Innovation in the Wholesale and Retail Sectors in the Czech Republic 2008-2014

Marek Vokoun

Institute of Technology and Business in České Budějovice

Abstract

This paper focuses on the innovation activities of Czech wholesale and retail companies between 2006 and 2014. Based on data from four Czech Innovation Surveys (2008, 2010, 2012 and 2014), 1,630 observations were made about companies in the trade sector. The subsequent estimations are based on the structural modelling of the innovation process, i.e. decision to innovate, innovation input and innovation output. The size of a company was found to increase the probability of engagement in new-to-the-market innovation, however, no statistically significant relationship could be established for the intensity of innovation input or output. Being part of a group of companies was found to be a positive contributor to innovation activities, in particular in the first stage (decision, R&D input) of the innovation process. Significant differences were also found between the manufacturing and trade sectors in terms of market orientation. Having a national market focus was found to be linked to an increased probability of innovation, with a broader market focus proving not to be a significant factor during the analysed period. The trade sector was also found to engage in more types of innovation activities (processes, logistics and others), whereby the direct link between innovation input and innovation output was found to be in product innovation. Product innovation was also the only type of innovation in this sector which directly contributed to sales of new-to-the-market goods and services per employee. However, innovation activities were dampened in times of economic crisis, but only in terms of lower sales of innovated goods and services. The decision to innovate remained on average unchanged in the period 2006-2012.

Keywords: innovation, SME, productivity, manufacturing, dynamics.

Introduction

The technological and knowledge skills-set within the wholesale and retail trade sectors is the lowest in the national economy. In comparison to high-tech manufacturing or knowledge intensive services, the value added in this sector is on average lower. Their activities are usually limited and often reduced to the resale of products. The innovation strategies and activities in this field have not been studied in detail. This study therefore aims to analyse this sector and its innovation activities and characteristics.

Current literature focuses on the fact that marketing, logistics and technological innovations are not continuously or scarcely introduced, for example, only in 11.2% of Ukrainian companies in the automotive component trade industry (Ilchenko 2016). Design innovations are examined by Schen et al. (2016). They compared the Original Equipment Manufacturer (OEM) strategy versus the Original Design Manufacturer (ODM) strategy on the basis of wholesale price contracts. They concluded that the motivation to innovate was lower in supply companies under the DOM strategy. The strategies differ and depend on the market focus and types of contracts available.

There is a link between competition, innovation and productivity in the Dutch retail trade. Creusen et al. (2009), analysed the link between producers and customers and concluded that: "competition and innovation may speed up productivity in the Dutch retail trade. But, competition also stimulates innovation, and therefore the initial effect of fiercer competition on productivity becomes even larger in the long term. However, we show that on average competition hardly increased in the Dutch retail trade in the period 1993–2002."

Literature dealing with the theoretical aspects of the trade sector is very scarce. Authors have been developing models of technological change (Nordhaus 1969; Silverberg and Verspagen 1994; Sutton 2001), but the trade sector and the importance thereof are not studied in detail. Fein (1998) suggests an evolutionary model and points to the differences between manufacturing and non-manufacturing industries. Another problem is the shortcomings in innovation research, which was studied by Žižlavský (2015) and Vokoun (2015).

Material and methods

The sample consists of wholesale and retail trade companies identified under company codes 45 to 47 (Section G) in NACE[1]. The full sample set of innovators and non-innovators encompasses 1,630 observations about these companies taken from four Czech Innovation Surveys (2008, 2010, 2012 and 2014), including 307 observations about new-to-the-market innovators (57 % of innovators). Almost one third of the observations relate to multinational

[1] Nomenclature statistique des activités économiques dans la Communauté européenne (NACE)

companies. It appears that companies are on average innovators in all areas, but that the standard deviation in all these areas is quite high. This higher volatility (variation coefficient 275 %) indicates that there are a range of determinants that influence innovation activities.

Table 1: Summary of statistics, Czech trade sector (NACE 45-47) in 2008, 2010, 2012 and 2014

Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
Logistics innovation	1630	0.13	0.34	0	1
Product innovation	1630	0.12	0.33	0	1
Service innovation	1630	0.12	0.33	0	1
New-to-the-market	307	0.57	0.50	0	1
New-to-the-firm	307	0.78	0.42	0	1
R&D Expenditures – in-house	336	2817.57	12799.68	0	190365
R&D Expenditures – total	479	8492.29	25787.21	0	403367
Cooperation	526	0.33	0.47	0	1
Sales	1630	1495585.00	4673689.00	530	6.52E+07
Employees	1630	142.11	400.10	10	7708
Foreign ownership	1630	0.30	0.46	0	1

Source: Calculations based on data from Czech Statistical Office (2017).

This sample does not contain micro-enterprises (≤ 9 employees). The dynamic component of micro-enterprises is therefore not captured in the analysis. The results will therefore only deal with the behaviour of small, medium-sized and large companies. In summary, this sample is heteroscedastic and the regression analysis should reveal the determinants of the innovation activities of companies in the trade sector (see Table 1). The data (Czech Innovation Survey) is derived from data compiled by the Czech Statistical Office. The data are provided only for scientific purposes.

The method (see Table 2) is based on the innovation model of Castellacci (2009) and Crepon, Duguet and Mairesse (1998). The first step is to carry out a Heckman procedure, whereby innovators are selected for the second equation and the selection bias is accounted for. This is possible with the introduction of Mill's ratio (non-selection hazard variable), which is calculated from the first equation. The analysis of R&D expenditures occurs on the basis of the second equation.

The determinants of product, process and logistics innovation are analysed in the second step and then only for innovators. The ability of innovated products and services to generate profit is analysed in the third step. Since we cannot use instrumental variables due to the availability of data, some of the coefficients will be biased. The endogeneity is quite

problematic in the models. The coefficients are therefore interpreted cautiously. Due to the omitted variables, there is also attenuation bias.

Table 2: CDM and model as a recursive system of four econometric equations

Heckman procedure	$\boldsymbol{r_{it}^{*}}\begin{cases}\mathbf{1}\ \boldsymbol{if}\ \boldsymbol{r_{it}} = \left(\boldsymbol{X_{1it}\beta_1} + \boldsymbol{\rho_i} + \boldsymbol{\varepsilon_{it_1}}\right) > \mathbf{0} \\ \quad\mathbf{0}\ \boldsymbol{otherwise}\ \ (\boldsymbol{r_{it}} \leq \mathbf{0})\end{cases}$
	$\boldsymbol{k_{it}^{*}} = \mathbf{ln}(\boldsymbol{k_{it}})\,\vert(\boldsymbol{r_{it}} > \mathbf{0}) = \boldsymbol{X_{2it}\beta_2} + \boldsymbol{\rho_i} + \boldsymbol{\varepsilon_{it_2}}\ \boldsymbol{with}\ \boldsymbol{Df}(\boldsymbol{k_{it}}) = (\mathbf{0}, \infty)$
Innovations (product, process and logistics)	$\boldsymbol{ppl_{it}^{*}}\begin{cases}\mathbf{1}\ \boldsymbol{if}\ \boldsymbol{ppl_{it}} = \left(\boldsymbol{X_{3it}\beta_3} + \boldsymbol{\rho_i} + \boldsymbol{\varepsilon_{it_3}}\right) > \mathbf{0} \\ \quad\mathbf{0}\ \boldsymbol{otherwise}\ \ (\boldsymbol{ppl_{it}} \leq \mathbf{0})\end{cases}$
Appropriability	$\mathbf{t_{it}^{*}} = \mathbf{ln}(\boldsymbol{t_{it}})\vert(\boldsymbol{k_{it}} > \mathbf{0}) = \boldsymbol{X_{4it}\beta_4} + \boldsymbol{\rho_i} + \boldsymbol{\alpha k_{it}^{*}} + \boldsymbol{\varepsilon_{it_4}}\ \boldsymbol{with}\ \boldsymbol{Df}(\boldsymbol{t_{it}}) = (\mathbf{0}, \infty)$

Source: Author

Where $Xn_{it}\beta_n$*'s* (with n = 1, 2, 3 and 4) are the vectors of the explanatory variables and ε_{itn}*'s* (with n = 1, 2, 3 and 4) are the random-error terms that can be estimated with fixed effects ρ_i. The error terms are assumed to be independent of the exogenous variables, but with a bias due to the omitted variables and endogeneity. Under the Heckman procedure, the error term is estimated as a system (Heckman, 1976). The vector of the parameters to be estimated is denoted as β_n (with n = 1, 2, 3 and 4) and the single parameters to be estimated as α in the last equation (innovation input-output elasticity).

The first equation (r_{it}^{*}) deals with the probability that company *i* engages in new-to-the-market R&D activities in a given year *t*. This is specified as a panel probit model, i.e. $P(r_{it}^{*}>0) = \Phi(X_{1it}\beta_1)$, where r_{it}^{*} equals 1 if firm *i* is an innovator. The second linear equation (k_i^{*}) describes innovation input (the log of internal and external R&D expenditures in relation to the number of employees in firm *i*). In all the equations, there are a number of potential determinants ($Xn_{it}\beta_n$'s), such as a company size, foreign ownership (a multinational firm), being part of a group of companies, cooperation, etc. Some of these determinants are used uniquely to identify each equation in a simultaneous estimation (i.e. hampering factors).

The second step (ppl_{it}^{*}) deals with the probability of firm *i* engaging in the new-to-the-market product, process and logistics innovation in a given year *t*. This is specified as a panel probit model, i.e. $P(ppl_{it}^{*}>0) = \Phi(X_{1it}\beta_1)$, where ppl_{it}^{*} equals 1 if firm *i* is a product, process and/or logistics innovator respectively.

The fourth equation (t_{it}^{*}) models the innovation log of sales of goods and services in relation to the number of employees. Here the focus is on the input-output elasticity (α) and other explanatory variables ($Xn_{it}\beta_n s$) which describe the behaviour and market determinants of process innovators. The fourth linear equation usually describes labour productivity but is not applied due to the limitations of the data available from the Czech Statistical Office.

Results

The first step deals with the decision to innovate and the intensity of innovation expenditure as measured by total R&D expenditure per employee (see Table 4, Model 1a). The probability of engagement in new-to-the-market innovation is higher in larger companies and in companies that are part of a group. The wholesale sector is different from that of the manufacturing sector, where a broader market orientation significantly increases the probability of innovation (Vokoun, 2016). The probability that companies engage in innovation is lower in those companies that focus their operations on the EU or the world than in those that focus on the Czech market alone. The trend in the probability to innovate was constant between 2008 and 2010 (the period covers the years 2006 to 2010). This sector was able to innovate at the same pace even during the economic crisis. There was even an increase in the probability to innovate in 2012 (questionnaire covers the period 2010-2012), followed by a sudden decrease in 2014 (period 2012-2014). This decrease can be explained by the fear of a second economic crisis and the decreases in real GDP growth in the EU28 in 2012 and in the Czech Republic in 2012 and 2013.

Table 3: Innovation decision – hampering factors, Czech trade sector (NACE 45-47)

Trade sector 2008 - 2014	**(1b)**
	New-to-the-market innovator (0/1)
Innovation was not required	-1.039***
	(0.31)
Lack of information about markets	0.861***
	(0.30)
Lack of qualified personnel	0.754**
	(0.35)
Lack of credit (external sources); market is dominated by incumbents; uncertain demand for innovations; insufficient finances; lack of cooperation partners	Not significant at $p < 0.05$

Note: Robust standard errors in parentheses, ** $p < 0.05$, *** $p < 0.01$
Source: Author

There are factors that hamper innovation activities across the whole trade sector (see Table 3). The most frequent reason stated for not innovating was because it was not required. The probability of engaging in new-to-the-market innovation activities was higher in those

companies that recognised the importance of a skilled labour force and the need to acquire market information.

Table 4: Innovation decision and intensity, Czech trade sector (NACE 45-47) in 2008, 2010, 2012 and 2014

Czech Innovation Survey (2008, 2010, 2012, 2014) Trade sector	**(1a)** **New-to-the-market innovator (0/1)**	**(2)** **Total R&D expenditures per employee (ln)**
Number of employees (ln)	0.223**	0.219
	(0.09)	(3.50)
Being part of a group	0.780***	2.568**
	(0.26)	(1.00)
Cooperation partners		Not significant
Market orientation - National	0.467**	
	(0.22)	
Market orientation – Europe	0.599	
	(0.41)	
Market orientation - World	0.969	
	(0.75)	
Year 2010	-0.050	0.979
	(0.26)	(3.00)
Year 2012	0.651**	-1.413
	(0.28)	(1.71)
Year 2014	-0.839**	0.129
	(0.40)	(1.81)
Non-selection hazard		-5.878***
		(2.03)
Constant	-4.849***	10.559
	(1.03)	(13.75)
Panel-level variance component	1.038**	
	(0.51)	
Observations	1606	153
Adjusted R^2 within		43,5 %

Note: Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Source: Author

Innovation intensity is measured by the total R&D expenditures per employee (see Table 3, Model 2). The size of the company is not statistically significant. This result is different from that in the Czech manufacturing sector where smaller companies invest more in R&D projects than larger companies (Vokoun 2016). Being part of a group of companies

contributes to significantly higher R&D expenditures per employee. However, no link was found between R&D expenditures and cooperation with partners.

Table 5: Determinants of innovation, Czech trade sector (NACE 45-47) in 2008, 2010, 2012 and 2014

Czech Innovation Survey (2008, 2010, 2012, 2014) Trade sector	**(3)**	**(4)**	**(5)**
	Logistics innovation (0/1)	**Process innovation (0/1)**	**Product innovation (0/1)**
Being part of a group	0.778	-0.441	-0.518
	(0.65)	(0.91)	(0.72)
Foreign ownership	-0.772	-0.242	0.587
	(0.64)	(0.98)	(0.76)
Cooperation	0.165	0.501	0.963
	(0.43)	(0.76)	(0.64)
Total R&D expenditures per employee (ln)	0.195	-0.240	0.267*
	(0.12)	(0.22)	(0.14)
Year 2010	-0.044	-0.698	0.267
	(0.55)	(0.91)	(0.76)
Year 2012	-0.278	-0.551	1.562**
	(0.42)	(0.87)	(0.65)
Year 2014	-1.083	-0.714	1.837*
	(0.68)	(0.86)	(1.03)
Constant	-0.845	2.228	0.160
	(0.68)	(1.45)	(0.80)
Panel-level variance component	1.181	2.372***	1.711
	(1.04)	(0.68)	(1.70)
Observations	153	153	153

Note: Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Source: Author

The analysis of the three types of innovation (see Table 5) reveals that there is only one link between R&D expenditures per employee and product innovation. This analysis is however very limited due to the lack of available data. The last analysis relates to the ability of companies to generate profits from their innovation activities (see Table 6).

Sales of new-to-the-market goods and services per employee showed a downward trend in the analysed period 2006-2014 (covered by the surveys conducted between 2008 and 2014). The input-output elasticity ratio was not statistically significant. This means that there is a high heterogeneity in the ability to transform R&D expenditures into innovation outputs as measured by sales of new-to-the-market goods and services per employee in the trade sector. The only significant control variable was product innovation, which led to

increased sales from innovated goods. No other types of innovation (process or logistics) were statistically significant determinants of innovation output.

Table 6: Innovation appropriability conditions, Czech trade sector (NACE 45-47) in 2008, 2010, 2012 and 2014

Czech Innovation Survey (2008, 2010, 2012, 2014) Trade sector	**(6)**
	Sales of new-to-the-market goods and services per employee (ln)
Number of employees (ln)	1.165
	(0.83)
Year 2010	-0.995***
	(0.32)
Year 2012	-0.403*
	(0.24)
Year 2014	-0.752***
	(0.24)
Non-selection hazard	1.129
	(1.04)
Total R&D expenditures per employee (ln)	0.122
	(0.08)
Product innovation	0.572**
	(0.26)
Process innovation	-0.306
	(0.75)
Logistics innovation	0.148
	(0.18)
Constant	-0.920
	(3.98)
Observations	153
Adjusted R^2	0.399

Note: Robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Source: Author

Conclusion

The innovation activities of Czech companies in the wholesale and retail trade sectors between 2006 and 2014 differ from the manufacturing sector. On the basis of the structural modelling of the innovation process, the size of a company increases the probability of engagement in new-to-the-market innovation, however, no statistically significant relationship was found for innovation input or output intensity. Being part of a group of companies is a strong and positive determinant of innovation activities in the first stage (decision, R&D input) of the innovation process. A national market focus increases the

probability of innovation, whereas a broader market focus was not found to be a significant factor in the analysed period. The trade sector engages in more types of innovation activities (process, logistics, and others), but a direct link between innovation input and innovation output was only found in relation to product innovation. Product innovation was also the only type of innovation in this sector which directly contributed to the sales of new-to-the-market goods and services per employee. The innovation activities of the trade sector were dampened in times of economic crisis only in terms of lower sales of innovated goods and services. The decision to innovate remained on average unchanged in the period 2006-2012.

Acknowledgement

This paper was supported by the Department of Humanities at the Institute of Technology and Business in České Budějovice.

References

CASTELLACCI, F., 2009. *How does competition affect the relationship between innovation and productivity? Estimation of a CDM model for Norway.* [online]. Munich: University Library of Munich. [accessed: 2012-04-02]. Available at: http://ideas.repec.org/p/pra/mprapa/27591.html.

CREPON, B., E., DUGUET and Jacques MAIRESSE, 1998. Research, Innovation and Productivity: An Econometric Analysis at the Firm Level. *Economics of Innovation and New Technology* [online]. **7**(2), 115–158. ISSN 1043-8599. Available at: http://www.tandf.co.uk/journals/titles/10438599.asp

CREUSEN, H., B. VROOMEN. and H. VAN DER WIEL, 2008. Shopping with friends give more fun; how competition, innovation and productivity relate in Dutch retail trade. In: *Productivity Measurement and Analysis.* Paris: OECD, 479-503. ISBN 978-3-303-04079-9.

FEIN, A. J., 1998. Understanding evolutionary processes in non-manufacturing industries: Empirical insights from the shakeout in pharmaceutical wholesaling. *Journal of Evolutionary Economics.* **8**(3), 231-270. ISSN 0936-9937.

HECKMAN, J. J., 1976. The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models. *Annals of Economic and Social Measurement*. **5**(4), 475–492. ISSN 0044-832X.

ILCHENKO, N., 2016. Issues of innovative approaches implementation to the wholesale trade enterprises. *Economic Annals.* **160**(7-8), 66-70. ISSN 0013-3264. DOI: 10.21003/ea.V160-13

NORDHAUS, W. D., 1969. An Economic Theory of Technological Change. *The American Economic Review*. **59**(2), 18–28. ISSN 0002-8282.

SHEN, B. et al., 2016. Design outsourcing in the fashion supply chain: OEM versus ODM. *Journal of the Operational Research Society.* **67**(2), 259-268. ISSN 0160-5682.

SILVERBERG, G. and B. VERSPAGEN, 1994. Learning, Innovation and Economic Growth: A Long-run Model of Industrial Dynamics. *Industrial and Corporate Change*. **3**(1), 199–223. ISSN 1464-3650.

SUTTON, J., 2001. *Technology and market structure: theory and history*. Cambridge: MIT Press. ISBN 978-0-262-69264-9.

VOKOUN, M., 2016. Innovation Behaviour of Firms in a Small Open Economy: The Case of the Czech Manufacturing Industry. *Empirica*. **43**(1), 111–139. ISSN 0340-8744.

VOKOUN, M., 2017. Issues Inside the Field of Economics of Innovation: Definitions, Data Sources, Estimation Procedures and Comparability of Results. *Littera Scripta* [online]. České Budějovice: Institute of Technology and Business in České Budějovice, **10**(2), 165-176 [accessed: 2017-12-15]. ISSN 1805-9112. Available at: http://journals.vstecb.cz/category/litterascripta/10-rocnik-2017/2_2017/.

ŽIŽLAVSKÝ, O., 2015. Innovation Project Performance Measurement: Selected Shortcomings. *Littera Scripta* [online]. České Budějovice: Vysoká škola technická a ekonomická v Českých Budějovicích, **8** (2), 173-186 [accessed: 2015-12-17]. ISSN 1805-9112. Available at: http://portal.vstecb.cz/publishingportal/littera-scripta/rocnik/8/cislo/2.

Contact address of the author:

Ing. Marek Vokoun, Ph.D., Department of Humanities, Faculty of Corporate Strategy, Institute of Technology and Business in České Budějovice, Okružní 517/10, 370 01 České Budějovice, Czech Republic; e-mail: marek.vokoun@vstecb.cz.

VOKOUN, M., 2018. Innovation in the Wholesale and Retail Sectors in the Czech Republic 2008-2014. *Littera Scripta* [online]. České Budějovice: Institute of Technology and Business in České Budějovice, **11**(1), 145-154 [accessed: 2018-06-29]. ISSN 1805-9112. Available at: http://journals.vstecb.cz/category/littera-scripta/11-rocnik-2018/1_2018/.