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Alfons Palangkaraya and Jongsay Yong

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A. Palangkaraya and J. Yong
Melbourne Institute of Applied Economic and Social Research
The University of Melbourne

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Melbourne Institute of Applied Economic and Social Research
The University of Melbourne
Victoria 3010 Australia
***Telephone* (03) 8344 2100**
***Fax* (03) 8344 2111**
***Email* melb-inst@unimelb.edu.au**
***WWW Address* http://www.melbourneinstitute.com**

Abstract

We use unpublished establishment level data of Australian manufacturing from 1993-94 and 1996-97 censuses to study how trade liberalisation affects productivity. More specifically, we use the variation in the extent of trade liberalisation across four digit ANZSIC manufacturing industries classification to identify the link between trade liberalisation and three outcomes: establishments' probability of exit, the change in the size of output and the change in employment. There is weak evidence that establishments in industries with greater reductions in effective rate of assistance are more likely to exit. We find strong evidence that they reduce employment. There is no evidence for economies of scale through output expansion. Together these indicate that the documented productivity gains of trade liberalisation may come more from the pro-competitive effects which forces establishments to reduce their slackness rather than from the exit of less efficient establishments.

JEL Classification: D21; F21

Keywords: Productivity; Exports, Australia; Manufacturing; Establishment; Exit; Employment.

1. Introduction

In this paper we utilise unpublished Australian manufacturing establishment census data covering the period of 1994 to 1997 to study how trade liberalisation may lead to productivity gains. Earlier studies such as Chand (1999) and Bloch and McDonald (2002) have found evidence that the reductions in domestic industry assistance in Australia in late 1980s through early 1990s are associated with improvement in productivity.[1] It is still not clear from these studies, however, what sorts of mechanism leads to such possibly desirable outcome. As a result, a further study which tries to improve our understanding of the mechanism is potentially worthwhile, especially given the potential policy implications in terms of the performance of the Australian manufacturing sector.

At the micro level, there are several possibilities of how a more open trade regime may lead to a higher productivity. Levinsohn (1993), for example, tested the old idea that the international trade increases competition. He tested the hypothesis that increased competition on the domestic market as trade barriers and other subsidies to domestic producers are reduced may lead to lower price-cost margin and improved *allocative efficiency* or to lower costs and improved *productive efficiency* or both. This hypothesis is often referred to as the "imports-as-market-discipline" hypothesis. Recent firm level theoretical and empirical studies such as Melitz (2003) and those reviewed by Tybout (2000, 2003) have also confirmed the hypothesis. Similarly, it is also possible that the competitive pressure may push firms to reduce their slack and x-inefficiency by using inputs more efficiently or through the increased availability of cheaper imported inputs (Holmes and Schmitz, 2001; Fernandes, 2007).

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[1] See also the extension of Chand (1999) by Oczkowski and Sharma (2001) and Mahadevan (2002) and the reference within.

Another possible mechanism also consistent with the above hypothesis is the idea of less efficient firms exiting the market while surviving firm increases in size to move downward along their decreasing cost curve through economies of scale or learning by doing.[2] More recent studies focus on the investigation of which of these two mechanisms dominates, if any. In addition, they also look at whether or not a possible third mechanism namely embodied technology in increased imported products, is important. For example, Schor (2004) found that nominal tariff and tariff on intermediate inputs have negative impacts on Brazilian manufacturing firm productivity indicating the possible importance of greater knowledge diffusion through embodied technology imports. In terms of exit decision, one of recent studies is Pavnick's (2002) which found that trade liberalisation increases the probability of firm exit especially in sectors in which the domestic country have no comparative advantage and in which firms produce goods which compete with imports.

The focus of our paper is on how the documented productivity gains from trade liberalisation in Australia is realised. In particular, we study how Australian firms respond to the increased competition from abroad in terms of market presence decision and/or size of output and employment. Similar to Gibson and Harris (1996), we investigate which manufacturing establishments exit as the industry declines with the gradual introduction of trade liberalisation. In addition, following Gu, Sawchuck, and Whewell (forthcoming), we also examine firms response to such decline in terms of their employment to investigate whether or not increasing returns to scale explain the observed improvement in productivity as import competing industries possible enlarge with the more open economy. Finally, similar to Gaston (1988), we examine establishments' adjustments in

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[2] See, for examples, Rodrik (1988, 1991), Olley and Pakes (1996), Roberts and Tybout (1996), and Aw, Chen and Roberts (1997) as cited in Pavcnik (2002).

terms of employment. However, unlike these earlier studies, ours is conducted at the establishment level. [3]

In order to link firm responses to trade liberalisation as described above, we make use of unpublished, establishment level manufacturing census data for the financial years of 1993-94 and 1996-97 from the Australian Bureau of Statistics (ABS) and the four-digit industry classification variation in the reduction of the effective rate of assistance (ERA).[4] We estimate the average effects of both absolute (measured in each percentage point) and proportional (percent) reduction on ERA on the probability to exit and the proportional change the size of output and employment of the establishments.

Section 2 provides a brief discussion on the gradual trade liberalisation in Australia in the mid-1990s. Section 3 provides a brief review of relevant theoretical and empirical studies. Section 4 provides an explanation of the empirical model and the construction of measures used to estimate the model. Section 5 provides and discusses the estimation results. Section 6 concludes.

2. Australia trade liberalisation in the mid-1990s

In an effort to prevent from a falling standard of living relative to other developed nations, the Australian government began a gradual trade liberalisation process of its manufacturing sector in the early 1970s with the announcement of a 25 percentage point tariff reduction by the Withlam government. For various reasons such as deteriorating balance of trade, however, the degree of liberalisation varies across the different industries within the manufacturing sector. For example, while tariffs were reduced in the textile,

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[3] Fernandes (2007) also found that the gains in productivity from trade liberalisation vary positively with increases in imported intermediate inputs. Due to lack of relevant data, we do not investigate this possible channel.

clothing, footwear and motorcar industries with the announcement of Whitlam government, significant quantitative restriction measures were introduced and continued in effect until early 1990s which would then lead to increased protection in these industries in the earlier period of trade liberalisation. As time goes by, however, these industries are among those with the largest cuts in ERA percentage point wise as shown in Figure 1 below. Overall, by mid-1990s the average effective rate of assistance (ERA), defined as the percentage mark-up per unit of output relative to the hypothetical case of no trade protection nor subsidy, fell from around 36 per cent in 1970-71 to 6 per cent in 1996-97.

As shown in Figure 1, the extent of trade liberalisation during the period of study varies significantly across the industries in the manufacturing sector. Apparel, textiles, paper products and footwear industries, for example, experienced more than 8 percentage point reduction in ERA. On the other hand, industries such as printing, non-metallic mineral and wood products received less than 5 percentage point reduction. We exploit this variation at the four digit ANZSIC industry classification to identify the effects of trade liberalisation on the probability of establishment exit and the change in firm level employment between 1993-94 and 1996-97 using unpublished establishment level data from two censuses of Australian manufacturing establishments held in these periods. More specifically, we use three measures of the extent of trade liberalisation based on the change in ERA namely, percentage change in ERA, percentage point change in ERA, and percentage change in the power of protection defined as the percentage change in (1+ERA).[5] Table 1 summarises these three different measures of trade liberalisation across broad industries.

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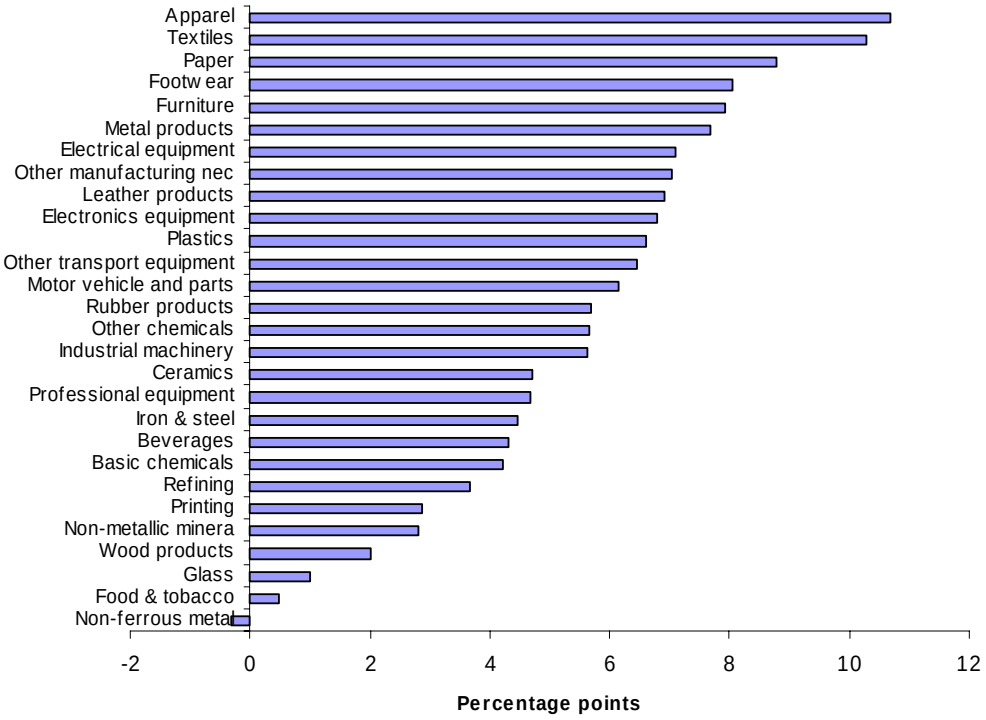
[4] See Industry Commission (1995).

[5] We thank Jonathan Pincus for suggesting the last measure.

Figure 1: Average Reductions in Effective Rate of Assistance, 1993-94 -- 1996-97 (percentage points)



3. Trade liberalisation and domestic firms' response

As explained in the previous section, trade liberalisation in Australia is a gradual process that is similar to the case of New Zealand analysed in Gibson and Harris (1996). In their paper, Gibson and Harris argued that the effects of the phased nature of New Zealand trade liberalisation can be analysed under the framework of establishments faced with declining demand models. They summarised a number of theoretical predictions from these models. For example, when demand declines, establishments with higher variable costs would exit earlier (Dierickx, Matutes and Neven, 1991; Reynolds, 1988). The intuition from Dierickx, Matutes and Neven is that because of trade liberalisation there is a reduction in consumer's willingness to pay (WTP) due to improved availability of cheaper or better substitutes through imports. This reduction in WTP affects the high variable cost establishments more than the low variable cost ones.

Table 1: Extent of trade liberalisation by manufacturing sector, 1993-94 – 1996-97

Sector	Average extend of trade liberalisation		
	percentage point reduction in ERA	percent reduction in ERA	percent reduction in (1+ERA)
Apparel	10.7	21.3	7.0
Basic chemical	4.2	13.1	3.5
Beverages	4.3	33.9	3.8
Ceramics	4.7	38.7	4.2
Electrical equipment	7.1	56.0	6.3
Electronic equipment	6.8	49.1	6.0
Food and tobacco	0.5	48.1	0.3
Footwear	8.0	47.3	6.5
Furniture	7.9	58.3	7.0
Glass	1.0	25.0	0.1
Industrial machinery	5.6	50.9	5.0
Iron and steel	4.5	30.8	3.9
Leather product	6.9	24.2	5.4
Metal products	7.7	58.0	6.7
Motor vehicle and parts	6.1	30.5	4.9
Nonferrous metal	-0.3	2.2	-0.4
Non-metallic mineral	2.8	31.7	2.5
Other chemical	5.7	37.9	4.9
Other manufacturing	7.0	58.0	6.1
Other transport	6.5	17.2	5.2
Paper	8.8	61.1	7.6
Plastics	6.6	54.2	5.9
Printing	2.9	16.0	2.6
Professional equipment	4.7	41.4	4.2
Refining and coal	3.7	28.3	3.2
Rubber products	5.7	48.8	5.1
Textiles	10.3	18.4	6.7

Other characteristics found to be important include the relative age and size of the establishments. Age is important since it possibly relates to the scrap value of the establishment, with newer establishments are possibly easier to scrape due to higher resale value (Baden-Fuller, 1989). On the other hand, if there is learning-by-doing, older establishments may have lower relative costs or higher productivity. Size is important as shown by Ghemawat and Nalebuff (1985), for example. They showed that when

production is all-or-nothing and establishments have the same costs, larger establishments may exit earlier because the smaller establishments suffer less loss and thus has higher expected net profits as a monopoly once every other establishments have exited the industry. Also important is whether or not the establishments belong to a firm with multiple establishments or to a diversified firm. For diversified or multi-establishment firms, Baden-Fuller (1989) argued they can move resources across their establishments more easily and thus avoid, say, labour termination costs resulting in a higher probability for establishments under such firms to exit.

In general, these important correlates of establishment closures have also been identified by more recent firm heterogeneity studies that looked at correlates of establishment closures empirically such as Dunne, Roberts and Samuelson (1988, 1989) and Bernard and Jensen (2002) and theoretically under dynamic industry model such as Hopenhayn (1992) and Melitz (2003).

Another aspect of the possible impacts of trade liberalisation relates to changes in output and employment. Instead of exiting the market completely, it is possible for domestic establishments to respond by reducing their scale of operation when faced with declining demand to cut losses by improving efficiency. For example, in the extension of their earlier work, Ghemawat and Nalebuff (1990) allow for continuous capacity adjustment and find that the larger establishments would shrink into the smaller establishment's size, and then they would shrink together along with the shrinking demand. On the contrary, if the domestic market is relatively small, it can be argued that a reduction in tariffs may lead to domestic firms' reducing activities in non-profitable import competing sector and increasing specialisation in which they have comparative advantage. This specialisation

would end up in the firms serving a larger international market and thus leading to economies of scale and productivity gains (Harris, 1984; Cox and Harris, 1985; as cited in Gu, Sawchuck and Whewell, forthcoming).

4. Empirical Model and Data

4.1. Probability of exit

We follow the modeling framework of Gibson and Harris (1996) which is, as explained earlier, based on models of firms when the industry is declining. As argued by them, this modelling framework is appropriate for the case when trade liberalisation is introduced gradually such as in the case of New Zealand, the subject of their study, and Australia, the subject of ours. Facing a declining demand in its industry *i*, a firm *f* considers whether or not to close its establishment *p* which operates in that industry by comparing the expected revenue of keeping it operating to the opportunity cost. Firm *f* closes down establishment *p* when the expected opportunity costs of keeping *p* operating exceed the expected revenue.

As discussed in the previous section, factors that may increase the expected opportunity costs of keeping *p* operating includes production costs, current resale value of the establishment and other assets, and the potential "external" benefit of establishment *p* operating that may flow to other establishments that *f* owns. For examples, with declining demand, high cost establishments would be more likely to exit and so would establishments owned by diversified firms or establishments owned by multi-establishment firms be because these firms can move away resources from the closed establishment to other establishments. On the contrary, if sunk investment costs are important, then the resale value might be low even for new establishment, reducing the probability of exit. In addition, exit might occur in a decreasing order of firm size. This

means, the largest single-establishment firm might exit first, all else equal. In summary, we follow Gibson and Harris (1996) in using these insights to select control variables in our reduced form empirical model of establishment probability of exit in addition to our main variable of interest, which is the relative extent of trade liberalisation in the industry where the establishment operates.[6]

Let $\pi_{pi} = h(C_{pi}, r, S_{pi}, E_{pi}, \tau_i)$ denotes the expected profit from keeping establishment *p* operating in industry *i* as a function of establishment *p*'s production cost, resale value, externality for firm *f*'s other establishments, and trade protection of industry *i* entering through industry *i* demand. Then, defining $Exit_p = 1$ if establishment *p* exits and 0 otherwise, we model establishment *p*'s probability of exit as

$$\Pr[Exit_p = 1] = \Lambda(x_p, \tau_i; \beta) + \varepsilon_p \qquad (1)$$

where Λ is a distribution function specified so that (1) can be estimated as a standard logit model, *x* is a vector of observable establishment *p*'s characteristics, β is the corresponding vector of parameters to be estimated, and ε_p is a random term assumed. From the previous discussion, the establishment characteristic vector *x* contains variables that capture variations at (i) the industry level such as the extent of trade liberalisation and market concentration, and (ii) the establishment level, such as production costs, size, and whether or not the establishment belong to a multi-establishment and/or diversified firm.

4.2. Output and employment adjustments

As discussed earlier, it is also possible for firms to adjust their employment or output levels instead of closing down completely. For example, surviving firms may be able to expand their output by specializing and serving other markets through export (Bernard et

[6] See also the empirical specification of recent related studies such as Baggs (2005).

al., 2003). This rationalisation effect has been shown to be significant for Canadian manufacturing following United States - Canadian Free Trade Aggreement in early 1990s (Head and Ries, 1999). In terms of employment, Gaston (1998) surveyed the literature on how firms adjust to trade liberalisation and found that employment changes appeared to be the dominant method used by firm to adjust. However, in the same paper, using Australian manufacturing panel data at two digit ASIC classification from between 1973-74 and 1991-92, he found small effects of the ERA reductions on employment and attributed most of the observed changes to the underlying structural reform.

In this paper, we also investigate the extent of these two possible adjustments following ERA reductions at the establishment level since they may serve as channels for the observed improvement in productivity. More specifically, we re-estimate the reduced form equation (1) as standard linear regression with percentage change in output and employment as the dependent variable.

4.3. Establishment level data

The censuses producing the data we use for our empirical analysis gather production activity statistics at the establishment level, business operations statistics at the management unit (MU), and some financial statistics at the enterprise group levels. The production activity statistics collected that we use include, for example, number of employees, wages, and output (ABS, 1997). The provided establishment identification number is useful in identifying which establishments belong to each MU and, more importantly, in defining which establishment exits the industry within the two period. For the latter, an establishment which appears in the 1993-94 census but not in the 1996-97 census is classified as an *exit*. Originally, there are 52,263 establishments in the 1993-94 census data. Using the above exiting establishment definition, approximately 47 per cent of the establishments exited between 1993-94 and 1996-97. Table 2 provides the number

Table 2: Establishment exit rate by manufacturing sector, 1993-94 – 1996-97

Sector	Number of establishments in 1993-94	Exit rate (%)
Refining and coal	85	65.9
Food and tobacco	4,007	56.3
Ceramics	532	55.6
Basic chemical	468	55.1
Apparel	3,447	54.1
Textiles	1,622	52.0
Electronic equipment	936	52.0
Leather product	276	51.1
Other chemical	977	51.0
Paper	406	50.7
Beverages	488	50.2
Glass	320	50.0
Other transport	1,098	49.1
Non-metallic mineral	1,372	48.3
Other manufacturing	2,590	48.0
Printing	6,093	47.9
Nonferrous metal	135	46.7
Electrical equipment	1,622	46.2
Footwear	255	45.5
Rubber products	301	44.2
Plastics	1,594	44.2
Motor vehicle and parts	1,572	43.0
Industrial machinery	3,722	42.9
Metal products	7,889	42.7
Iron and steel	718	42.2
Furniture	4,606	42.1
Wood product	4,101	41.4
Professional equipment	1,185	40.0
Total	52,263	46.7

of establishments in 1993-94 and the proportion of establishments with 'exit' status in 1996-97 across 28 broad sectors of the manufacturing industry.[7]

In addition to the 52,263 establishments in the 1993-94, there are 71,748 establishments in the 1996-97 census data. However, after match-merging both data sets and dropping

[7] There are 206 establishments with missing sector classification not shown in Table 1.

observations with missing information on any of the measures used in estimating the regression model as discussed below, we end up with 31,682 useable observations of establishments existing in 1994 for the exit regression and 16,676 observations of establishments existing in both 1993-94 and 1996-97 for the change in employment regression.[8] Table 3 provides a summary of the characteristics of establishments in terms of the dependent and independent variables used in the exit probability regressions.[9]

Table 3: Dependent and independent variables in the exit probability regression

Variables	Mean	Std. Dev.	Min	Max.
Exit status	0.345	0.475	0	1
dERA	7.770	5.692	-5	41
%dERA	0.375	0.535	-3.000	0.833
%dPower	0.047	0.031	-0.021	0.113
log(avgcost) $_{94}$	-1.321	0.832	-6.422	6.032
mktshare$_{94}$	0.005	0.022	0.000	0.997
MUnumest$_{94}$	1.496	3.000	1	50
diversified$_{94}$	0.969	0.175	0	1
HHIsales$_{94}$	0.041	0.057	0.003	0.995
CR4$_{94}$	0.266	0.169	0.067	1
entryrate$_{97}$	0.638	0.330	0.111	6.175
family	0.095	0.293	0	1
ptyltd	0.653	0.476	0	1
public	0.001	0.038	0	1
Number of establishments		31,682		

5. Results

Table 4 summarises logit regression estimates based on equation (1) using three different measures of the extent of trade liberalisation namely the reduction in ERA in level

[8] The number of observation in the employment change regression is lower because it represents the number of surviving establishments. Also there are some establishments for which the employment figure is missing.

Table 4: Estimates of exit probability using logistic regression

Independent Variables	Coefficient		Std. Error	dy/dx	Coefficient		Std. Error	dy/dx	Coefficient		Std. Error	dy/dx
Dependent variable: Exit probability in 1997												
dERA	0.007	*	0.004	0.002								
%dERA					-0.036		0.030	-0.008				
%dPower									0.817	*	0.480	0.184
log(avgcost)$_{94}$	-0.047	***	0.015	-0.010	-0.047	***	0.015	-0.011	-0.046	***	0.015	-0.010
mktshare$_{94}$	0.312		0.581	0.070	0.343		0.586	0.077	0.316		0.586	0.071
MUnumest$_{94}$	0.083	***	0.006	0.008	0.033	***	0.006	0.007	0.034	***	0.006	0.008
diversified$_{94}$	0.850	***	0.068	0.205	0.853	***	0.068	0.206	0.849	***	0.068	0.205
HHIsales$_{94}$	0.121		0.438	0.027	0.189		0.440	0.043	0.099		0.438	0.022
CR4$_{94}$	0.419	***	0.160	0.094	0.370	**	0.161	0.083	0.429	***	0.160	0.096
entryrate$_{97}$	-0.019		0.038	-0.004	-0.026	**	0.038	-0.006	-0.021		0.038	-0.005
family	0.114	**	0.045	0.026	0.114	***	0.045	0.026	0.114	**	0.045	0.026
ptyltd	-0.203	***	0.029	-0.046	-0.203	***	0.029	-0.046	-0.203	***	0.029	-0.046
public	1.008	***	0.326	0.245	0.984		0.330	0.240	1.008	***	0.329	0.245
constant	-0.697	***	0.070		-0.687	***	0.070		-0.697	***	0.071	
Pseudo-R^2:	0.028				0.028				0.028			
Number of establishments: 31,682												

(dERA) and in relative terms (%dERA) and the relative reduction the power of tariff industry with a four percentage point (approximately one standard deviation) higher reduction show an average of less than one percent higher probability of exit.[10] Using the relative measure of ERA reduction does not provide any further evidence that the reduction in ERA is positively associated with exit probability. In fact, the sign of the coefficient is negative, though it is not statistically significant. On the other hand, when (%dPower). From the second column, for example, establishments in a four-digit ANZSIC we use the relative reduction in the power of tariff as shown in the last column in Table 4,

[9] See Appendix Table 1 for the definition of the variables. Furthermore, Appendix Tables 2 and 3 provide a summary of the variables in the output and employment adjustment regressions.

[10] In all regression tables, *, **, *** indicate statistically significant at 10, 5 and 1% level of significance, respectively. Also, all regressions include two digit sector and state dummy variables and an indicator variable whether or not the establishment exists in 1992-93.

we find a stronger positive relationship between trade liberalisation and exit probability. Overall, these findings indicate that measuring the extent of trade liberalisation and thus increased competition effects correctly is important in assessing the effects on domestic establishments.

Before we discuss the effects of trade liberalisation on establishment size, it is insightful to see some of the estimated effects of the covariates and compare them to the theoretical predictions. First, consistent with the falling demand predictions, establishments which belong to management units with multiple establishments and with multiple establishments operating in more than a single four digit ANZSIC industry are more likely to exit following trade liberalisation. More interestingly, however, is the negative relationship between the average cost before the reduction of ERA period and the probability of exit after the reduction. This indicates that less efficient establishments are not necessarily more likely to exit. Finally, establishments in industry with a higher CR4 ratio are on average more likely to exit. These last two observations seem to be consistent with the idea that when some establishments have enough market power, they may be able to survive better than the more efficient establishments when demand is falling.

Table 5 summarises the estimation results of ordinary least square regression of percentage change in total sales. As discussed earlier, the surviving establishments might be able to move down their cost curve following trade liberalisation and thus gain in productivity. In fact, our results, especially with the relative measure of reduction in ERA, suggest that surviving establishments in industries experiencing a more intensive trade liberalisation have on average become smaller. Also interesting is the finding that less efficient establishments in terms of average cost and those in more concentrated industries have increased their sales.

Table 5: Estimates of change in output size regression

Variables	Coefficient		Std. Error	Coefficient		Std. Error	Coefficient		Std. Error
Dependent variable: % change in total sales									
dERA	-0.003		0.002						
%dERA				-0.031	**	0.016			
%dPower							-0.335		0.234
log(avgcost) $_{94}$	0.273	***	0.008	0.272	***	0.008	0.273		0.008
mktshare$_{94}$	-2.178	***	0.294	-0.218	***	0.294	-0.218	***	0.294
MUnumest$_{94}$	-0.018	***	0.005	-0.018	***	0.005	-0.018	***	0.005
diversified$_{94}$	0.350	***	0.046	0.351	***	0.046	0.350	***	0.046
HHIsales$_{94}$	0.557	**	0.229	0.601	***	0.230	0.566	**	0.229
CR4$_{94}$	-0.089		0.081	-0.109		0.082	-0.092		0.081
entryrate$_{97}$	-0.004		0.019	-0.004		0.019	-0.003		0.019
family	-0.005		0.024	-0.005		0.024	-0.005		0.024
ptyltd	-0.020		0.014	-0.021		0.015	-0.020		0.015
public	-0.529	**	0.220	-0.558	**	0.221	-0.529	**	0.220
constant	0.572	***	0.036	0.562	***	0.036			
R^2	0.090			0.090			0.090		
Number of establishments: 16,696									

From Table 6, we can see how the surviving establishments adjust to the increased competition following trade liberalisation in terms of size of employment. Only the %dERA measure of trade liberalisation shows the expected relationship that increased foreign competition may force establishments to improve their efficiency through reduction in employment. Consistent with this is the finding that establishments with higher average costs and which are in more concentrated industries show larger reduction in employment.

Furthermore, following Gaston (1998), the last set of tables provides re-estimation of the probability regression for two separate sub-samples according to the intensity of import and export of the four digit industry. In terms of exit probability, from Table 7 there is no

Table 6: Estimates of change in employment size regression

Variables	Coefficient		Std. Error	Coefficient		Std. Error	Coefficient		Std. Error
Dependent variable: % change in employment									
dERA	0.001		0.001						
%dERA				-0.024	***	0.010			
%dPower							0.068		0.148
log(avgcost) $_{94}$	-0.064	***	0.005	-0.065	***	0.005	-0.064	***	0.005
mktshare$_{94}$	-0.371	**	0.181	-0.367	**	0.181	-0.432	***	0.185
MUnumest$_{94}$	0.002		0.002	0.002		0.002	-0.001		0.003
diversified$_{94}$	0.004		0.021	0.005		0.021	0.051	*	0.029
HHIsales$_{94}$	0.333	**	0.147	0.372	**	0.148	0.337	**	0.147
CR4$_{94}$	-0.071		0.051	-0.095	*	0.052	-0.073		0.052
entryrate$_{97}$	-0.016		0.012	-0.018		0.015	-0.017		0.012
family	-0.025	*	0.015	-0.025		0.015	-0.025		0.015
ptyltd	0.036	***	0.009	0.035	***	0.009	0.036	***	0.009
public	0.274	**	0.140	0.247	*	0.141	0.266	*	0.140
constant	-0.099	***	0.031	-0.101	***	0.031	-0.091	***	0.023
R^2	0.021			0.021			0.021		
Number of establishments: 16,676									

Table 7: Estimates of exit probability - import intensive industries

Independent Variables	Coefficient		Std. Error	dy/dx	Coefficient		Std. Error	dy/dx	Coefficient		Std. Error	dy/dx
Dependent variable: Exit probability												
dERA	-0.011		0.008	-0.003								
%dERA					0.026		0.087	0.006				
%dPower									-1.791		1.111	-0.408
log(avgcost) $_{94}$	-0.048		0.032	-0.011	-0.046		0.032	-0.010	-0.049		0.032	-0.011
mktshare$_{94}$	0.295		0.992	0.067	0.247		0.991	0.056	0.300		0.992	0.068
MUnumest$_{94}$	0.086	***	0.029	0.020	0.086	***	0.029	0.020	0.086	***	0.029	0.020
diversified$_{94}$	0.519	***	0.169	0.125	0.522	***	0.169	0.125	0.521	***	0.169	0.125
HHIsales$_{94}$	-0.766		0.700	-0.175	-0.510		0.673	-0.116	-0.775		0.694	-0.177
CR4$_{94}$	0.879	***	0.318	0.200	0.797	**	0.315	0.182	0.873	***	0.316	0.199
entryrate$_{97}$	0.120		0.180	0.027	0.098		0.182	0.022	0.156		0.183	0.036
family	0.230	*	0.117	0.054	0.230	*	0.117	0.054	0.231	**	0.117	0.054
ptyltd	-0.131	*	0.071	-0.030	-0.128	*	0.071	-0.030	-0.132	*	0.071	-0.030
public	1.306		0.807	0.315	1.330		0.808	0.321	1.305		0.806	0.315
constant	-0.795	***	0.174									
Pseudo-R^2:	0.024				0.024				0.024			
Number of establishments: 5,720												

further evidence for the positive relationship between the probability of exit and the extent of trade liberalisation when we limit our samples to establishment in the high import intensive sectors only. From Table 8, it appears that establishments in the high export industries with a higher relative reduction in ERA are less likely to exit.

Table 8: Estimates of exit probability - export intensive industries

Independent Variables	Coefficient		Std. Error	dy/dx	Coefficient		Std. Error	dy/dx	Coefficient		Std. Error	dy/dx
Dependent variable: Exit probability												
dERA	-0.008		0.006	-0.002								
%dERA					-0.086	**	0.037	-0.020				
%dPower									-0.792		0.723	-0.181
log(avgcost)$_{94}$	-0.030		0.026	-0.007	-0.032		0.026	-0.007	-0.030		0.026	-0.007
mktshare$_{94}$	-0.717		0.815	-0.164	-0.758		0.816	-0.174	-0.733		0.814	-0.168
MUnumest$_{94}$	0.031	***	0.008	0.007	0.031	***	0.008	0.007	0.031	***	0.008	0.007
diversified$_{94}$	0.756	***	0.103	0.183	0.760	***	0.103	0.184	0.756	***	0.103	0.183
HHIsales$_{94}$	0.681		0.685	0.156	0.634		0.686	0.145	0.722		0.684	0.165
CR4$_{94}$	-0.390		0.265	-0.089	-0.311		0.265	-0.071	-0.396		0.265	-0.091
entryrate$_{97}$	-0.248	**	0.105	-0.057	-0.261	**	0.104	-0.060	-0.241	**	0.104	-0.055
family	0.146	*	0.079	0.034	0.147	*	0.079	0.034	0.146	*	0.079	0.034
ptyltd	-0.141	***	0.051	-0.032	-0.146	***	0.051	-0.033	-0.141	***	0.051	-0.033
public	0.077		0.471	0.017	-0.028		0.472	-0.006	0.080		0.471	0.018
constant	-0.284	**	0.118		-0.343	**	0.116		-0.290	**	0.117	
Pseudo-R^2:	0.035				0.035				0.035			
Number of establishments: 10,047												

From Tables 9 and 10, we find that the surviving establishments are more likely to reduce their output size regardless of import or export intensity. In fact, from Table 10, the reduction in output size among establishments in high intensive export sectors appears to be stronger than shown by the full sample in Table 5. This provides further contradictory evidence of productivity gains from a downward movement along the cost curve as establishment expand sales to overseas markets following trade liberalisation.

Table 9: Estimates of change in output size regression – import intensive industries

Variables	Coefficient		Std. Error	Coefficient		Std. Error	Coefficient		Std. Error
Dependent variable: % change in total sales									
dERA	-0.007	*	0.004						
%dERA				0.0126		0.045			
%dPower							-0.835		0.561
log(avgcost) $_{94}$	0.322	***	0.017	0.323	***	0.017	0.322	***	0.017
mktshare$_{94}$	-1.142	***	0.449	-1.441	***	0.449	-1.431	***	0.449
MUnumes$_{94}$t	0.015		0.020	0.0123		0.020	0.014		0.020
diversified$_{94}$	0.111		0.115	0.120		0.116	0.112		0.115
HHIsales$_{94}$	-0.399		0.340	-0.234		0.326	-0.365		0.338
CR4$_{94}$	0.396	**	0.158	0.339	**	0.155	0.381	**	0.157
entryrate$_{97}$	0.238	***	0.088	0.226	**	0.089	0.253	***	0.090
family	0.083		0.063	0.080		0.063	0.083		0.063
ptyltd	0.000		0.035	0.001		0.035	-0.000		0.035
public	-0.898	*	0.518	-0.854	*	0.518	-0.896	*	0.518
constant	0.417	***	0.086	0.394	***	0.086	0.416	***	0.086
R^2	0.137			0.137			0.137		
Number of establishments: 2,984									

Table 10: Estimates of change in output size regression – export intensive industries

Variables	Coefficient		Std. Error	Coefficient		Std. Error	Coefficient		Std. Error
Dependent variable: % change in total sales									
dERA	-0.008	***	0.003						
%dERA				-0.027		0.021			
%dPower							-0.868	**	0.360
log(avgcost) $_{94}$	0.271	***	0.014	0.270	***	0.014	0.271	***	0.014
mktshare$_{94}$	-2.756	***	0.396	-2.785	***	0.369	-2.778	***	0.396
MUnumest$_{94}$	0.005		0.007	0.005		0.007	0.005		0.007
diversified$_{94}$	0.233	***	0.068	0.234	***	0.068	0.234	***	0.068
HHIsales$_{94}$	0.999	***	0.375	1.024	***	0.375	1.051	***	0.375
CR4$_{94}$	-0.456	***	0.135	-0.415	***	0.135	-0.463	***	0.136
entryrate$_{97}$	0.005		0.049	0.022		0.049	0.011		0.049
family	0.021		0.043	0.021		0.043	0.021		0.043
ptyltd	-0.027		0.026	-0.031		0.026	-0.028		0.026
public	-0.271		0.275	-0.294		0.277	-0.269		0.275
constant	0.637	***	0.060	0.592	***	0.059	0.632		0.060
R^2	0.091			0.089			0.090		
Number of establishments: 5,273									

Finally, comparing the results in Tables 11 and 12, there seems to be some evidence for establishments in import intensive sectors to experience a larger reduction in employment than those in the export intensive sectors possibly indicating a larger import competing pressure from trade liberalisation.

Table 11: Estimates of change in employment size regression – import intensive industries

Variables	Coefficient		Std. Error	Coefficient		Std. Error	Coefficient		Std. Error
Dependent variable: % change in employment									
dERA	-0.009	***	0.003						
%dERA				-0.047		0.029			
%dPower							-1.219	***	0.361
log(avgcost) $_{94}$	-0.061	***	0.011	-0.061	***	0.011	-0.061	***	0.011
mktshare$_{94}$	-0.247		0.301	-0.265		0.301	-0.250		0.301
MUnumes$_{94}$t	-0.006		0.013	-0.006		0.013	-0.006		0.013
diversified$_{94}$	0.033		0.078	0.036		0.078	0.034		0.078
HHIsales$_{94}$	-0.108		0.224	0.098		0.216	-0.088		0.222
CR4$_{94}$	0.135		0.102	0.034		0.102	0.123		0.101
entryrate$_{97}$	0.088		0.059	0.091		0.059	0.111	*	0.060
family	0.014		0.042	0.011		0.042	0.014		0.042
ptyltd	0.042	*	0.023	0.043	*	0.023	0.041	*	0.023
public	0.574	*	0.035	0.610	*	0.345	0.569	*	0.345
constant	-0.152	***	0.056	-0.157	***	0.057	-0.149	***	0.057
R^2	0.025			0.022			0.025		
Number of establishments: 3,035									

6. Conclusion

In this paper, we investigated how trade liberalisation might bring improvement in productivity. In particular, following Gibson and Harris (1996), we estimated reduced form regression models motivated by the declining industry literature using Australian establishment level data to look at whether or not inter-sectoral variation in the extent of gradual reductions in effective rates of assistance (ERA) is associated with variation in the

Table 12: Estimates of change in employment size regression – export intensive industries

Variables	Coefficient		Std. Error	Coefficient		Std. Error	Coefficient		Std. Error
Dependent variable: % change in employment									
dERA	-0.004	**	0.002						
%dERA				-0.048	***	0.014			
%dPower							-0.417	*	0.234
log(avgcost) $_{94}$	-0.066	***	0.009	-0.067	***	0.009	-0.066	***	0.009
mktshare$_{94}$	-0.659	**	0.312	-0.590	**	0.258	-0.583	**	0.259
MUnumest$_{94}$	-0.002		0.004	-0.001		0.004	-0.001		0.004
diversified$_{94}$	0.071		0.045	0.071		0.044	0.070		0.045
HHIsales$_{94}$	0.277		0.249	0.248		0.246	0.284		0.246
CR4$_{94}$	-0.147	*	0.089	-0.112		0.088	-0.146	*	0.089
entryrate$_{97}$	0.019		0.032	0.011		0.032	0.021		0.032
family	-0.014		0.028	-0.013		0.028	-0.014		0.028
ptyltd	0.039		0.017	0.038	**	0.017	0.039	**	0.017
public	0.322	*	0.179	0.263		0.180	0.322	*	0.179
constant	-0.099	**	0.039	-0.130	***	0.038	-0.102	***	0.039
R^2	0.022			0.023			0.021		
Number of establishments: 5,267									

probability of establishment exit. In addition, we also investigated the possibility of productivity improvement gained through economies of scale as surviving establishments expand their outputs or through their reducing x-inefficiency by cutting employment.

We found that the documented gains in productivity following Australian trade liberalisation in the mid-1990s appeared to come more from reduced x-inefficiency through employment shedding than from the exit of less efficient establishments or economies of scale. We found evidence for this productivity enhancing channel among the establishments in both import and export intensive sectors. However, the effects seemed to be stronger for establishments in the import intensive sectors, possibly indicating the stronger competitive pressures resulted from trade liberalisation. It should be noted however that the evidence we found might include possible effects from better technology in cheaper embodied imports. Lastly, we found that our results are sensitive to the type of

proxy of variation in the extent of trade liberalisation we used. Overall, using percentage reduction in effective rates of assistance (ERA) provided the weakest link between trade liberalisation and the channels of productivity gains. Quite intuitively, using relative changes in ERA or in 1+ERA as percentages of the base year figures gave us stronger links.

Overall, our findings support that of Fernandes (2007) in the sense that trade liberalisation increases overall productivity by pressuring firms to improve their internal efficiency mostly through labour adjustments rather than by forcing less efficient firms to exit. In terms of policy implication, this seems to suggest that how easy firms can adjust their employment can be crucial. Thus, further studies which focus on the interplay between labour policy and firm adjustment during trade liberalisation is potentially worthwhile.

Appendix 1: Data source and definition

The main data set used in the paper is constructed from unpublished, establishment level data obtained from two ABS Manufacturing Censuses conducted for financial years 1993-94 and 1996-97. The definitions of the variables constructed based on the information in the data sets are provided below:

- Value of output = Total sales and transfers out of goods produced and not produced + selected other income (govt. subsidies, service income, income from rent, leasing and hiring, and imputed commission)
- Quantity of output = Value of output / 3-digit Producer Price Index
- Value of labour = Total salaries and wages
- Quantity of labour = Total number of employees at June 30
- Value of raw materials = Total purchases and transfers-in of raw materials and goods for resale + selected expenses (motor vehicle running expenses, outward freight, rent, leasing and hiring expenses, subcontract/commission expenses, repair and maintenance expenses, and imputed commission paid)
- Quantity of raw materials = Value of raw materials / 3-digit Material Price Index
- Value of capital input = Value of output - Value of labour - Value of raw materials
- Quantity of capital input = Value of capital / simple average of Private machinery and equipment investment implicit deflator and Non-dwelling construction implicit deflator

Appendix Table 1: Variables definition

Variables	Definition
Exit	= 1 if in 1993-94 census but not in 1996-97 census; 0 otherwise
dlogout	= log($Sales_{97}$)-log($Sales_{94}$)
dlogemp	= log($Employment_{97}$)-log($Employment_{94}$)
dERA	= ERA_{97}-ERA_{94}
%dERA	= (ERA_{97}-ERA_{94})/ ERA_{94}
%dPower	= (ERA_{97}-ERA_{94})/ (1+ERA_{94})
log(avgcost) $_{94}$	= log[(wages+salaries+purchases of materials & goods for sale)/Sales)] $_{94}$
$mktshare_{94}$	= $Sales_{94}$ / Total $sales_{94}$ in the same four digit ANZSIC
$MUnumest_{94}$	= Number of establishments (ES) under the same management unit (MU)
$diversified_{94}$	= 1 if the MU has multi ES and in more than 1 four digit ANZSIC; 0 otherwise
$HHIsales_{94}$	= Four digit ANZSIC level Herfindahl-Hirschman index based on $Sales_{94}$
$CR4_{94}$	= Four digit ANZSIC level top four ES concentration ration based on $Sales_{94}$
$entryrate_{94}$	= Number of ES in 1996-97 which are not in 1993-94 / Number of ES in 1996-97 (at the four digit ANZSIC level)
family	= 1 if type of legal organisation is "7-Family partnership"; 0 otherwise
ptyltd	= 1 if type of legal organisation is "1-Proprietary, 2-Limited, or 3-Proprietary limited"; 0 otherwise
public	=1 if type of legal organisation is "21-36 Australian/State/Local Government organisation"; 0 otherwise

Appendix Table 2: Dependent and independent variables in the output regression

Variables	Mean	Std. Dev.	Min	Max.
dlogout	0.068	0.795	-13.549	8.855
dERA	5.559	3.743	-2.000	20.000
%dERA	0.356	0.446	-3.000	0.769
log(avgcost) $_{94}$	-1.305	0.789	-5.621	6.032
$mktshare_{94}$	0.005	0.000	0.022	0.997
$MUnumest_{94}$	1.274	1.725	1	50
$diversified_{94}$	0.035	0.184	0	1
$HHIsales_{94}$	0.039	0.055	0.003	0.995
$CR4_{94}$	0.258	0.166	0.067	0.964
$entryrate_{94}$	0.632	0.328	0.111	6.175
family	0.084	0.277	0	1
ptyltd	0.686	0.464	0	1
public	0.001	0.027	0	1
Number of establishments		16,696		

Appendix Table 3: Dependent and independent variables in the employment regression

Variables	Mean	Std. Dev.	Min	Max.
dlogemp	-0.005	0.488	-3.829	4.339
dERA	7.837	5.541	-5	41
%dERA	0.403	0.496	-3	0.833
log(avgcost) $_{94}$	-1.292	0.803	-5.621	6.032
mktshare$_{94}$	0.005	0.022	0.000	0.022
MUnumest$_{94}$	1.279	1.740	1	50
diversified$_{94}$	0.968	0.176	0	1
HHIsales$_{94}$	0.040	0.055	0.003	0.995
CR4$_{94}$	0.259	0.166	0.067	0.964
entryrate$_{94}$	0.632	0.329	0.111	6.175
family	0.084	0.277	0	1
ptyltd	0.685	0.465	0	1
public	0.001	0.027	0	1
Number of establishments		16,676		

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