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THE IMPACT OF TECHNOLOGICAL AND NON-TECHNOLOGICAL INNOVATIONS ON FIRM GROWTH

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ABSTRACT: This study investigates the relationship between innovations and firm growth, based on the data of Finnish firms operating in the software industry. We find that in terms of turnover and employment, firms with only technological innovations do not grow more rapidly than other firms. However, firm growth is positively associated with the combination of technological and non-technological innovations.

KEY WORDS: Innovation, technological, non-technological, R&D, firm, development, employment, growth, Finland.

JEL-CODES: O3, O33, L2

Ali-Yrkkö, Jyrki ja **Martikainen**, Olli**. TEKNOLOGISTEN JA EI-TEKNOLOGISTEN INNOVAATIOIDEN VAIKUTUS OHJELMISTOYRITYSTEN KASVUUN.** Helsinki, ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2008, 19 s. (Keskusteluaiheita, Discussion Papers; ISSN 0781-6847; no. 1165).

TIIVISTELMÄ: Tutkimuksessa tarkastellaan innovaatioiden vaikutusta yritysten kasvuun. Erityisenä kiinnostuksen kohteena ovat eri innovaatiomuotojen eli teknologisten ja ei-teknologisten innovaatioiden vaikutukset kasvuun. Empiirinen aineisto koostuu Suomessa toimivista ohjelmistoalan yrityksistä. Tulosten mukaan pelkillä teknologisilla innovaatioilla ei ole vaikutusten yritysten kasvuun. Sen sijaan yritykset, jotka tekevät teknologisia ja ei-teknologisia innovaatioita, kasvavat muita yrityksiä nopeammin sekä liikevaihdon että henkilöstömäärän suhteen.

AVAINSANAT: Innovaatio, teknologinen, ei-teknologinen, t&k, yritys, liikevaihto, työllisyys, kasvu, Suomi

JEL-KOODIT: O3, O33, L2

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1 INTRODUCTION

Innovations have long been recognised to have the central role in economic growth (e.g. Kuznets 1930, Schumpeter 1939). However, the majority of empirical evidence concerning the relationship between innovations and firm growth has focused on innovations relating to technology development.

To measure innovation, most previous studies have used R&D expenditure as an indicator. The evidence from the UK suggests that R&D intensity (R&D expenditure divided by net sales) has a positive relation to firm growth (Nolan et. al. 1980). Similar results have also been reported in some other countries. For example, Del Monte and Papagni (2003) used a panel data consisting of 500 Italian firms to study R&D and the growth of firms. Their results suggested that the growth rates of sales and personnel in firms conducting R&D were larger (56% and 18%, respectively) than those of firms without R&D (48% and 10%, respectively) with a statistically significant difference. A study focusing on Japanese manufacturing firms (Yasuda 2005) displays that the R&D expenditure per employee has a significant positive effect on firm growth. A similar study on Taiwanese electronics firms (Yang and Huang 2005) shows that an increase in R&D induces a higher growth rate, and that this impact is larger in small firms.

Nurmi (2004) analysed a large dataset (more than 70,000 observations) consisting of Finnish plant-level data and reported the positive relation between R&D intensity and plant growth. In terms of the net rate of change of employment, Maliranta (2003, pp. 187-191) found a positive relation between R&D intensity and growth but the effect disappeared when industry effects were controlled for. Rantala (2006, pp. 103-108) used different methods to measure innovativeness. As alternative innovation indicators, he used CIS survey (Community Innovation Survey) questions and R&D expenditure. The coefficients of innovation regressors were statistically insignificant and in many cases the coefficients were actually negative.

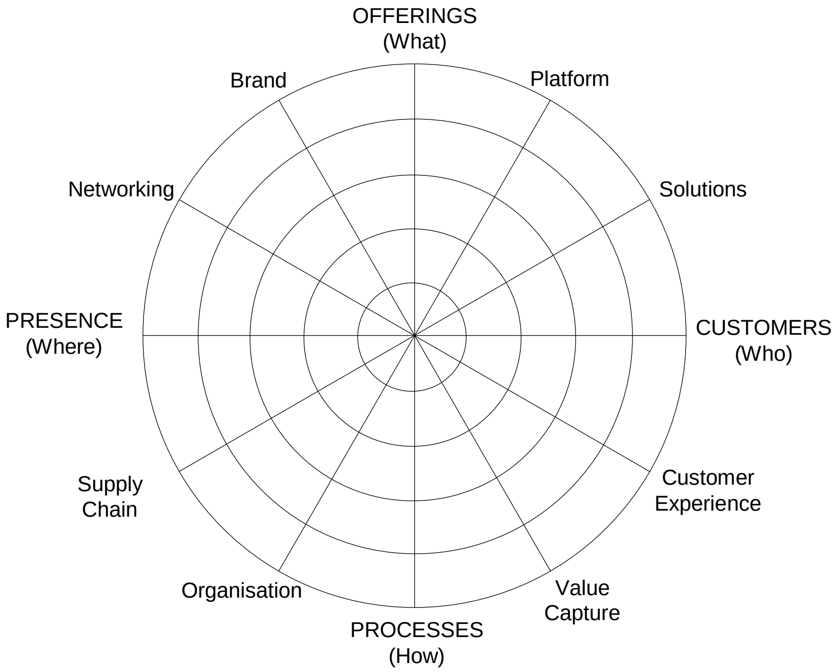
But what is innovation? Innovations are often seen as synonymous with technological development relating to new or improved products or processes. Hence, other types of innovations such as organisational or branding innovations have been ignored.

Morone and Testa (2008) contribute to the literature by taking into account organisational changes and marketing innovation as potential factors impacting on firm growth. The results from 2,600 Italian manufacturing firms indicate that process innovation and organisational change have a stronger effect on a firm's growth than product and marketing innovations. The results by Schmidt and Rammer (2007) give some support to a view that the relationship between technological and non-technological innovations is complementary. Firms that combine their product innovations with both marketing and organisational innovations perform better in terms of sales with market novelties than those focusing purely on product innovations.

In this paper, we divide firms' total innovations into two groups: technological and non-technological innovations and ask what are the impacts of different types of innovation on firm growth.

As a first step towards examining this issue, we use survey data on software firms in Finland. The survey was conducted in spring 2008 as a joint effort by Helsinki University of Technology (Software Business Lab) and University of Turku (Software Product Development Research Group). To measure different dimensions of innovation, we utilise the Innovation radar approach by Sawney, Wollcott & Arroniz (2006). The innovation radar is composed of 12 dimensions of innovation (Figure 1.1)

Figure 1.1. Innovation radar



This framework allows us to separate technological innovations and non-technological innovations. In addition to the innovation dimensions based on the radar, our data also included the R&D expenditure of firms.

The remainder of this study proceeds as follows. Section 2 describes our data. Section 3 gives an empirical analysis, main results and robustness tests. Finally, Section 4 contains a summary and conclusions.

2 DATA

Our data is a unique dataset consisting of Finnish firms operating in the software industry. Two separate data sources have been merged. Our primary data were collected using a WWW questionnaire. The survey (the OSKARI questionnaire) was conducted in spring 2008 as a joint effort by Helsinki University of Technology (Software Business Lab) and University of Turku (Software Product Development Research Group).

The survey was nation-wide and the target population consisted of software firms [1]. Typically, the respondent of the survey was the firm's CEO.

The survey produced 615 usable responses. To exclude pure software resellers or distributors, we included only those firms that have in-house software development operations. The primary data was complemented by secondary data from Statistics Finland which contained the year that firms were established. As a result, our final estimation sample includes 267 observations.

We have operationalised the key variables as follows:

Firm size: We use both employment and net sales as a measure of firm size. The questionnaire offers information about net sales and number of employees in 2007 and 2008 (budgeted).

Firm age: Because the OSKARI questionnaire does not include the establishing year of firms, we merged the questionnaire data with the company register of Statistics Finland. The company register included the year that firms were established and we used that information to calculate the firm age by subtracting the year of establishment from 2007.

Technological innovations: To measure technological innovations, we use two variables both based on the information on the firm's R&D. *First*, we define a technological innovation dummy ($TECH\_INN\_D_{it}$) equaling 0 if a firm has no R&D expenditure and 1 if the firm's R&D expenditure is greater than zero. *Second*, as another indi-

[1] The detailed description of the survey is presented in Rönkkö et. al. (Forthcoming). Downloadable at: http://www.sbl.tkk.fi/

cator of technological innovations we use R&D intensity (RD_INT_{it}), that is, R&D expenditure divided by net sales.

Non-technological innovator (dummy variable): To find firms with non-technological innovations, we utilise survey questions related to innovation radar dimensions presented in the introduction. The questionnaire included two (5-point) Likert-scale questions for each 12 innovation dimensions (see Appendix). The questions were originally formulated by the developers of the innovation radar[2] but due to the space limitations, the OSKARI questionnaire did not include all questions of the original questionnaire by Sawney, Wollcott & Arroniz (2006).

Out of these 12 dimensions, three (offerings, platform and processes) are clearly related to technology development. Offerings are products and services, and the innovation of these requires the creation of new products of services. A platform is a set of common components, assembly methods or technologies that serve as building blocks or modules for a portfolio of products and services. Processes are the configuration of activities used to conduct internal operations. Innovations along offerings, platform and processes very often require R&D.

We treat other 9 dimensions of the innovation radar as non-technological innovations. To define firms with non-technological innovations, we proceeded as follows. In the first step, we defined dummy variables D_i^n for each type of non-technological innovation dimensions n separately (n varies between 1 and 9). If the respondent answered "*strongly agree*" to either of the two questions related to innovation dimension n , then the firm i has done that kind of innovation, and D_i^n gets the value 1, otherwise zero. In the second step, we construct a dummy variable ($NON\_TECH\_D_{it}$) equaling 1, if a firm i has done any kind of non-technological innovation n (i.e., if D_i^n =1 for some n = 1,..,9), otherwise zero.

Sum of non-technological innovation dimensions: To calculate the sum of non-technological innovation dimensions ($SUM\_NON\_TECH\_INN_i$) of a firm i we sum up firm-specific (non-technological) innovation dimension dummies D_i^n s.

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[2] We gratefully acknowledge Professor Sawhney and Dr. Jiyao Chen for providing us with the original questionnaire form.

Hence, for a firm *i* the number of non-technological innovation dimensions is calculated as:

$$SUM\_NON\_TECH\_INN_i = \sum_{n=1}^{9} D_i^n$$

Basic statistics

Our cross-section data consists of 267 software firms. The next table (2.1) describes our data that we use in statistical analyses.

Table 2.1. Descriptive statistics

	N	Mean	S.D.	Median	Min	Max
Net Sales (2007), EUR	267	2,622,010	9,142,646	400,000	1,000	74,700,000
Net Sales growth rate (2007-2008)	267	0.274	0.391	0.201	-1.792	2.303
Employment (2007)	267	28.76	97.90	5	1	850
Employment growth rate (2007-2008)	267	0.130	0.426	0.063	-3.750	1.099
Age	267	8.90	6.99	7	1	40
R&D (Dummy)	267	0.88	0.32	1	0	1
R&D intensity (all firms)	267	0.155	0.156	0.105	0.000	0.798
R&D intensity (firms with R&D >0)	236	0.176	0.154	0.132	0.000	0.798
Sum of non-technological innovations	267	1.12	1.84	0	0	9

Table 2.1 shows that in terms of net sales and employment our sample firms are, on average, rather small. Among the firms with R&D expenditure, the average R&D intensity is rather high representing as much as 17.6% of their net sales.

3 HAS INNOVATION IMPACTED FIRM GROWTH?

3.1 Univariate Analysis

We begin our statistical analysis by considering univariate analyses. First, we divide the sample into technology innovators and others (Table 3.1). A firm is classified as a technology innovator if its R&D expenditure is greater than zero.

Table 3.1. Descriptive statistics for technology innovators and others (two-tailed *t*-tests in means)

	Technology innovators (R&D>0), N=236	Other firms (R&D=0), N=31	*t*-test	
Net Sales (2007), EUR	2,862,855	788,484	-1.19	
Net Sales growth rate (2007-2008)	0.25	0.48	3.09	***
Employment (2007)	31.60	7.13	-1.31	
Employment growth rate (2007-2008)	0.12	0.20	0.93	
Age	9.26	6.13	-2.36	**
Sum of non-technological innovations	1.15	0.90	-0.71	

Note: ***=significant at the 1% level, **= significant at the 5% level, and *=significant at the 10% level

Table 3.1 shows that there are some statistically significant differences in means between the two groups. First, the comparison suggests that technology innovators' growth rate is LESS than other firms (significant at better than 1 % level). Second, technology innovators are also somewhat older than other firms (significant at better than 5 % level). However, it should be noted that our sample includes only 31 firms without R&D.

Next, we consider differences between non-technology innovators and others. As a classification criteria we use the non-technology innovator variable ($NON\_TECH\_D_{it}$) defined in Section 2. Interestingly, comparisons suggest that there are also significant differences between firms that have made non-technology innovations and other firms.

Table 3.2. Descriptive statistics for non-technology innovators and others (two-tailed *t*-tests in means)

	Non-technology innovators (*NON_TECH_D* =1), N=124	Other firms (*NON_TECH_D* =0), N=143	*t*-test	
Net Sales (2007), EUR	1,903,113	3,245,390	1.20	
Net Sales growth rate (2007-2008)	0.33	0.23	-2.12	**
Employment (2007)	19.82	36.51	1.39	
Employment growth rate (2007-2008)	0.19	0.08	-2.27	**
Age	7.86	9.79	2.26	**
R&D (Dummy)	0.89	0.88	-0.15	
R&D intensity	0.17	0.139	-1.83	*

Note: ***=significant at the 1% level, **= significant at the 5% level, and *=significant at the 10% level

In terms of sales growth rate, the comparison indicates that non-technology innovator firms grow faster than other firms (significant at better than 5 % level). Moreover, it seems that these non-technology innovators also increase their number of employees more than others. The table also indicates that compared to other firms, non-technology innovators are younger (significant at better than 5 % level) and their R&D intensity greater (significant at better than 10 % level). The last result is interesting because it suggests that non-technology innovators also invest in technology development. To consider this issue in detail, next we compare multi-innovator firms, that is, firms that have both technological and non-technological firms, to other firms (Table 3.3).

Table 3.3. Descriptive statistics for multi-innovators (both technological and non-technological innovations) and others (two-tailed *t*-tests in means)

	Multi-innovators (R&D>0 and *NON_TECH_D* =1), N=110	Other firms (R&D=0 or *NON_TECH_D* =0), N=157	*t*-test	
Net Sales (2007), EUR	2,013,555	3,048,317	0.91	
Net Sales growth rate (2007-2008)	0.320	0.242	-1.62	+
Employment (2007)	21.232	34.032	1.05	
Employment growth rate (2007-2008)	0.199	0.082	-2.21	**
Age	7.918	9.580	1.92	*

Note: ***=significant at the 1% level, **= significant at the 5% level, *=significant at the 10% level, +=significant at the 15% level

The comparison indicates that in terms of net sales and employment, multi-innovators' grow faster than other firms. Furthermore, these firms are younger.

3.2 Basic regressions

We use Evans' model (Evans 1987), as a starting point to analyse firm growth. According to Evans, the firm growth for a firm *i* is a function of size and age:

$$SIZE_{i,t+1} = G(SIZE_{it} AGE_{it}) SIZE_{it} e_{it} \, , \qquad (1)$$

where e_{it} is a lognormally distributed error term. Based on this equation, the regression model can be formulated as:

$$\ln SIZE_{i,t+1} - \ln SIZE_{it} = \ln G(SIZE_{it} AGE_{it}) + u_{it} \, , \qquad (2)$$

where u_{it} is distributed normally with zero mean. When Gibrat's law holds, the coefficient of firm size is zero. To capture the potential impact of innovation activities, in the first step we include the technological innovation regressor ($TECH\_INN\_D_{it}$) in the equation (2).

by defining $GR_{it} \equiv \ln SIZE_{i,t+1} - \ln SIZE_{it}$ our baseline specification for the estimation is:

$$GR_{it} = \beta_0 + \beta_1 \ln SIZE_{it} + \beta_2 \ln AGE + \beta_3 TECH\_INN\_D_{it} + e_{it} \qquad (3)$$

Because our dataset is cross-sectional, in practice we estimate the following model:

$$GR_{i,2007-2008} = \beta_0 + \beta_1 \ln SIZE_{i,2007} + \beta_2 \ln AGE_{i,2007} + \beta_3 TECH\_INN\_D_{i,2007} + e \qquad (4)$$

Our estimation strategy proceeds as follows. *First*, we consider the growth of employment. We estimate the model (4) by using the ordinary least squares (OLS) method. This model, however, has a narrow view because it includes only innovation activities related to technology. Hence, it does not take into account the possibility that in order to lead to a positive market outcome, technology innovation may also require non-technological innovations ($SUM\_NON\_TECH\_INN_i$). To control for this, we include an interaction term ($RD\_INT_{it} \times SUM\_NON\_TECH\_INN_{it}$) in the equation (3). *Second*, we repeat the estimations above by using the growth of net sales as a dependent variable. Finally, we use several alternative definitions to check the sensitivity of our basic results.

In terms of employment growth, our basic results are contained in Table 3.3.

Table 3.3. Innovations and the growth of firms' employment (OLS-regressions)

	(a) Coef./S.E.	(b) Coef./S.E.	(c) Coef./S.E.
ln(SIZE)	-0.019	-0.017	-0.018
	(0.029)	(0.028)	(0.028)
ln(AGE)	-0.082 ***	-0.085 ***	-0.081 ***
	(0.020)	(0.019)	(0.019)
TECH_INN_D (Dummy)	0.010	-0.035	-0.032
	(0.064)	(0.062)	(0.062)
RD_INT		0.247	0.105
		(0.169)	(0.180)
RD_INT * SUM_NON-TECH INN.			0.093 **
			(0.047)
Constant	0.513	0.492	0.497
	(0.337)	(0.326)	(0.326)
Observations	267	267	267
Wald(Model)	6.977 ***	6.294 ***	5.633 ***
R2	0.05	0.06	0.07

NOTES: Heteroscedasticity-corrected standard errors in parentheses.
Wald (Model) = test the hypothesis that all coefficients excluding constant are zero.
*** = significant at the 1% level
** = significant at the 5% level
* = significant at the 10% level

The results reported in columns (a) and (b) suggest that technology innovation does not have a statistically significant relation to employment growth. In column (*a*), the coefficient of technological innovation dummy ($TECH\_INN\_D_{it}$) is positive but it does not differ statistically significantly from zero. However, it should be noted that only 31 out of the whole sample (267 firms) do not carry R&D hence the reference group with no R&D is quite small. In column (*b*), we have added R&D intensity (RD_INT_{it}) to the model. The coefficients of $TECH\_INN\_D_{it}$ and RD_INT_{it} are statistically insignificant indicating again that there are no statistically significant relationship between technology innovation and employment growth.

Until now our analyses have focused on technological innovations and their potential impact on firm growth. However, it is possible that the effect of technology innovations on growth occurs only when they are combined to non-technological innovations. To take this into account, we expand the model by adding the interaction term

(R&D intensity * Number of non-technological innovation dimensions) to the regression (column *c*). The coefficient of this interaction term obtains the statistically significant positive value (0.09) indicating that firms with both technological and non-technological innovations grow faster than other firms.

We proceed by running similar regressions to sales growth (Table 3.4).

Table 3.4. Innovations and the growth of firms' net sales (OLS-regressions)

	(a) Coef./S.E.	(b) Coef./S.E.	(c) Coef./S.E.
ln(SIZE)	0.024 * (0.014)	0.026 * (0.014)	0.027 * (0.014)
ln(AGE)	-0.174 *** (0.026)	-0.177 *** (0.026)	-0.174 *** (0.025)
TECH_INN_D (Dummy)	-0.141 (0.095)	-0.202 ** (0.101)	-0.200 ** (0.101)
RD_INT		0.344 ** (0.143)	0.195 (0.151)
RD_INT * SUM_NON-TECH INN.			0.099 ** (0.049)
Constant	0.663 *** (0.108)	0.665 *** (0.109)	0.661 *** (0.109)
Observations	267	267	267
Wald(Model)	15.586 ***	12.506 ***	11.124 ***
R2	0.21	0.26	0.24

NOTES: Heteroscedasticity-corrected standard errors in parentheses.
Wald (Model) = test the hypothesis that all coefficients excluding constant are zero.
*** = significant at the 1% level
** = significant at the 5% level
* = significant at the 10% level

The first point worth noticing is that the results differ slightly compared to Table 3.3. In column (a), the coefficient of $TECH\_INN\_D_{it}$ does not differ statistically significantly from zero echoing the result of similar employment growth estimation (column *a* in Table 4.3). In column (b), the negative coefficient of $TECH\_INN\_D_{it}$ becomes statistically significant but the coefficient of RD_INT_{it} obtains a statistically significant positive value that makes it difficult to interpret the results. In column (c), the interaction term is added to the model. The coefficient of this interaction is positive and differs statistically significantly from zero (at better than 5 % level). Hence, this result suggests that firms that combine technological and non-technological innovations grow faster than pure technology innovators.

To better illustrate the nature of interaction between technological and non-technological innovations, we conduct a simple slope analysis suggested by Aiken & West 1991 (see also Cohen, Cohen, West & Aiken 2003, 267-268). Based on our data, we use three different values for the number of non-technological innovations (minimum, mean and maximum) and plot the conditional regression lines for R&D intensity (Figure 3.1). The scaling of X and Y axes of the figure is based on the range of our data.

Figure 3.1. Firm growth as a function of the number of non-technological innovations and R&D intensity.

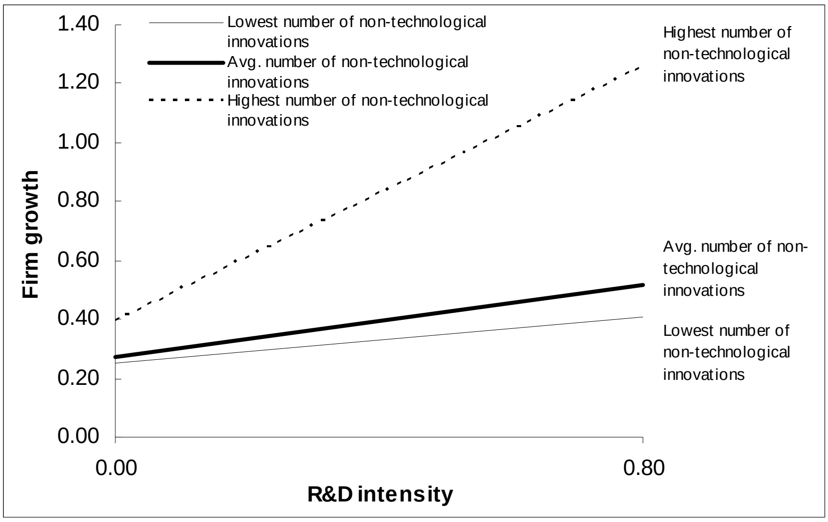

Figure 3.1 illustrates that the growth effect of R&D intensity is clearly stronger when the number of non-technological innovations is higher indicating the complementary relationship between technological and non-technological innovations.

3.3 Robustness Tests

Next, we perform two robustness tests. To save space, we do not completely report the results of these new regressions.

Robustness test 1:

In the basic estimations (Tables 3.1 and 3.2), we used the existence of R&D expenditure as a measure of technological innovations ($TECH\_INN\_D_{it}$). However, R&D expenditure can be seen as an input of technological innovations rather than output or realisation. To address this concern, we re-defined the technological innovation dummy-variable ($TECH\_INN\_D_{it}$) as follows. If a firm has answered "*Very much*" to any of the questions related to offerings, platform or process innovations then the variable ($TECH\_INN\_D_{it}$) gets the value 1, otherwise zero. After this re-definition, we re-run the models.

Our estimations based on the alternative technological innovation variable show that in the employment growth equation the coefficient of the interaction term ($TECH\_INN\_D_{it} \times SUM\_NON\_TECH\_INN_{it}$) remains positive and statistically highly significant (the coefficient of interaction term is 0.03 with *p*-value 0.002). However, in the sales growth equation the coefficient of the interaction term ($TECH\_INN\_D_{it} \times SUM\_NON\_TECH\_INN_{it}$) turns to statistically insignificant (the coefficient of interaction term is 0.01 with *p*-value 0.56)

Robustness test 2:

In the basic models, we defined dummy variables D_i^n for each type of non-technological innovation dimensions *n* separately (*n* varies between 1 and 9). If the respondent answered "*Very much*" to either of the two questions related to innovation dimension *n*, then the firm *j* has done that kind of innovation, and D_i^n gets the value 1, otherwise zero. However, this definition is very strict because D_i^n gets the value 0 if the respondent answered "*A lot*". Hence, it is possible that by the above mentioned definition we are too conservative in defining innovation dummies (D_i^n). To test this, we re-defined dummy variables D_i^n as follows: First, if the respondent answered "*A lot*" or "*Very much*" to either of the two questions related to innovation dimension *n*, then the firm *j* has done that kind of innovation, and D_i^n gets the value 1, otherwise zero. Second, we calculated the sum of non-technological innovation dimensions ($SUM\_NON\_TECH\_INN_i$) exactly in the same way as in basic models (i.e. $SUM\_NON\_TECH\_INN_i = \sum_{n=1}^{9} D_i^n$). Then we re-ran the basic models.

The results of these new regressions show that our results echo our previous findings. First, in the employment growth equation the coefficient of the interaction term

($RD\_INT_{it} \times SUM\_NON\_TECH\_INN_{it}$) is 0.08 and statistically significant at 0.04% level. Second, in the sales growth equation, the coefficient of the interaction term is also positive and highly statistically significant (the coefficient of interaction term is 0.09 with *p*-value 0.03).

4 CONCLUDING REMARKS

This study analysed the impact of innovations on firm growth using data on Finnish software firms. Our dataset (267 observations) consisted of mostly small and private firms. In contrast to the existing literature, we considered both technological and non-technological innovations to study the relationship between innovations and firm growth.

Our empirical analysis provided us with important findings. The results suggest that innovations have a statistically significant positive relationship with firm growth. However, we find this positive relationship only in the cases when firms have made both technological and non-technological innovations. Without non-technological innovations, pure technological innovations or R&D activities do not seem to turn to firm growth indicating the complementary relationship between technological and non-technological innovations.

Our results, however, are only a first step in analysing the impact of different kinds of innovations on firm performance. Our dataset covers only a single industry, hence the findings can not be generalised to all industries. Another caveat of our study is that due to data limitations, we are unable to consider the effect of different types of innovation on firm survivability.

Despite these limitations, our findings are interesting from the perspective of innovation policy makers. Like all other developed countries Finland has also used public R&D funding to encourage private R&D spending. The main public funding organisation for research and development in Finland is Tekes (Finnish Funding Agency for Technology and Innovation). Traditionally, Tekes has focused on funding pure technology development though recently Tekes has widened its scope to also cover service innovations and new business models. In the light of our results, this change is justified. Our results support the view that firms who combine their technological innovations with non-technological innovations perform better in terms of firm growth.

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6 APPENDIX

Appendix 1. Survey questions related to the innovation radar

The following questionnaire maps the pattern of the innovation activities of the firm. The responses are mapped on 12 innovative dimensions, each of which contains two questions. Hence, each firm was asked 24 questions.

Please mark to what extent the following statements describe your firm (1=Not at all, 2=little, 3=somewhat, 4=A lot, 5=very much)

1. Offerings:

1.1. We upgrade and improve our existing products and services faster than anyone in our industry

1.2 Our customers consider our new products and services to be innovative

2. Platform

2.1. We have developed new ways to integrate outside technologies or resources into our products

2.2. We use modularity or product platforms more than our competitors

3. Solutions

3.1. We combine products and services in new ways to integrated solutions

3.2. We have a well-defined process for creating solutions for customers

4. Customers

4.1. We serve customer segments that others do not recognise as opportunities

4.2. We are able to identify underserved customer needs more than our competitors

5. Customer experience

5.1. We provide a better customer experience compared to our competitors

5.2. We have developed new ways to differentiate ourselves from our competitors at different stages of the customer’s buying process

6. Value capture

6.1. We have created innovative pricing schemes for our products and service (e.g., subscription pricing) more than our competitors

6.2. We innovate (you can't have new innovations – innovation from Latin in + novare = to renew – thus proving again the usefulness of learning Latin ☺) ways to monetize intellectual property assets in business

7. Processes

7.1. Our operating processes are very creative compared to industry standards

7.2. We look for higher levels of operational effectiveness by innovatively managing our business processes

8. Organisation

8.1. We consider our organisation design to be a source of competitive advantage

8.2. Our company culture is regarded as creative and innovative

9. Supply chain

9.1. We have created more new ways than our competitors for sourcing our inputs and delivering our products and services to our markets.

9.2. We have made innovations to interact with our supply chain partners

10. Presence

10.1.We have created new channels or methods to tap into new markets compared to industry standards

10.2. We lead the industry in terms of applying new channels of distribution

11. Networking

11.1., We use network technologies to deliver our product or services more than our competitors

11.2. We have been pioneers in creating Internet versions of traditional products and services

12. Brand

12.1. We are considered to be innovators in terms of how we have managed and built our brands

12.2. Our brand innovations have allowed us to enter new markets and customer segments more than our competitors,.

Appendix 2: Correlation matrix

	Net Sales	Employment	Age	R&D-dummy	R&D-intensity	*NON_TECH_D*	Sum of non-technological innovations
Net Sales	1.000						
Employment	0.947	1.000					
Age	0.217	0.167	1.000				
R&D dummy	0.073	0.080	0.144	1.000			
R&D intensity	-0.066	-0.081	0.096	0.363	1.000		
NON_TECH_D	-0.073	-0.085	-0.138	0.009	0.112	1.000	
Sum of non-technological innovations	-0.069	-0.081	-0.039	0.043	0.115	0.656	1.000

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