Geographical co-location on Chilean SME's export performance

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\textbf{A R T I C L E  I N F O}

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\textbf{A B S T R A C T}

Recent studies report conflicting results on the impact of geographic co-location on small firm's export performance. This paper contributes to the management literature by providing a new conceptual framework that explains the apparently disassociated findings of recent studies. It is proposed that specific positive externalities are the principal components of the co-location effect on export performance. This is examined in the context of a particular South American economy, Chile. Unexpectedly, results indicate that geographical co-location has a negative effect on export performance in this particular environment. This has implications for practitioners and further research.

1. Introduction

Exports are the most common strategy chosen by firms for internationalization and constitute a crucial element of firm's international competitiveness (Morgan, Katsikeas, & Vorhies, 2012). Hence, export performance, defined as the study of the components of firm's export success (Katsikeas, Leonidou, & Morgan, 2000), remains a relevant subject in a globalized context in general (Kaleka, 2012; Portugal-Perez & Wilson, 2012) and in particular, for Latin American firms as presented in recent issues of Journal of Business Research (Carneiro & Brenes, 2014; Brenes, Camacho, Ciravegna, & Pichardo, 2016; Ciravegna, Lopez, & Kundu, 2016).

The resource-based view (RBV) of the firm posits that gathering a set of distinguishing resources is crucial for the attainment of competitive advantage in export performance (Sousa, Martinez-Lopez, & Coelho, 2008). In this sense, small and medium-sized enterprises (SMEs) confront high barriers towards exports because of their limited resources and constraints (Bianchi & Wickramasena, 2016; Ciravegna et al., 2016). As an alternative theory, the contingency criterion suggests that the firm context will influence firm characteristics, therefore rendering an effect on export performance (Cavusgil & Zou, 1994). Under this paradigm, SMEs experience a disadvantage in sustaining export strategies appropriately aligned with their environments.

Many exporting SMEs in the Latin American context operate in industry clusters or in close firm's environment which affects geographical proximity (Brenes et al., 2016). Geographical proximity or co-location refers to the physical agglomeration of firms in a location (Felzensztein, Gimmon, & Carter, 2010; Geldes, Felzensztein, Turkina, & Durand, 2015), allowing interaction among them (Porter, 2000). This article uses and follows the words co-location, agglomeration, and cluster indistinctively when referring to geographical co-location (Felzensztein et al., 2010). Expected interaction brings with it the creation of bonds, ties, relationships and interdependencies among SMEs (Audretsch & Feldman, 1996; Geldes et al., 2015).

Recent studies have pointed out fragmented results when measuring the impact of co-location in export performance. Fernhaber, Gilbert, and Mcdougal (2008) report that geographic co-location has a curvilinear effect on export intensity in highly technological new ventures located in the USA. Zhao and Zou (2002) previously detailed that firms located in China's coastal areas, where most agglomeration is present, have a higher likelihood of being exporters and a higher export intensity; in China's new industry clusters represent a successful case study. Becchetti and Rossi (2000) report a positive relationship between co-location and export intensity in Italian firms, which represent a good example for the creation of social capital among regional districts and clusters (Felzensztein, Brodt, & Gimmon, 2014). Questions arise from the review of these past studies. For instance: Can the effect of co-location be negative in some contexts and positive in others? What are the components of the effect of co-location on SMEs' export performance in a particular Latin American context?

The article is structured as follows: First, we introduce some theoretical perspectives on industry clusters and export performance. Second, the methodology is presented, followed by results and conclusions, which includes some practical implications.
2. Theoretical perspectives

2.1. Industry clusters and externalities

Marshall (1920) made a substantial contribution with his theory of industrial agglomeration by indicating three fundamental reasons (externalities) why firms co-locate: 1) industries place themselves close to customers and suppliers to minimize transfer costs of inputs and finished products; 2) industries locate closely to develop labor market pooling; and 3) industries cluster to escalate the learning process of workers (knowledge spillovers). This triad therefore suggests two types of positive effects on firm performance: increase in productivity and increase in demand. Recently, Ellison, Glaeser, and Kerr (2010) have confirmed Marshall’s three propositions using data from the US Census Bureau’s Census of Manufacturing. Their results reinforce the idea that firms account for the transportation cost of three different and essential resources: people, inputs or products, and ideas. Krugman (1991) identified four agglomeration forces: technological spillovers, labor market pooling, non-traded inputs, and positive market linkages. The first three are considered as technological externalities, while the latter as a pecuniary externality (being mediated by markets).

The co-location literature argues that as firms agglomerate, some externalities, which only exist when firms are closely placed together, come to play a role affecting firms both positively and negatively. On one hand, industrial areas accommodate their industries by expanding the resources required by the firms, and this effort supports higher productivity (Niosi & Bas, 2001). Simultaneously, as the number of industries co-located rises, competition reduces the profit margins of corporations (Arthur, 1990). The final outcome will depend on the specifics of the industry, as well as regional, and country factors (Kukalis, 2010; Nicholson, Gimmon, & Felzensztein, 2017).

Recent co-location literature outlines a myriad of externalities that could logically exert a positive impact on export performance. Some examples are: Increased marketing externalities (Felzensztein et al., 2010; Felzensztein et al., 2014; Geldes et al., 2015) expressed in pursuing joint sales efforts towards international markets, joint trading and distribution, engaging in co-branding, sending joint missions to assess foreign market potential, conducting joint market research, as well as sharing information (either raw data or business contacts) on international markets. These actions should reduce the liability of foreignness as well as the liability of outsidership (Johanson & Vahlne, 2009) by directly decreasing the cost of acquiring the information required to penetrate a foreign market. Also, such strategies would increase the access to valid opportunities and new technological knowledge through already verified business contacts, thus resulting in an increase of export performance. Other examples include: Higher capacity to gather external capital (Folta, Cooper, & Baik, 2006); Increments in the productivity of workers (Ciccone & Hall, 1996) would create lower costs (Jaffe, Trajtenberg, & Henderson, 1993), a particular externality which could benefit export performance by allowing a more attractive product or service price; and more efficient collaboration (Felzensztein et al., 2014; Geldes et al., 2015; Saxenian, 1994). Boehm (2013) shows that collaborative intensity, a measure of the degree of participation of the firm with other companies, is correlated positively with export intensity in the Brazilian furniture manufacturing industry; Knowledge spillovers (Alcacer & Chung, 2007) are also key in the advancement of export performance, as a higher level of innovation is shown to develop within certain industries when co-location increases (Harrison, Kelley, & Gant, 1996; Shefer & Frenkel, 1998). Co-located firms have better chances of acquiring knowledge through a sophisticated set of channels conforming within social interaction (Bianchi & Bellini, 1991; Felzensztein et al., 2014; Nicholson et al., 2017). These interactions are important for a responsible part of the exploitation of collective knowledge by co-located firms (Harrison, 2007). Bell (2005), for instance, models the innovation of Canadian mutual fund companies and finds that clustering and network centrality in the managerial network increase firm innovation.

Bunker, Owen-Smith, and Powell (2009) analyze the biotechnology sector and conclude that co-location and social networks have independent and contingent effects on innovation. Finally, Foreign market knowledge: Co-location enhances foreign market knowledge because local firms can access foreign corporations more easily. Foreign companies have a tendency to locate in denser regions (Fernhaber et al., 2008; Pino, Felzensztein, Zwerp-Villegas, & Arias-Bolzmann, 2016). As companies further develop their knowledge of foreign markets, they can tackle better opportunities and reduce the risks in the foreign market operation (Johanson & Vahlne, 1977). This factor may also be related to the mimetic pressure on internationalization (Cheng, 2010).

2.2. The co-location mechanism of cooperation

Porter (1998, p. 88) addresses the co-location mechanism expressing: “… managers tend to be wary, at least initially. They fear that a growing cluster will attract competition, drive up costs, or cause them to lose valued employees to rivals or spin-offs. As their understanding of the cluster concept grows, however, managers realize that many participants in the cluster do not compete directly and that the offsetting benefits, such as the greater supply of better trained people, for example, can outweigh any increase in competition”. Zhao and Zou (2002) and Becchetti and Rossi (2000) seem to subscribe to the view of Porter (1998). The idea of the mechanism behind the effect of co-location on export performance in their studies could be summarized as co-location produces a set of externalities in a region, some with positive values (e.g. knowledge spillovers) and some with negative values (e.g. competition), the net outcome of this “co-location black box” is a net positive effect on export performance. Becchetti & Rossi (2000, p. 58) add the following on firms from traditional and specialized sectors: “costs from increased competition are lower than gains from increased cooperation when firms are located in geographically agglomerated areas”. This “black-box” interpretation of the co-location mechanism resembles a ying and yang approach where cooperation and competition are opposite forces that complement each other (LaPlaca, 2014; LaPlaca & Lindgreen, 2016; Li, 2016; Nicholson et al., 2017). Cooperation is viewed as yielding a positive effect on export performance, while competition exerts a negative effect on export performance.

Fernhaber, Gilbert & Mclougual (2008, p. 284) add an interesting consideration. Rather than focusing on the average effect of co-location on export performance, they argue that the effect of co-location changes at different levels. Under their perspective, the mechanism behind the effect of co-location on export performance could be described as follows: Co-location increases a set of positive externalities in a region, but after a certain point, competition counters the positive effects of co-location. In effect, this view also accounts for a set of positive externalities (e.g. knowledge spillovers, labor market pooling) and one negative externality (competition).

The previous overview pinpoints a fundamental oversight by Fernhaber et al. (2008), Zhao and Zou (2002) and Becchetti and Rossi (2000). These studies ignore the fact that cooperation may cause a negative externality (Geldes et al., 2015), therefore impacting export performance negatively.

To simplify the understanding of cooperation, the concepts of cooperative action and imperfect cooperation are presented. A cooperative action (or cooperative venue) is a cooperation opportunity that renders two possible strategies for participants, either cooperating or not cooperating (also referred as defecting). For instance, two firms may join in exploring a new potential market. They can either cooperate in this project or decide not to cooperate. Both actions are part of the cooperative venue. One of the advantages of displaying cooperation as a game with a dual action strategy is showing that some cooperative venues might render negative outcomes to players (Nowak, 2012). To understand the concept of imperfect cooperation is also important. Imperfect cooperation describes the situation where one partner decides to cooperate while the other one defects. In this
particular case the cooperating partner that decides to cooperate ends up in a position that is worse than not cooperating at all (Nowak, 2006). To summarize cooperation mechanisms, the cost-benefit relationship is the essential defining concept in the emergence and sustainability of a cooperative environment. Only certain cost-benefit ratios produce pathways towards a cooperating venue that yields positive outcomes for all cooperating partners (Nowak, 2006). Some cost-benefit ratios will produce imperfect cooperation and a negative outcome for cooperating partners.

Knowledge spillovers are the result of diverse cooperative actions among firms or simple observations of close firms. Therefore, knowledge spillover is a “final effect” produced by specific actions of firms (Marshall, 1920; Nicholson et al., 2017). We suggest a categorization from a different perspective, a grouping of externalities based on their “causes”. This new view advocates for three basic categories of externalities: Let Θ = co-location, λ = externalities that require cooperation between firms, β = externalities derived from competition among firms, and π = externalities resulting from the mere action of location. It can be later derived that the net effect of geographical co-location on export performance corresponds to (Θ) = λ + β + π.

Fig. 1 depicts the co-location mechanism proposed in our model. We argue that as co-location increases, the externalities from cooperation, competition and location increase. Also new externalities caused by cooperation, competition and location emerge, therefore impacting export performance.

Table 1 classifies multiple externalities present in the co-location literature under the proposed categories of: externalities derived from cooperation, externalities resulting from competition and externalities resulting from mere location. Such externalities may exert a significant influence on export performance.

### 2.3. Effect that is context dependent and hypotheses

It is important to consider that each one of the externalities that require cooperation among firms (λ) could also render a negative effect on export performance depending on the costs and benefits involved in the cooperative action (Nowak, 2012). Cooperation could restrict innovation and technological investments, it could leave partners vulnerable when others change their levels of commitment towards the cooperative action, and it could create unintended dependencies (Akdogan & Cingöz, 2012). Opportunistic actions can also emerge and damage the final outcomes of firms involved in cooperative actions (Estrada, Faems, & de Faria, 2015).

Under this approach, competition is not the only negative externality affecting the outcome of the agglomeration effect on export performance. Cooperation could develop negative externalities as well in some contexts (Geldes et al., 2015). Essentially, cooperation (λ) could have a positive effect, zero effect, or perhaps, a negative effect on export performance. That means that the affirmations of Porter (1998) and Becchetti and Rossi (2000) pointing out returns from cooperation that are higher than costs from competition in agglomerated areas can only be made for a particular context and not in a generalized manner to all contexts, industries, and countries.

In addition, competition (β), as shown in Table 1, is not just the negative force that restricts firm’s internationalization portrayed by Fernhaber et al. (2008). It also creates positive externalities that should increase export performance. Akdoğan and Cingöz (2012) for instance, argue that competition stimulates new resource, process and skill mixtures. This means that competition should not be viewed as a negative force in all cases. Competition (β) could display an average negative effect, zero effect or a positive effect on export performance. Once again, affirmations on the sign of the competition effect within the “co-location black box” should only be based on a specific context and cannot be generalized. Finally, Location (π) may be an advantage if there are abundant natural resources (Ellison & Glaeser, 1999) or if better infrastructure is present (Porter, 1990). But location could also be a disadvantage if natural resources are scarce and infrastructure is poor. The average sign of the effect deriving from being located at a certain area, when cooperation and competition are controlled for, could be either positive, negative or neutral. That means that location effects are tied to a specific context (Geldes et al., 2015; Pino et al., 2016).

In summary, the decomposition of the effects of co-location on export performance shown in Table 1 and Fig. 1 reveal that the net effect of co-location on export performance is context-dependent. Local context is a variable receiving increasing attention in the management literature (Mudambi, Mudambi, Mukherjee, & Scaler, 2017; Nicholson et al., 2017; Pino et al., 2016). Meyer and Peng (2015) state that differences in context are at the center of the explanation of today’s global business field. Therefore, building hypotheses on the effects of co-location on a particular cluster region must consider the specificities of such context. For instance, in a context where cooperation is positive (strong and stable) competition is negative (but mild) and location effects are positive (and strong) we would observe (λ + β) > β and therefore a positive net effect of co-location on export performance.

In a context where cooperation is positive, location effects are positive, and competition is negative (but increasingly negative as co-location increases) we would observe (λ + β) > β at low levels of co-location and (λ + π) < β at higher levels of co-location. We could then report a curvilinear relationship consistent with Fernhaber et al. (2008). Finally, in a context where imperfect cooperation prevails (when cooperating renders lower outcomes than not cooperating), if competition is negative and location effects are positive but mild we would observe: [(−λ − β)] > π and therefore a negative net effect of co-location on export performance.

That’s why in order to build hypotheses and measure the effects of co-location on export performance, we must first introduce the reality of a specific context, in this case Chile, into our theoretical framework. Past studies of such context could provide essential elements that might assist us in deducing the average signs of the components of co-location (cooperation, competition and location) and the net effect of co-location on export performance in such specific context.

In the specific context of emerging economies, like Chile, institutions that facilitate joint actions are scarce and firms lack access to superior technology and infrastructure (Gutiérrez-Martínez, Duhamel, Luna-Reyes, Picazo-Vela, & Huerta-Carvajal, 2015; Mesquita & Lazzarini, 2010). In Latin American clusters, it is difficult to acquire higher productivity because of un-operational institutions and infrastructure (Schmitz & Nadvi, 1999; Pino et al., 2016). Lack of horizontal cooperation of actors does not foster the development of capabilities needed to achieve better export performance (Rabelloitt, 1999). Firms located in Chile are embedded in this challenging situation. In the subject of competition, managers interviewed in previous studies have argued that the culture and mentality in Chile does not integrate
cooperation as much as competition (Felzensztein, 2008; Geldes et al., 2015). A lack of trust is an overwhelming element in this business environment. Trust is an important factor in the construction of cooperation (Felzensztein et al., 2014; Huemer, Boström, & Felzensztein, 2015). The increase in interaction frequency brought up by co-location could easily increase the competitive advantage. We proposed:

**H2.** Higher levels of co-location will result to higher cooperation effects on export performance.

On the other hand, the mere action of location could provide firms with better natural resources and foster export performance (Ellison & Glaeser, 1999). A better access to suppliers and lower cost of resources (Krugman, 1991; Marshall, 1920) should impact export performance positively as well. More supportive institutions (Bosscha & Lambooy, 1999), better infrastructure (Porter, 1990) and a qualified pool of workers (Marshall, 1920) should increase productivity, thus enhancing competitive advantage. But an increase of firm density would mean more competitors feasting on the same resources and therefore diminishing any location specific advantage. We proposed:

**H3.** Higher levels of co-location will result to lower location effects on export performance.

Finally, competition could also change at various levels of agglomeration. Table 1 shows that competition carries positive and negative externalities. On one hand, it does affect firm profits negatively through price competition (Fernhaber et al., 2008), but it also improves product quality (Becchetti & Rossi, 2000), and fosters a creative environment of innovation (Saxenian, 1994). We must once again look into the specific context of Chile to develop a hypothesis. Chilean businesses competition is fierce due to the small internal market, extreme free-market environment, and trust not being a strong element (Felzensztein et al., 2014; Geldes et al., 2015). The increase in interaction frequency brought up by co-location could easily increase the negative competition effects depicted by Fernhaber et al. (2008). We therefore propose:

**H4.** Higher levels of co-location will result to lower effects of competition on export performance.

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**Table 1**
Decomposing co-location externalities.

<table>
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<tr>
<th>Cooperation (κ)</th>
<th>Competition (β)</th>
<th>Location (ξ)</th>
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<tbody>
<tr>
<td>Better capacity to gather external capital (Folta et al., 2006)</td>
<td>Competition fosters environment creativity and innovation (Saxenian, 1994)</td>
<td>Expansion of skilled workers availability (Marshall, 1920)</td>
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<td>Marketing externalities: pursuing joint sales efforts, joint trading and distribution, co-branding, joint missions to assess market potential, conducting joint market research, information sharing on international markets (Felzensztein, 2008; Felzensztein et al., 2014)</td>
<td>Competition improves product quality (Becchetti &amp; Rossi, 2000)</td>
<td>Close observation of competitors &amp; better knowledge of opportunities (Bell, 2005; Marshall, 1920; Pouders &amp; John, 1996)</td>
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<td>Higher social interaction for technological exchange (Bianchi &amp; Bellini, 1991)</td>
<td>Competition motivates firms to outdo others in several dimensions (Porter, 2000)</td>
<td>Arousal of mental models among managers and patterns of competitive behavior (Pouders &amp; John, 1996)</td>
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<td>Increase of firm innovation (Bell, 2005)</td>
<td>Competition stimulate search for new combination of resources, skills and processes (Akdogan &amp; Cingilti, 2012)</td>
<td>Increase pool of venture capitalists (Porter, 1990)</td>
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<td>Better understanding of competitive market (Chung &amp; Kalnis, 2001)</td>
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<td>Better local infrastructure (Porter, 1990)</td>
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<td>Higher exposure to foreign markets &amp; industry standards through contact with foreign firms (Karageozoglou &amp; Lindell, 1998)</td>
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<td>More supportive Institutions (Bosscha &amp; Lambooy, 1999)</td>
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<td>Tighter ties among firms (Fernhaber et al., 2008) More cooperative alliances &amp; trust (Saxenian, 1994)</td>
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<td>Increased firm value (Boasson, Boasson, MacPherson, &amp; Shin, 2005)</td>
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<td>Enhanced collective learning (Maskell &amp; Malmberg, 1999) More shared media such as local newspapers, business journals. (Pouders &amp; John, 1996) More information sources (Bell, 2005)</td>
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<td>Increased capital investment. (Gabe, 2005)</td>
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<td>Higher motivation through local pride (Porter, 1990)</td>
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3. Context and methodology

Chile is known for its openness towards international trade. It is considered to be the most international trade oriented economy in Latin America (Guimón, Chaminade, Maggi, & Salazar-Elena, 2017). It is also a reference for other countries in South America that intend to expand their international orientation (Felzensztein, Ciravegna, Robson, & Amorós, 2015). Chile hosts a wide spectrum of exporting SMEs in various industries including mining, wine, consulting, and finance (Felzensztein et al., 2015; Geldes et al., 2015). In this sense, focusing in a small emerging economy like Chile provides a different perspective from such of developed economies, where most research on co-location and cooperation has been conducted (Nicholson et al., 2017).

In order to test our hypotheses we gathered the data from the 8th and 9th Survey of Innovation from the National Institute of Statistics from Chile (2013 & 2015), where we built a pooled cross-section database. Both surveys are representative of the population of Chilean firms at two different periods: 2011–2012 and 2013–2014.

One of the major advantages in these surveys is that they control for selection bias. The 8th and 9th innovation surveys have a substantial part of participants that had to fill the surveys by law. This fact assures the correct representation of firm population. These surveys also offer survey weights. Survey weights are a technique used to adjust the sample to the population. In our analysis we expanded the databases considering survey weights (Little, 1991). Small and Medium Enterprises (SMEs), with 200 or fewer employees, compose 97% of the sample in this survey.

Coefficients for International Intensity as the dependent variable were obtained by the estimation of a General Linear Model with a logit transformation, which was calculated in Stata with family (binomial) link (logit) and robust estimates, as proposed by Papke and Wooldridge (1996). This estimation methodology is also known as fractional logit (Fryges, 2006). Coefficients shown in the results are log odds. Our models consider the following:

3.1. Dependent variable

We gauged export performance by measuring international intensity. International intensity, also referred by some as export intensity (Boehe, 2013), is the percentage of total sales in the firm obtained from sales in international markets (Fernhaber et al., 2008). The use of this ratio is vastly present in the internationalization literature (e.g., Beamish, Karavis, Goerzen, & Lane, 1999; Capar & Kotabe, 2003; Knight & Kim, 2009; Lages, Jap, & Griffith, 2008; Tallman & Li, 1996). It indicates the relevance of foreign market exposure in a firm (Elango & Pattnaik, 2007).

3.2. Independent variables

a) We captured co-location in this study by measuring a regional location quotient as described by the Cluster Mapping Project from the U.S. Department of Commerce, the U.S. Economic Administration and Harvard Business School’s Institute for Strategy and Competitiveness.

\[
LQ = \frac{e_i/E_i}{E/\varepsilon}
\]

\[e_i = \text{Local employment in industry } i\]
\[E_i = \text{Country area employment in industry } i\]
\[E = \text{Country total employment}\]

We applied a logarithmic transformation to the location quotient to facilitate interpretation. This technique is frequently used in econometric estimation.

b) Cooperation: In order to measure the level of firm cooperation with multiple actors, we used principal components (eigenvalues and loadings on Appendix A). The survey has 6 questions that measure the cooperation with: Trade Associations, Suppliers, Consulting firms, Competitors, Universities, and Public Labs. All questions are phrased in the same format. The specific question in the case of universities asks: “Were universities an important source of information for innovation development in the firm?” Firms could answer “Very Important”, “Important”, “Less Important” or “Not Relevant” to this question. We used this question as a proxy of cooperation and therefore assumed that firms that obtain more information that is important for innovation development through universities, cooperate more with such source. We assumed similarly in the case of Trade Associations, Suppliers, Consulting firms, Competitors and Public Labs. We retained 2 factors from the principal components analysis and named them “institutional cooperation” and “inter-firm cooperation”. The names were based on the loadings of the 6 variables on each selected factor.

c) Location: Chile is divided into 15 political regions. Some of them concentrate the country’s richest natural resources. Mining and fishing products are the most important export products in Chile. We created a variable and coded with 0 the firms located in regions with no mining or fishing natural resource advantage. We coded with 1 the firms in areas with mining and fishing natural resources (regions I, II, X, XI & XII). The location variable captures the relevance of natural resources on performance referred by Ellison and Glaeser (1999).

3.3. Control variables

R &D: This is a dummy variable where firms that conducted research and development take value 1, while the ones that did not conduct research and development take value 0. R&D as a proxy for innovation is included as control variable in many studies of export performance. It usually reflects a positive impact of innovation on export performance (Fernhaber et al., 2008; Zhao & Zou, 2002). Structural Changes: This is a dummy variable that takes value 0 if firms belong to the 8th innovation survey and value 1 if firms belong to the 9th innovation survey. This variable captures macroeconomic structural changes in time that might impact export performance. Age: This variable captures the age of the firm from start up. As firms gain experience export barriers should decrease. That is why this variable is present in many export performance models (Zou & Stan, 1998). Size: We capture the size of the company by the number of workers in the firm. Company size should reduce export barriers (Zhao & Zou, 2002). We transformed this variable to logarithmic form to facilitate interpretation. Economic sectors: We constructed this variable as a dummy where 1 accounts for the firm being a part of the specific economic sector. Economic sectors include: Agriculture and Livestock, Fishing, Mining, Manufacturing, Electricity, Construction, Commerce, Hotels, Transport, Finance, Consulting, Health Services and Entertainment. The consulting sector serves as base or reference. This means that the coefficients displayed for each economic sector are compared to the consulting sector.

4. Results

Table 2 shows correlations of the variables in our models. We examined the variance inflation factor and condition index, which confirm that the moderate correlation observed between covariates does not pose a high multicollinearity problem to our estimates. Also, the models exhibit good explanatory powers with a p > Chi-squared value of zero.

Table 3 displays the coefficients of the GLM regression models. The results confirm H1 (model 2) and show that the effects of co-location on international intensity are negative and statistically significant.
Table 2
Correlation matrix.

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Table 3
Coefficients of GLM estimation with logistic transformation.

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<th>Regression models</th>
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<td>Int. intensity</td>
<td>Int. intensity</td>
<td>Int. intensity</td>
</tr>
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<td>−0.701***</td>
<td>−0.276**</td>
<td>−0.276**</td>
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<tr>
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<td>(0.0409)</td>
<td>(0.0400)</td>
<td>(0.0400)</td>
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<td>0.160**</td>
<td>0.016**</td>
<td>0.016**</td>
</tr>
<tr>
<td>cooperation</td>
<td>(0.0173)</td>
<td>(0.0190)</td>
<td>(0.0190)</td>
<td>(0.0190)</td>
</tr>
<tr>
<td>Inter-firm</td>
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<td>−0.298**</td>
<td>−0.298**</td>
<td>−0.298**</td>
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<tr>
<td>cooperation</td>
<td>(0.0249)</td>
<td>(0.0266)</td>
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<tr>
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<td>2.408***</td>
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<td>0.146*</td>
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</tbody>
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Robust standard errors in parentheses. Coefficients expressed as log odds.

*** p < 0.01
** p < 0.05
* p < 0.1

Institutional cooperation and Inter-firm cooperation impact export performance negatively on average (models 3 & 4). Location has a positive effect on international intensity (model 5).

When addressing the issue of correctly displaying and interpreting interaction results in the management literature, Kingsley et al. (2017, p. 1) stated: "we advocate that IB scholars also evaluate the statistical significance of the marginal effect of the primary independent variable over the range of values of the moderating variable". Following their recommendation, we evaluated the marginal effects of cooperation, location and competition at a range of levels of co-location. Selected levels were based on the distribution of the co-location variable. We used the mean and standard deviation as reference. Selected values of the co-location distribution were: (1) the mean minus 3 standard deviations, (2) the mean minus 2 standard deviations, (3) the mean minus 1 standard deviation, (4) the mean, (5) the mean plus one standard deviation (6) the mean plus 2 standard deviations and (7) the mean plus 3 standard deviations.

We followed the recommendations of Williams (2012, pp. 319–320) in the plotting process of the effects of cooperation, location and competition as co-location increases. This methodology does not require the inclusion of interactions in the model. Model 4 was chosen for this calculation because it includes all the required variables for the analysis. The tables with the coefficients of marginal effects of cooperation, competition and location at increasing values of co-location are shown in the Appendix B.

Results confirm H2 for institutional cooperation and inter-firm cooperation. As co-location increases, the effects of cooperation on export performance remain negative. However, at each upper increasing level of co-location, the negative effects of cooperation on export performance approach zero. This indicates that positive externalities from cooperation become stronger with co-location, but never as strong as to turn cooperation into a positive effect.

H3 is also confirmed. At higher levels of co-location the location effect on export performance diminishes. This reaffirms the fact that more firms exploit the limited resources available in a particular geographic area, thus decreasing the firm’s competitive advantage derived from mere location.

Competition is not a variable present in the survey. Nevertheless, this limitation in the data does not mean that we cannot deduce the behavior of competition as co-location increases. Regression model coefficients communicate how much the variance of the independent variable explains the variance of the dependent variable with statistical significance. Our study shows through Table 1 that the literature of co-location supports a decomposition of the co-location effect into three groups of externalities arising from cooperation, location and competition. Following this logic, in model 4, the cooperation regression coefficients capture how cooperation variance explains international intensity. Similarly, the location coefficient captures how the variance in location explains international intensity. That means that the regression coefficient of co-location is mostly capturing how the variance of competition is explaining the variance of international intensity. In other words, the co-location variable may be a valid proxy of competition.

We therefore evaluated how the marginal effects of co-location changes as agglomeration increases in model 4. As cooperation and location are controlled for in model 4, our results on this evaluation...
portray how competition is changing as co-location increases. Our findings reject H4. Unexpectedly, the positive externalities of competition are reinforced as co-location increases. But as in the case of co-operation, such externalities are never as strong as to turn competition into a positive effect. Competition exerts a negative effect on international intensity at all levels of co-location. The effects plotted in Figs. 2 through 5 are statistically significant at a 95% confidence level.

4.1. Control variables/context

Age and size correlate positively to international intensity. In this case our results are consistent with previous findings (e.g. Boehe, 2013; Zhao & Zou, 2002). R&D is positively correlated to international intensity. These results are consistent with Bell (2005) and speak of the importance of innovation on overcoming export barriers. Most industry sectors are significant in explaining international intensity as they capture the particular industrial factors that impact export
performance.

We introduced a variable in our pool cross-section database in order to capture the macroeconomic changes that firms experience in time. This variable (named structural changes) has a negative effect on international intensity. This is consistent with a decrease in Chile’s gross national product and total exports from years 2011–2012 to years 2013–2014.

5. Conclusions

This study proposes a framework that decomposes co-location externalities into the categories of: externalities caused by competition, externalities resulting from cooperation and externalities derived from mere location. Unexpectedly, our results show that the positive externalities of competition are reinforced as co-location increases. But as in the case of cooperation, such externalities are never as strong as to turn competition into a positive effect. The model introduced argues that as co-location increases, the externalities carried out by competition, location and cooperation increase in strength. Also, new externalities that derive from cooperation, competition, or location arise as agglomeration escalates. This vision unifies previous studies and shows that positive, negative, curvilinear and neutral effects of co-location on export performance are indeed possible. The nature of cooperation, competition, and location advantages at each site will be the determining factors of the net co-location effect on export performance.

Our study contributes to the current management debate on the effects of co-located firms in industry clusters by detailing the externalities that rise directly from the actions of cooperation, competition and location (Geldes et al., 2015). Previous conceptual models depicting the mechanism of co-location on export performance (e.g. Becchetti & Rossi, 2000; Fernhaber et al., 2008; Zhao & Zou, 2002) were fairly limited and did not consider cooperation to render a potential negative effect on export performance or competition to have a conceivable positive effect on export performance.

Our results highlight that we can only predict the effect of co-location on export performance by considering the specific environment of firms. In the context of Chile, the results show that cooperation and competition impact export performance negatively in average. As co-location rises, the effects of cooperation and competition on export performance increase, but not enough as to switch the negative sign of both effects into a positive sign. Location impacts export performance positively in average, but as co-location increases, this positive impact decreases. Ultimately, the net effect of co-location on export performance is negative (Table 3: Model 2).

5.1. Limitations and further studies

This study is limited by the nature of the pooled cross-sectional secondary data it used: the innovation survey. Endogeneity is always a potential issue in all cross section studies. The authors also acknowledge limitations in the use of international intensity as a measurement of export performance and the use of the location quotient as a measurement of agglomeration. Other measures, like cross industry location quotients (Morrissey, 2014) could be included in future studies to address these limitations. Similar research needs to be done in other Latin American countries for comparative purposes and generalization of results and conclusions.

Future studies should address new questions opened by this study. How is cooperation yielding a negative outcome on export performance? What elements turn cooperation from a positive force into a negative influence on export performance? What is the relationship between context and cooperation? This latter question needs further attention from Latin American scholars.

5.2. Practical implications

The fact that cooperation renders, in average, a negative effect on export performance in Chile, is a cause of concern. In a previous research, Geldes et al. (2015) reported a negative impact of cooperation on marketing innovation in Chile. Our results as well as findings supported evidence of imperfect cooperation in this context. Such evidence signals an unexplored potential towards cooperation improvement in Chile.

The dynamics of cooperation need to be reassessed in light of our results. Governments in small emerging economies, like Chile, should develop special programs with the intention of strengthening cooperation between firms in an accelerated way, especially in those sectors that government has a stronger desire to expand internationally. Efforts towards the increment of co-location should be addressed with caution. Our results show that even at the highest levels of co-location, cooperation, and competition effects on export performance remained negative. Also, the advantages provided by mere location increasingly disappeared. This suggests that co-location might not be the panacea that some emerging economies are eager to find. Co-location on its own might not be a sufficient strategy to push SMEs towards internationalization, at least in the case of Chile.
## Appendix A. Principal component analysis

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<th>Method: principal-component factors</th>
<th>Retained factors = 2</th>
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<tr>
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<td>Factor analysis/correlation</td>
<td>Number of obs = 51,378</td>
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LR test: independent vs. saturated: $\chi^2(15) = 7.1e + 04$

Prob > $\chi^2 = 0.0000$

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LR test: independent vs. saturated: $\chi^2(15) = 7.1e + 04$

Prob > $\chi^2 = 0.0000$
Rotated factor loadings (pattern matrix) and unique variances

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Factor rotation matrix

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Scoring coefficients (method = regression; based on varimax rotated factors)

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Appendix B. Marginal effects

Marginal effects of Institutional_Cooperation at increasing levels of agglomeration

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<th>Agglomeration</th>
<th>dy/dx</th>
<th>St. error</th>
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<th>P &gt; z</th>
<th>95% confidence interval</th>
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Marginal effects of Interfirm_Cooperation at increasing levels of agglomeration

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Marginal effects of location at increasing levels of agglomeration

<table>
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<th>Agglomeration</th>
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Marginal effects of competition at increasing levels of agglomeration

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<th>z</th>
<th>P &gt; z</th>
<th>95% confidence interval</th>
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References


