CBS COPENHAGEN BUSINESS SCHOOL
HANDELSHØJSKOLEN

Learning in Foreign and Domestic Value Chains
The Role of Opportunities and Capabilities

Belderbos, Rene; Grimpe, Christoph

Document Version
Accepted author manuscript

Published in:
Industrial and Corporate Change

DOI:
10.1093/icc/dtaa027

Publication date:
2020

License
Unspecified

Citation for published version (APA):
Belderbos, R., & Grimpe, C. (2020). Learning in Foreign and Domestic Value Chains: The Role of Opportunities and Capabilities. *Industrial and Corporate Change*, *29*(6), 1431-1450. https://doi.org/10.1093/icc/dtaa027

Link to publication in CBS Research Portal

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
If you believe that this document breaches copyright please contact us (research.lib@cbs.dk) providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 16. Apr. 2024

LEARNING IN FOREIGN AND DOMESTIC VALUE CHAINS – THE ROLE OF OPPORTUNITIES AND CAPABILITIES

René Belderbos
University of Leuven, UNU-MERIT and Maastricht University
Faculty of Economics and Business
Naamsestraat 69, 3000 Leuven, Belgium
Phone: +32-16326912, Email: rene.belderbos@kuleuven.be

Christoph Grimpe*
Copenhagen Business School
Department of Strategy and Innovation
Kilevej 14A, 2000 Frederiksberg, Denmark
Phone: +45-38152530, Email: cg.si@cbs.dk
and
ZEW – Centre for European Economic Research
Department Innovation Economics and Industrial Dynamics
L7.1, 68161 Mannheim, Germany

* Corresponding author

Keywords: learning from internationalization; innovation; technology leadership

LEARNING IN FOREIGN AND DOMESTIC VALUE CHAINS – THE ROLE OF OPPORTUNITIES AND CAPABILITIES

ABSTRACT

We suggest that the benefits of learning in international value chains for firms' innovation performance are heterogeneous and depend on the specific source of learning (customers, suppliers, or competitors), whether these sources are based in countries that are technologically advanced or less advanced (learning opportunities), on technology leadership (learning capabilities) on the part of the focal firm, and on the simultaneous learning that occurs from domestic firms. Using direct survey evidence on learning and innovation by German firms, we confirm that technology leaders benefit from advanced foreign customer and supplier learning, that technology laggards benefit from less advanced foreign customer learning and advanced foreign competitor learning, and that both leaders and laggards benefit from domestic customer learning. The findings suggest a tradeoff between the opportunities to learn from foreign or domestic customers.

Keywords: learning from internationalization; innovation; technology leadership

INTRODUCTION

Globalization has increased exposure of firms to foreign value chain participants (suppliers, customers, and competitors). Exposure to foreign competitors and different ways of competing in the market, and exposure to the different, and more stringent, demands of foreign customers, can lead to new ideas for product and process innovation, resulting in increased firm performance in terms of innovation and productivity. Access to a wider variety of intermediate inputs from foreign suppliers and the exploitation of superior technologies embedded in these inputs can aid process innovation and the capability of firms to introduce new products.

Both the literatures on trade and on Foreign Direct Investment (FDI) have provided evidence on these relationships. The literature on 'learning by exporting' has highlighted that internationalization through export can be a means to source external knowledge abroad and, by doing so, to strengthen competitive advantage (e.g. Bernard and Jensen 1999; Blalock and Gertler 2004; Cassiman and Golovko 2011; Crespi *et al.* 2008; Salomon and Jin 2008, 2010; Salomon and Shaver 2005b; Anderson and Lööf 2009; Castellani 2002). Studies have also found that there are productivity gains from importing (Augier et al. 2013; Forlani 2017; Lööf and Andersson 2010; McCann 2011; Silva et al. 2013; Wagner 2012; Amiti and Konings 2007; Halpern et al. 2015). Similarly, the literature on FDI spillovers has suggested that exposure to foreign firms in domestic environments through inward FDI can increase productivity of local firms (Görg and Strobl 2001; Keller and Yeaple 2009; Haskel et al. 2007) through competition and demonstration effects, and by learning from foreign affiliates in their roles of suppliers and clients of domestic firms (Blalock 2001; Kugler 2006; Liang 2017; Smarzynska Javorcik 2004).

Despite the abundance of studies on learning from internationalization through trade or interactions with foreign owned affiliates, there are at least three factors that have complicated

drawing clear conclusions. First, a common feature of prior studies is that they infer learning and productivity effects from a statistical relationship between (changes in) FDI, imports or exports and (changes in) innovation or productivity, but could not rely on direct evidence on learning from foreign firms. Second, studies usually did not distinguish the different sources of learning (suppliers, customers, competitors) and their potential heterogeneous consequences for innovation performance. Third, in their focus on interactions with foreign firms, prior studies have ignored the role of learning from domestic firms (e.g. Salomon and Shaver 2005b). Firms can learn from domestic suppliers, customers and competitors at the same time as they learn from these firms' foreign counterparts. For instance, searching for and capturing new clients in previously unexplored segments of the domestic market may require adaptation of products and can provide ideas for product innovation – foremost when the domestic market has demanding and sophisticated users (e.g. von Hippel 1998). When an increasing international orientation limits such domestic customer interaction, firms may forego opportunities for learning from domestic firms. This suggests that a correct assessment of the contribution of internationalization to learning requires an analysis of the simultaneous effects of learning from domestic and foreign firms.

The contribution of this study is threefold. First, we address the shortcomings of prior literature by utilizing a unique dataset on German firms to examine direct, survey-based, measures of actual learning for innovation from customers, suppliers, and competitors. In this regard, our study responds to calls in the literature (e.g. Salomon and Shaver 2005b; Golovko and Valentini 2014) to collect and examine direct evidence on internationalization and innovation. Second, we bring in the simultaneous, but also heterogeneous, effects of learning from domestic firms, which prior studies have largely ignored. We assess the effects of such domestic learning, in conjunction with learning from exposure to foreign firms through internationalization, on focal firms' product innovation success.

Third, we provide a more nuanced perspective on internationalization and learning by taking heterogeneity in the sources of learning and associated innovation performance effects into account. We develop and test arguments as to when and why learning from domestic and foreign sources has substantive consequences for innovation performance. We argue that innovation performance effects are determined by three factors: differences in the *source* of learning (the type of firms: suppliers, customers, competitors), differences in *learning opportunities* as indicated by the technological strength of the country in which the foreign firms are based, and differences in the focal firms' *learning capabilities* related to their technology leadership position in the industry. Here we contribute to an emerging literature on heterogeneity in learning from internationalization that has until now focused on the role of firm size (Golovko and Valentini 2011), R&D investments (Aw *et al. 2*011; Salomon and Jin 2010) and customer and supplier characteristics in OEM relationships (Alcacer and Oxley 2014). Our study extends earlier work on firms' learning capabilities (e.g. Salomon and Jin 2008; Winston Smith 2014; Girma et al. 2001; Lenaerts and Merlevede 2015) in fostering effective knowledge spillovers.

Empirically, we draw on unique survey data on the sources of ideas and learning for innovation in 1082 German manufacturing firms, collected in the context of the German Community Innovation Survey in 2003. We also conducted a number of semi-structured interviews with responding firms' executives involved in new product planning and management.[1] These interviews confirmed the reliability of the measures and provided us with a better understanding of the mechanisms through which learning from foreign and domestic firms and its associated benefits for innovation performance occur.

Our findings suggest that the relationship between internationalization and a firm's innovation performance is more complex than prior literature could show. Leading firms with

[1] We interviewed five executives and innovation managers from the automotive, chemical, pharmaceutical, and industrial textiles industries.

strong learning capabilities benefit from advanced foreign customer learning and advanced foreign supplier learning, while lagging firms with fewer learning capabilities benefit from advanced foreign competitor learning and customer learning from foreign firms based in less advanced countries. Hence, the strength of the learning-innovation relationship depends on the leadership position of foreign firms (learning opportunities), focal firms' technology leadership (learning capabilities), and the specific source of learning. At the same time, we find that learning from domestic customers is strongly associated with innovation for all firms, suggesting that the effects of learning from foreign firms can only be assessed correctly if patterns of domestic learning are taken into account.

BACKGROUND AND THEORY

In the following, we will outline four factors, which we believe are important contingencies for learning from interactions with foreign value chain participants. We derive our theoretical framework from contributions to the literature on learning by exporting (e.g. Cassiman and Golovko 2012; Damijan *et al.* 2010; Salomon and Jin 2008, 2010; Salomon and Shaver 2005b), learning from importing intermediate goods from suppliers (e.g. Augier et al. 2013; Forlani 2017; Lööf and Andersson 2010; McCann 2011; Silva et al. 2013), and learning from interactions with foreign (multinational) firms that are active in a firm's home market (Görg and Strobl 2001; Görg and Greenaway 2004).

The four factors have not been addressed jointly in prior research and may contribute to the explanation of the often mixed results in extant literature. Our framework takes into account 1) the strength of learning opportunities in the industry of the foreign-based firms, 2) the strength of learning capabilities of the focal firm associated with technology leadership, 3) the different sources from which learning may occur (customers, suppliers and competitors), and 4) the role of learning from domestic sources. Incorporating these heterogeneities and

broader learning patterns leads to a more detailed pattern of learning and innovation, and brings new insights that can resolve prior ambiguities.

Contingencies: Learning opportunities and learning capabilities

Probably the two most salient contingencies for effective learning for innovation are the strength of *learning opportunities* depending on the advanced or less advanced status of foreign firms, and focal firms' *learning capabilities*, associated with technology leadership. If firms are exposed to foreign competitors, suppliers, or customers that are more advanced, there are more opportunities to learn (e.g. Salomon and Shin, 2008). Prior studies argue, for instance, that productivity effects of exporting occur if exports are directed at more advanced markets compared to the home market (Castellani 2002; De Loecker 2007; Salomon 2006). Hence, what matters for innovation is the extent to which interactions with foreign value chain participants and competitors entail *learning opportunities.* This notion is confirmed by a manager from an industrial textiles firm:

> *"It's a cliché but it's true: Italy has a very strong position in textiles. Our customers there like to experiment. Most of the input into our innovation processes comes from them. Then we develop and scale up production at home."*

It has also been accepted that learning effects require sufficient *learning capabilities*: the absorptive capacity to recognize, assimilate and utilize external knowledge (Cohen and Levinthal 1990; Salomon and Jin 2010; Zahra et al. 2000). This requires a set of appropriate routines and practices and a well-developed (technical) knowledge base to recognize and act upon external knowledge obtained through the feedback and ideas from (foreign) suppliers and customers as well as exposure to new competitive conditions. The literature on export learning has suggested the importance of absorptive capacity on the part of the exporting firms (Salomon and Jin 2010). A similar importance of absorptive capacity and technological capabilities has been observed for firms aiming to benefit from interactions with foreign

affiliates in their home market (Görg and Greenaway 2004; Girma et al. 2001; Lenaerts and Merlevede 2015).

The management literature has also pointed out that firms need the appropriate mindset and technological expertise to be able to learn from (foreign) suppliers, customers and competitors. Learning effects are more likely to occur if the management of the firm views internationalization as opening up the potential for gathering new knowledge and improving productivity (Autio et al. 2000; Zahra et al. 2000). The presence of appropriate learning routines and resources committed to act on customer feedback (such as customer relationship management capabilities), supplier innovation, and competitor intelligence is essential to benefit from external knowledge sourcing (e.g. Czinkota and Pinkwart 2011; Gao et al. 2010; Joshi and Sharma 2004). Hence, the presence of sufficient *learning capabilities* on the part of focal firms constitutes a second important contingency for the relationship between learning from foreign value chain participants and effective innovation. In general, such capabilities are most strongly developed in firms that adopt a technology leadership strategy (Salomon and Jin 2010).

We argue that the interplay between learning capabilities and learning opportunities is crucial for the extent to which learning from foreign firms has positive consequences for innovation performance: both learning opportunities and learning capabilities have to be present to generate effects on innovation. Thus, we seek to provide more nuance by taking into account leader and laggard status of the focal firms, as well as leading and lagging status of foreign firms, in the industry in which they operate. We represent the latter contingency by the distance to the global technology frontier of the countries and industries in which the foreign firms are based, and the former by the focal firm's technology leadership strategy in the industry.

At the same time, and more fundamentally, we argue that the extent of learning opportunities and requirements in terms of learning capabilities differs depending on the source of learning. Learning for innovation can only be understood and unearthed properly by taking these underlying sources of learning (customers, suppliers or competitors) into account, while paying due attention to simultaneous and heterogeneous learning effects through interactions with domestic firms. Below, we assess the learning opportunities and capabilities for each source of (foreign) firm learning to arrive at predictions concerning the specific circumstances under which we expected strong effects on innovation performance.

Sources of learning: customers

An important way to learn from internationalizing is through the feedback, assistance and demands of foreign customers. Generally, information from customers is considered to be useful throughout the innovation process (Dosi 1988; von Hippel 1988), both in early phases in which exposure to (lead) users can provide firms with access to novel ideas, and in later phases with an emphasis on gaining (foreign) market acceptance for the new innovation and stimulating its wider diffusion (Belderbos *et al.* 2012; Czinkota and Pinkwart 2011; Tidd *et al.* 2005). Interaction with customers can be instrumental in reducing the risks associated with the market introduction of new products, in particular when products require adaptations in use, for instance due to their complexity and novelty (von Hippel 1988). Acceptance in foreign markets and by foreign firms often requires the adaptation or improvement of products, which provides impetus for further innovation (Salomon 2006), and foreign buyers can give valuable technical feedback for the innovation process (Evenson and Westphal 1995). The literature on knowledge spillovers from multinational firms likewise has suggested that foreign owned affiliates – as demanding customers – play an important role in facilitating the upgrading of the quality of inputs from supplier industries (e.g. Haskel *et al.* 2007; Javorcik 2004; Kugler 2006).

Two features of customer learning are important. First, learning about specific product demands associated with differential market circumstances and the associated challenges for innovation are not only limited to advanced customers. It is also the heterogeneity in customer needs that can spur innovation. The literature on 'reverse innovation' and 'bottom of pyramid' strategies has documented that attending to the needs of poor and unsophisticated customers in less developed countries may give impetus to new, frugal, solutions, designs, and products, that may subsequently have a positive influence on product innovation in developed markets as well (e.g. Govindarajan and Ramamurti 2011). Our interviews with executives of responding firms confirm the importance of learning from foreign customers operating in different markets for product innovation:

> *"A customer who contacts you with an idea or a requirement is the trigger for us. However, we need to see that the entire market could be interested. The Asian markets work differently compared to ours. We once responded to a customer request which led to the introduction of a new product group in Asia."*

Second, responding to differential customer needs requires an active innovation process and relatively strong learning capacity in identifying demands, seeking new solutions and developing new products and processes. Successful development of ties to new foreign customers is then associated with the introduction of new and improved products suited to these customers, utilizing feedback and taking on the product development challenges posed. The important roles of learning capabilities and technology leadership ambitions in the case of active foreign customer learning are illustrated by a quote from one of the interviewees:

> *"We are a leading technology group and strive for excellence in technology, innovation and product quality. That means we use the knowledge of our customers and research partners in more than 60 countries to develop leading-edge solutions. For us, innovation is an important part of our corporate culture."*

The features of customer learning described *supra* suggest that there are widespread opportunities to learn across foreign markets and firms, although effective learning and innovation does require substantial learning capabilities. Hence, technology leaders may be able to translate customer learning in advanced as well as less advanced countries into improved product innovation. We posit: *technology leaders benefit from customer learning opportunities based in advanced as well as less advanced countries.*

Conversely, technology laggards will experience difficulties in translating learning from customers based in advanced countries into substantive innovation performance effects, but the broader learning opportunities from customers do suggest innovation potential stemming from learning from customers based in less advanced, non-leading, countries. We posit: *technology laggards have learning opportunities from customers based in advanced as well as less advanced countries, but are only likely to have sufficient learning capabilities in interactions with customers based in less advanced markets.*

Sources of learning: suppliers

The effective integration of suppliers into new product development efforts can help firms achieve advantage over competitors in terms of reducing the cost of new product development, technologies and development time. Such supplier involvement has been shown to increase product innovation (Eisenhardt and Tabrizi 1994), and can help firms realize higher process efficiencies (Saeed et al. 2005). In addition, there is evidence that collaboration with suppliers may reduce risk and lead time of product development (Chung and Kim 2003; Nieto and Santamaria 2007). This view is shared by one of the interviewed firms, as the following quote illustrates:

> *"[Firm name] works closely with suppliers across the globe. They are innovative, service-oriented and quality-conscious and support us in continuously improving*

our products and processes while ensuring the consistently high quality and reliable availability of raw materials, machinery, equipment and services."

Learning from suppliers shares a key characteristic with learning from customers: that there is an interest in knowledge exchange and collaboration that can enhance both firms' performance. However, different from learning from customers, innovation through learning from suppliers is most likely if these suppliers provide the most advanced and performance enhancing inputs (van Echtelt et al. 2018). Hence, there will be fewer learning opportunities from transactions with suppliers based in less advanced markets.

Similar to the relationship between learning from customers and innovation, benefiting from supplier innovation is also likely to require effort and substantial learning capabilities on the part of the focal firm. If firms want to utilize higher quality, technology embodied, inputs this will often require adapting technologies and processes to optimize the use of these inputs, which then may spur product and process innovations. This learning for innovation is likely to require substantial interaction with the supplier, which is echoed in the above quote. Hence we posit: *Technology leaders benefit from the opportunities of learning from suppliers based in advanced countries; technology laggards have opportunities of learning from suppliers based in advanced countries but are less likely to have the learning capabilities to benefit from these opportunities.*

Sources of learning: competitors

Characteristics of learning are different when (foreign) competitors are the source of information and learning. Exposure to foreign-based competitors can allow firms to learn how rivals compete in different market settings and provide ideas for, and potentially allow re-engineering of, new products. This may be a necessary requirement for successful market entry or sustained market positions in the face of strong competition from foreign (owned) incumbents (Cassiman and Golovko 2011; Filippetti *et al.* 2011; Salomon and Jin 2010). This

was also apparent when our interviewees described learning from competitors in foreign markets:

> *"When I am present on a market I also see the foreign competitor's product specifications. We look at our product portfolio, we look at the competitor's, and when we see that there is a product we don't offer that the competitor makes money with, we try to develop the same or even a better product."*

In contrast with supplier and customer learning, the presence of market rivalry provides strong incentives to foreign competitors to reduce knowledge spillovers as much as possible in order to protect their market position (e.g. Belderbos et al. 2012; Bloom et al. 2013). While customer and supplier learning tends to be more widespread, as it can build on mutual interest and shared views on the advantages of knowledge sharing, this is rarely the case for competitor learning, which is likely to take the form of competitive imitation. Overall, the features of foreign competitor learning reduce the opportunities for learning and innovation and suggest that this learning is less widespread.

Imitation leading to effective innovation will be more likely if the competitors with which the firm is confronted have developed superior or more effective products. An interviewed executive of a leading firm in the chemicals industry illustrated:

> *"We want to develop leading-edge technologies and excellent products. Then it's of course more important to learn from our customers than to reverse-engineer what our competitors have."*

The features of competitor learning also suggest a different influence of the focal firm's technology leadership on competitor learning and innovation. For firms with leading technologies and advanced technological capabilities, products offered by foreign competitors based in lagging, but also in comparable leading countries, are less likely to provide useful ideas and opportunities for improvement. Imitation of foreign competitors and relatively

simple product adaptations are unlikely to be compatible with the leadership status of the firm and the associated strategy of outcompeting foreign firms with improved technologies and products (Cavusgil *et al.* 1993). Leading firms will also see imitation as less aligned with their innovation strategy, and such alignment is crucial for effective implementation of learning and the coupling of learning with performance outcomes (David *et al.* 2002).

In contrast, technology laggards are more likely to benefit from competitor learning, as they will still find opportunities to imitate competitor products that have better features than their own. Although these firms may be less receptive to learning due to more weakly developed learning capabilities, imitation of existing products puts fewer demands on innovation capabilities compared with the development of new products. The imitators do not have to take on the same level of risk as the original innovators, since they can copy, emulate or reverse-engineer product designs and observe customer needs (Dell'Era and Verganti 2007). The status of firms as technology followers will also be associated with a greater focus on innovation through product imitation. For instance, as firms seek to respond to competitive pressures when they expand abroad in more advanced markets, and seek to sell to advanced customers, taking clues from foreign competitors concerning the product characteristics that are demanded by these foreign firms will be essential for performance. Hence, for lagging firms, competitor learning is likely to be positively associated with innovation performance if these competitors are based in leading countries.

In summary, we posit: *technology leaders have few competitor learning opportunities abroad; technology laggards have opportunities to learn from competitors based in advanced markets and are likely to possess the (less demanding) learning capabilities to act on competitor learning.*

Domestic learning

Most firms with exposure to foreign suppliers, customers, and competitors through foreign expansion are also simultaneously active on their domestic market and interact with domestic firms. Disregarding the importance of domestic sources of learning may thus considerably bias measured effects of learning from foreign firms on innovation performance. An important feature of domestic learning is that the requirements on firms' learning capabilities may be less stringent. For instance, exporting to foreign markets is typically associated with extensive effort and time to develop an understanding of the norms, habits, institutions and routines of the foreign context (e.g. Ghemawat 2001). In general, firms have to identify the most rewarding source of learning before directing learning effort towards a specific supplier, customer or competitor and engaging in a relationship (Laursen and Salter 2006). This may require substantial effort in an unfamiliar environment abroad (Cavusgil et al. 1993). Effective knowledge transfer and interorganizational learning are typically complicated by geographic as well as cultural and institutional distance. Geographic and cultural proximity, in contrast, allows more frequent face-to-face interactions and the generation of trust, facilitating the exchange of tacit knowledge (e.g. Boschma 2005) and local knowledge spillovers (Jaffe et al. 1993, Audretsch and Feldman 1996).[2]

This suggests that effective learning for innovation from customers and suppliers – where learning capabilities and substantive interaction are most crucial – will be easier to achieve if such learning takes place with domestic firms. The arguments above on the broad learning opportunities from customers suggest that both lagging and leading firms may have relevant customer learning opportunities by interacting with domestic firms. As proximity will facilitate interaction and reduce the learning capability hurdle for laggards, both leaders and

[2] We note that in case of learning from foreign (multinational) firms that have located in the focal firms' home country, the proximity advantage also applies, but differences in corporate cultures often remain.

laggards may experience innovation benefits. Learning from domestic suppliers, on the other hand, is less likely to be salient as we expect effective innovation to be dependent on intermediates with superior quality, which is not guaranteed in domestic markets. Finally, domestic competitor learning is not expected to play a salient role in innovation. Learning opportunities are limited, since it is less likely that there are competitors with superior products and technologies active in the focal firm's domestic industry. Domestic peers are generally less likely to be a source of relevant information for innovation. We posit: *for both leading and lagging firms, there are domestic customer learning opportunities and relevant (less stringent) learning capabilities; there are few learning opportunities from domestic competitors and domestic suppliers.*

Summary

The arguments above suggest that the balance between learning opportunities and learning capabilities will be different depending on the firm's leadership status, distance to the global technology frontier of the country in which the foreign firms are based, and the source of learning. Table 1 summarizes our expectations formulated above.

----------Insert Table 1----------

The table draws a distinction between learning from customers, suppliers and competitors, and whether these are foreign or domestic. Depending on the leadership status of the focal firm and the position of the foreign country and industry, the table shows whether we would expect learning opportunities to exist and whether we expect firms to have sufficient learning capabilities. Given that both learning capabilities and learning opportunities are necessary conditions for effective learning and innovation performance, we do not expect innovation effects to occur when one of these is weak. In the case of customer learning, there are broad learning opportunities, which are stronger if foreign customers are based in leading countries.

Leading firms generally have strong learning capabilities, while lagging firms are only likely to have sufficient capabilities in case of learning from domestic customers and customers in lagging countries.

Supplier learning for innovation is expected to occur for leading firms with suppliers based in advanced countries. In the case of competitor learning, there are less demanding learning capabilities, but substantive learning opportunities are restricted to lagging firms learning from firms based in leading countries. This leads to an interesting pattern in which the conditions under which competitor learning is expected to occur, are the only conditions under which the framework does not predict customer learning to occur. More specifically, the framework suggests that learning for innovation is most effective in the cases of a) learning from customers based abroad and at home by leading firms, b) customer learning from firms based in less advanced markets and at home by lagging firms, c) supplier learning from firms based in advanced countries by leading firms, and d) competitor learning from firms based in leading countries by lagging firms.

DATA AND METHODS

Sample

The empirical analysis draws on survey data for German firms contained in the German Community Innovation Survey (CIS) performed in 2003. The survey has been conducted by the Centre for European Economic Research (ZEW) on behalf of the German Federal Ministry of Education and Research. Although the survey in 2003 was not a regular CIS Survey (which were conducted every 2 or 4 years at the time), the methodology and questionnaire used by the survey, which is targeted at enterprises with at least five employees, complies with the harmonized survey methodology prepared by Eurostat for CIS surveys in Europe. To ensure interpretability, reliability and validity, CIS surveys are subject to extensive pre-testing and piloting in various countries, industries and firms (Laursen and

Salter 2006). Comprehensive non-response analyses of the German survey did not indicate any systematic distortions between responding and non-responding firms with respect to their innovation activities (Rammer *et al. 2*005). Although the survey dates back to the year 2003, it has since been the only survey containing measures on the learning for innovation detailing the country and source of learning.

As a unique feature, the survey conducted in 2003 contains specific questions on the location of customers, suppliers and competitors as sources of ideas and learning for innovation, whether they are located at home or abroad and if so in which countries. This information is not standard in the CIS, in which the distinction between foreign and domestic learning is normally absent.[3] The information in the 2003 survey allows examining to what extent learning from foreign customers, suppliers and competitors took place, and the relationship between observed learning and innovation performance – with our focus of analysis on the latter. The question in the 2003 survey regards learning in the three-year period from 2000 to 2002, as is common in CIS-type data.

Information on innovation activities and learning experience is only available for firms in the survey that indicate that they are engaged in innovation activities in the first place. Hence, our sample is restricted to firms engaged in innovation efforts. In a supplementary analysis, we estimated models applying a parametric correction for sample selection (Heckman 1979). We omit foreign multinational firms from the sample, as for these firms existing activities in their home country will complicate the analysis of learning in the German context (e.g. Salomon and Shaver 2005a). Excluding observations with item non-responses, our sample contains 1082 firms. The distribution of the firms in the sample across

[3] If firms indicate that they learned from sources abroad, they reported on average 2.7 countries in the case of foreign customer learning, 2.1 countries in the case of foreign supplier learning, and 2.2 countries in the case of foreign competitor learning.

industries closely resembles the distribution over industries of all 2390 manufacturing firms in the survey.

Measures

Dependent variable. A variety of measures have been proposed to capture a firm's *innovation performance* (OECD 2005), for example the number of patents (Salomon and Jin 2008, 2010) or new products (Katila 2002) a firm achieved in a given time period. Other studies also weigh the market impact of innovations to measure performance (Laursen and Salter 2006). We follow the latter approach and take the sales due to products that are new or substantially improved (in logarithmic form) as our measure for innovation performance. The variable measures sales in the last year of the three-year survey period (i.e. in 2002) of product innovations that were introduced during that three-year period. This measurement is consistent with the design of recent studies using CIS data to establish innovation performance (e.g., Klingebiel and Adner 2015; Cassiman and Valentini 2016).

Learning. The key explanatory variables of interest refer to learning from customers, suppliers and competitors, which are based on firms' answers to questions whether these firms had served as external sources of ideas or pressure leading to the introduction of innovations during the period 2000-2002.[4] The survey provides information on whether these firms as external sources were located in Germany or abroad and, in which countries the firms were located. Specifically, the questions and information for the responding firms read:

> "*External innovation sources are defined as those innovation initiators whose impulses were indispensable in the development of a new product, service or process. Were any of the new or significantly improved products/services or*

[4] It should be noted, though, that the survey question refers to "sources of information" and not directly to learning. We argue that this measure reflects learning by the firm since it was asked whether the respective information source was effective in enabling innovation.

processes introduced during 2000-2002 by your enterprise innovations being introduced because specific customers had expressed a wish for them or because they were expressly demanded by buyers (e.g. identified through market research)?"

"Were any of the new or significantly improved products/services or processes introduced during 2000-2002 by your enterprise innovations first made possible because of recent innovations by suppliers?"

"Were any of the new or significantly improved products/services or processes introduced during 2000-2002 by your enterprise innovations specifically initiated because of innovations by competitors or enterprises in the same sector?"

The survey subsequently asks where those customers, suppliers and competitors as external innovation sources are located – where the respondents can fill in multiple countries. Since the survey asks for the countries of suppliers, customers and competitors, learning can be related to interactions with foreign multinationals with affiliates in Germany, or to interactions with foreign firms abroad due to importing and exporting. The information allows for a differentiation between learning from customers, suppliers and competitors on domestic and foreign markets – learning that is judged by the firm as being consequential for product innovation. Moreover, the information on the countries in which the foreign competitors and customers were located allows identifying whether learning occurred from customers, suppliers or competitors in leading or lagging countries in the industry. To identify leading or lagging foreign industries we follow prior research (Salomon and Jin, 2008; Belderbos *et al.* 2105) and compare the industry's R&D intensity in 2000 (NACE two-digit) in the country of the foreign source with the OECD average industry R&D intensity. Consequently, learning occurs from a customer or competitor in a leading (lagging) industry abroad if that industry's

R&D intensity is higher (lower) than the OECD average industry R&D intensity. If sources are mentioned in different countries, both above and below the average OECD R&D intensity, then both learning from leading countries and learning from lagging countries are present. This leads to six dummy variables indicating the incidence and types of learning: *leading foreign customer learning, lagging foreign customer learning, leading foreign supplier learning, lagging foreign supplier learning, leading foreign competitor learning*, and *lagging foreign competitor learning*. For domestic learning, we construct dummy variables taking the value one if a firm answered affirmative to the respective learning questions and filled in Germany as the location of the customer, supplier or competitor (*domestic customer learning, domestic supplier learning, domestic competitor learning*).

The particular features of these questions merit further discussion. First, the specific questions refer to a rather narrow definition of learning, in particular where they focus on foreign customer demands and ideas for new products (among which those identified through market research). Similarly, the question on supplier learning specifically focuses on the implications from innovations introduced by suppliers. While this is a limitation of the survey data suggesting that measures drawing on these questions may represent a lower bound of learning, the questions are introduced within the broader framework of the importance of external sources of information for firms' innovation process. We confirmed through our interviews that respondents see the questions more broadly as referring to ideas, information, and feedback from customers, competitors, and suppliers that were associated with, and relevant for, new product introductions.

Second, a particular feature of the questions is that they refer to '*effective'* learning: learning that is associated with, and instrumental for, the introduction of product innovations. Hence, there is no doubt that in case of affirmative answers, foreign market exposure aided the product innovation process and ultimately resulted in the introduction of new or improved

products – at least in the opinion of the respondents. While this implies another restriction to the concept of learning, the advantage is that the answers give direct insight into the relevance of foreign learning in conjunction and in comparison with domestic learning. While learning is defined in relationship to product innovation, our analysis focuses on whether these heterogeneous sources of learning have real consequences for the *magnitude* of firms' sales from innovative products.

Technology Leadership. We take an in-depth perspective on firms' technology leadership and learning capabilities, taking into account R&D activities as well as aspects of mindset and organization. Prior research has suggested that firms' strategic intent towards learning and innovation is an important moderator of the relationship between learning and innovation performance (e.g. Autio et al. 2000; Zara et al. 2000). Such heterogeneity in innovation strategy and learning intent will to an important extent be captured by differences across firms in the adoption of technology strategies. A learning mindset is in place if the firm's aim is to enhance competitiveness by staying at the forefront of technology development in all its markets and to exploit technological advantages by introducing new products with higher quality, improved service, and greater functionality. These features are best captured by the presence of a leadership strategy in technology development. While a focus on technology leadership is clearly associated with enhanced investments in R&D, the essence of a leadership strategy is broader and encompasses managerial awareness and learning intent, which is associated with the presence of organizational procedures and routines to implement learning and continuous innovation (Autio et al. 2000). Even in innovating and R&D active firms with sufficient potential absorptive capacity to benefit from information coming from foreign markets, the realization of learning benefits requires an active approach to exploit this information (Zahra et al. 2000).

Following this logic, our measure of learning capabilities derives from information in the survey whether the main goal of innovation efforts of the firm is to attain technology leadership status in its industry. *Technology leadership* is a dummy variable taking the value one if this is the case, and zero if this is not the case (for convenience termed 'technology laggards'). In our sample, 53 percent of the firms are identified as technology leaders. In the descriptive statistics, we confirm that these firms exhibit relatively high R&D intensities, higher export intensities, and more domestic and foreign learning. In auxiliary analyses, we observe that technology leadership is also associated with the implementation of a range of innovation management and coordination practices expected to enhance the effectiveness of learning.

Control Variables. A key control variable is the firm's *R&D intensity*, defined as the ratio of R&D expenditures to sales (in 2000). The analysis also controls for another external source of learning for innovation that firms could have made use of. Similar to the questions on customer, supplier and competitor learning, firms were asked whether they learned from universities (*university learning*) which may be an important source of state-of-the-art technological knowledge (e.g. Belderbos *et al.*, 2004).[5] The variable for university learning captures whether a firm's innovation activities benefitted from scientific knowledge generated by public research institutions and universities.

We control for *firm size* by including the number of employees in 2000 (in logarithmic form). The models include a regional dummy variable for *Eastern Germany* since economic differences are still pronounced between Eastern and Western Germany. We add a dummy variable (*affiliate abroad*) that takes the value of one for firms operating a (sales) affiliate abroad, which may enhance foreign learning potential. We include the firm's *export intensity* in 2000 to control for influences of exports on innovation that may not be captured by the

[5] Specifically, firms were asked to indicate whether improved products/services or processes introduced were made possible because of recent research results from universities and other public research institutions.

learning variables. Finally, we control for *industry* differences in innovation by including ten industry dummies based on the two-digit European NACE classification system.[6]

Methods

We estimate tobit models relating innovation performance to foreign and domestic learning from customers, suppliers and competitors. Tobit models are appropriate because our dependent variable is truncated: 22% of all firms report no sales of innovative products at all. This may be due to the firms' inability to commercialize new products or the fact that they had started but not yet completed or failed in their innovation effort.

There are two ways to examine the structural differences in the relationship between learning and innovation for technology leaders and laggards: multiplicative interaction terms or a split-sample analysis of leaders versus laggards. We follow prior literature (e.g., Salomon and Jin 2008, 2010) and use split sample tests. A split sample analysis is the more general test specification for differences between groups, because it allows the influence of other firm characteristics to differ systematically between leading and lagging firms as well, ensuring consistent within-group estimates (e.g., Hoetker 2007). Interaction analysis would assume that such other characteristics are equal across firms – an assumption that is violated in the context of our analysis, as the empirical results will show.

We examined whether the survey responses and our results are likely to suffer from common method bias. CIS surveys are constructed in a way that alleviates concerns about common method bias as the questionnaire employs different scale endpoints and formats for dependent and explanatory variables. Questions are ordered such that respondents cannot easily relate dependent and explanatory variables cognitively (Murray *et al.* 2005). Moreover, our dependent variable – the sales with product innovations – is unlikely to be biased because

[6] In the estimations, we combine some of the two-digit industries if these are represented by less than five observations.

it is not a perceptual measure but a fact-based item (Podsakoff *et al.* 2003). We further investigated common method bias by applying Harman's single-factor test (Podsakoff *et al.* 2003), which is based on an exploratory factor analysis involving the dependent and explanatory variables. Common method variance would be indicated if the factor analysis yielded only a single factor or when one factor accounted for the largest share of covariance between the variables. For our sample, the analysis results in 13 factors with an eigenvalue greater than 1 (5 factors when estimating without industry dummies) and the first factor explains 12 percent of the variance. We therefore conclude that common method bias is unlikely to affect the validity of our study.

Given the cross-section nature of our data and the potential presence of omitted variables affecting innovation performance, we cannot easily rule out potential endogeneity bias. In the absence of suitable valid instruments[7], we therefore treat the relationships investigated as associations rather than as causal effects. At the same time, we argue that, since we identify learning directly from the survey evidence specifically as interactions with suppliers, customers, and competitors affecting the innovation process, our core explanatory variables measure the underlying mechanisms. The empirical models demonstrate *which type* of learning is most strongly associated with the extent of innovation performance.

EMPIRICAL RESULTS

Table 2 provides information on the five main countries from which foreign suppliers, customers, and competitors originate that were instrumental for the focal firms' learning for innovation. The table shows relatively little variation in the countries: customers, suppliers and competitors from the US occupy the top-ranking position for each. Foreign sources of learning from Switzerland and Japan follow, even though with a considerably less frequent

[7] We cannot use instruments such as foreign market growth or exchange rate shocks (e.g. Berman et al. 2014; Salomon and Shaver 2005a) because we lack data on firm's export scope and exposure to such shocks.

occurrence in the sample. In general, firms in the survey indicated a large variety of countries, spanning all continents, but many countries were mentioned only once or twice due to the high degree of heterogeneity in firms' international exposure.

Table 3 shows summary statistics of the variables included in the models for leading and lagging firms. As expected, we find that the mean values of all variables except for firm age are significantly different across the two samples, with leaders showing significantly higher values for the incidence of learning, R&D, exports and size.

----------Insert Tables 2 and 3----------

Tables 4a and 4b report pairwise correlations for the two subsamples. The average variance inflation factors (VIF) of the covariates are 1.32 and 1.38 for laggards and leaders, respectively, well below the commonly applied thresholds (Belsley *et al.* 1980), and thus do not raise multicollinearity concerns.

----------Insert Tables 4a and 4b----------

Table 5 presents results of the tobit models. Models 1 and 2 present results for all firms while Models 3 and 4 (5 and 6) present results for the subsample of lagging (leading) firms. For each sample, we present the results of the controls-only model and the full model. It turns out that the relationships of the control variables with innovation performance are largely consistent across the different models and samples, even though some coefficients become insignificant in the subsamples due to lower sample size. We find that export intensity is positively and significantly associated with innovation performance in the full sample and the subsample of laggards, as is R&D intensity. There are no significant associations of these variables with innovation observed in the subsample of leaders, which will be partially related to the higher average levels of R&D and export intensity among these firms. Firm size is positively and significantly associated with innovation performance in all models, while firm

age and a location in East Germany show no significant association with performance. Having an affiliate abroad is negatively and significantly associated with innovation performance for laggards in Model 4, perhaps because learning takes place through the foreign affiliate and may be unreported by the focal firm. Learning from universities is only positive and significant in Model 1 and Model 5 for the subsample of firms following a leadership strategy, which is in line with the notion of leaders' stronger learning capabilities to integrate scientific knowledge (e.g. Belderbos et al., 2016). The industry dummies (not reported but included in the regressions) are jointly significantly different from zero in all models.

Regarding our main explanatory variables, the sample including all firms shows a statistically significant positive relationship for the learning from leading foreign suppliers and domestic customer learning variables only. The results for the two subsamples indicate that considering all firms together conceals a great amount of heterogeneity.[8] For laggards, there is a statistically significant association between innovation and learning from domestic customers ($p<0.05$), foreign customers in lagging markets ($p<0.01$), and foreign competitors in leading markets ($p<0.01$). For leaders, we observe statistically significant associations between innovation and learning from leading foreign customers ($p<0.10$), leading foreign suppliers ($p<0.05$) and domestic customers ($p<0.01$). Foreign and domestic competitor learning are irrelevant for leaders. These patterns are in line with our expectations and underline the differential nature of learning capabilities and opportunities for innovation for leaders and laggards. The only exception is the insignificant association between innovation and learning in leading markets by lagging firms, where we expected a positive relationship.

The effect sizes of foreign customer and competitor learning on innovation appear sizable. Marginal effects in the Tobit model consist of effects on the probability that the dependent variable is positive rather than zero, and effects on the magnitude of the dependent

[8] Including interaction effects of the learning variables with leading and lagging industry variables in the sample of all firms (instead of using split-sample analysis) leads to similar estimates for the learning variables.

variable conditional on the variable being positive (e.g. McDonald and Moffit 1980). We are interested in the marginal effects for the unconditional expected value of the dependent variable. For laggards, calculations suggest that learning from lagging foreign customers is associated with 82 percent higher innovation sales. These percentages are 114 in case of learning from leading foreign competitors, and 33 for learning from domestic customers. Leaders exhibit 25 percent higher innovation sales when they learn from leading foreign customers, 53 percent in case of learning from leading foreign suppliers, and 56 percent in case of learning from domestic customers.

----------Insert Table 5----------

Supplementary analyses

We examined the potential influence of sample selection bias by estimating a two-stage model and applying a parametric correction for sample selection (Heckman, 1979) (available from the authors upon request). In the first stage model, the probability of selection into the sample (as innovating firm) for the population of manufacturing firms represented in the survey is related to a set of control variables and two instruments: the industry share of innovators calculated at the two-digit level and the firm's credit score. While the former variable captures an industry-specific likelihood of following an innovation-based competitive strategy, the latter measures a firm's availability of resources to engage in innovation. Both variables should be related to the decision to innovate, but unrelated to the eventual outcomes of a firm's innovation activities. The adapted innovation model including the inverse Mills ratio from the first stage model does not show altered signs or significance of the main explanatory variables, while the inverse Mills ratio itself is insignificant.

DISCUSSION AND CONCLUSION

Prior research has frequently documented the potential effects of firms' exposure to, and learning from, foreign firms related to importing, exporting, or interactions with foreign affiliates in the home country, but has delivered ambiguous results. In this paper, we develop and test a framework describing the conditions under which learning from interactions with foreign firms in the value chain (customers, suppliers, and competitors) is likely to have substantive consequences for firm innovation. We argue that the benefits of learning for focal firms' innovation performance depend on the source of learning (whether firms learn from suppliers, customers or competitors), whether the focal firms are technology leaders or laggards, and whether the foreign firms as sources of learning are based in countries that are leading or lagging in their industries. At the same time, firms can learn from domestic suppliers, customers and competitors – and these learning opportunities may decrease with a strong reliance on internationalization and learning from foreign firms. Based on unique survey-based evidence on the sources of learning for innovation in a large sample of German firms, we find evidence of highly heterogeneous benefits of domestic and foreign learning for innovation performance, measured as sales of new and improved products.

Our study suggests a nuanced view on the relationship between international exposure, learning, and innovation, as a function of the balance between learning opportunities and learning capabilities. Empirical findings provide support for four notions. First, learning opportunities from customers (based in leading or lagging countries) are broader in scope, but acting on such opportunities requires strong learning capabilities, which are more widely available in leading firms. Hence, leading (lagging) firms benefit from interactions with customers based in leading (lagging) countries.[9]

[9] We acknowledge that lagging firms may also have selected customers based in less technologically advanced countries in the first place, leaving them with fewer opportunities to learn from sophisticated foreign-based customers abroad. Our data, unfortunately, do not allow us to investigate this question in more detail.

Second, translating learning from suppliers to product innovation requires strong learning capabilities as well as strong learning opportunities, and is limited to technology leaders in interaction with suppliers based in leading countries. Third, learning and imitation from competitors requires fewer learning capabilities but will only be salient if learning is from more advanced competitors, with the innovation benefits confined to lagging firms. Fourth, the innovation performance of both leaders and laggards is positively related to learning from their domestic customers. Hence, interestingly, domestic customers matter for both types of firms while foreign customers matter differentially for leaders and laggards. We attribute the more widespread learning opportunities from domestic customers to the easier interaction between firms and their domestic customers given their cultural and geographic proximity, allowing innovation benefits to occur also in lagging firms.

Beyond domestic customer learning we observe little effective learning for innovation from domestic value chain partners, even in the context of the advanced German economy. We posit that learning from domestic suppliers is less likely to be salient, as effective innovation depends on intermediates with superior quality, which is not always guaranteed in domestic markets. Similarly, domestic competitor learning may not play a salient role in innovation as it is not guaranteed that there are competitors with superior products and technologies active in the focal firm's domestic industry. Exposure to value chain partners based in countries that are operating at the technology frontier provides more guarantees for effective learning opportunities.

Our findings provide novel insights regarding the complex and contingent relationships between internationalization and innovation and contribute to both the trade and performance literature as well as the literature on spillovers from FDI. Whereas prior research on exporting has noted the opposing forces of learning capabilities (e.g. Aw et al. 2011; Damijan et al. 2010; Salomon and Shaver 2005b) and learning opportunities (Castellani 2002;

De Loecker 2007; Salomon 2006) in influencing the relationship between exporting and learning, results have been ambiguous (Salomon and Jin 2008; Winston Smith 2014). Similarly, studies on the spillover effects of inward FDI have paid attention to the roles of technology advantages of multinational firms and absorptive capacity on the part of domestic firms (e.g. Girma et al., 2001; Lenaerts and Merlevede, 2015), suggesting that this gap should be neither too big nor too small. However, these studies have generally obtained inconclusive results (Görg and Greenaway, 2004). Our study suggests that such ambiguities can be resolved by taking into account simultaneously the heterogeneity in the (strength of) the specific sources of foreign learning: suppliers, customers, and competitors, as well as heterogeneity in leadership and learning capabilities of the focal firms.

Our study also revealed that learning from domestic customers occurs simultaneously with foreign learning and is as important for firms as learning from foreign sources. Increasing internationalization through exporting or interactions with foreign firms, however, reduces the extent of interaction with domestic firms and domestic learning, and this can reduce the net innovation benefits of exposure to foreign firms. An important implication for prior and future research concerning specifically the relationship between exports and innovation is that ignoring firms' domestic learning is likely to lead to inappropriate inference on the effects of learning through exporting. In particular, in an advanced market such as Germany, domestic customers remain an important inspiration for innovation. For firms that set their initial steps on export markets, domestic customer learning will still be a salient factor and it is conceivable that the co-occurrence of domestic and foreign learning leads to overestimation of the effects of exports. On the other hand, for firms that are highly export intensive and reduce their exposure to domestic customers, export learning effects may be underestimated if the negative consequences for innovation performance due to the reduced opportunities to learn in the domestic market are not taken into account.

In this regard, our paper also contributes to the emerging literature on the variance in export learning outcomes and the benefits from exporting (Alcacer and Oxley 2014; Golovoko and Valentini 2011; Salomon and Jin 2010; Shaver 2011; Winston Smith 2014). Our findings suggest that this variance is related to both the source of export learning, i.e. customers, suppliers and competitors, the leadership position of the focal firm, and the advanced or less advanced nature of foreign suppliers, customers and competitors. The findings support the notion in Alcacer and Oxley (2014) – for the specific case of OEM suppliers to telecommunication client firms – that the source of knowledge as well as characteristics of the focal firms matter for learning outcomes and the performance effects of interactions with foreign firms.

Limitations and further research

We note a number of limitations associated with the current study. First, the limitation of the learning-by-country-of-origin questions to innovating firms in a single innovation survey restricted our analysis to a cross-section. Although we identify learning from interactions with foreign firms directly from the survey evidence, our cross-section analysis may still suffer from omitted variable bias, such that we treated the relationships investigated as associations. In future work it would be desirable to have more periods of observation available and to explore the use of instrumental variables.

Second, although our measures for learning provide a much more fine-grained picture than those used in prior studies, they have their limitations as well. The questions are narrowly defined focusing on product demands, ideas, and innovation, but do not explicitly refer to information flows or interactions with foreign suppliers, customers and competitors or to the precise mechanisms (e.g. reverse engineering) through which learning translates into stronger innovation performance. While interviews with respondents confirmed the validity of the measures, it would be of substantial value if future research could draw on surveys that

contain more elaborate learning questions specifying the sources of learning. Furthermore, the questions do not distinguish between learning from foreign firms as a result of the firm's own internationalization (exporting and importing) and learning due to the internationalization of foreign firms setting up affiliates in Germany. We do find, however, a strong positive association between export intensity and foreign customer and competitor learning, and a negative association between export intensity and domestic customer and competitor learning, which may suggest that firms' own internationalization efforts drive most of the relationships.

Third, we note that the scope of our dependent and explanatory variables is limited to product innovations and that the analysis abstracted from process innovations. There is evidence that process innovation also has intricate relationships with internationalization (e.g. Golovko and Valentini 2011), and the lack of inclusion of process innovations may make it more difficult to establish the full benefits of in particular supplier learning.

Finally, our results pertain to innovating firms in Germany: innovating firms in one of the world's most advanced and export-oriented countries. Clearly, this raises issues of representativeness. This set of firms is more likely to have a learning orientation and the capacity to absorb and utilize new ideas, while domestic customers are likely to be sophisticated and to provide opportunities for learning. While our analysis of leading versus lagging firms in German industries and differences in the origin of foreign learning revealed important heterogeneities, we hope that future work will be able to analyze data on learning and innovation in less advanced economies.

REFERENCES

Alcacer, J. and Oxley, J. 2014. Learning by Supplying, *Strategic Management Journal*, 35: 204-223.

Amiti, M. and Konings, J. 2007. Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia, *American Economic Review,* 97(5): 1611-1638.

Andersson, M. and Lööf, H. 2009. Learning-by-Exporting Revisited: The Role of Intensity and Persistence. *Scandinavian Journal of Economics,* 111(4): 893-916.

Audretsch, D.B. and Feldman, M.P., 1996. R&D Spillovers and the Geography of Innovation and Production. *American Economic Review* 86(3): 630-640.
Autio, E., Sapienza, H.J. and Almeida, J.G. 2000. Effects of age at entry, knowledge intensity and imitability on international growth. *Academy of Management Journal*, 43: 909-924
Aw, B.Y. and Batra, G. 1998. Technological Capability and Firm Efficiency in Taiwan (China). *The World Bank Economic Review*, 12: 59-79.
Aw, B.Y. and Hwang, A.R. 1995. Productivity in the Export Market: a Firm Level Analysis. *Journal of Development Economics*, 47: 313-332.
Aw, B.Y., Roberts, M.J. and Xu, D.Y. 2011. R&D Investment, Exporting, and Productivity Dynamics, *American Economic Review,* 101: 1312-1344.
Belderbos, R. and Sleuwaegen, L. 1998. Tariff jumping FDI and export substitution: Japanese electronics firms in Europe, *International Journal of Industrial Organization*, 14: 601-638.
Belderbos, R., Gilsing, V. and Lokshin, B. 2012. Persistence of and interrelation between horizontal and vertical technology alliances. *Journal of Management*, 38(6), 1788-1811.
Belderbos, R., Lokshin, B. and Carree, M. 2004. R&D Cooperation and Firm Performance, *Research Policy*, 33: 1477-1492.
Belsley, D.A., E. Kuh and R.E. Welsh 1980. Regression Diagnostics: Identifying Influential Data and Sources of Collinearity, New York
Berman, N., Berthou, A. and Héricourt J. 2014. *Exporting Dynamics and Sales at Home*, Working paper series No. 1720, European Central Bank.
Bernard, A. B., Redding, S. J., and Schott, P. K. 2007. Firms in international trade. *Journal of Economic Perspectives*, 21: 105-130.
Bernard, A., and Jensen, J.B. 1999. Exceptional export performance: cause, effect, or both? *Journal of International Economics*, 47: 1-25.
Blalock, G. and Gertler, M. 2004. Learning from exporting revisited in a less developed setting. *Journal of Development Economics* 75: 397-416.
Bloom, N., Schankerman, M. and Van Reenen, J., 2013. Identifying Technology Spillovers and Product Market Rivalry. *Econometrica*, 81: 1347-1393.
Boschma, R. 2005. Proximity and innovation: a critical assessment. *Regional studies*, 39(1), 61-74.
Cassiman B, Valentini G. 2016. Open Innovation: Are Inbound and Outbound Knowledge Flows Really Complementary? *Strategic Management Journal* 37(6): 1034-1046.
Cassiman, B., Golovko, E., 2011. Innovation and Internationalization through Exports, *Journal of International Business Studies,* 42: 56-75.
Cassiman, B., Martinez-Ros, E., Martinez, E., 2010. Innovation, Exports and Productivity, *International Journal of Industrial Organization,* 28: 372-376.
Castellani, Davide. 2002. Export Behavior and Productivity Growth: Evidence from Italian Manufacturing Firms. *Review of World Economics* 138: 605-628.
Cavusgil, S. T., Zou, S., & Naidu, G. M. 1993. Product and Promotion Adaptation in Export Ventures: An Empirical Investigation. *Journal of International Business Studies*, 24(3): 479-506.
Chung, S., & Kim, G.M. (2003). Performance effects of partnership between manufacturers and suppliers for new product development: the suppliers standpoint. Research Policy, 32(4), 587–603.
Clerides, S. K., Lach, S. and Tybout, J.R. 1998. Is Learning by Exporting Important? Micro-dynamic Evidence from Colombia, Mexico, and Morocco. *Quarterly Journal of Economics*, 113: 903-947.
Cohen W.M., Levinthal D.A. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly,* 35): 128-152.

Crespi, G., Criscuolo, C. and Haskel, J. 2008. Productivity, exporting and the learning by exporting hypothesis: direct evidence from UK firms. *Canadian Journal of Economics* 41: 619-638.
Damijan, J.P., Kostevc, C. and Polanec, S. 2010. From innovation to exporting or vice versa?, *The World Economy*, 33: 374-398.
David, J. S., Hwang, Y. and Pei, B. K. W. 2002. The performance effects of congruence between product competitive strategies and purchasing management design. *Management Science*, 48: 866-885.
De Loecker, J. 2007. Do exports generate higher productivity? Evidence from Slovenia, *Journal of International Economics*, 73: 69-98.
Delgado, M., Farinas J. and Ruano S. 2002. Firm Productivity and Export Markets: a Nonparametric Approach. *Journal of International Economics* 57: 397-422.
Delgado, M., Ketels, C., Porter, M. E. & Stern, S., 2012. The determinants of national competitiveness. *NBER, Working Paper No. 18249*, Cambridge, MA.
Dell'Era, C., Verganti, R. 2007. Strategies of Innovation and Imitation of Product Languages. *Journal of Product Innovation Management* 24(6): 580-599.
Dosi, G., 1988. Sources, procedures and microeconomic effects of innovation. *Journal of Economic Literature,* 26: 1120-1171.Eisenhardt, K., & Tabizi, B. (1994). Accelerating adaptive processes: product innovation in the global computer industry. Administrative Science Quarterly, 40, 84-110.
Filippetti, A., Frenz, M. and Ietto-Gillies, G. 2011. Are Innovation and Internationalization Related? An Analysis of European Countries. *Industry and Innovation*, 18: 437-459.
Gao, G.Y., Murray, J.Y., Kotabe, M. and Lu, J. 2010. A 'strategic tripod' perspective on export, *Journal of International Business Studies,* 41: 377-396.
Ghemawat, P., 2001. Distance still matters: The hard reality of global expansion. *Harvard Business Review,* 79(8): 137-147.
Girma, S., Greenaway, D. and Kneller, R. 2004. Does exporting increase productivity? A microeconometric analysis of matched firms, *Review of International Economics*, 12: 855-866.
Golovko, E. and Valentini, G. 2011. Exploring the complementarity between innovation and export for SMEs' growth, *Journal of International Business Studies*, 42: 362-380.
Golovko, E. and Valentini, G. 2014. Selective learning-by-exporting: Firm size and product versus process innovation. *Global Strategy Journal*, 4(3): 161-180.
Görg, H., Strobl, E., 2001. Multinational companies and productivity spillovers: A meta-analysis. *The Economic Journal* 111, 723-739.
Govindarajan, V. and Ramamurti, R. 2011, Reverse innovation, emerging markets, and global strategy. *Global Strategy Journal*, 1: 191–205.
Haskel, J., Pereira, S. and Slaughter, M., 2007. Does Inward Foreign Investment Boost the Productivity of Domestic Firms? *The Review of Economics and Statistics*, 89: 482-496.
Heckman, J. J. 1979. Sample selection bias as a specification error. *Econometrica*, 47: 153-161.
Hoetker, G. 2007. The use of logit and probit models in strategic management research: Critical issues. *Strategic Management Journal*, 28: 331-343.
Ito, K. 1997. Domestic competitive position and export strategy of Japanese manufacturing firms: 1971–1985. *Management Science* 43(5): 610-622.
Jaffe, A., Trajtenberg, M. and Henderson, R., 1993. Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *Quarterly Journal of Economics* 108: 577-598.

Javorcik, B. S., 2004. Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages. *American Economic Review*, 94: 605-627.
Joshi, A.W. and Sharma, S., 2004. Customer Knowledge Development: Antecedents and Impact on New Product Performance. *Journal of Marketing*, 68: 47-59.
Katila, R. 2002. New Product Search over Time: Past Ideas in Their Prime? *Academy of Management Journal,* 45: 995-1010.
Katila, R. and Ahuja, G. 2002. Something Old, Something New: A Longitudinal Study of Search Behavior and New Product Introduction. *Academy of Management Journal* 45(6): 1183-1194.
Klingebiel R, Adner R. 2015. Real Options Logic Revisited: The Performance Effects of Alternative Resource Allocation Regimes. *Academy of Management Journal* 58(1): 221-241.
Kugler, M., 2006. Spillovers from Foreign Direct Investment: Within or Between Industries? *Journal of Development Economics*, 80: 444-477.
Laursen, K. and Salter, A. 2006. Open for Innovation: The Role of Openness in Explaining Innovation Performance among U.K. Manufacturing Firms. *Strategic Management Journal* 27: 131-150.
Lee, S.-H., Beamish, P. W., Lee, H.-U. and Park, J.-H. 2009. Strategic choice during economic crisis: Domestic market position, organizational capabilities and export flexibility. *Journal of World Business* 44 (1): 1-15.
Leiponen, A., Helfat, C. E. 2011. Location, Decentralization, and Knowledge Sources for Innovation. *Organization Science*, 22: 641-658.
Lenaerts, K., Merlevede, B., 2015. Firm size and spillover effects from foreign direct investment: the case of Romania. *Small Business Economics* 45, 595-611.
MacGarvie, M. 2006. Do Firms Learn From International Trade? *Review of Economics and Statistics* 88 (1): 46–60.
McDonald, John F., and Robert A. Moffit, 1980, The Uses of Tobit Analysis, *Review of Economics and Statistics*, 62, 318-321.
Melitz, M. J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71: 1695-725.
Murray, J. Y., Kotabe, M., and Zhou, J. N. 2005. Strategic alliance-based sourcing and market performance: Evidence from foreign firms operating in China. *Journal of International Business Studies*, 36(2): 187-208.
Nieto, M.J., & Santamaria, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. Technovation, 27(6), 367-377.
OECD. 2005. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data* (3rd ed.). Organisation for Economic Co-operation and Development: Paris.
Petersen, B., Pedersen, T., & Lyles, M. A. 2008. Closing knowledge gaps in foreign markets. *Journal of International Business Studies*, 39(7): 1097-1113.
Podsakoff, P. M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology* 88: 879-903.
Porter, M. 1990. *Competitive advantage of nations*. New York: Free Press.
Rammer, C., Peters B., Schmidt, T., Aschhoff B., Doherr, T. and Niggemann, H. 2005. Innovationen in Deutschland. Ergebnisse der Innovationserhebung 2003 in der Deutschen Wirtschaft 78, Nomos Verlag, Baden-Baden.
Roberts, M. and Tybout, J. 1997. The Decision to Export in Colombia, *American Economic Review* 87: 545-565.

Roper, S. and Love, J. 2002. Innovation and export performance: evidence from the UK and German manufacturing plants. *Research Policy*, 31: 1087-1102.
Rosenkopf, L. and Nerkar, A. 2001. Beyond Local Search: Boundary-Spanning, Exploration, and Impact in the Optical Disc Industry. *Strategic Management Journal*, 22: 287-306.
Salomon, R. and B. Jin 2008. Does Knowledge Spill to Leaders or Laggards? Exploring Industry Heterogeneity in Learning by Exporting, *Journal of International Business Studies*, 39: 132-150.
Salomon, R. and B. Jin 2010. Do Leading or Lagging Firms Learn More from Exporting?, *Strategic Management Journal,* 31: 1088-1113.
Salomon, R. and Shaver, J. M. 2005a. Export and Domestic Sales: Their Interrelationship and Determinants, *Strategic Management Journal* 26, 855-871.
Salomon, R. and Shaver, J. M. 2005b. Learning by Exporting: New Insights from Examining Firm Innovation. *Journal of Economics and Management Strategy*, 14: 431-460.
Salomon, R. M. 2006. Spillovers to foreign market participants: assessing the impact of export strategies on innovative productivity. *Strategic Organization* 4: 135-164.
Serti, F., and Tomasi, C. 2008. Self-selection and post-entry effects of exports: Evidence from Italian manufacturing firms. *Review of World Economics,* 144(4), 660-694.
Shaver, J.M. 2011. The benefits of geographic sales diversification: how exporting facilitates capital investment. *Strategic Management Journal,* 32: 1046-1060.
van Echtelt, F.E.A., Wynstra, F., van Weele, A.J., Duysters, G. 2008. Managing Supplier Involvement in New Product Development: A Multiple-Case Study. *Journal of Product Innovation Management*, 25: 180-201.
Von Hippel, E. 1988. *The Sources of Innovation*. New York: Oxford University Press.
Wagner, J. 2012. International trade and firm performance: a survey of empirical studies since 2006. *Review of World Economics,* 148(2), 235-267.
Wagner, J. 2007. Exports and Productivity: A Survey of the Evidence from Firm-level Data. *The World Economy*, 30: 60-82.
Winston-Smith, S. 2014. Follow me to the innovation frontier? Leaders, laggards, and the differential effects of imports and exports on technological innovation. *Journal of International Business Studies*, 45: 248-274.
Wooldridge, J. M. 2007. *Econometric analysis of cross section and panel data* (2. ed.). Cambridge, MA.
Zahra, S., Ireland, R. and Hitt, M. 2000. International expansion by new venture firms: international diversity, mode of market entry, technological learning and performance. *Academy of Management Review*, 43: 925-950.

TABLES

Table 1. Summary of theoretical expectations

Learning from customers	**from foreign-based firms**				**from domestic firms**	
Firm's position	leading	leading	lagging	lagging	leading	lagging
Foreign country	leading	lagging	leading	lagging		
Learning opportunities	strong	moderate	strong	moderate	moderate	moderate
Learning capabilities	strong	strong	weak	moderate	Strong	moderate
Expected effect on innovation	*yes*	*yes*	*no*	*yes*	*Yes*	*yes*
Learning from suppliers	**abroad**				**at home**	
Firm's position	leading	leading	lagging	lagging	leading	lagging
Foreign country	leading	lagging	leading	lagging		
Learning opportunities	strong	weak	weak	weak	Weak	weak
Learning capabilities	strong	strong	moderate	moderate	Strong	moderate
Expected effect on innovation	*yes*	*no*	*no*	*no*	*No*	*no*
Learning from competitors	**abroad**				**at home**	
Firm's position	leading	leading	lagging	lagging	leading	lagging
Foreign country position	leading	lagging	leading	lagging		
Learning opportunities	weak	weak	strong	weak	Weak	weak
Learning capabilities	strong	strong	moderate	moderate	Strong	moderate
Expected effect on innovation	*no*	*no*	*yes*	*no*	*No*	*no*

Table 2. Learning from foreign-based customers, suppliers, and competitors: Main countries

Customers		Suppliers		Competitors	
Country	Freq. (%)	Country	Freq. (%)	Country	Freq. (%)
USA	8.7	USA	2.6	USA	4.3
France	3.4	Switzerland	1.3	Japan	2.1
Switzerland	2.5	Japan	1.0	UK	0.8
Japan	2.3	Italy	0.6	Switzerland	0.6
UK	2.3	Netherlands	0.5	France	0.5

Table 3. Summary statistics: leaders vs laggards in learning capabilities

	Laggards (n=502)		Leaders (n=580)		
Variable	Mean	SD	Mean	SD	T-test for mean differences
Innovation performance	1.19	1.40	1.86	1.73	***
Leading customer learning	0.06	0.24	0.29	0.45	***
Lagging customer learning	0.04	0.20	0.24	0.43	***
Leading supplier learning	0.02	0.13	0.10	0.30	***
Lagging supplier learning	0.01	0.10	0.04	0.19	***
Leading competitor learning	0.02	0.14	0.12	0.33	***
Lagging competitor learning	0.01	0.12	0.07	0.25	***
Domestic customer learning	0.20	0.40	0.55	0.50	***
Domestic supplier learning	0.07	0.25	0.17	0.38	***
Domestic competitor learning	0.08	0.26	0.18	0.38	***
Export intensity	0.20	0.24	0.28	0.25	***
R&D intensity	0.03	0.07	0.05	0.10	***
University learning	0.04	0.19	0.17	0.37	***
Firm size	4.19	1.57	4.80	1.81	***
Firm age	2.96	1.05	3.05	1.08	
East Germany	0.36	0.48	0.29	0.45	***
Affiliate abroad	0.04	0.20	0.24	0.43	***

Notes: Innovation performance is defined as log (sales with new products in million Euros). * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table 4a. Pairwise correlations: laggards (n=502)

	Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Leading customer learning	1.00														
2.	Lagging customer learning	0.51	1.00													
3.	Leading supplier learning	0.17	0.05	1.00												
4.	Lagging supplier learning	0.14	0.08	0.47	1.00											
5.	Leading competitor learning	0.26	-0.03	-0.02	-0.01	1.00										
6.	Lagging competitor learning	0.32	0.06	0.26	0.16	0.23	1.00									
7.	Domestic customer learning	0.35	0.26	0.14	0.15	0.14	0.15	1.00								
8.	Domestic supplier learning	0.13	0.10	0.42	0.22	-0.04	0.11	0.19	1.00							
9.	Domestic competitor learning	0.15	0.16	0.08	0.05	0.17	0.16	0.37	0.26	1.00						
10.	Export intensity	0.14	0.09	-0.04	-0.02	0.01	0.06	-0.16	-0.10	-0.13	1.00					
11.	R&D intensity	0.06	0.01	-0.01	-0.02	-0.02	0.00	0.10	-0.04	0.01	0.06	1.00				
12.	University learning	0.22	0.06	-0.02	-0.02	0.13	0.07	0.20	0.21	0.07	-0.04	0.08	1.00			
13.	Firm size	0.01	-0.01	0.05	0.02	-0.05	-0.04	-0.12	-0.07	-0.08	0.32	-0.11	-0.09	1.00		
14.	Firm age	-0.01	-0.01	0.05	0.00	-0.02	-0.04	-0.02	0.03	-0.09	0.06	-0.11	0.02	0.20	1.00	
15.	East Germany	0.12	0.10	0.04	0.01	0.04	0.09	0.13	0.02	0.08	-0.15	0.07	0.12	-0.18	-0.34	1.00
16.	Affiliate abroad	0.11	0.05	-0.03	-0.02	0.11	0.14	-0.03	-0.02	-0.02	0.08	-0.03	0.01	0.20	0.06	-0.06

Table 4b. Pairwise correlations: leaders (n=580)

	Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	Leading customer learning	1.00														
2.	Lagging customer learning	0.44	1.00													
3.	Leading supplier learning	0.17	0.17	1.00												
4.	Lagging supplier learning	0.19	0.27	0.51	1.00											
5.	Leading competitor learning	0.29	0.26	0.21	0.20	1.00										
6.	Lagging competitor learning	0.18	0.22	0.14	0.16	0.56	1.00									
7.	Domestic customer learning	0.22	0.17	0.05	0.00	0.07	0.00	1.00								
8.	Domestic supplier learning	0.08	0.06	0.40	0.20	0.13	0.01	0.19	1.00							
9.	Domestic competitor learning	0.07	0.00	0.11	0.10	0.27	0.09	0.20	0.28	1.00						
10.	Export intensity	0.33	0.23	0.01	0.05	0.20	0.11	-0.05	-0.03	-0.04	1.00					
11.	R&D intensity	0.16	0.08	0.03	0.00	0.03	-0.03	0.09	-0.03	0.01	0.08	1.00				
12.	University learning	0.19	0.16	0.11	0.13	0.09	0.08	0.15	0.08	0.05	0.05	0.18	1.00			
13.	Firm size	0.12	0.14	0.13	0.14	0.26	0.17	0.02	0.11	0.07	0.29	-0.22	0.04	1.00		
14.	Firm age	-0.06	-0.05	0.02	0.02	-0.07	-0.03	-0.05	0.04	0.00	0.11	-0.17	-0.13	0.31	1.00	
15.	East Germany	0.02	0.04	0.01	-0.03	0.01	-0.02	0.04	0.02	0.03	-0.19	0.10	0.08	-0.24	-0.40	1.00
16.	Affiliate abroad	0.20	0.17	0.07	0.12	0.17	0.12	0.06	0.00	0.07	0.27	-0.02	0.06	0.47	0.05	-0.14

Table 5. Learning and innovation performance: Results of tobit models

	Model 1 *all firms*	Model 2 *all firms*	Model 3 *laggards*	Model 4 *laggards*	Model 5 *leaders*	Model 6 *leaders*
Export intensity	0.723***	0.722***	1.207***	1.187***	0.310	0.292
	(0.201)	(0.204)	(0.289)	(0.291)	(0.273)	(0.276)
R&D intensity	1.168**	0.779	2.011**	2.081**	0.581	0.179
	(0.555)	(0.541)	(0.912)	(0.894)	(0.697)	(0.671)
University learning	0.412***	0.11	0.393	0.146	0.322*	0.100
	(0.147)	(0.148)	(0.344)	(0.359)	(0.170)	(0.166)
Firm size	0.631***	0.606***	0.560***	0.576***	0.664***	0.632***
	(0.032)	(0.031)	(0.045)	(0.045)	(0.043)	(0.043)
Firm age	0.003	0.002	0.051	0.04	-0.051	-0.043
	(0.047)	(0.046)	(0.066)	(0.065)	(0.066)	(0.064)
East Germany	-0.041	-0.101	-0.101	-0.190	0.016	-0.047
	(0.106)	(0.103)	(0.143)	(0.142)	(0.152)	(0.147)
Affiliate abroad	0.156	-0.038	-0.444	-0.662**	0.155	0.044
	(0.137)	(0.136)	(0.315)	(0.317)	(0.163)	(0.158)
Leading foreign customer learning		0.203		-0.306		0.276*
		(0.140)		(0.332)		(0.157)
Lagging foreign customer learning		0.174		0.959***		0.122
		(0.142)		(0.349)		(0.159)
Leading foreign supplier learning		0.487**		0.068		0.574**
		(0.222)		(0.596)		(0.241)
Lagging foreign supplier learning		0.279		0.299		0.285
		(0.320)		(0.671)		(0.363)
Leading foreign competitor learning		0.284		1.303***		0.096
		(0.204)		(0.469)		(0.236)
Lagging foreign competitor learning		-0.112		0.745		-0.07
		(0.250)		(0.567)		(0.284)
Domestic customer learning		0.520***		0.415**		0.632***
		(0.101)		(0.180)		(0.129)
Domestic supplier learning		-0.107		0.039		-0.142
		(0.151)		(0.292)		(0.177)
Domestic competitor learning		0.077		-0.386		0.171
		(0.140)		(0.262)		(0.167)
Constant	-1.506***	-1.702***	-1.600***	-1.705***	-1.247***	-1.665***
	(0.210)	(0.207)	(0.298)	(0.295)	(0.290)	(0.288)
N	1082	1082	502	502	580	580
LR/Wald chi2	569.242	638.25	0.00	0.00	0.00	0.00
Log likelihood	-1708.427	-1673.923	-739.442	-726.244	-951.434	-924.516

Notes: * p<0.10, ** p<0.05, *** p<0.01. Table shows regression coefficients (standard errors in parentheses). Industry dummies included.