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The Link between Innovation and Export: Evidence from Australia's Small and Medium Enterprises

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Abstract: This paper investigates the direction of causality between export market participation and innovation using firm level data from Australia. Using the propensity score matching approach, the paper asks whether: (i) exporting in the current period is positively correlated with the probability to innovate in the same or the next period, (ii) the relationship in (i) is true for firms who have no export market participation in the previous period, (iii) innovating in the current period leads to export market participation in the same or the next period, and (iv) the relationship in (iii) is true for firms who have no innovation in the previous period. The paper finds a statistically and economically significant positive correlation between export and innovation in the current period. Furthermore, with regards to the direction of causality, there is evidence that it runs both ways for process innovation particularly for the services sector. For product innovation, there is evidence that current product innovator may lead to a higher probability of becoming 'new' exporter in the current period.

Keywords: Innovation; Export; Small and medium enterprises; Propensity score matching

JEL Classification: F14, O12, O14, O31

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1. Introduction

Do exporting firms learn from their participation in foreign markets so that they become more innovative than the firms which focus only on domestic markets (learning-by-exporting hypothesis) or do firm invest in innovative activities in order to become more innovative and productive before they decide to enter foreign markets (self-selection hypothesis)? These are the questions that this paper aims to address. Specifically, this paper is an empirical investigation of the direction of causality between innovation and export market participation using firm level data of Australian small and medium enterprises (SMEs). It asks whether past export market participation explains current innovative performance and whether past innovative performance explains current export market participation.

Understanding the effects of globalisation on economic performance, particularly the performance of firms, is important to ensure that public policy is designed to attain its optimum benefit. One potential benefit of globalisation comes in the form of a productivity improving mechanism via participation in the international market through export. Strong empirical and theoretical evidence seems to indicate that the productivity advantage of exporting firms relative to non-exporting firms come from their pre-export differences in performance.

However, there has been no satisfactory theoretical explanation of how the pre-export differences occur. In addition, recent studies which look at innovation and investment in Research and Development (R&D) provide some evidence that there might be learning effects from participating in the export market. If there is indeed such an effect, then failure to recognize it could lead to suboptimal policy in support of globalisation. This means, any further study that can entangle the causality between globalisation and economic performance which focuses on the role of the intermediate step, that is innovation, would be highly valuable. Hence, the main objective of the proposed study is to contribute to the empirical investigation of the link between export and performance through the effect on innovation using richer data and a better methodology.

This paper extends the existing literature such as the studies by Damijan *et al*. (2010) and Crespi *et al*. (2008) on the evaluation of the competing hypotheses described above. The first contribution of this paper is that the sample of the study consists of firms from all industries instead of just manufacturing. It is quite plausible that lessons from the manufacturing sector may not apply to other sectors. Second, it can identify both process and product innovation, with the former perhaps playing a more important role especially for SMEs and firms in non-manufacturing sectors. Finally, the study focuses on small and medium firms, addressing the limitations in the findings based on large firms.

To some extent, this study and other similar studies which look at the link between innovation and export rather than between productivity and export incorporate an important aspect mentioned by Crespi *et al*. (2008) by linking the way in which export affects innovation directly to the types of source of information used by firms. Thus, while earlier studies only looked at how such information sources were related to export via productivity growth (leaving the details of how the information leads to improved performance inside the black box), our study looks at the more direct relationship between the export market as a potential source of information and the propensity to innovate. For Australia, the proposed study provides further insights to those established by existing studies such as Palangkaraya and Yong (2007; 2011) on the relationship between international trade and productivity by looking at innovation as a likely intermediate step.

The findings of the study provide important information for evaluating the benefits of globalisation to small and medium firms. A confirmation of the learning-by-exporting hypothesis, for example, indicates that export market participation improves a firm's performance through the stimulation of innovations. Thus, the potential benefits of policies designed to improve global market activities (particularly in the export market) would be higher than in the case when there are no learning effects. Furthermore, the findings could also demonstrate how the learning effects are generated both in terms of the types of innovation involved and the roles of the export market activities. Knowing these, governments would be in a better position to design policies that can address any market failure which may lead to suboptimal resource allocation on different types of innovative and export market activities. For developing countries in particular, evidence from studies based on small and medium firm data in developed countries is probably more relevant to draw any policy inference rather than studies based on large corporations, especially when relevant evidence from developing country studies is still rare.

To achieve its objectives, this paper applies the propensity matching score (PSM) approach on firm level Business Longitudinal Database from the Australian Bureau of Statistics from the period of 2004/05 to 2006/07 covering approximately 3000 firms with less than 200 employees. The rest of the paper is structured as follows. Section 2 provides a brief discussion on related studies, Australian SMEs export and innovation activities in general, and two case studies based on an existing study of the Australian wine industry and the characteristics of Australian SMEs which received the Australian Exporter Award from the Australian Government between 2001 and 2010. Section 3 discusses the empirical framework and the data. Section 4 presents and discusses the results. Section 5 summarises the finding and discusses some of their policy implications.

2. Literature Review

2.1. Export and Innovation

The link between export and productivity has been the subject of many different studies over for many years due to its important implications for the benefits of globalisation. As the availability of large, firm-level, longitudinal data has improved over the last fifteen years; the ability to evaluate the two major competing hypotheses (which are not mutually exclusive) behind the export-productivity relationship has also improved in terms of detail and sophistication. The first hypothesis of interest is called the ‘self-selection’ hypothesis and it is based on the idea that more productive firms self-select into the export market because of the extra (sunken) costs for entering foreign markets. These costs may include, for example, transportation costs, distribution or marketing costs, or the costs to tailor the products to foreign consumers. Because of such entry barriers, firms may exhibit forward-looking behaviour by taking action to improve their productivity before entering any foreign market. As a result, any cross-sectional performance difference between exporters and non-exporters can be explained by the ex ante differences between the two types of firms.

The competing hypothesis, the learning-by-exporting hypothesis, argues that export market participation provides an opportunity for exporters to improve their performance due to a higher level of market competition and the potential for knowledge flows from international consumers. Wagner (2007), for example, surveys more than 40 studies based on firm level data from more than 30 countries and finds that a majority of the studies support the self-selection hypothesis while participation in the export market does not appear to lead to improved productivity.

More recent empirical studies, such as Aw *et al*. (2008), look at the relationship in more detail by incorporating R&D investment or innovation decision and also find evidence for the self-selection hypothesis. The lack of support for the learning-by-exporting hypothesis is further shown by a number of theoretical models which emphasise the role of firm heterogeneity. Other recent studies which also support self-selection include Kirbach and Schmiedeberg (2008) and Chada (2009). The latter is interesting because it finds that innovation can act as a strategic tool to gain market share in the world markets and thus it is important for firms to innovate to enter the export market. Similarly, a recent theoretical study Constantini and Melitz (2008) which, unlike its predecessors, endogenize firm's the decision by firms to export and innovate and show that the export-productivity link can be explained by the decision to innovate before export market entry, consistent with the self-selection hypothesis. Finally, Long *et al*. (2009) explores the effects of trade liberalization on the incentives for firms to innovate and on productivity. They find that trade liberalization's impact is dominated by the selection effect and while the effects on innovation or the incentive to spend in R&D depends in the costs of trade.

Nevertheless, other studies such as Crespi *et al*. (2008), Damijan *et al*. (2010), Girma *et al*. (2008), MacGarvie (2006) and Fernandes and Paunov (2010) provide evidence that globalization may feedback into improved domestic performance through the learning effects on innovation. The last two studies mentioned above show the learning effects through imports while the other studies show the effects through export market participation. What is needed now are further studies employing a similar methodology and similarly rich data from different countries in order to see if the evidence is robust and can be generalized to other settings.

Given the reliance of most of the studies cited above on data from medium and large enterprises and, particularly, from the manufacturing sector, there is a need for a complementary set of evidence drawn from SMEs across different industries (agriculture and resources, manufacturing, and services). For reasons such as the cost of acquiring legal protection on innovation and its enforcement, it has been argued that SMEs may have a lower propensity to innovate than larger firms.[1] Thus, according to Jensen and Webster (2006), such potential for underinvestment in innovation activity by SMEs and the relatively significant share of SMEs in the economy means that a better understanding of the innovative patterns of SMEs is crucial for an effective innovation policy.

In addition, an analysis of industrial sectors other than manufacturing is also important. First, the extent of market failure in innovation activities varies by industrial sectors and the effectiveness of instruments to combat such market failure including the provision of intellectual property rights (IPRs) protection also varies by sector.[i] Second, the type of innovation activities also varies across industrial sectors because of the multifaceted nature of innovation. Schumpeter (1934), for example, discussed innovation in terms of product innovation, process innovation, organisation innovation and market innovation. Thus, depending on their product or market characteristics, different industries focus more on product innovation while others focus on process innovation. Furthermore, IPRs protection such as patents or trademarks may be more effective for product innovation than process innovation, leading to varying patterns of innovative activity across industrial sectors and dependent upon the size of the firms.

2.2. Australian SMEs' Export And Innovative Activities

Australian SMEs are an interesting case to study the determinants of firm level innovative activities and the link between export and innovation because of the reasons discussed above. In addition, SMEs are important for the Australian economy, accounting for slightly more than 60% of total employment and 50% of value added

[1] See, for examples, Acs and Audretsch (1988) and Arundel and Kabla (1998).

(ABS, 2001); and, because of these, the SMEs have received specific attention from the Australian government in terms of various policies and incentives directed at them in order to help improve their productive and innovative performance. Naturally, the importance of Australian SMEs varies across industries ranging from, for example, a contribution of as much as 97% of the industry value added in 2006/07 in Agriculture, Forestry and Fishing, to 90% in Rental, Hiring and Real Estate Services, to 75% in Accommodation, Cafes and Restaurant, to 56% in Retail Trade, to 45% in Manufacturing and down to 17% in Information Media and Telecommunication (ABS, 2008).

In terms of export market participation, in 2005-06 SMEs made up approximately 90% of Australia's exporters of goods, but they accounted for less than 10% of the total value of goods exports (ABS, 2006). In terms of export propensity, ABS (2001) indicates that around 15% of SMEs with an employment size 20-199 are exporters whilst less than 5% of SMEs with an employment size 5-19 are exporters. Based on the value of goods export, by 2008-09, Australian SMEs contributed the most in the Construction sector (37%), Transport, postal and warehousing (23%) and Wholesale trade (16%) (ABS, 2010).

For innovative activities, the latest ABS Innovation Survey conducted in December 2005 (ABS, 2007) shows that there were approximately 141,300 businesses[2] operating in Australia and, of this number, around 34% of them undertook innovation in terms of new products, new operational processes and/or new organisational processes.[3] As expected, the extent of innovativeness varies by business size with around 58% of very large businesses (250+ employees), 46-48% of medium businesses (20-99 employees), and 25-34% of small businesses (5-19 employees) reported as innovators. It also varies by industry with industries such as Electricity, gas and water supply (49% of businesses are innovators), Wholesale trade (43%) and Manufacturing (42%) leading the way.

Furthermore, between 2003 and 2005, Accommodation, cafes & restaurants, Mining, and Wholesale trade showed the highest increases in the proportion of innovating businesses. The high growth in innovation incidence among businesses in

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[2] See Mansfield *et al*. (1981) as cited in Jensen and Webster (2006).
[3] Here, 'new' may refer to 'new to businesses' (74% of product innovation), 'new to the industry' (10%), 'new to Australia' (10%), or 'new to the world' (6%).

the Wholesale trade industry, for example, reflects increased incidence of innovation in operational and organisational processes. On the other hand, the growth of innovation activities in Accommodation, cafes & restaurants is due to significant increases in all types of innovation. Finally, some industries appeared to become less innovative between the two periods including Communications services and Finance and insurance.

In terms of the type of innovation, ABS reports that the proportion of Australian businesses with product innovation in 2005 is the lowest at around 19%, followed by operational process and organisational process innovation at around 22 and 25% respectively (ABS, 2007). It is worth noting that in 2003 the proportion of businesses with product innovation is only around 13%. For SMEs, operational process innovation is the most important type of innovation compared to the other two.

Finally, in terms of the contribution to the degree of sales turnover, 65% of innovating businesses reported that less than 10% of their turnover could be attributed to product innovation. This also varies across industries with businesses in most services industry reporting less than 10% attribution while those in Mining and Manufacturing were more likely to attribute between 10% and 50% of their turnover to product innovation. In terms of business size, it is interesting to note that none of the large businesses (100+ employees) reported that their product innovation contributed more than 50% of their turnover. In contrast, 12% of small businesses (5-19 employees) reported that 12% of their turnover could be attributed to product innovation.

2.3. Case Studies

Given the anonymity of firms and the minimal level of details provided by the panel data used in this study, it is probably a good idea to look at a number of case studies on how Australian SMEs conduct their export and innovation activities in practice. This section briefly discusses the case of the Australian wine industry and small and medium businesses in the services sector which have received one form or another of the Australian Exporter Award.[4] The discussion of the wine industry illustrates the

[4] The Australian Export Awards has run for 48 years and provided recognition and honors to exceptional Australian exporters based on the criterion of sustainable export growth achieved

relationship between innovation and export in that industry and is based on the in depth study of Aylward (2004; 2006). Unfortunately, due to a lack of other similarly detailed studies, the services sector discussion can only highlight certain characteristics of select Australian Exporter Award winners between 2001 and 2010.

2.3.1. Australian Wine Industry Australian Exporter Award Winners In Services Sector

According to Aylward (2004; 2006), in 2004 Australia is the 4th largest exporter of wine in terms of value, with 40% exported into the United States. In terms of production, Aylward's study finds that the Australian wine industry consists of two major clusters (South Australia and New South Wales / Victoria). Furthermore, he points out that while the South Australian cluster accounts for only around 25% of wineries, its shares of production and export reach 50% and 60% respectively.

From the interviews that he conducted in his study, Aylward links the South Australian wine cluster's higher productivity and propensity to export to the differences between the two clusters in terms of innovation-related factors. For example, 66% of the firms in South Australia responding to Aylward's interview believed that there was a strong link between innovation and their export performance. In contrast, only 42% of the respondents from the New South Wales / Victoria cluster believed so. Aylward also finds that they differ in how they defined innovation, the extent of collaboration and the use of the wine industry's research and analytical services. Finally, an interesting finding to note from the study is that while there is a negligible difference in how the firms in both clusters define product innovation, they differ rather significantly in how they define process innovation. This last finding points to the possibility that process innovation is probably more important than product innovation in explaining the link between export and innovation.

2.3.2. Australian Exporter Award Winners In Services Sector

In the last 48 years, the Australian government has given awards to businesses deemed as having exceptional performance in the export market every year. The awards are given to businesses belonging to various categories such as agribusiness, arts and

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through innovation and commitment. See http://www.exportawards.gov.au/default.aspx (accessed March 11, 2011) for more details.

entertainment, emerging exporters, and large and advanced manufacturers. For the purpose of this study, two categories of particular interest are the emerging exporter and small and medium-sized businesses in services categories. Between 2001 and 2010, there were 24 businesses which received emerging exporter awards (10 are from the services sector) and 16 businesses which received the small and medium exporter in services awards. In terms of their product characteristics, a majority of these high-performing Australian exporters in the services sector operate in the information technology-related field (10 businesses), highly specialized engineering design and prototype manufacturing operations (8 businesses), or specialized manufacturing and industrial consultancy services for the mining industry (4 businesses). For example, one business in IT related services which employs around 50 consultants is the largest specialist provider of independent information security consulting services in the region, with consumers coming from over 20 countries such as Singapore, Malaysia, South Korea, Japan, the United States, and France. Another business provides maritime simulation, training and consultancy services to the international maritime and defense industries. Perhaps, the most important lesson for this study that can be taken from these award winning exporters, while noting that they may not be representative of the whole services sector, is that most of them rely on being able to continuously come up with better processing technology via skills and technology updating to deliver their services.[5] In other words, it appears that their export performance depends more on process innovation than on product innovation.

3. Empirical Model And Data

3.1. Empirical model

In order to answer the two research questions which require the ability of making causal inference as opposed to simply establishing the (in)existence of correlation, it is necessary to adopt a methodology which allows for an unbiased estimation of the relevant treatment effects (in this case, being an exporter or being an innovator). This

[5] See the case studies for the award winners provided by the Australian Export Awards website mentioned in the previous end note.

study follows Becker and Egger (2010) and Damijan *et al*. (2010) in adopting the propensity score matching methods to arrive at unbiased, robust estimates of the causal effects. As argued by, for example, Deheia and Wahba (2002), the estimation of causal effect through a comparison of a treatment group with a 'nonexperimental' comparison group could suffer from the problem of self-selection or other systematic bias relating to the sample selection. The propensity score-matching methods correct the sample selection bias by pairing treatment and comparison units in terms of their observed characteristics and thus providing a natural weighting scheme that ensures the unbiasedness of the estimated treatment effects.

For the study, there are two treatment effects of interest: innovation effects and exporting effects. Thus, two propensity matching score specifications are specified as follows:

$$\Pr[I_{it} = 1] = f(X_{it-1}) + \varepsilon_{it} \tag{1}$$

and

$$\Pr[E_{it} = 1] = f(Z_{it-1}) + \eta_{it} \tag{2}$$

where, at each period *t*, firm *i*'s propensities to innovate ($\Pr[I_{it} = 1]$) and to export ($\Pr[E_{it} = 1]$) are expressed as a function of observed (exogenous) previous period characteristics such as productivity, size of employment, capital intensity and import status. Based on the estimated propensity to innovate (equation (1)) 'matched' innovators and non-innovators at period *t* are obtained. Similarly, based on the estimated propensity to export we obtain matched exporters and non-exporters.

Based on the resulting matched innovators in period *t*, using a similar approach used by Becker and Egger (2010) and Damijan (2010), we estimate the average treatment effects of innovation on export market participation by comparing their probabilities to become exporters in period *t* and in period *t+1* separately. The latter provides some indication of the direction of causality. We also do the reverse case; that is based on the resulting matched exporters in period *t*, we estimate the average treatment effects of export market participation on innovation by comparing their probabilities to become innovators (product and/or process) in period *t* and in period *t+1* separately. Finally, we repeat the analysis on a restricted sample where we only consider exporters (innovators) at period *t* which were not exporters (innovators) in period *t-1*.

3.2. Data

To estimate the model described above, we use firm level data from the recently released confidentialised unit record file (CURF) Business Longitudinal Database (BLD) from the Australian Bureau of Statistics.[6] This first edition of the BLD CURF includes data for two panels, with 3,000 Australian small and medium businesses with less than 200 employees in each panel – Panel One (2004-05, 2005-06 and 2006-07) and Panel Two (2005-06 and 2006-07). The database contains a rich set of information including firm characteristics (e.g. business structure, markets and competition, financing arrangements; innovation, barriers to business activity, IT use) and financial information (sourced from the Business Activity Statements and Business Income Tax reported to the Australian Tax Office). Finally, in terms of industries, the database covers all of the three broad sectors (primary, manufacturing and services), except for government administration, education, health, and utilities.

The number of businesses covered by the BLD data with useable observations is 1,826 (2004-05), 3,486 (2005-06) and 3,314 (2006-07), for a total of 8,626 firms across years and sectors. The broad sectoral distribution of these firms by type of innovation and the firms' export status is provided in Table 1. From the table, the services sector has the highest number of sampled firms with 4,972. However, this reflects more of the sample design of the BLD database rather than the actual distribution of Australian businesses. Of the 8,626 businesses in the sample, 15% are exporters; and, the proportion of exporters in the sample varies by sector with the manufacturing sector having the highest proportion at around 29%, or double the rate of each of the other sectors.

In terms of innovation, Table 1 shows that overall 30% of the sampled businesses have either product or process innovation (7.8% product innovation only, 10.9% process innovation only, and 11.3% both product and process innovation). Similar to export, the proportion of innovating businesses also varies across sectors. For example, as implied in Table 1, businesses in the manufacturing sector have the highest proportion in terms of innovation with around 40% of them having either product or process innovation. Most importantly, from Table 1, we can see that non-innovators are less

[6] Note that the CURF BLD was supposed to be released in July 2009, but the expected release date has now been postponed to an undetermined date.

likely to be exporters. This is in sharp contrast to what Wakelin (1998) found with UK manufacturing firms, for example, where innovating firms are the ones who are less likely to be exporters. Finally, Table 1 shows that businesses with both product and process innovation are the most likely to be exporters, indicating possible complementary effects between product and process innovation such as the one identified by Van Beveren and Vandenbussche (2010).[7]

Table 1: Distribution of Firms by Sector, Innovation and Export Status (%)

Type of Innovation	Export Status	Sector			
		Primary (n=2,330)	Manufacturing (n=1,324)	Services (n=4,972)	Total n=(8,626)
Product innovation only (7.8)	Non-exporter	82.7	66.9	78.7	77.3
	Exporter	17.3	33.1	21.3	22.7
	Subtotal	100	100	100	
Process innovation only (10.9)	Non-exporter	83.8	66.1	84.1	80.7
	Exporter	16.2	33.9	15.9	19.3
	Subtotal	100	100	100	
Product and process innovation (11.3)	Non-exporter	76.2	54.5	76.7	71.4
	Exporter	23.8	45.5	23.3	28.6
	Subtotal	100	100	100	
No innovation (70.0)	Non-exporter	88.1	77.7	91.7	88.8
	Exporter	11.9	22.3	8.3	11.2
	Subtotal	100	100	100	
Total (100)	Non-exporter	86.7	71.1	88.0	85.0
	Exporter	13.3	28.9	12.0	15.0
	Subtotal	100	100	100	

Note: Primary sector includes agriculture, fishing & forestry and mining. Services sector includes construction, wholesale trade, retail trade, accommodation, cafes & restaurants, transport & storage, communication services, property & business services, cultural & recreational services, and personal & other services.

Source: Processed from pooled panel data 2004/05, 2005/06 and 2006/07 of the CURF Business Longitudinal Database (ABS, 2009) by the author.

After some further data-cleaning steps to ensure that each observation has non-missing values in the relevant variables to estimate the empirical model, the useable sample size is around 1,800 firms for each sample year. A descriptive summary of the clean sample is provided in Table 2. From Table 2, in 2005/06, approximately 20% of

[7] The issue of complementarities between product and process innovation and their link to export participation is not addressed in this paper and is left for future research.

the sampled SMEs are product innovators and 26% are process innovators. The proportion of those with either type of innovation is approximately 34%. Noting that these figures *exclude* innovation in organizational processes, the implied extent of innovativeness among the SMEs in the data sample used in this paper is relatively comparable to that based on the Australian Innovation Survey data discussed in the earlier section. Furthermore, from the same table, the proportion of manufacturing SMEs is approximately 15%, which is about double the proportion of manufacturing SMEs according to the overall figure for Australian SMEs (ABS, 2001). Finally, in terms of the propensity to export, approximately 15% of the SMEs in the clean data reported positive export income. This is similar to the proportion based on the raw BLD data explained above and the overall data of firms with employment size between 20 and 199 as discussed in Section 2.

Table 2: Descriptive Statistics

Variable	Description	t =2005/06			t=2006/07		
		N	Mean	Std. Dev.	N	Mean	Std. Dev.
$PRODINNOV_{t+1}$	=1 if had goods/service innovation at period t+1	3405	0.189	0.391			
$PRODINNOV_{t}$	=1 if had goods/service innovation at period t	3670	0.203	0.402	3365	0.188	0.391
$PRODINNOV_{t-1}$	=1 if had goods/service innovation at period t-1	1826	0.166	0.373	3719	0.204	0.403
$PROCINNOV_{t+1}$	=1 if had operational process innovation at period t+1	3417	0.207	0.406			
$PROCINNOV_{t}$	=1 if had operational process innovation at period t	3688	0.263	0.440	3376	0.209	0.407
$PROCINNOV_{t-1}$	=1 if had operational process innovation at period t-1	1826	0.150	0.357	3737	0.264	0.441
$INNOV_{t+1}$	=1 if had product/process innovation at period t+1	3405	0.289	0.453			
$INNOV_{t}$	=1 if had product/process innovation at period t	3668	0.341	0.474	3365	0.290	0.454
$INNOV_{t-1}$	=1 if had product/process innovation at period t-1	1826	0.227	0.419	3717	0.341	0.474
$EXPORT_{t+1}$	=1 if had any export income at period t	3267	0.146	0.353			

Table 2: (continued) Descriptive Statistics

Variable	Description	t =2005/06			t=2006/07		
		N	Mean	Std. Dev.	N	Mean	Std. Dev.
$EXPORT_{t}$	=1 if had any export income at period t	3440	0.156	0.363	3229	0.147	0.354
$EXPORT_{t-1}$	=1 if had any export income at period t-1	1826					
$EMPSIZE_{t-1}$	=number of employees at period t	1826	30.10	43.57	3764	31.49	44.74
$LLABPRODVA_{t-1}$	= log of value added (sales less non-capital purchases) per employee at period t	1594	10.25	1.354	3252	10.36	1.343
$LINVINT_{t-1}$	= log of capital purchase per employee in period t-1	1110	7.872	2.141	1559	10.70	1.534
$IMPORT_{t-1}$	= 1 if had any import purchase	1826	0.128	0.334	3476	0.169	0.374
MFG	=1 if industry division is manufacturing	4123	0.152	0.359	3764	0.152	0.359
SERVICE	=1 if industry division is services	4123	0.584	0.493	3764	0.579	0.494

Source: Author.

4. Results

4.1. Propensity to Innovate and to Export

Tables 3 and 4 present the estimated coefficients of the propensity to innovate and to export based on the specified equations 1 and 2 respectively.[8] The estimates are based on pooled sample across years and industrial sectors. In addition, each equation is also estimated with data from each of three major industrial divisions only. These broad sectors are: primary, manufacturing, and services. [9,10]

[8] Unfortunately, due to data access restrictions put in place by the Australian Bureau of Statistic on RADL users, we were not provided with the estimated marginal effects.

[9] Following ANZSIC Version 1993, Primary is A (Agriculture, Forestry & Fishing) and B (Mining), Manufacturing is C (Manufacturing), and Services is E (Construction), F (Wholesale Trade), G (Retail Trade), H (Accommodation, Cafes and Restaurants), I (Transport and Storage), J (Communication Services), L (Property and Business Services), P (Cultural and Recreational Services), and Q = Personal and Other Services.

Overall, the estimated coefficients are statistically significant and of the expected sign; and in all cases they are jointly statistically significant. From Table 3, the propensity to innovate in the current period is positively correlated with the previous period's levels of employment, labour productivity, capital intensity, and whether or not the businesses had any exposure to the import market. Furthermore, the positive relationships with size of employment and labour productivity appear to be non-linear, with diminishing effects. From Tables A.1-A.3 in the Appendix, the estimated coefficients at the sectoral level have similar signs to those based on pooled data across sectors, except for those for primary and manufacturing sectors which are mostly not statistically significant. The only variable that is consistently significant across different specifications is import engagement. One most likely reason for the insignificant coefficient estimates for primary and manufacturing sectors is the drop in the sample size. This needs to be kept in mind when interpreting the results of propensity score matching exercise which will be discussed later.

Table 3: Propensity to Innovate – All Sectors

	Product or process innovation or both $\Pr\left[INNOV_t = 1\right]$		Product innovation $\Pr\left[PRODINNOV_t = 1\right]$		Process Innovation $\Pr\left[PROCINNOV_t = 1\right]$	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
$EMPSIZE_{t-1}$	0.030***	0.009	0.043***	0.010	0.027***	0.001
$\left(EMPSIZE_{t-1}\right)^2$	-0.000***	0.000	-0.000***	0.000	-0.000***	0.000
$LLABPRODVA_{t-1}$	0.357*	0.195	0.564**	0.276	0.300	0.226
$\left(LLABPRODVA_{t-1}\right)^2$	-0.019	0.010	-0.029**	0.014	-0.018	0.011
$LINVINT_{t-1}$	0.064***	0.019	0.072***	0.022	0.055*	0.029
$IMPORT_{t-1}$	0.432***	0.087	0.410***	0.104	0.625***	0.106
$YEAR_{2006/07}$	-0.478***	0.087	-0.567***	0.097	-0.396***	0.105
$CONST$	-3.089***	0.997	-4.391***	0.339	-2.363***	1.144
N. Obs.	1996		1591		1501	
Log pseudo likelihood	-1175.4		-801.4		-720.6	
Pseudo R^2	0.071		0.1067		0.097	

Note: The probit regressions are estimated with 1-digit ANZSIC industry dummy variables when applicable and with robust standard error. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.

Source: Author.

[10] The coefficient estimates of the propensity to innovate equation estimated at the sector level are provided in Tables A.1-A.3 in the Appendix.

For export propensity, the estimates in Table 4 show that only employment and import variables are statistically significant.[11] It should be noted however that any variable constructed using employment size, such as labor productivity and capital intensity with respect to labor, is limited in the sense that the employment size figure is only provided at three discrete intervals: 1-5, 5-19, and 20-99. This might lead to a larger standard error of the estimates than in the case when a more precise measure of employment is available.

Table 4: Propensity to Export

$\Pr\left[Export_t = 1\right]$	All sectors		Primary		Manufacturing		Services	
	Coeff.	Coeff.	Std. Error	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
$EMPSIZE_{t-1}$	0.004***	0.002	0.002	0.001	0.006	0.017	0.004***	0.001
$LLABPRODVA_{t-1}$	0.029	0.002	0.052	0.035	0.071	0.078	0.041	0.056
$LINVINT_{t-1}$	0.016	-0.036	0.045	0.024	0.054	0.055	0.027	0.033
$IMPORT_{t-1}$	1.114***	0.886***	0.214**	0.092	1.091***	0.173	1.178***	0.129
$YEAR_{2006/07}$	-0.121	-0.040	0.178	0.105	-0.106	0.246	-0.206	0.152
CONST	-1.857***	-0.994	0.510	0.425	-2.336***	0.820	-2.112***	0.619
N. Obs.	1993		502		324		1167	
Log pseudo likelihood	-667.2		-174.6		-166.8		-321.9	
Pseudo R^2	0.2178		0.0596		0.1799		0.2480	

Note: The probit regressions are estimated with 1-digit ANZSIC industry dummy variables when applicable and with robust standard error. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.

Source: Author.

4.2. The Effects of Innovative Activities on Export Market Participation

Based on the estimated coefficients summarized in Tables 3-4 (and Tables A.1–A.3) and the resulting innovation propensity score, each SME which innovated in period *t* (the treated firm) is matched to one or more of the non-innovating firms (the untreated firms) using the nearest neighbor and the radius propensity score matching methodologies.[12] To ensure a satisfactory balancing property, the matching is restricted to those observations with common support and to those within the same 1-digit ANZSIC classification and year. The resulting matching estimators for average

[11] Unlike the innovation equation, we did not find any non-linearity in the effects of labour productivity and employment size.

[12] We refer to Imbens (2004) and the cited references therein for an excellent survey of the matching methodologies.

treatments of the treated of the effects of innovation on export market participation are summarized in Tables 5 and 6.[13]

In Table 5, the estimated effects of *current innovation on current export market participation* are presented. While the estimated rate differentials in export market participation are based on matched innovators–non-innovators using previous period conditions, because of their contemporaneous nature these estimates do not indicate any specific direction of causality. Instead, they should be interpreted as unbiased estimates of the nature and strength of the relationship between innovation and export market activities for Australian SMEs as a whole and in each of three major industries.

From the nearest neighbor estimates for all sectors in Table 5, for example, current innovating firms have a 9 - 17 percentage point higher propensity to be in the export market. This effect is also significant in magnitude given that, as discussed earlier, the overall proportion of exporting SMEs in our sample is only around 15%. Also in Table 5, in the last two columns, are estimates based on the radius-matching method. In that case, for each matching analysis, the largest value of radius to ensure that the balancing property test is satisfied. While the overall sector estimates based on the nearest neighbor method have the same sign as those of the radius method, there are dissimilarities in their magnitude. Furthermore, at the sectoral level, the differences between the estimates appear to be more pronounced. However, if we look at the balancing property test results summarized in Table A.4-A7, the balancing property of nearest neighbor matching results seem to be much better. Because of that we focus our discussion of the results on those based on the nearest neighbor method, keeping in mind that the results may not be robust compared to the matching method and should be interpreted with caution.[14]

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[13] Tables A.4-A.7 in the Appendix show that the balancing property tests are satisfied for the entire nearest neighbor matching exercises. As can be seen, despite the relatively weak estimates of the propensity models, the results of the matching process appear quite reasonable in identifying valid matched control observations. Furthermore, it appears that the balancing property of the results based on radius matching method is weaker compared to that of the nearest neighbor results.

[14] As indicated earlier, limited sample size may play a role here.

Table 5: Average Treatment Effects of $Innovation_t$ on $Pr[Export_t]$

Outcome: Export *Treatment: Innovation*	Average Treatment Effects on the Treated by Matching Method			
	Nearest Neighbor		**Radius**	
ALL SECTORS	ATT	SE	ATT	SE
Innovation type				
Product	0.168*** (334/334)	0.035	0.071** (200/451)	0.032
Process	0.090*** (399/399)	0.034	0.090** (162/226)	0.041
Product/process	0.104*** (655/655)	0.026	0.067* (210/321)	0.035
PRIMARY	ATT	SE	ATT	SE
Innovation type				
Product	0.222*** (45/45)	0.071	0.035 (34/316)	0.062
Process	0.055 (73/73)	0.059	-0.073* (52/276)	0.042
Product/process	0.027 (110/110)	0.061	-0.046 (66/186)	0.038
MANUFACTURING	ATT	SE	ATT	SE
Innovation type				
Product	0.123 (73/73)	0.098	0.021 (21/25)	0.156
Process	0.120 (100/100)	0.091	0.226*** (82/211)	0.072
Product/process	0.140** (143/143)	0.069	0.084 (52/70)	0.092
SERVICES	ATT	SE	ATT	SE
Innovation type				
Product	0.070 (214/214)	0.048	0.088** (110/234)	0.043
Process	0.098** (225/225)	0.040	0.077 (70/92)	0.058
Product/process	0.108*** (397/397)	0.030	0.052* (192/300)	0.030

Note: *,**,*** denote statistically significant at 10%, 5%, and 1% respectively. The standard errors are computed based on Lechner (2001) approximation. In the parentheses are the numbers of treated and matched control (possibly not unique) observations.
Source: Author.

If we look at the sector level and the type of innovation, the estimated co-temporal relationships between innovation and export based on the nearest neighbor matching method summarized in Table 5 seem to support our intuition that the relationship between innovation and export vary across industrial sectors as well as across the different types of innovation. For example, for the primary sector, the relationship between product innovation and export market activities is the strongest, especially if we look only at the nearest neighbor estimators. On the other hand, the relationship between current innovation and export is slightly stronger in terms of process innovation than product innovation. What this means is that the findings of studies which look at the export-innovation link based on data from a certain sector may not generalize to other sectors. It also means that if the sectoral distribution of industrial activities varies across countries, then any study based on data from a certain country may not be generalized to other countries with a different industrial structure.

As mentioned earlier, Table 5's results do not indicate any clear direction causality because of potentially unobserved contemporaneous shocks. In order to investigate the direction of causality in the relationship between innovation and export, we estimate the average treatment effects on the treated in the current period of innovation on the propensity to have any export income in *the next period*. The results of the estimation are provided in Table 6. From the table, most of the estimates are not statistically significant, indicating a lack of evidence that innovation causes export. While most of the estimates have positive signs, they are not statistically significant; possibly due to an increased variance from the smaller sample size. The only exception is process innovation; particularly for firms in the services sector of which current process innovation appears to lead to higher export market participation in the next period. From the table, SMEs in the services sector which have process innovation in the current period have around a 15 percentage point higher probability to have positive export income in the following period. It is interesting to note that the result is also supported by the radius matching method.

Table 6: Average Treatment Effects of *Innovation*$_t$ on *Pr*[*Export*$_{t+1}$]

Outcome: Export *Treatment: Innovation*	**Average Treatment Effects on the Treated by Matching Method**			
	Nearest Neighbor		**Radius**	
ALL SECTORS	ATT	SE	ATT	SE
Innovation type				
Product	0.131** (153/143)	0.061	0.051 (79/159)	0.057
Process	0.114** (201/200)	0.056	0.085 (58/82)	0.089
Product/process	0.116*** (313/305)	0.043	0.090 (83/120)	0.061
PRIMARY	ATT	SE	ATT	SE
Innovation type				
Product	0.174** (23/24)	0.810	-0.024 (16/115)	0.095
Process	0.144* (42/43)	0.079	0.054 (28/112)	0.074
Product/process	0.083 (60/60)	0.092	0.088 (30/83)	0.061
MANUFACTURING	ATT	SE	ATT	SE
Innovation type				
Product	0.156 (28/22)	0.273	0.143 (7/7)	0.361
Process	0.137 (46/37)	0.208	0.180 (38/54)	0.201
Product/process	0.118 (61/54)	0.160	0.108 (23/21)	0.239
SERVICES	ATT	SE	ATT	SE
Innovation type				
Product	0.022 (104/106)	0.081	0.029 (47/75)	0.094
Process	0.133* (112/111)	0.062	0.234** (27/32)	0.119
Product/process	0.066 (190/186)	0.056	-0.013 (62/75)	0.090

Note: *,**,*** denote statistically significant at 10%, 5%, and 1% respectively. The standard errors are computed based on Lechner (2001) approximation. In the parentheses are the numbers of treated and matched control (possibly not unique) observations.

Source: Author.

4.3. The Effects of Export Market Participation on Innovative Activities

Table 7 and, especially, Table 8 provide matching estimators to investigate the possibility of reversed direction of causality running from export market participation to innovative activities. Using identical matching methodologies based on the estimated propensity to export, we match current exporters (the treated) to current non-exporters (untreated) and estimate the average treatment effects on the treated with regard to their propensity to have product innovation, process innovation, or either type of innovation or both. As before, the estimated effects vary by industry and by type of innovation with process innovation (current and next period), especially for those SMEs in the services sector, appearing to have the strongest and most robust positive relationship with current export market participation.[15] From Table 8, there appears to be evidence that export market participation leads to a higher probability to have process innovation in the services sector.

Table 7: Average Treatment Effects of $Export_t$ on $Pr[Innovation_t = 1]$

Outcome: Innovation *Treatment: Export*	**Average Treatment Effects on the Treated by Matching Method**			
	Nearest Neighbor		**Radius**	
ALL SECTORS	ATT	SE	ATT	SE
Innovation type				
Product	0.122** (219/221)	0.058	0.187** (49/109)	0.077
Process	0.166*** (242/246)	0.054	0.115* (53/100)	0.070
Product/process	0.129** (299/303)	0.053	0.245*** (49/77)	0.082
PRIMARY	ATT	SE*	ATT	SE
Innovation type				
Product	0.043 (46/46)	0.101	0.085 (38/669)	0.063
Process	0.055 (47/50)	0.091	-0.074 (31/111)	0.068
Product/process	0.251*** (54/58)	0.085	0.096 (38/381)	0.078

[15] This is may also be due to services having a much larger sample size.

Table 7: (continued) Average Treatment Effects of *Export*$_t$ on *Pr*[*Innovation*$_t$ = 1]

Outcome: Innovation *Treatment: Export*	**Average Treatment Effects on the Treated by Matching Method**			
	Nearest Neighbor		**Radius**	
MANUFACTURING	ATT	SE	ATT	SE
Innovation type				
Product	0.065 (70/69)	0.119	0.139 (32/57)	0.112
Process	0.264*** (91/91)	0.094	0.280*** (34/63)	0.109
Product/process	0.062 (104/103)	0.102	0.190* (43/92)	0.097
SERVICES	ATT	SE	ATT	SE
Innovation type				
Product	0.225*** (102/102)	0.080	0.334*** (34/80)	0.099
Process	0.279*** (104/104)	0.078	0.198* (30/104)	0.102
Product/process	0.194** (139/139)	0.077	0.144 (29/65)	0.114

Note: *,**,*** denote statistically significant at 10%, 5%, and 1% respectively. The standard errors are computed based on Lechner (2001) approximation. In the parentheses are the numbers of treated and matched control (possibly not unique) observations.

Source: Author.

Table 8; Average Treatment Effects of *Export*$_t$ on *Pr*[*Innovation*$_{t+1}$ = 1]

Outcome: Innovation *Treatment: Export*	**Average Treatment Effects on the Treated by Matching Method**			
	Nearest Neighbor		**Radius**	
ALL SECTORS	ATT	SE	ATT	SE
Innovation type				
Product	0.077 (26/24)	0.317	0.000 (15/30)	0.174
Process	0.178* (104/106)	0.105	0.152 (22/42)	0.190
Product/process	0.153 (131/128)	0.110	0.222 (21/27)	0.151

Table 8: (continued) Average Treatment Effects of *Export*$_t$ on *Pr*[*Innovation*$_{t+1}$ = 1]

Outcome: Innovation *Treatment: Export*	**Average Treatment Effects on the Treated by Matching Method**			
	Nearest Neighbor		**Radius**	
PRIMARY	ATT	SE	ATT	SE
Innovation type				
Product	0.158 (25/24)	0.109	0.044 (19/212)	0.091
Process	-0.073 (25/24)	0.159	-0.009 (13/35)	0.125
Product/process	0.179 (28/28)	0.131	0.038 (18/124)	0.123
MANUFACTURING	ATT	SE	ATT	SE
Innovation type				
Product	0.132 (39/36)	0.245	0.212 (11/15)	0.319
Process	0.036 (39/36)	0.271	0.414 (11/18)	0.289
Product/process	-0.026 (39/36)	0.256	0.123 (14/25)	0.268
SERVICES	ATT	SE	ATT	SE
Innovation type				
Product	0.201 (46/47)	0.145	-0.081 (8/17)	0.317
Process	0.303** (47/49)	0.123	-0.073 (10/22)	0.278
Product/process	0.167 (62/66)	0.147	-0.021 (11/17)	0.278

Note: *,**,*** denote statistically significant at 10%, 5%, and 1% respectively. The standard errors are computed based on Lechner (2001) approximation. In the parentheses are the numbers of treated and matched control (possibly not unique) observations.
Source: Author.

4.4. New Exporters and New Innovators

In order to investigate further the direction of causality between export and innovation, we also conduct the propensity matching analysis by limiting the sample to 'new' exporters and 'new' innovators. We define 'new' exporters as firms with no export income in period *t-1*. Similarly, we define 'new' innovators as firms without any innovation in the previous period. However, due to the limitation of the sample size, we only conduct the analysis at the overall industry level. The resulting matching estimators of the average treatment effects on the treated are summarized in Tables 9 and 10.

Based on the results in Table 9, we attempt to determine if current innovative activities are correlated with the probability of becoming a 'new' exporter in the current period or in the next period. From the table, it appears that current innovators, especially product innovators, which are non-exporters in the previous period, are more likely to 'become' an exporter in the current period compared to current non-innovators. On the other hand, if we look at the probability of becoming a new exporter in period *t+1*, the relationship is strongest for the process innovators.[16]

Table 9: Average Treatment Effects of $Innovation_t$ on $\Pr[EXPORT_t = 1 | EXPORT_{t-1} = 0]$ and $\Pr[EXPORT_{t+1} = 1 | EXPORT_{t-1} = 0]$

Outcome: Export	Average Treatment Effects on the Treated by Matching Method			
Treatment: Innovation	Nearest Neighbor		Radius	
Innovation type	ATT on period t	SE	ATT on period t	SE
Product	0.054*** (242/242)	0.020	0.030 (61/106)	0.032
Process	0.021 (288/288)	0.020	-0.002 (100/191)	0.029
Product/process	0.027* (490/490)	0.014	-0.005 (90/132)	0.026
	ATT on period t+1	SE	ATT on period t+1	SE
Product	0.007 (114/110)	0.039	0.018 (22/36)	0.070
Process	0.074*** (148/147)	0.025	0.116** (43/70)	0.049
Product/process	0.027 (239/225)	0.027	0.033 (30/41)	0.033

Note: *,**,*** denote statistically significant at 10%, 5%, and 1% respectively. The standard errors are computed based on Lechner (2001) approximation. In the parentheses are the numbers of treated and matched control (possibly not unique) observations.
Source: Author.

Similarly, looking at the results presented in Table 10, we ask if current export participation is associated with a higher probability of becoming a 'new' innovator in

[16] It should be noted again that this study and other studies employing a similar methodology such as Damijan *et al*. (2010) are also sensitive to the matching methods.

the current or the next period. Again, the results appear to be sensitive to the matching method and if we only look at the nearest neighbor estimates, it appears that current exporters are more likely to become new process innovators in the current period. However, when we look at export market participation as the treatment, none of the estimated relationship with the propensity to become a new innovator in period *t+1* is statistically significant.

Table 10. Average Treatment Effects on $Export_t$ on $\Pr[Innovation_t = 1 \mid Innovation_{t-1} = 0]$ and $\Pr[Innovation_{t+1} = 1 \mid Innovation_{t-1} = 0]$

Outcome: Innovation	Average Treatment Effects on the Treated by Matching Method			
Treatment: Export	Nearest Neighbor		Radius	
Innovation type	ATT on period t	SE*	ATT on period t	SE*
Product	0.052 (129/132)	0.061	0.151*** (65/374)	0.056
Process	0.176*** (143/144)	0.058	0.017 (45/96)	0.058
Product/process	0.155** (157/162)	0.063	0.056 (47/118)	0.075
	ATT on period t+1	SE*	ATT on period t+1	SE*
Product	0.009 (57/59)	0.120	0.153 (26/116)	0.105
Process	0.156 (68/71)	0.111	0.076 (18/33)	0.131
Product/process	0.174 (76/77)	0.114	-0.005 (19/49)	0.129

Note: *,**,*** denote statistically significant at 10%, 5%, and 1% respectively. The standard errors are computed based on Lechner (2001) approximation. In the parentheses are the numbers of treated and matched control (possibly not unique) observations.
Source: Author.

Altogether, the estimated average treatment on the treated effects show a different characterization of the relationship between innovation and export for SMEs from the one for large firms or firms in the manufacturing sector, as reported by most existing studies. For example, it appears that for small firms like Australian SMEs for whom most product innovation involves products which are not new to the world and where most of them are more likely to be financially constrained relative to large firms, the type of innovative activities which appears to matter the most with regards to export market participation is process innovation.

Nevertheless, following the argument in Damijan *et al*. (2010), our results also indicate that the positive effects of current product innovation on the probability of becoming an exporter in the current period shown in Table 11 appear to be consistent with the conclusion of studies such as Cassiman and Golovko (2007), Cassiman and Martinez-Ros (2007) and Becker and Egger (2010) that product innovation is crucial for entering the international market successfully. While the strong positive relationship between current export market activity and the probability of becoming a ‘new’ process innovator in the current period in Table 12 also appears to be consistent with their conclusion that once in the export market, a firms need to conduct process innovation to stay competitive.

5. Conclusions and Policy Implications

This paper began by asking if exporting firms learned from their participation in the export markets and thus became more innovative than those which focused only on the domestic markets (learning-by-exporting hypothesis) and if firms had invested in innovative activities before they entered foreign markets (self-selection hypothesis). The paper aimed to provide empirical evidence based on firm level data of Australian small and medium enterprises (SMEs) in order to assess if the existing evidence based on medium and large firms and firms in the manufacturing sector can be generalised into smaller firms or firms from the resources and services sector.

The paper attempted to answer the questions by following recent studies in utilizing the propensity score matching methodology to obtain unbiased estimates of the effects of innovation on export market participation and vice versa and in identifying the direction of causality. Despite the various data limitations in terms of the way the data need to be accessed remotely exacerbated by computer programming restrictions that ruled out the use of certain matching estimators and the lack of detailed information such as the provision of information on industrial division at only one digit level or the amount of employment at three grouped intervals, the paper was able to provide some new insights with regard to the relationship between export and innovation. In particular, with regards to the direction of causality, there is evidence that it runs both ways for process innovation, especially for the services sector.[17] That is, the evidence is consistent with the idea that process innovation lead to export market activities which then leads to further process innovation.[18] For product innovation, there is weaker evidence that current product innovation may lead to a higher probability of becoming a 'new' exporter in the current period.

While these findings appear to be sensitive to the matching methodology used and perhaps are not as robust as those of existing studies,[19] they still provide a strong indication that the relationship between innovation and export depends on the size of the firms and the nature of the industry in which the firms operate. For small firms like Australian SMEs for whom most product innovation involves products which are not new to the world and where most of them are more likely to be financially constrained relative to large firms, the type of innovative activity which appears to matter the most with regards to export market participation is process innovation.[20] Not surprisingly, given the importance of the services industry to the Australian economy, the relationship between export market participation and process innovation appears to be the strongest in that industry.

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[17] This conclusion may need to be revisited when more data are available to make sure that the insignificant results for non-services sector are not due to sample size. Table A.8 shows the estimates similar to those in table 5 and 6 except for non-services sectors combined and indicates that sample size is possibly the limiting factor.

[18] Or, since it is not clear which comes first, export market participation leads to process innovation which leads to further export market participation.

[19] These are probably due to the limitations of the data as outlined above more than anything else.

[20] Aylward (2004) provides an interesting finding from his case study of the Australian Wine Industry that firms in the more innovative wine clusters in South Australia are more likely to be exporters than firms in Victoria or New South Wales. He finds that the differences between the two groups of firms are negligible in terms of 'new product development but are significant in terms of how they interpret 'production process improvements' and how they implement in-house training and the contraction of skilled labor.

In terms of policy relevance, the findings seem to suggest that government policies aimed at providing SMEs with better access to 'new' and improved operational processes or information that could lead to their development by SMEs may be the most effective in leading to higher innovative and export market activities at the same time compared to policies aimed at stimulating the development of new products. This is probably because it is easier for smaller firms in net technology-importing countries such as Australia to enter the international market by becoming a 'better' producer instead of a producer of a 'new' product and, at the same time, it is also easier for them to access new production technologies by becoming more actively involved in the global market in which most of these technologies are developed. In other words, a better export promotion policy would be one that is integrated with policies designed to increase innovation activities. As of now, at least in Australia, innovation policy still appears separate from international trade policy.

Furthermore, the findings also indicate the importance of paying attention to the nature of the industrial sector in which firms operate. In other words, different policies may need to be designed in order to best take advantage of the relationship between product innovation and export market activities among SMEs in the manufacturing sector compared to the policies aimed at SMEs in the services sector which tend to rely more on process innovation. That is, in addition to the need for trade policy and innovation to be more integrated, they also need to be industry specific in order to be the most effective. Finally, while we found indication that there may be complementarities between product and process innovation, we left this issue as well as further analysis with a larger sample of data for future research.

References

ABS (Australian Bureau of Statistics) (2001), 'Small Business in Australia', *ABS Catalogue,* No. 1321.0

ABS (Australian Bureau of Statistics) (2006), 'Number and Characteristics of Australian Exporters', *ABS Catalogue*, No. 5368.0.55.006.

ABS (Australian Bureau of Statistics) (2007), 'Patterns in Innovation in Australian Businesses 2005', *ABS Catalogue*, No. 8163.0.

ABS (Australian Bureau of Statistics) (2008), 'Australian Industry, 2006-07', *ABS Catalogue,* No. 8155.0.

ABS (Australian Bureau of Statistics) (2009), 'Business Longitudinal Database, Expanded CURF, Australia 2004-05, 2005-06 and 2006-07', *Technical Manual Catalogue*, No. 8168.055.002.

ABS (Australian Bureau of Statistics) (2010), 'Characteristics of Australian Exporters 2008-09', *ABS Catalogue*, No. 5368.0.55.006.

Acs, Zoltan J., and David B. Audretsch (1988), 'Innovation in Large and Small Firms: An Empirical Analysis', *American Economic Review*, 78: 678-90.

Arundel, Anthony, and Isabelle Kabla (1998), 'What Percentage of Innovations are Patented? Empirical Estimates for European Firms', *Research Policy* 27(2), pp.127-41.

Aw, Bee-Yan, Mark J. Roberts, and Daniel Y. Xu (2008), 'R&D Investments, Exporting and the Evolution of Firm Productivity', *American Economic Review: Papers & Proceedings* 98(2), pp.451-56.

Aylward, David K. (2004), 'Innovation-export Linkages within Different Cluster Models: A Case Study from the Australian Wine Industry', *Prometheus* 22(4), pp.423-37.

Aylward, David K. (2006), 'Global Pipelines: Profiling Successful SME Exporters within the Australian Wine Industry', *International Journal of Technology, Policy and Management* 6(1), pp.49-65.

Becker, Sascha O., and Peter Egger (2010), 'Endogenous Product versus Process Innovation and a Firm's Propensity to Export', *Empirical Economics,* forthcoming.

Cassiman, Bruno, and Elena Golovko (2007), 'Innovation and the Export-Productivity Link', *CEPR Discussion Papers*, no. 6411, London: CEPR.

Cassiman, Bruno, and Ester Martinez-Ros (2007), 'Product Innovation and Exports. Evidence from Spanish Manufacturing', mimeo, Madrid: IESE Business School.

Chadha, Alka (2009), 'Product Cycles, Innovation, and Exports: A Study of Indian Pharmaceuticals', *World Development* 37(9) pp.1478-83.

Constantini, James A., and Marc J. Melitz (2008), ‘The Dynamics of Firm-Level Adjustment to Trade Liberalization’, In Elhanan Helpman, Dalia Marin, and Thierry Verdier (eds.) *The Organization of Firms in a Global Economy*, Cambridge, MA: Harvard University Press.

Crespi, Gustavo, Chiara Criscuolo, and Jonathan Haskel (2008), ‘Productivity, Exporting, and the Learning-by-Exporting Hypothesis: Direct Evidence from UK Firms’, *Canadian Journal of Economics* 41(2), pp.619-37.

Damijan, Jozê. P., Crt Kostevc, and Saso Polanec (2010), ‘From Innovation, to Exporting or Vice Versa’, *The World Economy* 33(3), pp.374-98.

Dehejia, Rajeev J., and Sadek Wahba (2002), ‘Propensity Score-Matching Methods for Nonexperimental Causal Studies’, *The Review of Economics and Statistics* 84(1), pp.151-61.

Fernandes, Ana M. and Caroline Paunov (2010), ‘Does Trade Stimulate Innovation? Evidence from Firm-Product Data’, *OECD Working Paper*, No. 286. Paris: OECD.

Girma, Sourafel, Holger Görg, and Aoife Hanley (2008), ‘R&D and Exporting: A Comparison of British and Irish Firms’, *Review of World Economics* 144(4), pp.751-73.

Imbens, Guido (2004), ‘Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review’, *Review of Economics and Statistics* 86(1), pp.4-29.

Jensen, P. H., and Webster, E. (2006), ‘Firm Size and the Use of Intellectual Property Rights’, *The Economic Record*, 82(256), pp.44-55.

Kirbach, Mathias, and Claudia Schmiedeberg (2008), ‘Innovation and Export Performance: Adjustment and Remaining Differences in East and West German Manufacturing’, *Economics of Innovation and New Technology* 17(5), pp.435-57.

Long, Ngo Van, Horst Raff, and Frank Stähler (2009), ‘Innovation and Trade with Heterogeneous Firms’, *CESifo Working Paper*, No. 2796. Munich: Ifo Institute for Economic Research.

MacGarvie, Megan J. (2006), ‘Do Firms Learn From International Trade’, *The Review of Economics and Statistics* 88(1), pp.46-60.

Mansfield, Edwin, Mark Schwartz, and Samuel Wagner (1981), ‘Imitation Costs and Patents: An Empirical Study’, In Edwin Mansfield (ed.) *Innovation, Technology and the Economy. Selected Essays of Edwin Mansfield,* Aldershot, UK: Edward Elgar.

Palangkaraya, Alfons and Jongsay Yong (2007), ‘Exporter and Non-Exporter Productivity Differentials: Evidence from Australian Manufacturing Establishments’, *Melbourne Institute Working Paper* 4/07. Melbourne, Australia: The University of Melbourne.

Palangkaraya, Alfons and Jongsay Yong (2011), ‘Trade Liberalisation, Exit, and Output and Employment Adjustments of Australian Manufacturing Establishments’, *The World Economy* 34(1), pp.1-22.

Schumpeter, Joseph A. (1934), *The Theory of Economic Development: An Inquiry into Profits, Capital Credit, Interests, and the Business Cycles*. Cambridge, MA: Harvard University Press.

Van Beveren, Ilke, and Hylke Vandenbussche (2010), 'Product and Process Innovation and Firms' Decision to Export', *Journal of Economic Policy Reform* 13(1), pp.3-24.

Wagner, Joachim (2007), 'Exports and Productivity: A Survey of the Evidence from Firm-level Data', *The World Economy* 30(1), pp.60–82.

Wakelin, Katharine (1998), 'Innovation and Export Behaviour at the Firm Level', *Research Policy* 26(7-8), pp.829-41.

Appendix

Table A.1: Propensity to Innovate – Primary Sector

	Product or process innovation or both $\Pr[INNOV_t = 1]$		Product innovation $\Pr[PRODINNOV_t = 1]$		Process Innovation $\Pr[PROCINNOV_t = 1]$	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
$EMPSIZE_{t-1}$	0.023	0.017	0.012	0.023	0.027	0.019
$(EMPSIZE_{t-1})^2$	-0.000	0.000	-0.000	0.000	-0.000	0.000
$LLABPRODVA_{t-1}$	0.353	0.339	0.582	0.483	0.123	0.361
$(LLABPRODVA_{t-1})^2$	-0.017	0.018	-0.033	0.025	-0.002	0.019
$LINVINT_{t-1}$	0.036	0.039	0.008	0.050	0.058	0.044
$IMPORT_{t-1}$	0.740***	0.211	0.951***	0.274	0.479*	0.254
$YEAR_{2006/07}$	-0.534***	0.154	-0.263	0.202	-0.654***	0.177
$CONST$	-2.900*	1.662	-0.832	0.692	-2.539	1.828
N. Obs.	493		386		436	
Log pseudo likelihood	-246.3		-129.6		-184.2	
Pseudo R^2	0.068		0.067		0.072	

Note: The probit regressions are estimated with 1-digit ANZSIC industry dummy variables when applicable and with robust standard error. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.

Source: Author.

Table A.2: Propensity to Innovate – Manufacturing Sector

	Product or process innovation or both $\Pr[INNOV_t = 1]$		Product innovation $\Pr[PRODINNOV_t = 1]$		Process Innovation $\Pr[PROCINNOV_t = 1]$	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
$EMPSIZE_{t-1}$	0.025	0.022	0.045	0.028	0.054**	0.027
$(EMPSIZE_{t-1})^2$	-0.000	0.000	-0.000	0.000	-0.000*	0.000
$LLABPRODVA_{t-1}$	0.656	0.688	0.150	0.741	0.654	0.743
$(LLABPRODVA_{t-1})^2$	-0.037	0.034	-0.010	0.037	-0.035	0.037
$LINVINT_{t-1}$	0.059	0.048	0.056	0.063	0.069	0.053
$IMPORT_{t-1}$	0.280*	0.165	0.385*	0.202	0.401**	0.190
$YEAR_{2006/07}$	-0.207	0.164	0.043	0.278	-0.425*	0.241
$CONST$	-3.828	3.494	-1.976	3.763	-4.369	0.241
N. Obs.	326		221		255	
Log pseudo likelihood	-214.7		-134.6		-158.1	
Pseudo R^2	0.044		0.058		0.074	

Note: The probit regressions are estimated with 1-digit ANZSIC industry dummy variables when applicable and with robust standard error. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.

Source: Author.

Table A.3: Propensity to Innovate – Services Sector

	Product or process innovation or both $\Pr\lfloor INNOV_t = 1\rfloor$		Product innovation $\Pr\lfloor PRODINNOV_t = 1\rfloor$		Process Innovation $\Pr\lfloor PROCINNOV_t = 1\rfloor$	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
$EMPSIZE_{t-1}$	0.035***	0.011	0.027**	0.001	0.052***	0.015
$(EMPSIZE_{t-1})^2$	-0.000***	0.000	-0.000**	0.000	-0.000***	0.000
$LLABPRODVA_{t-1}$	0.167	0.286	0.185	0.321	0.672*	0.388
$(LLABPRODVA_{t-1})^2$	-0.009	0.014	-0.012	0.016	-0.035*	0.019
$LINVINT_{t-1}$	0.067***	0.024	0.067**	0.030	0.067**	0.028
$IMPORT_{t-1}$	0.404***	0.117	0.630***	0.138	0.384***	0.144
$YEAR_{2006/07}$	-0.527***	0.110	-0.569***	0.140	-0.554***	0.134
CONST	-1.942	0.405	-1.990	1.693	-4.742**	1.986
N. Obs.	1177		894		900	
Log pseudo likelihood	-708.8		-449.7		-455.1	
Pseudo R^2	0.058		0.086		0.1027	

Note: The probit regressions are estimated with 1-digit ANZSIC industry dummy variables when applicable and with robust standard error. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.

Source: Author.

Table A.4: Covariate Balance Tests – All Sectors

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Export propensity						
$EMPSIZE_{t-1}$	21.799***	6.947	2.612	0.630	6.034	0.962
$LLABPRODVA_{t-1}$	0.148**	1.949	0.044	0.479	-0.097	-0.520
$LINVINT_{t-1}$	0.131	0.908	-0.306	1.630	-0.246	-0.703
$IMPORT_{t-1}$	0.418***	14.171	0.007	0.162	0.025	0.561
Pseudo R^2 (Radius)	0.218		0.009		0.022 (0.0001)	
Innovation propensity						
$EMPSIZE_{t-1}$	14.641***	6.363	0.733	0.267	6.174	1.546
$LLABPRODVA_{t-1}$	-0.040	0.675	-0.059	0.889	0.003	0.026
$LINVINT_{t-1}$	-0.159	1.459	-0.055	0.429	-0.020	-0.113
$IMPORT_{t-1}$	0.138***	7.278	0.017	0.711	0.008	0.305
Pseudo R^2(Radius)	0.071		0.001		0.017 (0.0009)	

Table A.4: (continued) Covariate Balance Tests – All Sectors

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Product innovation propensity						
$EMPSIZE_{t-1}$	9.778***	3.339	-0.153	0.410	3.815	0.923
$LLABPRODVA_{t-1}$	-0.024	-0.307	0.069	0.720	0.076	0.770
$LINVINT_{t-1}$	-0.059	-0.417	0.045	0.259	-0.058	-0.337
$IMPORT_{t-1}$	0.209***	7.756	0.027	0.761	0.038	1.572
Pseudo R^2(Radius)	0.097		0.002		0.030 (0.0010)	
Process innovation propensity						
$EMPSIZE_{t-1}$	21.883***	7.709	0.736	0.206	7.462	1.531
$LLABPRODVA_{t-1}$	-0.041	-0.590	-0.041	-0.510	-0.037	-0.295
$LINVINT_{t-1}$	-0.234*	-1.721	-0.038	-0.220	-0.126	-0.587
$IMPORT_{t-1}$	0.144***	6.180	0.015	0.498	0.004	0.1181
Pseudo R^2(Radius)	0.107		0.000		0.017 (0.0006)	

Note: Pseudo R^2 is from the propensity equation regression using observations before and after matching. Radius is the maximum radius to yield statistically insignificant differences in means. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.
Source: Author.

Table A.5: Covariate Balance Tests – Primary Sector

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Export propensity						
$EMPSIZE_{t-1}$	9.538	1.655	4.814	0.678	7.200	1.464
$LLABPRODVA_{t-1}$	0.021	0.118	-0.082	-0.329	-0.073	0.336
$LINVINT_{t-1}$	-0.273	-1.041	0.003	0.010	-0.157	-0.598
$IMPORT_{t-1}$	0.199***	3.430	0.000	0.000	0.021	0.886
Pseudo R^2(Radius)	0.060		0.003		0.034 (0.0010)	
Innovation propensity						
$EMPSIZE_{t-1}$	8.802**	2.048	-5.255	-0.918	4.860	1.432
$LLABPRODVA_{t-1}$	0.129	0.844	-0.150	-0.878	-0.098	-0.586
$LINVINT_{t-1}$	-0.217	1.080	-0.007	-0.027	-0.402*	1.677
$IMPORT_{t-1}$	0.127***	3.259	0.036	0.744	0.010	0.608
Pseudo R^2(Radius)	0.068		0.010		0.036 (0.0009)	

Table A.5: (continued) Covariate Balance Tests – Primary Sector

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Product innovation propensity						
$EMPSIZE_{t-1}$	11.421*	1.851	-8.997	-0.800	9.038	1.365
$LLABPRODVA_{t-1}$	-0.099	0.501	0.203	0.685	0.033	0.127
$LINVINT_{t-1}$	-0.369	-1.410	0.070	0.175	-0.045	-0.132
$IMPORT_{t-1}$	0.161***	2.768	0.000	0.000	0.026	0.887
Pseudo R^2(Radius)	0.062		0.008		0.063 (0.0032)	
Process innovation propensity						
$EMPSIZE_{t-1}$	8.700*	1.710	-5.096	-0.726	3.897	0.845
$LLABPRODVA_{t-1}$	0.328*	1.851	-0.154	-0.726	0.054	0.480
$LINVINT_{t-1}$	-0.077	-0.325	0.112	0.311	0.086	0.356
$IMPORT_{t-1}$	0.080*	1.912	0.041	0.814	0.024	0.860
Pseudo R^2	0.072		0.0160		0.050 (0.0029)	

Note: Pseudo R^2 is from the propensity equation regression using observations before and after matching. Radius is the maximum radius to yield statistically insignificant differences in means. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.

Source: Author.

Table A.6: Covariate Balance Tests – Manufacturing Sector

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Export propensity						
$EMPSIZE_{t-1}$	28.9***	4.927	0.000	0.000	13.988	1.476
$LLABPRODVA_{t-1}$	0.115	0.798	0.054	0.344	0.162	0.773
$LINVINT_{t-1}$	0.296	1.043	0.029	0.010	-0.332	-0.757
$IMPORT_{t-1}$	0.422***	7.766	0.000	0.000	0.082	1.048
Pseudo R^2(Radius)	0.180		0.001		0.028 (0.0020)	
Innovation propensity						
$EMPSIZE_{t-1}$	19.702***	3.561	-3.566	-0.594	5.222	0.583
$LLABPRODVA_{t-1}$	-0.224*	-1.719	0.141	1.067	0.080	0.416
$LINVINT_{t-1}$	0.040	0.155	0.076	0.263	-0.456	-1.004
$IMPORT_{t-1}$	0.127**	2.515	0.042	0.762	0.059	0.899
Pseudo R^2(Radius)	0.044		0.005		0.014 (0.0010)	

Table A.6: (continued) Covariate Balance Tests – Manufacturing Sector

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Product innovation propensity						
$EMPSIZE_{t-1}$	18.518***	2.624	-5.890	-0.695	-2.922	-0.189
$LLABPRODVA_{t-1}$	-0.227	-1.285	0.489**	2.393	0.531	1.584
$LINVINT_{t-1}$	0.424	1.261	0.370	0.967	-0.034	0.051
$IMPORT_{t-1}$	0.174***	2.655	-0.041	0.509	0.021	0.143
Pseudo R^2(Radius)	0.058		0.039		0.080 (0.0008)	
Process innovation propensity						
$EMPSIZE_{t-1}$	23.330***	3.689	-10.580	-1.503	3.762	0.57
$LLABPRODVA_{t-1}$	-0.166	-1.102	0.009	0.055	0.047	0.356
$LINVINT_{t-1}$	-0.176	-0.575	0.036	0.100	-0.427	-1.353
$IMPORT_{t-1}$	0.174***	2.957	0.040	0.587	0.068	1.152
Pseudo R^2(Radius)	0.074		0.012		0.032 (0.0060)	

Note: Pseudo R^2 is from the propensity equation regression using observations before and after matching. Radius is the maximum radius to yield statistically insignificant differences in means. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.
Source: Author.

Table A.7: Covariate Balance Tests – Services Sector

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Export propensity						
$EMPSIZE_{t-1}$	18.165***	3.978	3.525	0.578	7.719	1.034
$LLABPRODVA_{t-1}$	0.265**	2.530	0.085	0.666	0.106	0.515
$LINVINT_{t-1}$	0.167	0.764	-0.317	-1.046	-0.668	-1.415
$IMPORT_{t-1}$	0.482***	11.229	0.014	0.241	0.134	1.491
Pseudo R^2(Radius)	0.248		0.012		0.088 (0.0004)	
Innovation propensity						
$EMPSIZE_{t-1}$	10.099***	3.347	0.091	0.026	0.714	0.159
$LLABPRODVA_{t-1}$	-0.045	-0.614	0.042	0.514	0.066	0.634
$LINVINT_{t-1}$	-0.164	-1.125	0.125	0.717	-0.074	-0.362
$IMPORT_{t-1}$	0.119***	4.946	0.030	1.033	0.049	1.646
Pseudo R^2(Radius)	0.058		0.005		0.020 (0.0022)	

Table A.7: (continued) Covariate Balance Tests – Services Sector

Covariate	Before matching		After matching			
			Nearest neighbour		Radius	
	Difference in means	t-stat	Difference in means	t-stat	Difference in means	t-stat
Product innovation propensity						
$EMPSIZE_{t-1}$	1.323	0.361	0.131	0.029	-0.450	-0.084
$LLABPRODVA_{t-1}$	-0.001	-0.014	-0.170	-1.479	0.037	0.305
$LINVINT_{t-1}$	-0.110	-0.603	0.011	0.048	-0.239	-0.951
$IMPORT_{t-1}$	0.193***	5.736	0.033	0.746	0.060	1.561
Pseudo R^2(Radius)	0.086		0.008		0.033 (0.0027)	
Process innovation propensity						
$EMPSIZE_{t-1}$	20.895***	5.454	0.827	0.173	7.820	0.100
$LLABPRODVA_{t-1}$	-0.132	-1.514	-0.062	-0.591	-0.240	-1.479
$LINVINT_{t-1}$	-0.274	-1.455	-0.117	-0.504	-0.207	-0.532
$IMPORT_{t-1}$	0.120***	3.974	0.013	0.343	-0.016	-0.310
Pseudo R^2(Radius)	0.103		0.002		0.028 (0.0020)	

Note: Pseudo R^2 is from the propensity equation regression using observations before and after matching. Radius is the maximum radius to yield statistically insignificant differences in means. ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.
Source: Author.

Table A.8: Average Treatment Effects of $Innovation_t$ on $\Pr[Export_t]$ and $Export_t$ - Manufacturing and Resources

Outcome: Export ***Treatment: Innovation***	Average Treatment Effects on the Treated by Matching Method			
	Nearest neighbor		Radius	
	ATT	SE	ATT	SE
$\Pr[Export_t]$				
Innovation type				
Product	0.103 (116/116)	0.069	0.105 (63/128)	0.064
Process	0.104* (173/173)	0.056	0.133** (89/184)	0.054
Product/process	0.109** (258/258)	0.047	0.000 (102/178)	0.049
$\Pr[Export_{t+1}]$				
Innovation type				
Product	0.119 (48/49)	0.133	0.165* (27/49)	0.085
Process	0.099 (88/82)	0.102	0.144* (44/83)	0.075
Product/process	0.086 (123/116)	0.092	0.078 (43/65)	0.083

Note: ***,**,* indicates statistically significant at the 1, 5, and 10% level of significance.
Source: Author.

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