innov: start of innovation activities, CIS data; Emp_skill: start of employing skilled workers. *** p<0.01, ** p<0.05, * p<0.1.
Source: SORS, own calculations

Base results - sequencing, nearest neighbour matching

Table 7: Type 2 sequencing; starting point = exports (period 1996-2010, nearest neighbour matching)

			Lag = 2		
	No. treat.	No. contr.	ATT	Std. Err.	t
Start_imp	226	28501	0.015	0.009*	1.69
Start_innov	10	705	-0.042	0.03	-1.425
Start_skill	193	12781	0.003	0.008	0.428
			Lag = 4		
	No. treat.	No. contr.	ATT	Std. Err.	t
Start_imp	139	20492	0.029	0.016*	1.796
Start_innov	8	410	0.057	0.117	0.488
Start_skill	102	9459	0.013	0.012	1.052

Notes: ATT stands for average treatment effects obtained with nearest neighbour matching after propensity score.
Variables: Start_imp: start of importing activities; Start_innov: start of innovation activities, CIS data; Emp_skill: start of employing skilled workers. *** p<0.01, ** p<0.05, * p<0.1.
Source: SORS, own calculations

Base results - sequencing, nearest neighbour matching

Table 8: Type 3 sequencing; starting point = presence of skilled workers (period 1996-2010, nearest neighbour matching)

			Lag = 2		
	No. treat.	No. contr.	ATT	Std. Err.	t
Start_imp	2260	19782	0.005	0.002**	2.059
Start_innov	199	2865	0.023	0.016	1.42
Start_exp	2260	19784	0.002	0.003	0.737
			Lag = 4		
	No. treat.	No. contr.	ATT	Std. Err.	t
Start_imp	1333	15767	0.004	0.003	1.336
Start_innov	141	1661	0.051	0.024**	2.168
Start_exp	1333	15767	-0.002	0.002	-1.024

Notes: ATT stands for average treatment effects obtained with nearest neighbour matching after propensity score. Variables: Start_imp: start of importing activities; Start_exp: start of exporting activities; Start_innov: start of innovation activities, CIS data. *** p<0.01, ** p<0.05, * p<0.1.
Source: SORS, own calculations

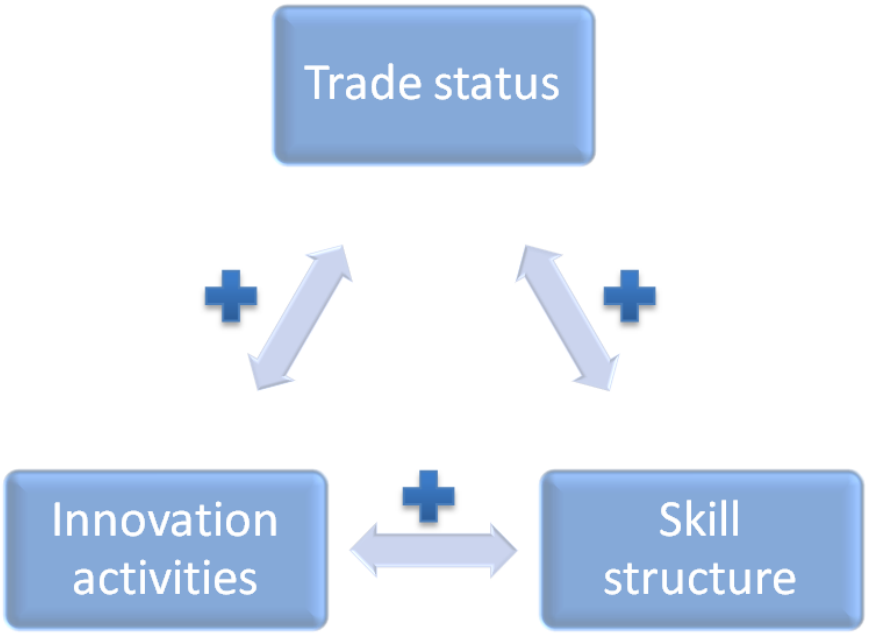
Robustness checks

Robustness checks included:

- controlling for different types of innovations;
- using different lags; and
- using kernel, radius, and continuous matching.

Main findings

Base results:



Main findings

Sequencing:

- importing leads to start of exporting, employing skilled workers, and innovations;
- presence of skilled workers in firms has a positive impact on the start of importing and innovation activities;
- exporting has a positive impact only on the start of importing;
- results for the type of sequencing, where the starting point are innovation activities, are not representative.

Contributions

- Not many papers have empirically studied the combined linkages and reversed causalities between all three phenomena.
- Rich dataset, which allows taking into account various set of controls.

Policy implications

- Besides researchers in the field, governments, firms, people on the job market and students will also be able to benefit from this study:
  - governments should first focus on establishing an environment that encourages international cooperation, followed by stimulation of skill upgrading and innovative activities of firms;
  - firms should have higher incentives for hiring more skilled workers;
  - students and people on the job market should have higher incentives for attaining higher educational level and acquiring additional on-the-job trainings in order to achieve higher employability.

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