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EMPIRICAL ARTICLE

Determinants of export performance: differences between service and manufacturing SMEs

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Abstract We explore the relationships among knowledge sourcing, innovativeness, and export performance of a firm, and investigate how these links differ between service and manufacturing companies. Based on survey data from 4347 East German firms, we develop a structural equation model which enables us to disentangle the direct and indirect (via innovativeness) impact of knowledge sourcing on a firm's export performance. We find that both internal and external knowledge influence a firm's exports both directly path and indirectly via firm innovativeness (mediator variable). For service firms, external knowledge sourcing is more important for enhancing internal knowledge and innovativeness than for manufacturing companies.

Keywords Internationalization · Export · Services · Manufacturing · SMEs

1 Introduction

Globalization and rapid progress in information and communication technologies, as well as international services trade agreements (such as the General Agreement on Trade in Services and the European Union Service Directive), have improved the position of service industries in the world economy. Consequently, ever-increasing

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numbers of service firms are engaging in foreign markets (e.g., Akehurst 2008; Chadee and Pang 2008; Daniels 1993; OECD 2008; Roberts 1999). The literature on internationalization, however, does not pay much attention to this sector, tending to focus more on the manufacturing sector and multinational enterprises (MNEs). Moreover, the body of literature that does exist on this topic mostly concentrates on particular branches of the service industry, without much generalization of concepts or findings (Bryson 2001; Contractor et al. 2003; Lommelen and Matthyssens 2005).

In today's knowledge-based economy, scholars argue that a firm's innovative and/or technological capabilities play a key role in its ability to create and sustain competitive advantage and, in turn, achieve international success (Audretsch 2000; Barney 1991; Cohen and Levinthal 1989). Building innovative capabilities is directly associated with gaining and accumulating knowledge within the firm—through combining internal and/or external knowledge—and then transforming that knowledge into innovations in order to strengthen economic performance (e.g., Cohen and Levinthal 1990; Ganotakis and Love 2011; García et al. 2012; Guerra and Camargo 2016). There is a large and growing research in the literature on the relationship between knowledge sourcing and innovation outputs (Bikfalvi et al. 2013; Frenz and Ietto-Gillies 2009; García et al. 2012; Hsu et al. 2014; Lejpras and Stephan 2011; Miles 2008; Rodriguez et al. 2016), and another body of research deals with the contribution of a firm's innovative performance to its engagement in overseas markets (Becchetti and Rossi 2000; Bleaney and Wakelin 2002; Doloreux and Laperrière 2014; Kirbach and Schmiedeberg 2008; Lejpras 2015). However, to the best of our knowledge, studies linking both these topics with a focus on the differences between service and manufacturing sectors are scarce. Our paper aims to shed some light on this area.

The main goal of this study is to explore the relationships among knowledge sourcing, innovativeness, and export behavior of a firm. The paper aims to give an overview of the innovation process as a whole, by taking into consideration input-oriented, output-oriented, and outcome-oriented measures of innovation. A further objective is to investigate how the process differs between companies from the service and the manufacturing sectors.

Based on survey data from 4347 East German firms engaged in various types of service and manufacturing activity, the empirical analysis employs a structural equation model for two reasons. First, this modeling approach allows taking into account the multidimensionality of latent (not directly observed) constructs. For example, firm innovativeness can be captured through different aspects and/or measures (such as product innovations, process innovation, and patents). Second, the approach's high flexibility in modeling various relationships enables us to include mediation effects. Thus, we disentangle the direct and indirect (via innovativeness) influences of knowledge sourcing on a firm's export performance.

The paper is structured as follows: Sect. 2 sets out the theoretical background of the study, and Sect. 3 provides details about the data and methodological issues. The estimation results appear in Sect. 4, and the conclusions and implications of the study, as well as suggestions for future research, are discussed in Sect. 5.

2 Theoretical background

2.1 Theories of Internationalization and the service sector

The literature takes four main approaches to firm internationalization: the internalization approach and the eclectic paradigm; stage models; the network perspective; and a business-strategy approach and/or resource-based view (RBV). These theoretical frameworks had been developed chiefly in the context of the manufacturing sector (Coviello and McAuley 1999; O'Farrell et al. 1998). Overall, scholars acknowledge that each framework on its own provides only a partial explanation and, hence, that they complement each other more than they compete (Coviello and McAuley 1999; Daniels 1991). The studies on service internationalization have drawn primarily on the last three theoretical approaches (Lommelen and Matthyssens 2005); these are briefly described below.

2.1.1 Stage models

This approach to firm internationalization examines foreign market expansion in terms of hypothetical development stages. This can take one of two paths: (1) the establishment chain (stage) model, also known as the Uppsala model or the U-model, introduced by Johanson and Wiedersheim-Paul (1975) and developed further by Johanson and Vahlne (1977); Johanson and Vahlne (1990); and (2) the diffusion of innovation theory, innovation-related model or I-model, derived from stages of the adoption process by Rogers (1962) (Young 1995). Both the U-model and the I-models are viewed as more dynamic than the internalization paradigm and focus on firm exporting activities rather than foreign direct investment FDI (Andersen 1993; Turnbull 1987; Young 1987).

The U-model suggests that firm internationalization occurs incrementally and gradually due to lack of knowledge, especially experiential knowledge, and uncertainty. The model argues that firms initially engage in psychically close foreign markets (i.e., those that are not so very different from the home market) through low-risk, indirect exporting approaches. Over time and on the basis of experience gained in this way, the firm will expand into more distant markets through higher control modalities (Johanson and Vahlne 1977; Johanson and Vahlne 1990; Johanson and Wiedersheim-Paul 1975).

The innovation-based approach sees the internationalization process as a learning sequence that occurs within the innovation adoption process. Various I-model adaptations, developed by Bilkey and Tesar (1977), Cavusgil (1980); Cavusgil (1982), Czinkota (1982), and Reid (1981), posit that export development depends on external stimuli (e.g., unsolicited orders or inquiries) and/or internal factors such as attitudinal and behavioral commitment of managers.

Reid (1983) argues that the stage model approach is too deterministic and that the internationalization process of individual firms is highly situational. Firms, regardless of industry sector, do not necessarily implement consistent and incremental steps toward internationalization (e.g., Bell 1995; Clark and Mallory

1997; McKiernan 1992). A further critique of the approach claims that it neglects the conditions under which a firm might begin international engagement or shift from one stage to another (Cavusgil 1980). Thus, stage models do not appear to provide an effective theoretical framework for investigating strategic firm internationalization.

2.1.2 Network perspective

A more recent school of internationalization research, known as the network perspective, recognizes that foreign market development does not solely depend on firm-related advantage but also relies on networking activities and strategic alliances (Blankenburg and Johanson 1992; Cunningham and Culligan 1991; Johanson and Mattsson 1988; Johanson and Mattsson 1992). Therefore, externalization rather than internalization of foreign markets and/or functions occurs. The portfolio of exchange relationships includes the firm's direct relationships (e.g., individuals, business units, public agencies, and noncommercial organizations) and its indirect connections to those individuals or entities with which firm personnel are directly linked; hence, networks can be limitless in extent and are viewed as unbounded and nontransparent (Blankenburg and Johanson 1992; Johanson and Mattsson 1992; Johanson and Vahlne 1990).

By exploiting the complementary and synergistic potential of their members' capabilities and competencies, networks facilitate joint accomplishment of mutually beneficial although not necessarily identical goals. A basic assumption of the network approach is that the individual firm is dependent on resources controlled by other firms and secures access to those resources via its network position. It follows logically from this idea that firm internationalization is also influenced by the network (Bell 1995; Cunningham and Culligan 1991; Johanson and Mattsson 1988; Johanson and Mattsson 1992; Johanson and Vahlne 1990; Johanson and Vahlne 1992; O'Farrell and Wood 1999).

From the network perspective, scholars emphasize the collaborative nature of the internationalization of knowledge-based services (e.g., Bell 1995; Knight 1999; O'Farrell and Wood 1999; O'Farrell et al. 1998). However, by focusing solely on the interdependencies among actors, the network approach does not provide any explanation for certain foreign market development that is only partially the result of collaboration and even less for that which occurs without any cooperation. Thus, the network perspective provides only a partial explanation for internationalization and needs to be complemented by broader aspects of firm strategy.

2.1.3 Business strategy

The business-strategy framework is a pragmatic approach to firm internationalization. This approach understands that firms take a wide range of variables into consideration when looking at the benefits and costs of various internationalization strategies, although at times, they do not have an entirely rational objective way of choosing among the alternatives. By calculating the profit potential of each alternative, the options can be assessed more rationally to find the optimal solution

and, thus, to find an appropriate mode of foreign market entry and/or to change the market servicing mode over time (Clark and Mallory 1997; Reid 1983; Welford and Prescott 1994).

Generally, scholars distinguish between two groups of variables relevant to the internationalization decision: external and internal factors (Bellak 2005; Harris and Li 2011; Kim and Hwang 1992; Porter 1985; Reid 1983; Root 1987; Turnbull and Ellwood 1986). The external factors involve the market characteristics and supply conditions of both the host country and home regions (e.g., workforce, market accessibility and attractiveness, cultural distance, ease of transportation, and degree of competition). The internal variables are comprised of firm-related factors, specifically the firm resources (such as size, branch, capital resources, managerial knowledge, export orientation and international trade experience) and firm product factors (particularly technology level and product differentiation).

Compared to the frameworks discussed above, the business-strategy approach is more multilateral and appears flexible enough to handle the development, characteristics, and goals of individual firms, on the one hand, and to capture the influence of the firm environment, on the other (Clark and Mallory 1997; Kim and Hwang 1992; O'Farrell et al. 1998). Therefore, this study is primarily based on the business-strategy approach, with some attention to the network perspective.

2.2 Conceptual framework and hypotheses

To explore the relationships among knowledge sourcing, innovativeness, and export performance, we develop the conceptual framework that appears in Fig. 1. The details of our hypotheses are given below.

2.2.1 Knowledge sourcing and firm innovativeness

Technological and/or innovative capabilities are considered to be key drivers of achieving and sustaining a firm's competitive advantage: thus, they are viewed as

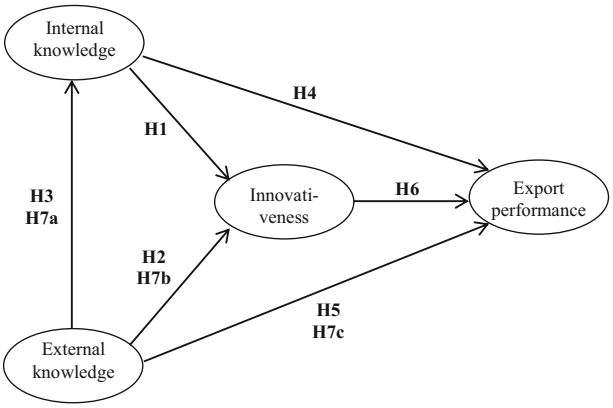

Fig. 1 Conceptual framework

crucial to its international success (Barney 1991; García et al. 2012; Hsu et al. 2014; Kim and Hwang 1992; Porter 1985; Turnbull and Ellwood 1986). Innovative capability is directly associated with the ongoing process of absorbing and creating knowledge—by acquiring and combining knowledge from internal and external sources, as well as accumulating skills within the firm—and transforming that knowledge into innovation (Bikfalvi et al. 2013; Cohen and Levinthal 1989; García et al. 2012; Hsu et al. 2014; Lall 1992; Miles 2008; Rodriguez et al. 2016).

Internal knowledge is embodied in the specific skills of a firm's workforce with respect to planning and control, market orientation, R&D investment, purchasing and production processes (e.g., Guerra and Camargo 2016; Rodriguez et al. 2016; Turnbull and Ellwood 1986). Among these skills, R&D—usually captured via R&D expenditures or R&D personnel—is considered the key antecedent of firm innovativeness (Frenz and Ietto-Gillies 2009). Note, though, that innovation in service firms depends less on formal R&D activities and, consequently, service companies devote fewer efforts than manufacturers to R&D (Miles 2008). Hence, we need to capture the role of human capital in a service firm's innovative abilities through alternative measures—through the share of highly qualified and educated workers—as well (García et al. 2012; Muller and Doloreux 2009; Shi et al. 2014). Overall, scholars find that there is a positive link between internal sources and the success of innovation (Rodriguez et al. 2016). Thus, we propose:

Hypothesis 1 Internal knowledge enhances firm innovativeness.

External knowledge sources also facilitate a firm's innovative capability: First, strategic alliances and close interactions with universities, research institutes, and other companies (e.g., specialized suppliers) enable firms to expand their innovative capacities and complement the internal resources required for introducing innovations (Asikainen and Mangiarotti 2017; Bell 1995; Camagni 1991; Guerra and Camargo 2016; Lejpras and Stephan 2011; O'Farrell and Wood 1999). Second, the firm's technological capability can be strengthened through licensing or purchasing new technology from other firms (Guerra and Camargo 2016). A third external driver of innovativeness is public R&D support (Belitz and Lejpras 2016; Bianchi 2011; Guerra and Camargo 2016; Lall 1992).

Hypothesis 2 External knowledge enhances firm innovativeness.

Moreover, scholars argue that external knowledge sourcing has a positive impact on developing a firm's internal knowledge base. The extent to which a firm is able to benefit from knowledge spillovers depends strongly on the absorptive capacity of its employees. In other words, absorption capacity can be regarded as a facilitator (or barrier) to achieving and developing innovative abilities (Cohen and Levinthal 1989; Cohen and Levinthal 1990). Here, we propose:

Hypothesis 3 External knowledge enhances internal knowledge.

2.2.2 *Knowledge sourcing and firm export performance*

As described above in Sect. 2.1.3 on the business-strategy approach, firm-related characteristics and capabilities—among them internal knowledge—play a key role in a firm's internationalization process (Clark and Mallory 1997; Jeong et al. 2018; Welford and Prescott 1994). There is a fairly extensive literature investigating the link between a firm's R&D intensity and exporting; however, the results are not straightforward. Scholars find that R&D has a positive impact either (1) on both export probability and export share (e.g., Kirbach and Schmiedeberg 2008), or (2) on export share only (e.g., Barrios et al. 2003; Ito and Pucik 1993). Further, the results of some studies indicate that R&D affects neither exporting activity nor intensity (Becchetti and Rossi 2000; Lejpras 2015; Schlegelmilch and Crook 1988). Yet, in line with the business-strategy framework, we propose:

Hypothesis 4 Internal knowledge enhances firm export performance.

According to the network perspective (see Sect. 2.1.2), external knowledge sourcing is positively related to the international activities of firms (Bell 1995; Knight 1999; O'Farrell and Wood 1999; O'Farrell et al. 1998). Strategic partnerships and collaboration, as well as participating in government support programs, can boost internationalization of firms by enabling them to take advantage of firm synergy, credibility and reputation, reduced costs and risks in foreign markets (Belitz and Lejpras 2016; Bianchi 2011; Bikfalvi et al. 2013; García et al. 2012; Kennedy and Keeney 2009; Lall 1992). Further, firms are more likely to innovate after purchasing technology (Wang and Zhou 2013). Hence, we arrive at our next hypothesis:

Hypothesis 5 External knowledge enhances firm export performance.

2.2.3 *Firm innovativeness and internationalization*

Scholars argue that a firm's innovative capabilities—assessed through output-oriented measures of the firm's innovation activity, such as product or process innovations—are essential for its internationalization (e.g., Barney 1991; Ganotakis and Love 2011; García et al. 2012; Guerra and Camargo 2016; Lejpras 2015). Numerous studies show a consistent finding of the positive link between a firm's introducing product innovations and its internationalization (Becchetti and Rossi 2000; Bleaney and Wakelin 2002; Doloreux and Laperrière 2014; Kirbach and Schmiedeberg 2008). Thus, we propose:

Hypothesis 6 Firm innovativeness enhances its export performance.

2.2.4 *Knowledge sourcing: services versus manufacturing sector*

Scholars highlight four features that distinguish services from manufactured goods: (1) intangibility (services are not transportable or storable); (2) inseparability (production and consumption occur simultaneously); (3) perishability (services cannot be saved but must be consumed as they are produced); and (4) heterogeneity

(services are unique and difficult to standardize) (e.g., Parasuraman et al. 1985). Of course, different services are characterized by varying degrees of these attributes. In fact, it is the intensity of the respective characteristics that influences tradability and performance of particular service industries in foreign market operations, and this also inevitably makes their internationalization pattern different from that of the manufacturing sector (Clark and Rajaratnam 1999; Ekeledo and Sivakumar 1998; Erramilli 1990; Knight 1999).

Overall, for service firms, the literature emphasizes a special role of external knowledge sourcing in gaining and sustaining competitive advantage (Miles 2008; Rodriguez et al. 2016). Since service companies' activities heavily rely on human capital, these companies make a significant effort to bring knowledge-based inputs to their clients' processes (Muller and Doloreux 2009). Further, compared to the manufacturing sector, development of a new product in services necessitates closer and more frequent collaboration between service companies and their clients (Koch and Stahlecker 2006). Consequently, innovation success depends more strongly on external relations established with customers and with suppliers of technology (Rodriguez et al. 2016; Wu and Shih 2014). Due to the intangibility of services, even a service exchange requires negotiation to some extent (Maister 1993). Finally, Doloreux and Laperrière (2014) find that service firms operating in international markets employ more sources of external knowledge than their peers with domestic sales only. Hence, we propose:

Hypothesis 7a The relationship between external knowledge and internal knowledge is stronger for service firms than for manufacturing companies.

Hypothesis 7b The relationship between external knowledge and innovativeness is stronger for service firms than for manufacturing companies.

Hypothesis 7c The relationship between external knowledge and export performance is stronger for service firms than for manufacturing companies.

3 Data and methodology

3.1 Data

The empirical analysis is based on firm-level data collected by the German Institute for Economic Research (DIW Berlin) in the course of a large survey entitled "Current Situation and Outlook of East German Firms."[1] This survey was sent to 30,000 firms in East Germany in 2004; the response rate was approximately 20%. Observations with missing values are excluded from the analysis, leaving a final sample of 4347 firms (3377 manufacturing firms and 970 engaged in services).

The questionnaire consisted of 49 questions eliciting general information about a firm, its business operations, its economic situation, R&D activities, innovation performance, as well as cooperation and networking. Due to the large number of

[1] The survey was carried out on behalf of the German Ministry of Education and Science.

issues, the survey data enable us to investigate the innovation process as a whole, taking into account input-oriented, output-oriented, and outcome-oriented measures of innovation. Table 1 sets out a detailed description of the variables used in the analysis.

3.2 Methodological issues

In order to explore our hypotheses, that is, the relationships among internal and external knowledge, firm innovativeness, and internationalization, this paper employs a structural equation model—for two reasons. First, such a model enables us to take into account the multidimensionality (i.e., various facets) of latent (not directly observed) variables (LVs). Second, its high flexibility in modeling various relationships allows us to estimate mediation effects; hence, we can disentangle the direct and indirect impacts of knowledge on firm export behavior. The structural equation model developed in this study is depicted in detail in Sect. 3.2.2. This model implements the partial least squares (PLS) method, which is briefly presented below.

Table 1 Specification of the variables

Variable	Description
IntK1	R&D personnel intensity (measured by R&D deployment over the total number of employees) in 2003 as a percentage
IntK2	Number of employees with a university degree over the total number of employees in 2003 as a percentage
ExtK1	Cooperation frequency in basic research
ExtK2	Cooperation frequency in product development
ExtK3	Cooperation frequency in process development
ExtK4	Cooperation frequency in sales
	The variables ExtK1-ExtK4 are measured on a five-point Likert scale, ranging from "we do not cooperate" (1)*, "we cooperate sometimes"* (3), to "we often cooperate" (5)
ExtK5	A dummy for acquiring licenses in 2003/2004
ExtK6	A dummy for participation in public r&d support programs in 2003/2004
Inno1	A dummy for introducing novel products in 2003/2004
Inno2	A dummy for introducing process innovations in 2003/2004
Inno3	A dummy for applying for patents in 2003/2004
Inno4	A dummy for introducing organizational innovations in 2003/2004
Inno5	A dummy for issuing licenses in 2003/2004
Inter1	A dummy for export activity in 2004
Inter2	Export intensity (measured by foreign sales over total sales) in 2004 as a percentage
Size	Firm size measured by the number of employees in 2002
Age	Firm age (in years)
Group	A dummy for affiliation with a firm group
Manu	A dummy for affiliation with the manufacturing sector

3.2.1 Estimation approach: PLS

The PLS approach is an interplay between data analysis and traditional modeling based on the distribution assumptions of observables (Wold 1982a). In contrast to parameter-oriented covariance structure analysis (CB-SEM, implemented in LISREL and AMOS), PLS is variance-based, distribution-free, and prediction-oriented approach (Fornell and Cha 1994). Further, the approach explicitly estimates the scores of LVs as weighted aggregates of their manifest (observed) variables (MVs) (Wold 1980).

Like CB-SEM, PLS modeling starts with a conceptual arrow scheme representing hypothetical relationships—sometimes including the expected correlation signs between LVs (structural or inner model) and between MVs and their LVs (measurement or outer models) (Wold 1982b). The LVs can be operationalized as reflective or formative measurement models. The reflective MVs (also called effect indicators) are reflected by their underlying LV and should be highly correlated. As long as the constructs have sufficient reliability, any single indicator can be left out without changing the meaning of the construct. The formative MVs (cause indicators) are assumed to determine their LV and need not be correlated. They should represent different aspects of their latent constructs and are not interchangeable (Diamantopoulos and Winklhofer 2001).

PLS estimation occurs in three stages: in the first iterative stage, the values of LVs are estimated; in the second stage, the inner and outer relations are calculated; and in the third stage, the location parameters (means of LVs and intercepts of linear regression functions) are determined (Lohmöller 1989).

Assessing the quality of results includes evaluation of the measurement models—applying different criteria for reflective and formative constructs—and evaluation of the structural model. The reliability of the reflective LVs can be assessed by evaluating internal consistency (i.e., composite reliability; 0.6–0.7 is considered acceptable), indicator reliability (outer loadings should be higher than 0.708), convergent validity (average variance extracted AVE should be higher than 0.5), and discriminant validity (an indicators outer loading on a LV should be higher than its cross loadings with other LVs). For formative LVs, the focus is on establishing content validity before assessing the quality of formatively measured constructs (Hair et al. 2014). Here, multicollinearity should be tested for and, if found, avoided (Diamantopoulos and Winklhofer 2001). Moreover, the significance of outer weights should be assessed. Evaluation of the estimation results in the structural model occurs by determining the coefficient R^2 of the endogenous LVs. Chin (1998) classifies R^2 values of 0.19, 0.33, and 0.67 as weak, moderate, and substantial, respectively. Further, on the basis of changes in R^2 values, the effect size f^2 of a particular exogenous LV on an endogenous LV can be determined. f^2 values of 0.02, 0.15, or 0.35 indicate a small, medium, or large effect. Finally, to check the significance of the inner and outer relations, t-statistics are calculated via bootstrap technique by resampling with replacements from the original data (Tenenhaus et al. 2005).

The estimations were carried out using the SmartPLS (software version 3.2.6) (Ringle et al. 2015) with PLS algorithm settings: path weighting scheme and

standardization of manifest variables. Furthermore, we chose the option for the bootstrapping procedure as suggested by Hair et al. (2014), namely, 5000 resamples with the number of cases equal to the original (sub)sample size and for sign changes, the no sign change option.

3.2.2 Model design

The conceptual framework (shown in Fig. 1) is applied as an inner model of our structural equation model. Hence, each construct presented there is considered as a latent variable, and the paths between the LVs represent our hypotheses. The latent constructs are operationalized as follows:

LV: Internal knowledge

*IntK*1 R&D personnel intensity (measured by R&D deployment over the total number of employees) in 2003 as a percentage
*IntK*2 number of employees with a university degree over the total number of employees in 2003 as a percentage

LV: External knowledge

*ExtK*1 cooperation frequency in basic research
*ExtK*2 cooperation frequency in product development
*ExtK*3 cooperation frequency in process development
*ExtK*4 cooperation frequency in sales
*ExtK*5 a dummy for acquiring licenses in 2003/2004
*ExtK*6 a dummy for participation in public R&D support programs in 2003/2004

LV: Innovativeness

*Inno*1 a dummy for introducing novel products to the market in 2003/2004
*Inno*2 a dummy for introducing process innovations in 2003/2004
*Inno*3 a dummy for applying for patents in 2003/2004
*Inno*4 a dummy for introducing organizational innovations in 2003/2004
*Inno*5 a dummy for issuing licenses in 2003/2004

LV: Export Performance

*Inter*1 a dummy for export activity in 2004
*Inter*2 export intensity (measured by foreign sales over total sales) in 2004 as percentage

The LVs *internal knowledge*, *external knowledge* and *innovativeness* are operationalized as formative measurement models. Before performing the estimation, we tested for multicollinearity among the MV and found it would not be a problem (see Table 7 in the Appendix for correlation matrix). However, *export performance* is modeled based on a reflective measurement model; thus, the two reflective indicators are expected to be caused by the underlying construct. Note that the criteria for assessing reliability are met for this construct: composite reliability

amounts to 0.887; outer loadings are higher are higher than 0.708; AVE is 0.708; and, finally, outer loadings of both indicators on LV internationalization are higher than cross loadings with other LVs. Finally, all indicators should be positively related to their latent variables.

The developed structural equation model is estimated for all firms so as to identify the determinants of their export behavior. Then the model is estimated separately for the manufacturing firms and the service firms in order to discover whether the significance and the magnitude of each explanatory variable differ between the two groups.

3.2.3 Control variables

This study controls for several variables that might affect a firm's ability to innovate and its operating in foreign markets. The business-strategy approach views a firm's international behavior as dependent on its resources and capabilities, as well as on external conditions (Bellak 2005; Harris and Li 2011; Kim and Hwang 1992; Porter 1985; Reid 1983; Root 1987; Turnbull and Ellwood 1986). Indeed, even though SMEs are internationalizing more frequently (Knight 2001; OECD 2008), the literature generally finds that these firms are less likely to engage in foreign activity than are larger companies, chiefly due, it is argued, to their lower resource capacities in terms of finance, knowledge, and managerial experience. They are also more sensitive to external barriers, for example, market and/or product standard regulations, than larger companies are (e.g., Acs et al. 1997; Belitz and Lejpras 2016; Hollenstein 2005; Lommelen and Matthyssens 2005; Mas-Tur and Ribeiro Soriano 2014). Further, as a firm ages, it develops managerial and entrepreneurial competencies and accumulates knowledge about and experience of the competitive environment. Hence, firm age should positively affect its innovation capabilities and involvement in foreign markets (e.g., Huergo and Jaumandreu 2004; Lommelen and Matthyssens 2005; Pla-Barber et al. 2011; Wagner 2015; Wang et al. 2017). Nevertheless, empirical studies present inconsistent results on the relationship between firm age and internationalization. Some scholars find no correlation, while others detect a positive sign or even a negative relation, emphasizing the growing role of born-globals—firms that engage in foreign activity soon after founding—in the business world (Autio et al. 2000; Baronchelli and Cassia 2014; Cavusgil and Knight 2015; Knight and Cavusgil 2004; Kundu and Katz 2003). Moreover, companies affiliated to a firm group appear to exhibit higher performance than their peers not affiliated to a firm group (e.g., De Abreu Dos Reis et al. 2007; Gaur and Kumar 2009).

To avoid the potential bias resulting from this heterogeneity, in the first stage of the analysis, these potential effects are eliminated by regressing the MVs on control variables and then using the residuals from these analyses in the subsequent step of analysis. The first-stage regression models are as follows:

$$MV_{ij} = Ln\_size_i + Ln\_size_i^2 + Ln\_age_i + Ln\_age_i^2 + Group_i + u_{ij},$$

where MV_{ij} is the (original) value of manifest variable j for firm i, Ln_size_i is the logarithm of firm size, $Ln\_size_i^2$ is the square of the logarithm of firm size, Ln_age_i

is the logarithm of firm age, $Ln\_age_i^2$ is the square of the logarithm of firm age, $Group_i$ is the dummy variable for affiliation with a firm group, and u_{ij} is the disturbance term of manifest variable j for firm i.

Here, we capture the impacts of the firm size and age through the log values and the squares of the log values to account for the possible nonlinear effects. Table 8 in the Appendix presents an outline of the results from estimating regression models.

In the second stage of the analysis, the residuals from these regressions are used to define the corresponding manifest variable: $(MV_{ij} = \hat{u}_{ij})$. Note that due to the bootstrapping technique employed in the second step, all statistical tests remain appropriate even if estimates from a first-step regression are used as input in the second step.

4 Results

4.1 Descriptive analysis

Table 2 presents the distribution of firms in industries (at the two-digit level of NACE[2]) and exporting activity. The fraction of service firms selling abroad amounts to approximately 21% which, not surprisingly, is lower than the fraction for manufacturing companies (about 36%). Further, we find that manufacturing firms selling in domestic markets only are more often affiliated with lower technology manufacturing, such as food products and beverages, wood products, publishing and printing, nonmetallic mineral products, and fabricated metal products. However, the results reveal that firms that choose to export are from both high-tech industries (such as various machinery and equipment or chemical products) and low-tech sectors of the economy (such as paper and paper products or textiles). Regarding the service sector, the vast majority of those firms engaged in real estate activities and education (100% of firms from the two branches), as well as the renting of machinery and equipment (about 96% of these firms), are chiefly oriented to domestic markets. Only those firms engaged in research and development appear to show on average a considerably higher internationalization degree than other services.

Table 3 presents the mean and standard deviations of the variables included in the analysis, as well as the results of *t*-tests on mean differences for manufacturing and service firms compared to all firms. The two types are considerably different. First, the service (manufacturing) firms are less (more) likely to sell abroad (*Inter*1)—but also they engage in significantly less (more) exporting—assessed in terms of share in total turnover in 2003/2004 (*Inter*2)—compared to the all-firms group. The average export quote for manufacturing firms (around 8%) is almost twice as high as that of services (almost 5%).

[2] NACE is the Statistical classification of economic activities in the European Union (EU); the term NACE is derived from the French Nomenclature statistique des activités économiques dans la Communauté européenne.

Table 2 Firm distribution in internationalization strategies and industries

	Export activity in 2003/2004 (Inter1)				Total
	0 = no		1 = yes		
	N	*RRF*	N	*RRF*	N
Food products and beverages	285	*85.1*	50	*14.9*	335
Textiles	42	*46.2*	49	*53.8*	91
Wearing apparel	29	*72.5*	11	*27.5*	40
Tanning and dressing of leather	18	*69.2*	8	*30.8*	26
Wood and products of wood and cork, except furniture	140	*83.8*	27	*16.2*	167
Pulp, paper, and paper products	16	*43.2*	21	*56.8*	37
Publishing, printing, and reproduction of recorded media	187	*79.2*	49	*20.8*	236
Chemicals and chemical products	29	*36.3*	51	*63.8*	80
Rubber and plastic products	81	*45.3*	98	*54.7*	179
Other nonmetallic mineral products	154	*76.2*	48	*23.8*	202
Basic metals	28	*46.7*	32	*53.3*	60
Fabricated metal products, except machinery and equipment	574	*75.3*	188	*24.7*	762
Machinery and equipment	191	*47.5*	211	*52.5*	402
Office machinery and computers	4	*30.8*	9	*69.2*	13
Electrical machinery and apparatus	77	*51.3*	73	*48.7*	150
Radio, television, and communication equipment and apparatus	20	*33.3*	40	*66.7*	60
Medical, precision, and optical instruments, watches, and clocks	104	*46.4*	120	*53.6*	224
Motor vehicles, trailers, and semi-trailers	18	*41.9*	25	*58.1*	43
Other transport equipment	23	*63.9*	13	*36.1*	36
Furniture; manufacturing	87	*58.4*	62	*41.6*	149
Recycling	63	*74.1*	22	*25.9*	85
Total manufacturing	*2170*	*64.3*	*1207*	*35.7*	*3377*
Wholesale and retail sales	32	*76.2*	10	*23.8*	42
Transport, storage, and communications	10	*83.3*	2	*16.7*	12
Real estate activities	6	*100.0*	0	*0.0*	6
Renting of machinery and equipment without operator and of personal and household goods	92	*95.8*	4	*4.2*	96
Computer and related activities	165	*77.5*	48	*22.5*	213
Research and development	15	*33.3*	30	*66.7*	45
Other business activities	442	*80.2*	109	*19.8*	551
Education	5	*100.0*	0	*0.0*	5
Total services	*767*	*79.1*	*203*	*20.9*	*970*
Total	2937	*67.6%*	1410	*32.4*	4347

RRF refers to the relative row frequency (as percentages)

Table 3 Descriptive statistics

Variable	Services		Manufacturing		All firms	
	Mean	SD	Mean	SD	Mean	SD
Inter1	0.21 −	0.41	0.36 +	0.48	0.32	0.47
Inter2	4.75 −	15.3	8.31 +	17.92	7.51	17.43
IntK1	10.06 +	22.45	4.65 −	11.94	5.86	15.11
IntK2	0.44 +	0.35	0.14 −	0.22	0.20	0.28
ExtK1	0.13	0.34	0.12	0.32	0.12	0.32
ExtK2	0.30	0.46	0.33	0.47	0.32	0.47
ExtK3	0.22	0.41	0.25	0.43	0.24	0.43
ExtK4	0.30	0.46	0.30	0.46	0.30	0.46
ExtK5	0.22 +	0.62	0.10 −	0.43	0.13	0.48
ExtK6	0.15	0.36	0.15	0.36	0.15	0.36
Inno1	0.14	0.35	0.14	0.35	0.14	0.35
Inno2	0.25 −	0.43	0.36 +	0.48	0.34	0.47
Inno3	0.08	0.27	0.09	0.29	0.09	0.29
Inno4	0.31 −	0.46	0.37	0.48	0.36	0.48
Inno5	0.05 +	0.21	0.01 −	0.12	0.02	0.14
Size	12.92 −	24.27	27.37 +	73.5	24.13	66.05
Age	11.39 −	11.29	22.26 +	35.67	19.83	32.20
Group	0.09 −	0.28	0.12	0.32	0.11	0.31
N	972		3375		4347	

Note: t-tests on differences of means: + significantly larger, − significantly smaller than comparison group (all firms) at the 5% level

Second, manufacturing firms are significantly older and larger than all firms; service firms are younger and smaller (see *Size* and *Age*, respectively). Thus, both the R&D intensity (*Int*K1) and the share of employees with a university degree (*Int*K2) is significantly higher (lower) for manufacturing (service) firms. With regard to external knowledge sources, the findings show that the fraction of service firms that acquired licenses in 2003/2004 is significantly higher than that of the reference group (*ExtK*5); but the opposite is true for manufacturing companies.

Regarding innovation activity, companies of the manufacturing (service) sector are more (less) likely to introduce process innovations (*Inno*2) than all firms. By contrast, compared to all firms, service firms issue licenses more frequently (*Inno*5); in the case of manufacturing activities, the reverse is true. Moreover, service companies introduce organizational innovations less frequently (*Inno*4) and are less likely to be affiliated to a firm group than all firms (*Group*).

4.2 Model estimation results

The next subsection presents the results of the model estimation using the data from all firms in the sample with respect to Hypotheses 1–6. Section 4.2.2 discusses the findings that relate to differences between the manufacturing and service firms with respect to the determinants of their export behavior (Hypotheses 7a–7c). Estimation results for the firm subsamples and all firms are presented in Tables 4, 5 and 6.

Table 4 contains relationships between the LVs (inner relations); Table 5 the R^2 determination coefficients and f^2 effect size values. The relationships between the MVs and their LVs (outer relations) are shown in Table 6. Furthermore, we report in Tables 4 through 6 on tests on differences between the model coefficients for service firms and manufacturing sectors; here, we run a PLS-SEM structural multigroup analysis (PLS-MGA) (Hair et al. 2014).

4.2.1 Antecedents of firm export performance: all firms

All postulated links between the LVs appear to be significant and positive, as expected (see Table 4). Indeed, internal and external knowledge influence firm involvement in foreign markets both directly and indirectly via firm innovativeness. Nevertheless, f^2 values reveal that the direct impacts of internal and external knowledge sourcing have only a small effect on explaining firm export performance (see Table 5). The corresponding effects on firm innovativeness are of medium strength. Further, external knowledge sourcing has a significantly positive effect on internal knowledge; here, we find the largest f^2 value of 0.416 for all firms. With regard to the R^2 coefficients of determination, the results show that the constructs internal knowledge and innovativeness can be moderately explained by their exogenous LVs; the adjusted R^2 values amount to 29.4 and 27.5%, respectively. Nonetheless, the LV export performance is rather weakly explained by the model; the proportion of explained variance is 12%.

Regarding the outer relations (see Table 6), the findings for all firms show that both measures—R&D personnel intensity and share of employees with a university degree—are significantly positively linked to internal knowledge; yet, the impact of the former variable appears to be stronger than that of the latter one. External knowledge is positively affected by cooperation frequency in the fields of basic research and product development, as well as acquiring licenses and participating in public R&D support programs. However, collaboration in process development appears to exert no influence on external knowledge capacity, and frequent cooperation in sales has a negative impact (at the 10% significance level). Firm innovativeness is positively related to four of the five indicators included—namely, product innovations, process innovations, patents and issuing licenses; the impact of organizational innovation is insignificant. Finally, both export activity and export intensity are positively linked to their LV export performance.

4.2.2 Differences between service and manufacturing firms

The model estimation results for the sub-samples of manufacturing and service SMEs reveal that there are substantial differences between the two sectors in regard to export behavior. For manufacturing firms, findings are similar to those obtained using all firms and show strong support for our propositions (Hypotheses 1 through

Table 4 Estimation results for services, manufacturing, and all firms—inner relations

	Services			Manufacturing			All firms		
	Internal knowledge	Innovativeness	Export performance	Internal knowledge	Innovativeness	Export performance	Internal knowledge	Innovativeness	Export performance
Internal knowledge		0.280***	0.124**		0.298***	0.139***		0.292***	0.070***
External knowledge	0.658*** +	0.381*** +	0.053	0.529***	0.281***	0.146***	0.542***	0.305***	0.149***
Innovativeness			0.182***			0.193***			0.202***

Notes: Bootstrapped t values (not reported) based on 5000 resamples: ***, **, and * refer to significance at the 1, 5, and 10% levels, respectively. Firm group comparison: + significantly larger, − significantly smaller than manufacturing firms at the 5% level

Table 5 Estimation results for services, manufacturing, and all firms—R^2 determination coefficient values and f^2 effect size values

F^2 values	Services			Manufacturing			All firms		
	Internal knowledge	Innovativeness	Export performance	Internal knowledge	Innovativeness	Export performance	Internal knowledge	Innovativeness	Export performance
Internal knowledge		0.070	*0.009*		0.086	*0.015*		0.083	*0.004*
External knowledge	**0.764**	0.129	*0.002*	**0.388**	0.077	*0.017*	**0.416**	0.090	*0.016*
Innovativeness			0.023			0.033			0.034
Adjusted R^2	**0.432**+	**0.362**+	0.092	0.279	0.256	0.147	0.294	0.275	0.120

Bold, plain, and italic values show a large, medium, and small f^2 effect of the respective LVs on explaining the dependent LV, respectively. Firm group comparison: + significantly larger, − significantly smaller than manufacturing firms at the 5% level

Table 6 Estimation results for services, manufacturing, and all firms—outer relations

MV	Services	Manufacturing	All firms
LV: Internal knowledge			
IntK1	0.900***	0.854***	0.898 ***
IntK2	0.239***	0.275	0.214 ***
LV: External knowledge			
ExtK1	0.308 *** +	0.159***	0.230***
ExtK2	0.252***	0.343***	0.297***
ExtK3	0.140** +	− 0.036	0.029
ExtK4	− 0.012	− 0.029	− 0.040*
ExtK5	− 0.005 −	0.127***	0.087***
ExtK6	0.616*** −	0.757***	0.724***
LV: Innovativeness			
Inno1	0.499***	0.596***	0.560***
Inno2	0.091*	0.088***	0.091***
Inno3	0.612***	0.570***	0.574***
Inno4	0.055	0.023	0.031
Inno5	0.195***	0.156***	0.212***
LV: Export Performance			
Inter1	0.659*** −	0.878***	0.891***
Inter2	0.450*** −	0.903***	0.895***

Notes: Bootstrapped t values (not reported) based on 5000 resamples: ***, **, and * refer to significance at the 1, 5, and 10% levels, respectively. Firm group comparison: + significantly larger, − significantly smaller than manufacturing firms at the 5% level

6). For service firms, however, we found that external knowledge sourcing has no significant direct impact on export performance of a firm; hence, we find no support for Hypothesis 7c. The results reveal that the influence of external knowledge both on internal knowledge and firm innovativeness is significantly larger for service firms compared to the group of manufacturing firms, as proposed in Hypotheses 7a and 7b. Moreover, the R^2 values of internal knowledge and innovativeness are significantly higher for services companies than for their manufacturing peers. Internal knowledge is substantially explained by the LV external knowledge (R^2 is here 43.2%); the R^2 value of innovativeness amounts to 36.2% and, thus, is moderately high. Nonetheless, the share of explained variance of the LV export performance is 9.2% and, thus, quite low in the model for services; for manufacturing, the corresponding R^2 is about 15%.

With regard to the results on differences in the measurement models, the findings show that for service firms the impacts of both indicators—R&D intensity and share of highly skilled workers—on internal knowledge capacity are significant; in the case of the manufacturing sector, only the R&D intensity effect appears to be significant. Further, the coefficients of collaboration in basic research and process development on the LV external variable are significantly higher for service firms than for manufacturing companies; in the case of the indicators, acquiring licenses and participation in public support measures, the opposite is true. Finally, the outer loadings on the LV export performance are significantly lower than those in the model for the manufacturing sector.

5 Conclusions and Implications

The main objective of this study is to investigate the driving forces behind international activity of SMEs, focusing on differences between the manufacturing and service sectors. To this end, we have developed a structural equation model based on survey data from 4347 firms from East Germany, which enables us to capture the complexity of the relationships among knowledge sourcing, innovativeness, and export performance of a firm. Another advantage of this modeling approach is the opportunity to take into consideration various aspects of constructs; for example, firm innovativeness is assessed in terms of product and process innovations, applying patents, etc.

Overall, the findings from the empirical analysis provide strong support for our propositions. Indeed, both internal knowledge—measured via R&D intensity and share of highly educated workforce—and external knowledge—captured through collaboration activities, licensing technology, and government support—influence a firm's international engagement both directly path and indirectly via firm innovativeness. Yet, we find that the direct effect of knowledge sourcing is quite small, which highlights the role of innovativeness as a mediator variable in firm export behavior. These results may explain the inconsistent findings with respect to the link between R&D and export activity and/or export intensity from previous studies (e.g., Barrios et al. 2003; Becchetti and Rossi 2000; Kirbach and Schmiedeberg 2008; Lejpras 2015). Future studies should, thus, include output-oriented measures of innovation as mediator effects when investigating relationships between R&D (an input-oriented measure) and firm internationalization and/or performance (outcomes of innovation), in general.

Compared to manufacturing firms, we find that service companies are both less likely to export and exhibit, on average, lower export shares. This finding is consistent with the literature (e.g., Lommelen and Matthyssens 2005) in emphasizing the lower tradability of services on international markets due to their distinct features (intangibility, inseparability, perishability, and heterogeneity), in contrast to those of manufacturing goods (as discussed by Parasuraman et al. 1985). Of course, one could argue that this does not hold any longer in the digital age—within this context, some scholars have prophesied the "death of distance" and proclaimed a decreasing importance of location (Cairncross 1997; Gray 1998). However, a wider body of research argues that location still is of high relevance because of the role of the "proximity factor" in the process of creation and transfer of knowledge—especially tacit knowledge (see, e.g., Audretsch 2000; Camagni 1991). In fact, the model estimation results emphasize the special role of external knowledge sourcing for internal knowledge and innovativeness in service firms. This is in line with the literature arguing that innovation in services is an interactive and social process, which is heavily dependent on close and frequent collaboration among several economic actors (Koch and Stahlecker 2006; Maister 1993). Overall, this finding might explain the lower export performance of services compared to that of manufacturing firms. Moreover, the study's results indicate that including the share of highly skilled members of the workforce—besides R&D—as an indicator of

internal knowledge capacity is more important for services than for the manufacturing sector. This highlights the fact that, in the services sector, many innovations are nontechnological and rely less on formal R&D activities (Miles 2008; Rodriguez et al. 2016). Beyond this, our research yields some results that seem to contradict our hypotheses. We find that there is no direct link between external knowledge sourcing and firm export performance. Future research may wish to examine and explain this unexpected result.

This paper has important implications, although it has some limitations. First, firm internationalization is operationalized via exporting (activity and intensity) only, although firms can choose many other internalization modes. Hence, future research should explore the links among knowledge sourcing, innovativeness, and other international strategies. A second possible limitation of this study concerns general classification and definitional problems with regard to service and manufacturing industries (e.g., Clark et al. 1996; Daniels 1993; OECD 2008; Pilat and Wölfl 2005), given that the distinction between the two sectors is increasingly blurred in today's world. We, however, maintain that the two sectors do play different roles in the economy. For example, the manufacturing sector is much more strongly linked to other industries (e.g., suppliers and transport). Thus, there is enough variation in the internationalization process of these two sectors to make a study of the differences worthwhile. A further constraint of our analysis is that our data contain limited information on the location and involvement in foreign markets of providers of external knowledge to service and manufacturing firms. Consequently, we were not able to investigate the role of geographic proximity to external knowledge sources in a firm's innovativeness and export behavior and how this role changes in response to ever-advancing digitalization. Future research should address this interesting issue.

Appendix

See Tables 7 and 8.

Table 7 Correlation coefficients

	IntK1	IntK2	ExtK1	ExtK2	ExtK3	ExtK4	ExtK5	ExtK6	Inno1	Inno2	Inno3	Inno4	Inno5
IntK1	1.000												
IntK2	0.388*	1.000											
ExtK1	0.325*	0.166*	1.000										
ExtK2	0.316*	0.162*	0.404*	1.000									
ExtK3	0.247*	0.103*	0.416*	0.572*	1.000								
ExtK4	0.078*	0.053*	0.197*	0.314*	0.257*	1.000							
ExtK5	0.065*	0.092*	0.040*	0.107*	0.054*	0.092*	1.000						
ExtK6	0.481*	0.229*	0.322*	0.366*	0.333*	0.092*	0.056*	1.000					
Inno1	0.352*	0.184*	0.197*	0.277*	0.185*	0.089*	0.074*	0.334*	1.000				
Inno2	0.096*	− 0.056*	0.137*	0.181*	0.258*	0.102*	0.073*	0.146*	0.169*	1.000			
Inno3	0.345*	0.151*	0.220*	0.228*	0.226*	0.063*	0.095*	0.385*	0.341*	0.145*	1.000		
Inno4	0.023	− 0.052*	0.071*	0.117*	0.110*	0.101*	0.063*	0.086*	0.086*	0.192*	0.065*	1.000	
Inno5	0.208*	0.151*	0.098*	0.142*	0.093*	0.074*	− 0.038	0.080*	0.113*	0.039*	0.126*	0.002	1.000
Inter1	0.195*	0.090*	0.159*	0.259*	0.213*	0.070*	0.056*	0.264*	0.242*	0.130*	0.250*	0.095*	0.081*
Inter2	0.209*	0.110*	0.160*	0.213*	0.166*	0.036	0.039*	0.252*	0.229*	0.092*	0.268*	0.075*	0.086*
Size[a]	− 0.020	− 0.081*	0.090*	0.129*	0.149*	0.050*	0.024	0.073*	0.056*	0.111*	0.136*	0.076*	0.075*
Age[b]	− 0.073*	− 0.139*	− 0.012	− 0.013	− 0.021	− 0.039*	− 0.029	− 0.043*	− 0.011	0.011	− 0.033	0.004	− 0.031
Group[c]	0.020	0.014	0.075*	0.096*	0.125*	0.032	0.056*	0.062*	0.044*	0.034	0.091*	0.076*	0.023
Manu[d]	− 0.149*	− 0.453*	− 0.019	0.027	0.031	0.001	− 0.103*	0.003	− 0.001	0.099*	0.019	0.055*	− 0.100*

	Inter1	Inter2	Size[a]	Age[b]	Group[c]	Manu[d]
Inter1	1.000					
Inter2	0.623*	1.000				
Size[a]	0.183*	0.206*	1.000			

Table 7 continued

	Inter1	Inter2	Size[a]	Age[b]	Group[c]	Manu[d]
Age[b]	− 0.025	− 0.003	0.106*	1.000		
Group[c]	0.164*	0.172*	0.232*	− 0.022	1.000	
Manu[d]	0.132*	0.085*	0.091*	0.141*	0.041*	1.000

[a]Size is measured by the number of employees in 2002

[b]Age refers to the firm age (in years)

[c]Group is a dummy for affiliation with a firm group

[d]Manu is a dummy for the manufacturing sector

*$p < 0.05$

Table 8 Estimation results—regression of manifest variables on control variables

Control variables:	Ln_size	Ln_size^2	Ln_age	Ln_age^2	Group	Adjusted R^2
Manifest variables						
IntK1			−			0.011
IntK2	−			−	+	0.066
ExtK1			−	+	+	0.016
ExtK2		+	−	+		0.050
ExtK3		+	−		+	0.060
ExtK4		+	−	+		0.014
ExtK5						0.008
ExtK6	+		−			0.040
Inno1	+					0.011
Inno2	+	+	−	+	−	0.044
Inno3		+	−			0.037
Inno4	+	−	−	+		0.044
Inno5	−		+	−		0.004
Inter1	+	+	−		+	0.109
Inter2	−	+	−	+	+	0.069

+ and − refer to a significantly positive and negative coefficients at the 5% level, respectively. The reference category is firms not affiliated to a firm group

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