Factors affecting outcomes of EU-supported investments in innovation among SMEs in the Greater Poland (Wielkopolska) region, Poland

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Structured Abstract:

Purpose: The European Union offers support mechanisms to help small and medium sized enterprises (SMEs) to innovate and grow. Given the substantial contribution of SMEs to national economies, the present paper explores what factors tend to be associated with the success of EU-supported innovation by SMEs in Poland during its early post-accession period.

Design/methodology/approach: A conceptual model relating the type of innovation, investment purpose, funding type and financial readiness, location and collaboration possibilities, company size and sector of operation to changes in the capital base, employment, unit price and revenue is proposed. This model is operationalised and estimated as a structural equations model and estimated using a sample of 110 SMEs surveyed in 2008 in the Greater Poland (Wielkopolska) region in Poland.

Findings: Two approaches to the successful use of innovation support have been observed among the studied companies. The first approach implements market innovations to establish a presence in foreign markets and to move the product or service up the value chain. The second approach uses the funding to de-risk workforce expansion and increase production capacity.

Originality/value: The paper provides the first systematic disaggregate level analysis of an early post-accession context where impacts of EU support for SME innovation are decomposed into effects of specific investment conditions and innovation type on changes in capital base, employment, unit price and ultimately revenue. The insights provided here are valuable for managers developing business and innovation strategies on the one hand, but also for policy-makers responsible for creating an entrepreneurship-friendly environment in emerging economies.

Keywords: innovation, small to medium sized enterprises, entrepreneurship, official support bodies

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1. Introduction

The European Union's strategy for supporting small and medium sized enterprises (SMEs) includes trade liberalisation, harmonisation of regulations, promotion of fair competition, simplification of fiscal and regulatory systems, as well as financial support for investment-, innovation-, and export-oriented activities (European Commission, 2008). To implement these approaches, the EU makes use of various policy tools, including tax exemptions, financial aid, public investment programmes, the development and transfer of technologies, training schemes and the creation of information and knowledge networks. These initiatives are aimed at creating a coherent and supportive environment for the SME sector, and are funded through multi-year programmes, including Framework Programmes for Research and Technological Development, European Investment Funds, European Social Funds, as well as Structural Funds (European Commission, 2014).

The significance of supporting SMEs rests on their contribution to national economies. Tarute *et al.* (2014) pointed out that SMEs constituted more than 90% per cent of all companies in developed countries, enjoying growth rates higher than large companies and also employing the majority of the labour force. Increasingly, however, the growth of SMEs has become dependent on the ability to innovate. Consequently, knowledge and experience regarding the utilisation of innovation-supporting funding have become more valuable. Such knowledge can assist SMEs in their business planning and thus lead to higher chances of successfully investing in innovation (Radas *et al.*, 2009; Rosenbusch *et al.*, 2011). The Polish context, in which this paper is placed, is a valuable setting for analysing the impacts of innovation support for SMEs under the conditions of a catching up, post-socialist economy. The country's SME sector proved instrumental following Poland's transition to the free market system in 1989, especially by providing employment opportunities for those made redundant during the restructuration of inefficient state-owned enterprises. At that time, however, a lack of access to suitable financing and support mechanisms meant that many such companies struggled to innovate, and were often unable to realise their full growth potential (Markovic *et al.*, 2011).

The accession of Poland to the EU in 2004 radically changed this landscape since the SME sector could start to benefit fully from the EU's support mechanisms. This support has been seen as one of the ways to accelerate convergence between the 'old' and 'new' countries (MID, 2013). A shortage of knowledge regarding how to obtain and, more importantly, utilise the EU funding successfully, however, has been identified as one of the main reasons for the relatively poor performance of Polish enterprises with regards to translating innovation into commercial success (Klonowski, 2012). This shortage of knowledge was caused partly by the fact that the existing expertise and guidance relied primarily on experiences and studies from more mature market economies, with conditions often very different from those of the newly joining states (Radas *et al.*, 2009; Romero-Martínez *et al.*, 2010). However, Polish SMEs have tended initially to concentrate their efforts on capital investment and import of foreign technology, rather than indigenous innovation (Breznitz and Ornston, 2017). Understanding factors that enable successful achievement of the latter is, however, key for enraging ongoing productivity growth and escaping middle income trap.

In the past decade researchers have started to address this gap in knowledge, and the present paper seeks to contribute to this strand of research through an analysis of 110 SMEs from the Greater Poland (*Wielkopolska*) region in Western Poland who successfully obtained EU support for their investments in innovation during the early post-accession years, i.e. 2006 to 2008. Five groups of factors[1] are analysed: funding availability, innovation type, investment purpose, location,

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[1] In the present context the phrase *factor* is used interchangeably with *conditions* and *circumstances*.

company attributes, which predisposed their EU-supported investment in innovation to lead to growth in revenue. Structural equation modelling (SEM) is used to decompose interrelationships between these factors and changes in the employment level, the capital base, the unit price and the revenue. This approach complements the existing literature by offering a systematic disaggregate analysis of in the context of early post-accession Poland, to date absent from the field. The geographically narrow focus is beneficial in light of findings of Bruton *et al.* (2014) who suggested that no single, ideal model for entrepreneurial firms exist. Hence insights provided here are valuable for managers developing business and innovation strategies on the one hand, but also for policy-makers responsible for creating an entrepreneurship-friendly environment in emerging economies.

The structure of the paper is as follows. Section 2 discusses findings from previous studies exploring factors associated with higher chances of an investment in innovation being successful. This knowledge provide a means of constructing, in section 3, a methodology in the form of a conceptual model of how innovation investment conditions influence the performance of a company. In section 4 empirical data and SEM operationalisation is presented. Section 5 discusses the findings while section 6 draws conclusions and presents suggestions for future research.

2. Previous research on factors influencing the effects of investments in innovation in the SME sector

The literature overview below presents existing studies on how the particular circumstances in which investment in innovation took place were associated with the growth of the innovating companies. The specific findings reported in each of the five groups of factors (innovation type, investment purpose, funding type and financial readiness of the companies, location and collaboration possibilities, company size and sector of operation) provide a rationale for the subsequent inclusion of these factors in the conceptual model and empirical analysis.

2.1 Innovation type

The most widely recognised taxonomy of innovation was suggested by Schumpeter (1943) who distinguished four types of innovation: process, product, organisation and market. Since then, this distinction has helped researchers to explore systematically and comparatively the effects of implementing these different types of innovation.

In terms of empirical research, Gunday *et al.* (2011) reported that all types of innovation have a positive influence in terms of improving the performance of SMEs. A similar set of findings was reported by Rosenbusch *et al.* (2011) who also noted that innovation had positive effects on the performance of the businesses, the relative returns on investing resources in different types of innovation (e.g. process and output) were different. Varis *et al.* (2010) provided evidence from Finland that the introduction of product and market was associated with company growth. Oke *et al.* (2007), meanwhile, noted that incremental rather than radical innovations appeared to be more cost-effective. Hall *et al.* (2009) provided evidence for the significant role of product and process innovation in improving the productivity of the SMEs. A similar finding was reported by Laforet (2013), although in relation to organisational innovation. They also noted the latter's association with increased margins, greater market leadership, and improved working environments, but not operational efficiency or employees' retention. Radas *et al.* (2009) looked at the SME sector in Croatia, concluding that product and process innovations were more likely to be associated with a company's expansion in both national and international markets.

Zapalska *et al.* (2015), working in the context of Polish tourism industry, demonstrated importance of organisation innovation, noting the role of suitable leadership style and communication, in ensuring company's growth and successful implementation of other types of innovation. Lewandowska *et al.* (2016) conducted a research using 6,855 Polish firms and examined complementarities between various types of innovation: product, process, and marketing innovations. They concluded that combining product and process innovation resulted in increased export intensity.

A more critical perspective was presented by Hoffman *et al.* (1998) who presented ambiguous results regarding the effects of innovation on company performance. They noted, however, the existence of substantial evidence for employment growth among expanding SMEs, although that evidence was questioned by other researchers at that time. On the other hand, Mazur and Zaborek (2016) indicated that organisation innovation in the form of so-called innovative culture, i.e. fostering creativity and inter-employee cooperation, had no direct effect on sales but improved operational performance and overall company efficiency.

2.2 Investment purpose

Another group of studies explored the associations between the expansion of companies and the purposes of the investment they undertook. One of the most important reasons for innovation is research and development (R&D) activities. Looking at those, Dmirel *et al.* (2012) and Piras *et al.* (2012) indicated that R&D activities tended to be associated with company growth, further reflected in the higher survival rates (Lee *et al.*, 2015). Karhunen *et al.* (2015) provided evidence for a growth in employment among companies undertaking more R&D activities, and a number of other studies have indicated a positive association with output and productivity (Doraszelski *et al.*, 2013; Hall *et al.*, 2009).

Conversely, Bottazzi *et al.* (2002) demonstrated that companies with a high expenditure on R&D and seeking international expansion would not necessarily seek to increase the level of employment. Hall *et al.* (2009) found that competing internationally encouraged R&D, which in turn was associated with a higher likelihood of process and product innovations, ultimately resulting in higher productivity. In addition, Moen *et al.* (2016) reported that an international orientation tended to be linked to a stronger focus on growth, thus leading to a better performance, which the authors attributed to the existence of a managerial practice of seeking to expand into new markets. In the Polish context, the importance of internal culture, communication and organisation was highlighted by Norek (2013) who indicated those as primary barriers to successful innovation activities by Polish SMEs.

A different stream of research looks at investment in information and communication technologies (ICT), often to stimulate organisational and process innovation. Studies reported that improvements in productivity resulting from the use of ICT by companies could amount to 30%, depending on context and technology (Becchett *et al.*, 2003; Grimes *et al.*, 2011). Based on a sample of Spanish companies, Díaz-Chao *et al.* (2015) reported that investment in ICT could lead to increased innovativeness and thus higher exporting potential and labour productivity, especially in companies with flexible remuneration practices. In the Polish context, Kmieciak *et al.* (2012) found the performance of company to be positively related to ICT knowledge and innovation activities in the companies, the latter also influenced by level of investment in ICT.

Tarute *et al.* (2014), having reviewed a number of studies on the role of ICT adoption in SMEs productivity, concluded that such technologies could improve the financial and operational performance of companies, especially through increased productivity, profitability, market value, market share and resource allocation, as well as better internal and external communication. Kossaï *et al.* (2014) argued, nevertheless, that introduction of ICT needed to be accompanied by suitable organisational changes, such as training or decentralised decision-making protocols, in order fully to utilise their potential to contribute to the long-term growth of a company (Martin *et al.* 2013).

2.3 Funding availability and financial readiness

Another group of factors of potential relevance describe the financial circumstances in which investment is taking place. In particular we explore the role of type of financial support (funding), and the company's financial readiness to undertake the investment if funding was not available to them (the latter being a net effect of the financial capacity of the company as well as perceived risk of the investment).

Hoffman *et al.* (1998) pointed towards the availability of funding being an important factor determining an investment's success. At the time of publication they were unable to state, however,

which form of financial support proved the most effective and under what circumstances. In addition, they also emphasised the need for a supportive policy environment for companies undertaking investment in innovation, and in the subsequent commercialisation of that innovation. Similar points were raised by Breznitz and Ornston (2017) who provided the example of Finland and Israel, where long-term and consistent funding for R&D and innovation from starting in 1970s had managed to transform countries into knowledge-intensive economies.

In their empirical study of Dutch companies, Keizer *et al.* (2002) found innovation subsidies to be important determinants of the extent and magnitude of the innovative efforts. The authors did not, however, report on any role for the financial readiness of the company. Radas *et al.* (2009), following a similar approach to that of Keizer *et al.* (2002), analysed the factors influencing the propensity to innovate among Croatian enterprises. While noting numerous similarities between the Croatian and Dutch SME sectors, the authors did not find the association between the presence of subsidies for innovation and the innovativeness of companies to be significant.

In the Polish context, Karpińska-Mizielińska *et al.* (2009) noted that SMEs utilising the EU support tended to have higher employment and revenue levels, in addition to exporting more and devoting more resources to investment. In addition, they noted an overall consensus among the surveyed companies that the availability of the funding improved their competitiveness, which was especially reflected in higher numbers of customers. They noted, however, that successful investments, i.e. leading to company's growth, tended to be primarily those which the companies would have undertaken even if the support had not been obtained. Also in the Polish context, Czerniak and Stefański (2016) argued that proportion of companies investing in R&D among companies with access to external funding was almost 10% higher as compared to those without such access.

Another perspective was presented by Heimonen (2012) and Lee *et al.* (2015) who concluded that the innovative ones would normally face more financial pressures, thus presenting a clear rationale for public support in order to achieve innovativeness and growth. An interesting point was also made by Mason *et al.* (2010) who suggested that not only financial, but also procedural readiness to undertake an investment were important determinants of success in the subsequent acquisition of further support, and in the company's growth.

2.4 Location and collaboration

Another factor of potential importance is the location of the company, especially in relation to the potential market, various infrastructure and facilities, or the resource base, among others (Heimonen, 2012). Kaufmann *et al.* (2002) and Adekola *et al.* (2008) noted that the crucial pre-conditions for the SME support to be effective in stimulating their growth, was the availability of suitably qualified manpower. They emphasised, therefore, the potential difficulty for that condition to be met in relatively poorer regions, which also tended to suffer more from 'the brain drain', and where consequently innovation-supporting initiatives could be hampered. Similarly, Hoffman *et al* (1998) pointed to the importance of the availability of suitably qualified scientists and engineers, who could form the key sources of innovation in companies. Interestingly, they also argued that, based on the UK data, rural enterprises tended to be more innovative as compared to their urban counterparts, although they did not explore this finding in detail. It should be noted, however, that their review was published in the late 1990s, and thus prior to the emergence of the digitally-oriented urban-based start-ups which currently constitute one of the main engines of innovation.

Keizer *et al.* (2002) provided evidence for the importance of links to knowledge centres in improving the innovative efforts of companies. In addition, Beck *et al.* (2006) suggested that an SME-friendly and competitive business environment was an important facilitator in the entry exit, and growth of companies. Breznitz and Ornston (2017) used the examples of Finland and Israel to emphasise the importance of collaboration between various stakeholders in innovation ecosystem, including SMEs, R&D institutions, universities, public sector and large industry as well as coordinated policy-making aimed at reforming other sectors such as education, tax policy or risk capital markets. The later point was also made by Bruton *et al.* (2014) who found the institutional

and policy setting to be strongly reflected in companies' management dynamics, and thus their overall strategy. Similarly, in the Polish context Nowacki and Staniewski (2012) pointed towards a limited access to knowledge about innovation due to poor collaboration with expert centres as a barrier to effective innovation. In a similar manner, Jankowska (2015) indicated that collaboration could serve as a way of internationalisation and growth, as cluster organisations could facilitate foreign market entry, otherwise difficult to achieve on their own by smaller companies.

2.5 Company size and sector

The final set of factors include attributes of the company itself, specifically its size (and hence scale) and sector of operation. Beck *et al.* (2006) noted that smaller firms tended to face more obstacles when obtaining funding for their investments, which placed them at a more disadvantaged position compared to larger companies. Nevertheless, Lee *et al.* (2015) demonstrated that it was actually small and micro companies that were more likely to apply for funding, although the authors did not report on how this affected their subsequent performance. The latter was explored by Hall *et al.* (2009), however, who analysed a sample of Italian SMEs and found that larger and older SMEs were in general less productive. Working in a Polish context, Kowalski (2009) reported that medium-sized companies experienced the highest increase in employment from EU-supported investments. Heimonen (2012), using a sample of companies from Finland, identified small companies, i.e. between 10 and 49 employees, as the most innovative.

Regarding the impact of operating in a specific sector, Jones-Evans *et al.* (1996) pointed towards technology-based businesses as displaying the most growth in revenue and employment. This was also supported by findings from Agarwal *et al.* (2001) who quoted technology-based start-ups as having higher survival rates than non-technological ones. Hoffman *et al.* (1998) indicated that biotechnological companies, especially those located in science parks, performed comparatively better.

3. Methodology

In order to investigate quantitatively how the different conditions introduced above predisposed particular investments in innovation to support companies' growth, the following conceptual framework is proposed (Figure 1). This framework seeks to jointly capture these relationships through changes in employment, capital and unit price.

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The framework is based on the classical microeconomic representation of companies whereby revenue is a function of labour and capital inputs and technology is used to combine these inputs, as well as the price of the goods and services offered. In this framework, an investment in innovation can affect the company's revenue through changes in the inputs and unit price. A number of factors can, however, affect the direction and relative magnitudes of these specific changes, as outlined in section 2. In this paper a number of such factors are explored (see Table 1). The conceptual representation thus incorporates elements of the heuristic proposed by Edwards *et al.* (2005), where the current exogenous variables serve as proxy variables for the 'innovative potential' while the endogenous variables describe the performance of the company.

The model accounts also for the possibility that changes in the labour and capital inputs are motivated by the company's strategy to change its product and service price, for example, to achieve higher market penetration by lowering the unit price. This is captured by the vertical arrows between the employment, capital and price change components.

The framework above is operationalised using the structural equation modelling (SEM) technique. SEM conveniently allows the incorporation of multiple simultaneous relationships between variables, and the estimation of the correlations between them implied by the covariance matrix observed in the sample. SEM has been used in similar studies in the field, e.g. Gunday *et al.* (2011) or Díaz-Chao *et al.* (2015). In the current paper, the SEM is estimated using the diagonally

weighted least squares (DWLS) approach relying on polychoric correlations (Rhemtulla *et al.*, 2012) in order to account for the limited sample size and discrete nature of the variables. The estimation was carried out using the 'lavaan' package (version 0.5-18) for the R environment (Rossel, 2012).

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4. Data

The model is estimated using data collected in the Greater Poland (*Wielkopolska*) region (*voivodship*) by means of a questionnaire survey. The region has traditionally been characterised by one of the highest SME entrepreneurship rates in Poland. In 2006, the final year of the funding period under investigation, there were almost 350,000 companies in the region but only 482 of these had 250 employees or more. While the population of the *voivodship* was less than 9% per cent of the country's total, its share of companies was 9.6% for micro, 9.9% for small, and 10.8% for medium ones respectively. In addition, the region has consistently been indicated as one of the most efficient in absorbing the pre-allocated EU funds (Kwieciński *et al.*, 2013), hence making it a useful place in which to conduct the proposed research.

The survey questionnaires were posted in 2008 to all SMEs in the Greater Poland region that received funding from the Sectoral Operational Programme – Improvement of Competitiveness of Enterprises (SOP-ICE) Priority 2 in the period 2004-06. The primary objective of the programme was to improve the competitiveness of Polish economy in the free-market environment (MRD, 2006, p. 86). The suitable SMEs were identified through a publicly available list of funding recipients obtained from the Polish Agency for Enterprise Development (PARP), which is the government body managing national and EU funding allocation and distribution to the SMEs. As a result, 242 companies were contacted and sent a questionnaire, which consisted of six parts covering the following aspects of funding use (recall Table 1 for a more detailed list of questions and the format of reporting):

- investment purpose;
- type of innovation implemented as a result of the investment;
- the company's previous experience in applying for and using the EU support mechanisms;
- funding and financial readiness;
- results of the investment, including changes in capital base, employment, unit price, and revenue;
- company location and collaboration;
- company size and sector of operation.

Out of the total 242 companies, 174 returned the questionnaire. 110 questionnaires were sufficiently complete and logically coherent to be included in the final analysis, thus yielding an effective response rate of 45.4%. The sample size is comparable to studies on innovation in SMEs conducted elsewhere, e.g. Kmieciak *et al.* (2012) or Codogni *et al.* (2017). Table 2 provides a number of descriptive statistics in respect to this final sample, subsequently used in the SEM analysis.

--- TABLE 2 HERE ---

Among the investigated companies, 53 were either micro or small (up to 50 employees) with the remaining 57 being medium-sized enterprises. The majority of the companies reported revenue above 1,000,000 PLN in 2007 (about €263,000), were located in urban areas, and operated in either the manufacturing or service sectors. Most companies had previous experience in using the SOP-ICE funding, with a large proportion also having experience in using the pre-accession fund PHARE (Poland and Hungary: Assistance for Restructuring their Economies). Only 14.5% of companies had no prior experience in using EU funding. The survey sample was drawn from

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companies already known to receive SOP-ICE funding, but in addition almost all (99.1%) applied for the SOP-ICE partial objective 2.3, i.e. increased competitiveness via investment. Process and product innovations were the most prevailing reasons for seeking this funding, at 69.1% and 72.7% respectively, but organisational and marketing innovations were implemented much less frequently, at 20% and 4.5% respectively. Most of the companies invested in order to increase their competitiveness both nationally (76.4%) and internationally (50%). Quality improvements and the development of an export strategy were also important, with 62.7% and 21.8% of companies, respectively, reporting such an investment purpose.

5. Findings

The model estimation results are summarised in Table 3. The overall root-mean-square-error of approximation (RMSEA) is below the benchmark 0.08, indicating a low discrepancy between the observed and model-implied covariance matrices (Hooper *et al.*, 2008). This is also confirmed by the other fit indices (CFI, NFI, and GFI) with the values above the benchmark of 0.95. Hence the achieved goodness-of-fit is acceptable. The sections below present the specific results concerning the endogenous and exogenous variables, followed by a synthesising discussion.

--- TABLE 3 HERE --

5.1 The endogenous variables: labour, capital and price

The relationships between the endogenous variables reflect how changes in the inputs or unit price were correlated with changes in revenue. In microeconomic terms, this reflects the technology of production. In the sample, only the changes in employment are positively correlated with the reported change in the level of revenue. Pokorski (2010) noted that one of the aims of SOP-ICE programme was to ensure an increase in employment by SMEs. In that respect the programme was successful with, on average, 11% increase in employment among supported companies. No effect on revenue from a change in the capital base or unit price is observed. In other words, the growth in revenue resulting from investment in innovation tended to result more from the hiring of new employees rather than from capital base expansion or changes in unit pricing which is also echoed in the findings of Czerniak and Stefański (2016). This can indicate that the funding support served as an instrument to de-risk the expansion of production through increased employment. The results suggest that this expansion is an important driver of revenue growth. There is, however, the possibility of a bi-directional interaction, where the revenue growth is taken by a company as a promising signal of the success of the investment, encouraging employment expansion.

Similar relationships in relation to changes in the capital base or unit price are not observed. In other words, changes in the capital base or employment do not tend to be reflected in changes in the unit price. It is possible, however, that instead of looking at the unit price, the companies could aim to change (reduce) the unit cost to increase their profitability. This interpretation would also be consistent with the SME sector being primarily price-taking, and for whom streamlining and cost reduction is normally a less risky strategy than price competition. In fact, price competition has been seen as an ongoing, primary competitive advantage of Polish SMEs as compared to their European counterparts (PARP, 2015, 2016).

5.2 The exogenous variables

5.2.1 Innovation type

Regarding the effects of the type of innovation implemented, the findings point towards this being of a lesser importance in determining market performance compared to the findings of Rosenbusch *et al.* (2011) or Gunday *et al.* (2011). Charucka (2014) indicated that almost 40% of companies at that time did not see benefits in innovation whilst 37% would see themselves as too small to innovate. The only statistically significant results are a negative correlation between marketing

innovation and changes in the capital base, and a positive correlation between marketing innovation and changes in the unit price. This finding indicates that companies focused on marketing innovations are less likely to engage in capital base expansion. This is largely consistent with the fact that during the survey period, access to support mechanisms for capital base expansion for the SME sector in Poland was still in its infancy. The only viable alternative was, therefore, to develop market strategies that sought to position products and services higher in the value chain. Such efforts were primarily aimed at increasing the value-added and thus to target more demanding and increasingly more affluent customers. This interpretation is supported by findings of Starczewska-Krzysztoszek (2011) who noted that in the local, regional, and national market Polish SMEs tended to compete primarily by means of quality and value improvement.

At the same time, investments in other types of innovation are not found to have statistically significant associations with changes in the production inputs or unit price. A possible explanation for this result is a high prevalence of these innovation types in the sample (recall Table 2), and hence limited variation. In other words, process, product and organisational innovations seem to be present in these companies regardless of changes in the capital base or employment. This finding emphasises that future studies require a much more in-depth understanding of the exact nature of the innovation investments that goes beyond the 4-type distinction.

5.2.2 Investment purpose

Regarding the investment purpose, a negative correlation between seeking to improve competitiveness in international markets and likelihood of changes in the capital base is observed. When interpreted in conjunction with the positive association between marketing innovation and unit price change, this can indicate that companies have sought to establish themselves in foreign markets within their existing production capacity, and to thus to innovate in respect to their target markets. For such companies, expansion in terms of capital and labour would be expected only following their successful establishment in a foreign market. This interpretation can also explain why the initiation of or an increase in exporting lack significant associations. Moreover, such an effect is not observed in the case of national competitiveness, where the company is, arguably, more aware of the local conditions and can therefore scale its operations more accurately and flexibly. An explanation to this finding is offered by Pokorski (2010) who pointed out that funding available as part of SOP-ICE 2.3 (which was the primary mechanism in the current sample) enabled the SMEs to become more competitive mainly in local, regional, and national markets. This was achieved by improvement of quality in the products and services and increased capacity. Last but not least, Jankowska (2015) pointed out that internationalisation of Polish SME has not been very intense in terms of sophistication of exporting activities, identifying this as a potential obstacle in long-term development of exporting capability.

No significant association between the purpose of investment being an improvement in the quality of goods or services and changes in the input factors is observed. This is unsurprising since SMEs would typically seek to improve the quality within their existing pools of resources through modifications of existing practices, rather than by altering the scale of production.

Neither is any significant relationship associated with investments in ICT observed. Such investments could include both capital base expansion, e.g. increased automation, equipment monitoring, and change to employment, e.g. hiring skilled workers, introduction of remote work practices. This can be a consequence of the relative immaturity of the SME sector at the time of the survey. This immaturity would translate into a lack of the necessary scale of adoption, which is crucial in achieving the full range of benefits enabled by ICT, or insufficient skills and organisational capacity to implement the ICT-based organisational changes (Kossai *et al.*, 2014; Martin *et al.*, 2013). In fact, the lack of digitally-skilled personnel has been identified as being an ongoing issue with successful implementation of ICT among Polish SMEs. For example, only 10% of Polish SMEs employ a dedicated ICT specialist as compared to 20% EU average (PARP, 2017).

5.2.3 Funding availability and financial readiness

As far as the funding is concerned, the use of SOP-ICE 2.3 is associated with a higher likelihood of seeking to increase the capital base. On the other hand, the relationship between the experience of having used SOP funding in the past and capital base expansion is negative. This can be interpreted in light of the findings of Pokorski (2010) who emphasised the role of SOP-ICE in addressing the shortage of capital base among SMEs prior to 2004 which had been a substantial barrier to SME sector growth.

Regarding the financial readiness, while the self-funded proportion of the investment does not display a significant association with the endogenous variables, the independent investment readiness is strongly positively correlated with change in employment. All these results jointly indicate the existence of companies who had already invested in the past, especially in capital base expansion, and are now using the EU funding as a means of enabling their workforce expansion. This is an important implication showing that SMEs which are mature enough to commit to investments regardless of the availability of external support, are also more likely to be the source of employment and, ultimately, revenue growth. This also confirms findings of Czerniak and Stefański (2016) pointed out that internal resources have remained by far the primary means of financing innovation, and in fact more general investments among Polish SMEs.

The finding above implies that in the context of supporting innovation among SMEs, external support to that sector in the form of EU funding could offer a means of facilitating growth in employment and the economy overall. Such evidence is especially important following the economic crisis which made it even more difficult for SMEs to obtain funding for innovative but also riskier investments (Lee *et al.*, 2015). The findings are in this respect in line with the results reported in recent years (Beck *et al.*, 2006; Heimonen, 2012; Lee *et al.*, 2015).

5.2.4 Location and collaboration

Regarding the role of location, no specific effects associated with a company being located in urban areas, or operating in a particular sector are observed. In that sense, the findings only partially support that of Laforet (2013) who reported on the role of both factors.

In addition, no evidence is found in relation to the role of being a technology co-creator in collaboration with an R&D institutions. It is possible that technologies involved in such investments tend to be at such an early stage that companies would be prevented from scaling their production until their effectiveness was proven. Similarly, the fact that a particular investment took place in an industrial or technological park, or enterprise incubator, could also indicate a lack of the necessary maturity for a company to commit to altering its production process. The lack of significant effect could be partly explained by findings by Breznitz and Ornston (2017) who reported on effectiveness of the support reported in the follow-up 2007-20013 period in Poland, which could simply reflect a longer lag between investment in an early R&D and its impact on company's performance. It is also possible that these factors had an effect on the willingness to undertake innovation in the first place, rather than on the actual result of the investment, as suggested in the literature (Keizer *et al.*, 2002; Radas *et al.*, 2009) although, unfortunately, the present data does not permit testing this hypothesis.

5.2.5 Company size and sector

In terms of the sector of operation, no significant associations with the inputs or unit price is statistically significant. This is in contrast to findings reported by Pokorski (2010) who indicated industrial sector SMEs as benefitting more as compared to services or commerce. Finally, in terms of a company's attributes, the medium-sized companies are observed to be more willing to increase their employment, but less so to increase their capital base. This finding is consistent with that of the aforementioned study by Kowalski (2009), also in the Polish context. It thus appears that medium-sized companies are focused more on the human capital-side of production which can also reflect their possession of a more substantial capital base, now requiring the commensurate labour input.

6. Conclusions and further research directions

The importance of analysing the conditions which are associated with successful investments in innovation in the SME sector results from the sector's growing role as a source of economic growth. The role of supporting innovative investments in the SME sector is especially important for countries that have undergone transformations to a market-based economic model relatively recently, including Poland and other countries of Central and Eastern Europe. These countries seek to advance their enterprises to high levels of technology and innovation through the most effective use of various EU funding mechanisms.

In the current analysis of 110 SMEs from the Greater Poland (*Wielkopolska*) region, a simple conceptual model of how the conditions in which EU-supported investment in innovation takes place may affect changes in the production factors (labour, capital), price, and ultimately the revenue. This framework delivers novel insights into how SMEs make use of the EU funding. Specifically, two different strategies for using the available funding are observed, although not necessarily mutually exclusive. The first approach utilises the funding to implement innovate in respect to the target market, often by establishing a presence in foreign markets, and moving the product up in the value chain. The second approach, more prevalent among medium-sized companies, uses the funding to expand the workforce so as to increase utilisation of the existing capital base, and hence the overall production capacity. The findings are largely consistent with observations and analyses conducted elsewhere although, to the best of the authors' knowledge, the present contribution represents the first attempt to analyse them in a single conceptual and econometric framework of SEM.

The results above contribute towards a better understanding of how the EU funding support for innovation in the SME sector can translate into employment and revenue growth. The findings can hence aid more effective policy design, especially in terms of more accurate forecasting of the subsequent micro- and macroeconomic implications. An especially interesting aspect of this concerns implications for the labour market, given that the results point towards a positive link between employment and the innovativeness of small enterprises. This naturally raises a question as to which occupations and skills may become more demanded as the SME sector becomes more and more innovation-oriented. Clearly, in the case of Polish SMEs there remains a gap with respect to skills of the labour force, e.g. in ICT use. Thus to realise the full potential of SME sector in Poland, it is urgent to increase efforts towards improving high-value skills of employees, both in terms of those demanded in the growing knowledge economy as well as in the high value-added industrial sector. An aligned education system and training programmes as well as closer collaboration between industry and educational institutions could offer an efficient way forward.

Another important implication emerging from the findings relates to the issue of access to suitable funding for small and medium enterprises to undertake investment in innovation. If the ongoing efforts towards integration of financial markets and the creation of a capital markets union (CMU) lead to greater availability of such funding, the findings can suggest positive implications for the labour market. This is particularly important in the case of Polish SMEs where access to suitable funding has remained an ongoing issue in successful implementation of innovation, and thus their long term growth and scaling.

From the managerial point of view, the results deliver useful insights for SMEs operating in conditions of economic transformation similar to those of Poland's, and other 2004 EU accession countries. The most important implication concerns the need to recognise the vital role of investments in innovation but also their multifaceted nature, and their consequences. The two distinct approaches to innovation by companies revealed in the analysis indicate that there is not a single, fit-for-all approach to investing in innovation. Instead, entrepreneurs and managers usually need tailored approaches and flexibility in using mechanisms of support specific to their context, the available resources (both human and capital) and the conditions of the sector.

Naturally, the findings presented in this paper are subject to a number of limitations. Firstly, they must be interpreted bearing in mind the specific context following Poland's accession to the

EU. The funding available at that time was focused primarily on strengthening SME sector characterised by relatively poor capital base, lack of technological advancement, and with very limited options for financing capital base expansion. Secondly, the set of exogenous variables was limited and in future research, could be expanded to include more detailed information about the companies (e.g. skills of the employees), use of external expertise when seeking funding, the innovation implemented or macroeconomic conditions prevailing in the sector, region or country. We also note that availability of a larger sample would increase statistical power of the analysis. In addition, the specificity of the companies in both a geographical and temporal sense means that the conclusions drawn here may not hold in other contexts. On the other hand, carrying out similar analyses across countries and time, and involving more harmonised datasets could shed light on the extent to which certain patterns prevail internationally and how they evolve over time.

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Table 1. Survey variables representing various effects in the conceptual model of Figure 1

Empirical variables	Variable format (categories)	Evidence base
Exogenous variables (conditions)		
Innovation type		
• Innovation type implemented: process	Categorical (YES/NO)	Edwards *et al.* (2005)
• Innovation type implemented: product	Categorical (YES/NO)	Gunday *et al.* (2011)
• Innovation type implemented: organisation	Categorical (YES/NO)	Hall *et al.* (2009)
• Innovation type implemented: marketing	Categorical (YES/NO)	Hoffman *et al.* (1998)
		Laforet (2013)
		Lewandowska *et al.* (2016)
		Mazur and Zaborek (2016)
		Oke *et al.* (2007)
		Radas and Bozic (2009)
		Rosenbusch *et al.* (2011)
		Varis and Littunen (2010)
		Zapalska *et al.* (2015)
Investment purpose		
• Purpose of the investment: increased competitiveness in national market	Categorical (YES/NO)	Bailey and Kurland (2002)
		Becchetti *et al.* (2003)
• Purpose of the investment: increased competitiveness in international market(s)	Categorical (YES/NO)	Bottazzi and Da Rin (2002)
		Carayannis *et al.* (2013)
• Purpose of the investment: improved quality of goods/services	Categorical (YES/NO)	Cooke and Wills (1999)
		Díaz-Chao *et al.* (2015)
• Funding enabled initiation or increase in export	Categorical (YES/NO)	Dmirel and Mazzucato (2012)
• Investment in Information and Communication Technologies	Categorical (YES/NO)	Doraszelski and Jaumendreu (2013)
		Golden (2012)
• Company has created the technology which is to be funded	Categorical (YES/NO)	Grimes *et al.* (2011)
		Hall *et al.* (2009)
		Hashi and Krasniqi (2011)
		Hill *et al.* (1998)
		Hoffman *et al.* (1998)
		Kandybin and Khin (2004)
		Karhunen and Huovari (2015)
		Kmieciak *et al.* (2012)
		Kossai and Piget (2014)
		Lee *et al.* (2015)
		Marsili (2006)
		Martin *et al.* (2013)
		Moen *et al.* (2016)
		Norek (2013)
		Piras *et al.* (2012)
		Tarute and Gatautis (2014)

Table 1. Survey variables representing various effects in the conceptual model of Figure 1 (continued)

Empirical variables	Variable format (categories)	Evidence base
Funding and financial readiness		
• Funding mechanism used	Categorical (SOP-ICE 2.2.1/2.3/2.4/ PHARE)	Beck and Demirguc-Kunt (2006)
• Previous funding experience	Categorical (SOP-ICE/ PHARE/ SAPARD)	Breznitz and Ornston (2017) Czerniak and Stefański (2016)
• Independent investment readiness – strategy if funding not allocated	Ordinal (proceed/ reduce or delay/ reduce and delay/abandon)	Heimonen (2012) Hoffman *et al.* (1998)
• Proportion of the investment that is self-funded	Continuous (percentage)	Karpińska-Mizielińska, *et al.* (2009) Keizer *et al.* (2002) Mason and Kwok (2010) Lee *et al*. (2015) Radas and Božić (2009)
Location and collaboration		
• Adoption of technology created at the request of the applicant in co-operation with R&D institution	Categorical (YES/NO)	Adekola *et al.* (2008) Beck and Demirguc-Kunt (2006)
• Investment in industry park, scientific-technological park, enterprise incubator	Categorical (YES/NO)	Breznitz and Ornston (2017) Bruton *et al.* (2014)
• Company's location	Categorical (urban/rural)	Hadjimanolis (1999) Heimonen (2012) Jankowska (2015) Kaufmann and Tödtling (2002) Keizer *et al.* (2002) Nowacki and Staniewski (2012) Radas and Božić (2009)
Company size and sector		
• Company size	Categorical (micro/small/medium)	Agarwal and Audretsch (2001)
• Sector of company's operation	Categorical (industry, services, trade/commerce)	Beck and Demirguc-Kunt (2006) Heimonen (2012) Hoffman *et al.* (1998) Jones-Evans and Westhead (1996) Kowalski (2009) Lee *et al.* (2015) Hall *et al.* (2009)

Table 1. Survey variables representing various effects in the conceptual model of Figure 1 (continued)

Empirical variables	Empirical variables	Empirical variables
Endogenous variables		
• Change in employment compared to base year	Continuous (percentage)	
• Increased the capital base (estates, machines)	Categorical (YES/NO)	
• Change in unit price	Ordinal (Lower/No change/Higher)	
• Change in revenue compared to base year	Continuous (percentage)	

Table 3. Results of model estimation (n=110)

Variable	Change in employment compared to base year	Increased the capital base	Change in unit price	Change in revenue compared to a base year
Direct effects of the endogenous variables				
• Change in employment compared to the base year	-	-	-0.041(0.684)	0.261(0.001)
• Increased the capital base (estates, machines)	-	-	-0.003 (0.983)	-0.007(0.715)
• Change in unit price	-	-	-	0.162(0.164)
Direct effects of the exogenous variables				
Innovation type				
• Innovation type implemented: process	.	.	.	-
• Innovation type implemented: product	.	.	.	-
• Innovation type implemented: organization	.	.	.	-
• Innovation type implemented: marketing	.	-0.228(<0.001)	0.207(0.034)	-
Investment purpose and characteristics				
• Purpose of the investment: increased competitiveness in national market	.	.	.	-
• Purpose of the investment: increased competitiveness in international market(s)	.	-0.553(<0.001)	.	-
• Purpose of the investment: improved quality of goods/services	.	.	.	-
• Funding enabled initiation or increase in export	.	.	.	-
• Investment in Information and Communication Technologies	.	.	.	-
• Company has created the technology which is to be funded	.	.	.	-
Funding availability and financial readiness				
• Funding mechanism used: SOP-ICE Purpose 2.3	.	0.043(<0.001)	.	-
• Previous funding experience: SOP (any purpose)	.	-0.445(<0.001)	.	-
• Independent investment readiness – strategy if funding not allocated	0.284 (0.042)	.		-
• Proportion of the investment that is self-funded	.	.		-

**Table 3. Results of model estimation (n=110) (continued)**

Variable	Change in employment compared to base year	Increased the capital base	Change in unit price	Change in revenue compared to a base year
Location and collaboration				
• Adoption of technology created at the request of the applicant in co-operation with R&D institution	.	.	.	-
• Investment in industrial park, scientific-technological park, enterprise incubator	.	.	.	-
• Company's location: urban	.	.	.	-
Company size and sector				
• Company size: small	.	.	.	-
• Company size: medium	0.284 (0.031)	-0.420(<0.001)	.	-
• Sector of company's operation: industry	.	.	.	-
• Sector of company's operation: services	.	.	.	-
• Sector of company's operation: trade or commerce	.	.	.	-

Goodness of Fit (scaled): RMSE: 0.0753 (p=0.196); CFI: 0.987; NFI: 0.958; GFI: 0.992

Table 2. Descriptive statistics of the data (n = 110)

Attribute	Number	%
Company size		
Micro (0-9 employees)	9	8.2
Small (10-49 employees)	44	40.0
Medium (50-249 employees)	57	51.8
Revenue (2007, PLN)[a]		
Up to 30 000 PLN	1	0.9
30 001 – 100 000 PLN	1	0.9
100 001 – 200 000 PLN	1	0.9
200 001 – 1 000 000 PLN	8	7.3
1 000 001 – 5 000 000 PLN	18	16.4
Above 5 000 000 PLN	48	43.6
Refused to answer	33	30.0
Location		
Urban	70	63.6
Rural	40	36.4
Sector(s) of operation (multiple possible)		
Production/manufacturing	81	73.6
Services	36	32.7
Trade/commerce	8	7.3
Other	1	0.9
Past EU-funding experience		
SAPARD	6	5.5
PHARE	41	37.3
SOP-ICE	79	71.8
Other	5	4.5
None	16	14.5
Support mechanism used		
SOP-ICE	110	100
SOP-ICE sub-purpose 2.2.1: Support for companies undertaking investments	19	17.3
SOP-ICE purpose 2.3: Increase in SME's competitiveness through investments	109	99.1
SOP-ICE purpose 2.4 Support for environmental standards adjustments for companies	1	0.9
PHARE	19	17.3
Other	3	2.7
Innovation type implemented		
Process	76	69.1
Product	80	72.7
Organization	22	20.0
Marketing	5	4.5
Investment purpose		
Increase in national competitiveness	84	76.4
Increase in international competitiveness	55	50.0
Quality improvement	69	62.7
Development of export strategy	24	21.8
Other	5	4.5

[a] 1 PLN ≈ 0.263 EUR (on average during the study period)
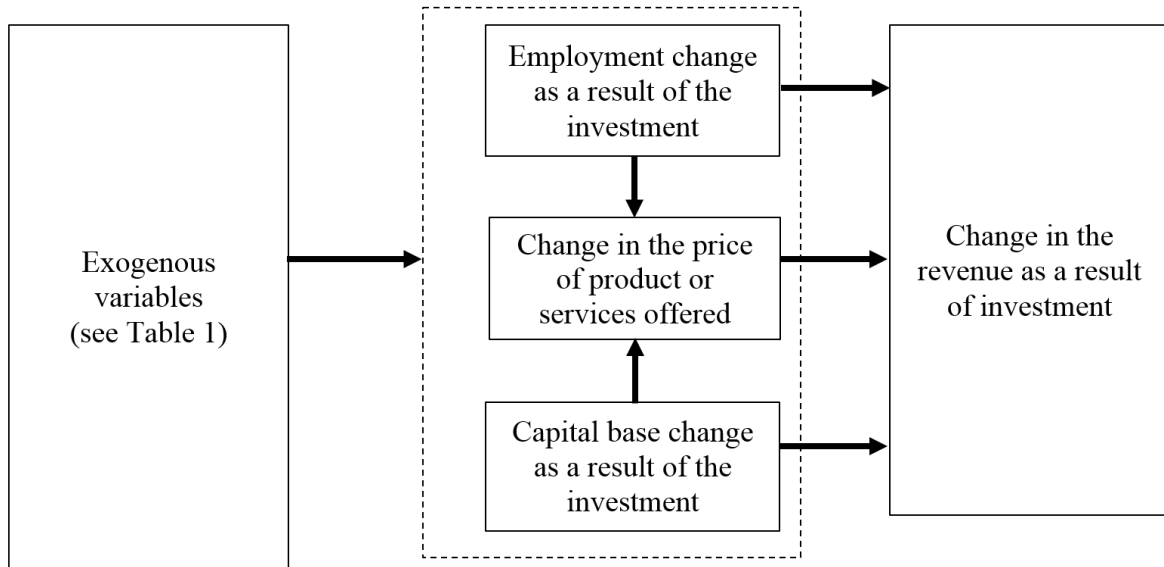
Figure 1. Conceptual model of interaction between investment conditions and changes to employment, price and revenue