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Product and Market Knowledge Spillover Effects on Innovation and Regional Export Growth : The Case of New Zealand

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Contents

Abstract

This study extends the previous research into the effects of knowledge spillovers on innovation and regional exports growth by more clearly distinguishing, both theoretically and empirically, two different types of knowledge spillovers, namely product and market knowledge spillovers. More importantly, this research provides insights on their role of knowledge spillovers in shaping regional innovative activities and, eventually, regional export growths. Furthermore, this research makes an important contribution to the understudied market knowledge spillovers by developing two variables that could be used to assess the flow of market knowledge spillovers at the regional level: localization economies and export consulting advice. Using secondary data on eight 2-digit manufacturing industries in ten New Zealand regions over a seven year period, this research found that regional competition, localization economies and the availability of export consulting advice have positively and significantly impact on the regional export growth in New Zealand.

Key Words : product and market knowledge spillovers, innovation, regional export growth in New Zealand

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Ⅰ. Introduction

There is widespread agreement that knowledge based activities are increasingly important to the competitive advantage of first world economies, as knowledge is one of the crucial ingredients of innovation. Leading edge innovations are one of the main bases of international competitiveness and hence of successful export performance. The export base of both national and regional economies is a major driver of economic growth. Knowledge is therefore part of a virtuous circle leading to innovation, competitiveness and exports. Exports and trade in their turn are major vehicles for the sharing and transfer of international leading edge knowledge and hence complete the iterative circle (Simmie, 2003).

Recent studies on knowledge externalities have shifted the level of analysis from the individual firm to a regional scale as a unit of analysis of innovation and international activities of firms (Audretsch, 2003). This shift is largely due to the recognition that knowledge not only spills over to other firms, but that such knowledge spillovers also tend to be geographically bounded within the region (Van Stel and Nieuwenhuijsen, 2004; Audretsch, 2003).

The spatial agglomeration of firms triggers the geographical concentration of information and knowledge spillovers, and, therefore, may play an important role in shaping national and regional patterns of comparative advantage (Chevassus-Lozza and Galliano, 2003; Porter, 1990). Consequently, studies of how regional structure and local context may affect innovative activities, as well as levels of economic activity, have emerged rapidly over the last decade as an important contribution to the research on both knowledge spillovers and regional economic growth.

Although some studies have shed light on the issues of localization of knowledge spillovers (Varga et al., 2003; Varga, 1997), little research has been conducted on the relationship between different types of knowledge spillovers and the propensity for export performance of the regions. The purpose of this paper is, therefore, to explore the link between spatial knowledge spillovers, innovation and regional export growth.

The previous literature has rarely distinguished between product knowledge spillovers and market knowledge spillovers, both of which would result in different types of knowledge flow, and consequently would play a different role in developing regional export activity. Drawing on literature from international business, as well as innovation and regional studies, this study distinguish market knowledge spillovers from product knowledge spillovers in order to more clearly understand regional export differences.

This paper is organized as follows. First we review the literature on knowledge spillovers and regional exports in order to develop the hypotheses guiding this research. Next we discuss the methodology and data used to test the hypotheses. The results section reviews the techniques used to estimate our econometric model before

presenting the outcomes of the analyses. Last, we present our conclusions and highlight the key implications arising from our study.

Ⅱ. Literature Review

1. Three Theories on Knowledge Spillover Effects

The first theory on the knowledge spillover effects was developed by Marshall (1890), Arrow (1962) and Romer (1986) and is abbreviated as MAR. They assume that knowledge spillovers are most effective between homogeneous enterprises. Therefore, spillovers primarily emerge within one sector in a given region in the form of specialization. An example of this type of intra-industry spillover would be the microchip manufacturing industry in Silicon Valley (Glaeser, 1992). The MAR economists further assume that the situation of local monopoly is beneficial for economic growth, since in that case, the vast share of the yields generated by innovation benefits the innovator itself. That is, the externalities associated with innovation are internalized by the innovator, producing an additional incentive to innovate. In the MAR theory, regional sectoral growth is maximized if the sector is dominant in the region, and if local competition is not too strong.

The second theory is that of Porter (1990), who agrees with MAR that knowledge spillovers between firms in specialized sectors stimulate economic growth. In contrast to MAR, however, Porter assumes that local competition has a positive impact on growth. In his view, competition accelerates imitation and upgrades innovation. Although competition decreases the relative benefits for the innovator, the amount of innovative activity will increase, because enterprises are 'forced' to innovate: enterprises that fail to improve products and production processes in due time will lose ground to their competitors and will ultimately go bankrupt. An example of fierce competition to innovate, resulting in growth, would be the Italian ceramics and gold jewellery industries (Glaeser, 1992). While MAR emphasizes the negative effect of competition on the amount of innovative activity, Porter assumes that the positive effect is dominating.

The third theory elaborating on the significance of local knowledge spillovers was developed by Jacobs (1969). Jacobs' theory departs from the assumption that knowledge spillovers work out most effectively among enterprises that practise different activities. Primarily this inter-industry knowledge transfers would thus be of significance. In her view, regions marked by a high degree of diversity will thrive. As regards competition, Jacobs agrees with Porter in that local competition accelerates the adoption of new technologies and, consequently, stimulates economic growth.

2. Product Knowledge Spillovers and Exports

The most common and widely studied type of knowledge spillovers refers to product knowledge spillovers that can be appropriated from external sources for the benefits of technological innovations. In other words, it is believed that knowledge that unintentionally spills over from innovating firms may create benefits for further innovative activities within other firms (Audretsch, 1998). For instance, by investing in R&D, a firm accumulates knowledge from which other firms might profit, increasing their productivity without incurring the associated costs, because the innovative firm itself cannot utilize all the benefits associated with innovation (Anselin, et al., 2004).

The majority of empirical studies on the factors affecting export performance at either a regional, sectoral or firm level, found strong evidence that innovation is an important variable, regardless of whether the study uses an input or output innovation measure (e.g. DiPietro and Anoruo, 2006; Davenport, 2005; Rope and Love, 2002; Bernard and Jensen, 1999; Sterlacchini, 1999; Wakelin, 1998; Frater et al., 1995; Kumar and Siddharthan, 1994; Ito and Pucik, 1993; Hirch and Bijaoui, 1985). Leading edge innovations determine international competitiveness and, consequently, success in export performance (DiPietro and Anoruo, 2006; Davenport, 2005; Simmie, 2003).

Recognition of the venture as an innovator could ease its entry into a foreign market by creating demand for the product (Zahra et al., 2003; Mariotti and Piscitello, 2001). As knowledge based activities are the main ingredient of innovation, knowledge, therefore, is increasingly important for the global competitiveness of firm and its export performance (Simmie, 2003; Roper and Love, 2002). Accordingly, the geographical concentration of product knowledge spillovers plays a critical part in shaping regional patterns of competitive advantage (Chevassus-Lozza and Galliano, 2003; Porter, 1990) and, thus, is important for regional export activity. Therefore, this study argues that the differentials in export flows of regions can be explained by the strength of the regional product knowledge spillovers. In other words, the asymmetry in regional export flows can be partially explained by the uneven distribution of product knowledge spillovers between these regions.

Thus, it is hypothesized that:

H1 There is a positive relationship between regional knowledge spillovers and regional export activity.

As mentioned above, three theories on the inter-firm product knowledge spillovers deal with dynamic technological externalities and form a theoretical foundation for the role of product knowledge spillovers in regional innovation and economic growth.

MAR/Porter spillovers are further distinguished by whether local competition is encouraged or not. MAR theory maintains that greater local industry competition tends to obstruct innovative activity among local firms, thus slowing down the overall process of technological upgrade and, in turn, the rate of regional economic growth (Glaeser et al., 1992). Thus, following from MAR theory, local competition is negatively related to industry level

competition and growth. Contrary to MAR theory, Porter (1990) argues that long-term monopoly profits on the innovation lead to firms reducing their innovative activities, as they prefer to exhaust the benefits of one particular risk rather than new innovation. Porter (1990) further believes that the consequences of loosing one's competitive position is far more destructive.

Both of these contradictory arguments have a solid theoretical foundation, and empirical evidence is rather mixed (e.g. Van Stel and Nieuwenhuijsen, 2004; Glaeser et al., 1992). Therefore, we sets competing hypotheses to test the relationship between intra-industry regional product knowledge spillovers and regional exports.

Thus, it is hypothesized that:

H1a ***There is a positive relationship between regional intra-industry product knowledge spillovers and regional exports.***

H1b ***There is a negaitive relationship between regional intra-industry product knowledge spilloversis and regional exports.***

In contrast to MAR/Porter, Jacobs (1969) suggests that important externalities do not arise within the industry, but rather across industries, thus, stressing the importance of heterogeneous agglomeration. According to this theory, industrial variety (or diversity) rather than specialization conducive to innovation and growth, because in diversified regions there is more interchange of diverse ideas. The heterogeneous businesses are often not in competition with each other and, therefore, may be more willing to engage in co-operative interactions (Doring and Schnellenbach, 2006) and knowledge sharing. There are empirical studies, supporting the hypothesis that Jacobian product spillovers between heterogeneous enterprises are important (e.g. Glaeser et al., 1992; Van Stel and Nieuwenhuijsen, 2004).

As the empirical literature does not yet provide convincing evidence on whether intra-industry prevail over inter-industry knowledge spillovers, or vice versa (e.g. Doring and Schnellenbach, 2006; Van Stel and Nieuwenhuijsen, 2004; Glaeser et al., 1992), we set up a further hypothesis to test the significance of both types of spillovers to regional exports.

Therefore, it is hypothesized that:

H1c ***There is a positive relationship between regional inter-industry product knowledge spillovers and regional exports.***

3. Market Knowledge Spillovers and Exports

The other type of knowledge spillovers is the so called market knowledge spillovers, which is unintentional knowledge about markets, more specifically overseas markets. This type of knowledge spillovers is believed to

generate gains for the internationalization activities of the firm, smoothing the overall entrance and expansion in overseas markets (e.g. Chevassus-Lozza 2002; Bonaccorsi, 1992; Aitken et al., 1997).

The research on market knowledge spillovers argues that knowledge resources are present in the network of the firm, and the usefulness of the resources depends on the experiences of the network members, as knowledge about international markets can be gained through 'learning by doing' (Mariotti and Piscitello, 2001; Johanson and Mattsson, 1988). Therefore, it is suggested that the concentration of highly internationalizes firms represent sources of knowledge spillovers about overseas markets (Johanson and Mattson, 1988). Market knowledge spillovers have not received as much attention in the literature as product knowledge spillovers, nevertheless, avaiable studies suggest that such market knowledge spillovers exist and tend to be geographically bounded (e.g. Chevassus-Lozza and Galliano, 2003; Sterlacchini, 2001; Becchetti and Rossi, 2000).

Based on the empirical results of the reviewed research, knowledge about overseas markets constitutes a competitive advantage of local firms and smoothes the process of internationalization by reducing uncertainty and increasing motivation for internationalization activities (Bonaccorsi, 1992; Forsgren, 2002; Mariotti and Piscitello, 2001). Knowledge about markets can be obtained through market knowledge spillovers that arise in areas with a high agglomeration of exporters due to the increased opportunities for the formal and informal exchanges of experiences (Camagni, 1991; Bonaccorsi, 1992). Thus, the greater the flow of market knowledge spillovers in the region, the greater the probability that local firms will be involved in international activities relative to firms located in regions without such agglomeration advantages, and the greater the resulting total export activity in the region. In other words:

H2 There is a positive relationship between regional market knowledge spillovers and regional exports.

The primary sources of market knowledge spillovers are identified in the literature - current exporters and export advice agencies. The literature (e.g. Mariotti and Piscitello, 2001; Becchetti and Rossi, 2000; Malmberg et al., 2000; Camagni, 1991) agrees and empirically validates that the main source of market knowledge spillovers is the regional agglomeration of export activities. It is suggested that a greater co-localization of exporters within the region stimulates and creates a greater flow of knowledge about the overseas markets (Manez et al., 2004; Aitken et al., 1997). Consequently, it is argued that the greater the localization of industry exporters within the region, the greater the amount of regional exports:

H2a There is a positive relationship between the localization of industry exporters in the region and regional exports.

The second source of market knowledge spillovers is derived from locally available specialist advice. The literature has found that there is propensity for export business advice to concentrate in core regions (e.g. Bennet

et al., 2000), which gives them a relative advantage over peripheral regions (Simmie, 2003). The concentration of export business advice provides local firms with the marketing and commercial knowledge necessary for the introduction of their product to overseas markets (Simmie, 2003).

The empirical literature has established that the majority of the specialist export advice is sourced within close proximity (Bennet et al., 1992; Todling and Traxler, 1995; O'Farrell et al., 1992; Van Diteren, 1987). The export knowledge stored within the local consulting businesses can be made available intentionally, however, some of this knowledge may in fact be communicated through informal inter-firm linkages, generating market knowledge spillovers. For instance, Mariotti and Pascitello (2000) have empirically found that the availability of qualified services in Italian regions, such as management consulting services, proxied by industrial, legal, administrative and organizational advice, have a positive significant impact on the amount of internationalization activities conducted in the regions.

Thus, the greater the concentration of export specialist advice within the regions, the greater the potential for the market knowledge spillovers and, consequently, the greater the amount of regional export activity:

H2b There is a positive relationship between the regional export advice available in the region and regional exports.

4. Interaction of Product and Market Knowledge Spillovers

Firms with innovative products or technologies may face considerable difficulties in their internationalization activities due to a lack of international market knowledge, whereas firms with knowledge about foreign markets may be unable to gain significant market share without innovative products. Thus, market knowledge spillovers and product knowledge spillovers may be required for successful export performance.

As discussed above, product innovation as well as knowledge about overseas markets are essential determinants of export performance. Innovative products provide firms with competitive advantage over rivals, enabling them to gain greater market share (DiPietro and Anoruo, 2006; Davenport, 2005; Simmie, 2003; Sterlacchini, 1999; Porter, 1990). In addition, knowledge about foreign markets smoothes the overall process of getting to and expanding in overseas markets (Bonaccorsi, 1992; Forsgren, 2002; Aitken et al., 1997).

Regions with high concentrations of product knowledge spillovers are likely to have higher regional exports than regions with scarce flow of product knowledge spillovers. However, at the same time, for the region with a high degree of product knowledge spillovers, the amount of regional exports will be lower than expected if the region has a weak flow of market knowledge spillovers. In other words, this study argues that there is a complementary effect between product knowledge spillovers and market knowledge spillovers and the amount of regional exports, thus:

H3 There is an interaction effect between local product knowledge spillovers and local market knowledge spillovers and regional exports.

Ⅲ. Method and Measures[1)]

The time frame of this study, from 1998-2004 inclusive, was chosen because the data employed in this study were fully available for this period and a 7-year period is considered sufficient to study the effect of knowledge spillovers. The unit of analysis is the region, specifically ten New Zealand regions with at least one international port. Overall, there are nine 2-digit manufacturing industries in New Zealand. Data are largely obtained from sources provided by Statistics New Zealand, which compiles several data sets at a sub-national level that include regional economic characteristics. By using pooled cross-section time series across seven years of data and eight 2-digit manufacturing industries from ten New Zealand regions, a final sample of 560 observations was obtained (7x8x10).

Data on the dependent variable, the value of manufacturing exports, were collected from overseas cargo statistics. Data are sourced from custom entries received from the New Zealand Customs Service. The overseas cargo statistics records the value and gross weight of all goods loaded or unloaded at New Zealand ports, both sea and air, and provides information on export cargo loaded at New Zealand ports between 1998-2004, and in our case excludes reexports.

Because this research uses dollar values for overseas cargo over a 7-year period, to account for inflation, export values adjusted using the overseas merchandise trade price indexes for export (XPI). Information on the XPI is obtained from Statistics New Zealand. We deflate the real dollar values by the change in the XPI in the related sector, taking 1998 as the base year, and calculating the percentage change in a given year from the base year. Manufacturing export flows from New Zealand regions to other countries serve as the dependent variable (EXPORTi,r,t), measured as the value of manufacturing exports for industry i loaded by port, both sea and air, in the respective region r in New Zealand in year t. This measure represents an annual flow of regional exports.

Two variables are used to capture intra-regional product knowledge spillovers, namely competition and diversity. To gauge competition this study uses the measurement originally developed by Glaeser et al. (1992), and later improved upon by Van Stel and Nieuwenhuijsen (2004). Thus, the variable assesses whether competition in the region in a given industry is higher/lower than national level competition. The expression of local competition

1) This section was greatly helped by the two authors (Dr. Wiison and Mr. Domney) of the Discussion Paper Series By Fedotova, et al. (2007), in the Dept. of International Business, the University of Auckland.

is as follows:

$$\frac{Bi,r,t/Emptot,r,t}{Bi,nz,t/Emptot,nz,t}$$

Where *B* is the number of businesses, i stands for industry, r stands for region, t for year and nz for New Zealand. *Emp tot,r,t* represents total employment in region r in year t. *Emp tot,nz,t* represents total employment in New Zealand in year t. The variable takes the value of 1 when calculated at the national level. Thus, the measure compares competition in the local industry to the national competition in that industry (Van Stel and Nieuwenhuijsen, 2004).

In line with previous research, diversity is defined as the employment share of the three smallest industries in a region, other than the industry in question, to total employment in that region (Van Stel and Nieuwenhuijsen, 2004). The rationale behind using employment in the smallest industries is that the potential to benefit from intra-regional spillovers, in relative terms, is higher for a small sector than for a large sector (Van Stel and Nieuwenhuijsen, 2004). The expression of the diversity measure reads as follows:

$$100 \times \frac{\sum_{k=1}^{3} Emp - i(k),r,t}{Emptot,r,t}$$

Where the numerator is total employment of the three smallest industries in region *r* in year *t*, industry *i* excluded, and *Emp tot,r,t* represents the total employment in the region *r* in year *t*. The variable is expressed as a percentage.

Two measurements are employed to capture the intra-regional market knowledge spillovers: localization economies and export advice, an attempt to capture both dynamic and static measurements respectively. The presence of localization economies is estimated in the literature using a location quotient (Becchetti and Rossi, 2000; Hustedde et al., 1993; Malmberg et al., 2000). The location quotient is usually measured as a percentage of local employment in a given industry relative to the percentage of national employment in the same industry (Hustedde et al., 1993). However, this study, following Malmberg et al. (2000), uses a location quotient based on the number of firms in the same industry, since the literature on industrial districts stresses the presence of similar firms as the basis for the localization economies, rather than the local employment in the industry. Thus, the localization economies variable is expressed as:

$$\frac{Bi,r,t/Bi,nz,t}{Br,t/Bnz,t}$$

Where *B* stands for a number of manufacturing businesses, *i* for industry, *r* for region, *nz* New Zealand and *t* for year. The higher the values of the coefficient, the greater the concentration of related firms, thus, the greater the potential export spillovers.

Export advice is measured by the presence of export specialist services within the region. Mariotti and Pascitello (2000), having studied the internationalization of Italian small and medium-sized enterprises (SMEs), found that there was a significant relationship between presence of consulting and management services firms in the region and the probability of firms being involved in exporting in that region. Additionally, Bennet at al. (2000) empirically confirm that , for a range of specialist services, most advisors are sought in relatively close proximity to the businesses. Consequently, the greater the concentration of export specialist services within the region, the greater the potential market knowledge spillovers. Thus, to capture this type of market knowledge spillovers, a variable that measures the presence of export consulting services is used. The variable is expressed as follows:

$$\frac{Consr,t}{Bi,r,t}$$

Where *Cons r,t* stands for the number of consulting firm in the respective region *r* in year *t*, *B i,r,t* stands for the number of businesses in industry *i* in region *r* in year *t*. The higher the value of this ratio, the greater the amount of export advice available relative to the total number of firms in the region, thus, the greater the potential for market knowledge spillovers.

The interaction term variables were created in the Shazam statistical package by multiplying the respective independent variables. In addition, two control variables were employed. A dummy variable was used to control for cross-industry variations. The initially selected eight 2-digit ANZSIC manufacturing industries are categorized as belonging either to low technology manufacturing or other manufacturing, which includes both medium-low/mediun-high technology manufacturing according to the classification given by Maskell et al. (1998) and based on an OECD list of R&D intensive industries.

This study does not attempt to clearly distinguish between medium and high technology manufacturing in New Zealand because low technology intensive industries account for the major proportion of total manufacturing function, namely 54 per cent, medium-low technology manufacturing comprises 33 per cent, medium-high technology intensive four per cent and high-technology intensive industries only 0.5 per cent of total production (OECD, 1999).

The industry dummy variable takes a value of 0 for the low technology intensive industry group and 1 otherwise. The literature (e.g. Audretsch and Feldman, 1996; Maskell et al., 1998) suggests that knowledge intensive industries benefit to a greater extent from co-location and knowledge spillovers, thus, we expect the industry dummy variable to be significant.

Another dummy variable has been used to control for the presence of university/universities in the region. The variable takes the value of 1 if a university/universities is/are present in the region and 0 otherwise. According to the literature, the presence of a university in he region has a positive impact on regional innovation activity, as universities are considered to be an important source of knowledge spillovers to the private sector (e.g. Jaffe, 1989; Audretsch and Feldman, 1996; Barrio-Castro and Garcia-Quevedo, 2005). Moreover, Audretsch and Lehmann (2005) found that the presence of the university in the region positively influences location decisions of start-up enterprises, thus triggering co-location and agglomeration.

This study assumes regional variations in knowledge spillovers in the context of regression model. Intra-regional spillovers, which are the focus of this study, are already captured by the variables such as competition, diversity, localization and consulting advice. Furthermore, the inclusion of regional dummies has a potential multicollinearity drawback (Van Stel and Nieuwenhuijsen, 2004). Such multicollinearity may nullify the significance of certain variables of interest (Van Stel and Nieuwenhuijsen, 2004). We tested our model against this assumption and established that, indeed, strong multicollinearity was present when regional dummies were included. Given this, as well as the fact that too many variables can make individual coefficients less precise (Ramanathan, 1998), we decided not to control for regional variations separately.

Given the continuous and quantitative nature of data, Ordinary Least Squares (OLS) was employed for estimating the influences of product knowledge spillovers and market knowledge spillovers on regional exports. The process of formulating a model that contains interactions among a set of variables is described in Cohen et al. (2003).

Overall, the equation for the model is as follows:

$$EXPORTirt = \alpha + \beta 1LEirt + \beta 2CONSirt + \beta 3COMPirt + \beta 4DIVirt + [\ \beta 5COMPirt*LEirt + \beta 6COMPirt*CONSirt + \beta 7DIVirt*LEirt + \beta 8DIVirt*CONSirt\ ] + \beta 9INDUSTRY + \beta 10UNIVr$$

where,

LE measure of localization economies

CONS measure of export consulting advice

COMP measure of competition

DIV measure of diversity

INDUSTRY industry dummy to capture technology intensity

UNIV university dummy to capture presence/absence

i stands for industry

r stands for region

t stands for year

The model was analyzed in two regression equations; Model 1a (additive effect model) contained only first-order predictors and model 1b contained first-order predictors and the interaction terms. Running a regression analysis for the additive effect Model 1a separately from the interaction term Model 1b allowed us to interpret the overall effect of the hypothesized predictors on the dependent variables. Model 1b containing the interaction term was, thus, used only to explore the nature of the interactions between the predictors (Cohen et al., 2003).

Ⅳ. Results

Before running the multiple regression analyses, the data were screened and corrected for any violations of OLS assumptions. The variables in Model 1a were not highly correlated and none of the VIF values exceeded 5 (Table 1). However, as expected, multicollinearity was present in Model 1b given the incorporation of interaction terms.

Table 1: Pearson Correlation Matrix & VIFs of Variables – (N=560), Model 1a

	EXPORT	COMP	DIV	LE	CONS	INDUSTRY	UNIV
EXPORT	1.000						
COMP	0.095	1.000					
DIV	0.263	0.383	1.000				
LE	0.049	0.335	0.009	1.000			
CONS	0.381	0.096	0.644	-0.124	1.000		
INDUSTRY	0.298	0.011	0.015	-0.019	0.20e-17	1.000	
UNIV	-0.189	-0.127	-0.544	0.154	-0.522	0.000	1.000
VIFs	1.324	1.384	2.301	1.197	2.126	1.120	1.565

Following the recommendations given in Hair et al. (1998) and Cohen et al. (2003), to correct for multicollinearity the explanatory variables were centered. However, even after centering, the correlation between CONS and the interaction DIV*CONS remained high (0.865), and the VIF values for both DIV and CONS exceeded 10. After omitting each of the problem variables one at a time, we decided not to include the interaction term variable DIV*CONS, which resulted in the best outcome (Hair et al., 1998). The final model had a satisfactory level of correlation between the variables and none of the VIFs exceeded the tolerance value of 10 (Table 2). In the end, this study used the centered equation with interaction terms (Model 1b) to explore the presence and nature of the interactions only, and the individual overall effects of first order predictors are predicted from Model 1a.

Table 2 : Pearson Correlation Matrix & VIFs of Variables -(N=560), Model 1b(centered)

	EXPORT	COMP	DIV	LE	CONS	COMP *LE	COMP *CONS	DIV *LE	INDUS TRY	UNIV
EXPORT	1.000									
COMP	0.095	1.000								
DIV	0.263	0.383	1.000							
LE	0.049	0.335	0.009	1.000						
CONS	0.381	0.096	0.644	-0.124	1.000					
COMP*LE	0.010	0.300	-0.066	0.471	-0.085	1.000				
COMP*CONS	-0.102	-0.584	-0.252	-0.164	0.049	-0.269	1.000			
DIV*LE	0.004	-0.127	-0.300	0.027	-0.256	0.312	0.225	1.000		
INDUSTRY	0.298	0.011	0.015	-0.019	0.20e-17	0.093	-0.053	0.121	1.000	
UNIV	-0.188	-0.127	-0.544	0.154	-0.522	0.209	0.034	0.168	0.000	1.000
VIFs	1.379	1.900	2.432	1.485	2.426	1.771	1.860	1.449	1.142	1.612

Secondly, autocorrelation was detected for both models and corrected for using the function AR(1) in the Pool command in the Shazam program (corrected DW statistics in Table 3). Lastly, both models featured heteroskedasticity, which was addressed via the heteroskedasticity consistent covariance matrix (HCCM) estimates of the standard errors (Ramanathan, 2002) obtained using the Hetcov option in the Pool command in the Shazam

statistical package. The results presented are those corrected for both autocorrelation and heteroskedasticity.

Hypothesis one proposed a positive relationship between product knowledge spillovers and regional exports. Two variables were used to capture product knowledge spillovers: competition and diversity. Competition measured the intra-industry knowledge spillovers (H1a and H1b), whereas diversity was intended to gauge inter-industry knowledge spillovers (H1c). Competition was positive and highly significant with p-value<0.001 (Table 3, Model 1a). Thus, the positive and significant result for the variable competition implies that the MAR view on knowledge spillovers, where highly competitive markets hinder the pace of innovation, has to be rejected for the sample of New Zealand manufacturing enterprises. In fact, this study found support for Porter's view that competition produces knowledge spillovers that, in turn, stimulate greater innovation in order for firms to retain their global competitiveness and associated market share.

Table 3 : Model OLS Estimation Results (N=560)

Variable		Model(1a)			Model (1b)	
COMP	0.146***		(5.126)	0.128***		(3.010)
DIV	0.053		(0.689)	0.025		(0.337)
LE	0.065**		(2.554)	0.127***		(4.020)
CONS	0.439***		(2.879)	0.468***		(3.109)
COMP*LE				-0.119***		(-4.232)
COMP*CONS				-0.157**		(-2.229)
DIV*LE				0.028		(1.115)
INDUSTRY	0.370***		(3.267)	0.386***		(3.397)
UNIV	0.109		(1.530)	0.095		(1.554)
CONSTANT	0.000**		(-2.480)	0.000		(-1.336)
DW		1.926			1.911	
F-statistic		16.731***			14.591***	
R2		0.145			0.162	

Note : 1. t-values between parentheses
2. ** Significant at 5% level (one-tailed test)
3. *** Significant at 1% level (one-tailed test)
4. Model 1a variable are raw scores, Model 1b variable are centered, deviation scores (excl. the control variables INDUSTRY and UNIV)

Thus, given the significant and positive parameter estimate for competition, H1a was supported, and the competing H1b had to be rejected. Diversity, however, was insignificant (*p*-value=0.548), although the associated positive coefficient for diversity suggests that there is a positive relationship between the variable and amount of regional exports (Table 3, Model 1a). Thus, H1c that suggested a positive relationship between regional inter-industry product knowledge spillovers was not supported.

Hypothesis two suggested that a positive relationship between market knowledge spillovers and regional exports. This research employed two variables to capture market knowledge spillovers: localization economies and export consulting advice. In Table 3 Model 1a, the estimated coefficient for localization economies is positive and significant at the 5 per cent level (*p*-value=0.011). Our finding supports H2a, thus, local market knowledge spillovers may positively impact on the amount of regional exports by enhancing overall regional global competitiveness. The variable export consulting advice is significant at the 1 per cent level (*p*-value=0.004) (Table 3, Model 1a), indicating that the presence of export consulting advice in the region has a positive effect on regional exports, as suggested by H2b. Thus, we found overall support for the Hypothesis H2 confirming that there is positive relationship between the strength of the market knowledge spillovers and the amount of regional exports.

In essence, the interaction term variables in our model signify that the expected increase in regional exports is related to both the flow of regional product knowledge spillovers and market knowledge spillovers in that region (H3). As might be expected from the earlier results, the interaction term diversity and localization economies (DIV*LE) is insignificant (Table 3, Model 1b), given the overall insignificance of diversity in the earlier Model 1a (Table 3, Model 1a). In addition, it was not possible to test the interaction term 'DIV*CONS' due to the earlier noted multicollinearity problem. Nevertheless, the interaction term competition and localization economies (COMP*LE) is significant at less than 1 per cent (*p*-value< 0.001), and the interaction term competition and export advice (COMP*CONS) is also significant at the 5 per cent level (*p*-value=0.026) (Table 3, Model 1b). Both of these interaction terms have negative regression coefficients.

Given that the variables have been centered, the negative coefficient denotes the fact that if a region scores above the mean on the competition scale, but below the mean on the localization economies or consulting advice scale, then regional exports are below that expected for the region at the average localization economies or consulting advice level in the sample. In other words, the effect of product knowledge spillovers is buffered by the effect of market knowledge spillovers, meaning that, for a region with a high degree of product knowledge spillovers, the amount of regional exports will be lower than expected if that region has a weak flow of market knowledge spillovers. Thus, the results seem to show that there is a degree of complementarity between market knowledge spillovers and product knowledge spillovers, as predicted by Hypothesis H3.

INDUSTRY is significant and positive in both of the specified models (see Table 3). This indicates that there

are cross industry variations in the associative strength of the relationship between knowledge spillovers and regional exports. Therefore, competitive advantage based on world leading innovation is more related to medium and high technology intensive industries, than to low technology intensive industries. In addition, although UNIV has positive coefficients, they are insignificant in both models (Table 3). This result was rather surprising, give that previous research has established a strong link between knowledge spillovers, innovation and the presence of a university in the region (e.g. Jaffe, 1989; Audretsch and Feldman, 1996; Barrio-Castro and Garcia-Quevedo, 2005). One possible explanation of our results could be a weak link between university research and private sector knowledge accumulation and innovation in New Zealand. Nevertheless, the lack of significance for this variable, combined with the previous results, points to the critical role of private sector knowledge spillovers in developing a region's export capacity.

Ⅴ. Conclusions and Implications

1. Conclusions

Overall, based on our research findings (especially in Table 3), there is evidence that both product and market knowledge spillovers are factors contributing to regional export competitiveness in New Zealand. More specifically, this study establishes a positive and highly significant relationship between competition (COMP), localization economies (LE) and export advice (CONS) at the local level and regional exports (EXPORT) at the global level. The complementary effect between the two types of knowledge spillovers is also confirmed. In addition, the results confirm that the effect of knowledge spillovers on regional exports is weaker for low technology intensive industries (INDUSTRY).

Contrary to previous research, we also find that the presence of university in the regions (UNIV) does not explain regional export differences, concluding that knowledge spillovers from the public sector might not be important for export activities. Therefore, the accumulation and dissemination of knowledge spillovers form a basis for the international competitiveness of regions. Consequently, the concentration or lack of knowledge spillovers within the regions influence the role they may play in national export activities and the global economy overall (Simmie, 2003).

This study also sheds some light on the validity of three major theories of kowledge spillover effects: MAR, Porter's and Jacobs' theories, that dispute what types of knowledge spillovers, intra-industry or inter-industry, are more important for innovation and regional export growth. In line with previous research (e.g. Glaeser et al., 1992;

Van Stel and Nieuwenhuijsen, 2004), this study confirms that intra-regional knowledge spillovers stimulate greater innovative activity, thus, empirically validating Porter's view on the role of knowledge spillovers. However, our results show that regional industry diversity in New Zealand, although positive, is not a significant source of knowledge spillovers and, thus, does not contribute to regional exports. This finding contradicts Jacobs' theory on knowledge spillovers, as well as the empirical findings of Glaeser et al. (1992) and Van Stel and Nieuwenhuijsen (2004).

Furthermore, this study found that product knowledge spillovers are significant for regional exports, however, they work more efficiently when the knowledge flow is within the same industry. The variable competition (COMP) served as a proxy for intra-industry knowledge spillovers. Values for regional industry competition greater than one mean that this industry is locally more competitive than elsewhere in the country. This results confirm that competition is positively and significantly related to regional exports. Thus, Porter's view on the significance of competition to innovation holds true for the sample of New Zealand regions, which means that higher levels of intra-industry competition indicate potentially greater product knowledge spillovers; consequently, the greater is the level of regional innovation and industry exports.

2. Policy Implications

The findings of this research have several policy implications. For instance, it appears that regions with high levels of intra-industry competition might show high levels of innovative activity, and, thus, will have a stronger competitive position and greater share of national exports. Therefore, regional policy could facilitate and enable the development of cycles of knowledge resources, enhanced by spatial competition, competitiveness and increased exports in particular regions, which in turn generate additional product knowledge spillovers (Simmie, 2003).

Given the insignificant results for the role of inter-industry product knowledge spillovers (Variable diversity or DIV) in the development of manufacturing regional exports, regional policy might be more focused on the development of policies to facilitate the tight agglomeration/co-location of particular industries rather than promoting diversity. At the national level, a more coordinated and cooperative approach to cluster development is important. Thus, regional and national policy makers should evaluate how far industry concentration has already taken place and how it can profit from its evolution.

With regard to market knowledge spillovers, this study confirmed the positive and significant relationship between intra-regional market knowledge spillovers and regional exports. More specifically, our results also found the important role of both localization economies (LE) and external export advice (CONS) to the development of regional exports. From a policy perspective, this indicates the importance of structuring regional policies to focus on the facilitation and utilization of the existing and potential future export knowledge base. This result

shows that export knowledge that exists among both private firms and professional market consulting agencies plays a critical role in the development of regional export competitiveness.

As far as external export advice (CONS) is concerned, the bigger the regional share of consulting firms that can provide qualified export advice, the more the opportunities for that region to increase its export base. Policy development should be directed towards the strengthening of localized qualified capabilities by encouraging the export-oriented activities of advanced services such as management, consulting and marketing agencies. This could partially be achieved by encouraging investment in to the development of a strong export consulting industry and provision for the export education in the periphery regions.

As for localization economies (LE), our results show that a concentration of industrial units facilitate a region's exports because it assists in the dissemination of foreign market knowledge between firms with international activities and firms with purely domestic operations. In other words, the international market knowledge of individual companies constitutes a region's internationalization capabilities. Policy measures aimed at maintaining the competitive positions of regions should be directed towards strengthening and maintaining the international market knowledge base. This could be firstly achieved by promoting and facilitating the export activities of industry firms, as well as creating a favorable environment for international new ventures or so called born globals. Attracting foreign companies to locate in the region also might provide a strong flow of overseas market knowledge and expertise.

Lastly, this research found that there is a complementary effect between product and market knowledge spillovers. For policy makers this indicates the importance of simultaneously pursuing both the promotion of product innovations, through increased competition, and export promotion policies. For some regions, policies directed towards strengthening product knowledge spillovers might be more important than those designed for fostering market knowledge spillovers and vice versa. The important point is that one should not stop at achieving high rates of industry innovative activity in the region, as further export support is needed to push innovative companies into foreign markets, again by creating an environment that facilitates the dissemination of market knowledge spillovers from both industry and advice agencies.

3. Limitations of This Research and Direction for Further Study

There are some important limitations, due largely to the unavailability of statistically robust data inherently containing the development of more precise measurements. Firstly, the main limitation relates to the nature of the dependent variable, namely the indirect and inexact measure of regional exports. The measure employed in this study represented the annual flow of regional manufacturing exports, and measured export cargo value loaded by port in New Zealand. However, firms are not limited to the sole use of their regional ports, and may use other

ports due to cost efficiencies or because some ports are not suited for transporting certain types of cargo. Therefore, the data employed by this study are rather an inexact measure of regional exports. However, there are no official measures of regional export activity in New Zealand and the type of data employed is the only secondary data available at a regional level at the present time.

Secondly, our measure of localization economies could be improved. Initially, the measure was developed to include the number of exporting manufacturing enterprises in the region. However, given the data unavailability, this research substituted the number of exporters with the total number of manufacturing businesses in the region. Consequently, further research could focus on employing a more direct measure, for instance hand-counting exporting firms listed in existing directories.

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