Trade Liberalisation and Plant Exit in New Zealand Manufacturing

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Abstract

Data on New Zealand manufacturing plants are used to examine the impact of trade liberalisation on plant exit. Recent theories suggest that the prospect of a declining market might lead firms to strategic behaviour that causes low cost plants to exit first. This hypothesis is generally unsupported. Surviving plants were larger, lower cost, and were owned by specialised firms with few plants. Plant costs were more important than firm size for explaining the plant-closing behaviour of single-plant firms. Diversified, multi-plant firms were more likely to close plants and were influenced by plant size but not plant costs.

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I. Introduction

Which plants exit when an industry faces increased competitive pressure due to trade liberalisation? Standard trade theory sees the market directed exit process as socially efficient in reallocating resources, and looks approvingly at trade liberalisation by small countries. Evaluations are not so clear when there is an oligopolistic domestic industry and imports are only imperfect substitutes for local production. For example, the prospect of a declining market might cause domestic firms to adopt strategic behaviour that causes high cost plants to survive lower cost plants.

This paper looks at plant exit using data from the New Zealand manufacturing sector during a period of trade liberalisation. Such a study is timely. A number of developing countries have begun to dismantle trade barriers and several free trade agreements have been implemented, e.g., between Australia and New Zealand, between the North American countries, and between the countries in the EU. This can be expected to push a number of manufacturing industries into decline in the face of intensified import competition, prompting a reallocation of resources within and across industries.

Coincidentally, the introduction of industrial organisation concepts has reduced the predictive power of trade theory. In the traditional small-country model, imports are perfect substitutes for domestic output, domestic price is the world price plus tariff and output is where a rising marginal cost curve cuts this price. Trade liberalisation lowers the perfectly elastic world excess supply function and the domestic industry contracts down its supply curve as high cost plants exit. Small static welfare gains are realised.[1]

Results can be much better with imperfect competition and differentiated products, or they can be worse. If the protected industry is crowded with small, high-cost plants, who use protection to help exclude imperfectly substitutable imports, domestic firms may react to trade liberalisation by cutting prices, closing high cost plants and reducing product variety (Eastman and Stykolt, 1966). Scale economies cause large welfare gains. For example, Harris (1984) predicted welfare gains of up to 8 percent from Canadian free trade; much larger than the usual 0.5 to 2 percent coming from standard models.

However, for certain shaped import supply functions, a domestic oligopoly can respond to trade liberalisation by raising prices (Buffie and Spiller, 1986; Ross, 1988). This suggests a perverse pattern of plant exit, with surviving domestic firms retreating to high cost, low volume niches, and consumers gaining no benefit from freer trade (Hazledine, 1993). Consequently, there has been considerable debate about the welfare consequences of trade liberalisation, particularly the Canada-U.S. agreement (Wigle, 1988). Knowing which type of plants survive trade liberalisation is essential for assessing the potential gains.

II. Manufacturing and Trade Liberalisation in New Zealand

At first glance New Zealand would seem a perfect case for the traditional small-country model. A price-taking economy, with an import-competing manufacturing sector protected by tariffs and import licenses on consumer goods. Inefficiencies were substantial with unit costs up to 40 percent above world levels (Pickford, 1985) and plant size often below the minimum efficient scale of overseas producers (Bollard and Daly, 1984). Market concentration was high, with 4-firm sales ratios averaging 60 percent. Plants had short production runs producing a multiple range of products, each guaranteed a market by import licensing (Deane, Nicholl and Walsh, 1981).

However, some special features make the assumption of differentiated products appropriate, meaning that it may be necessary to look to the literature on plant exit from declining markets. A free-trade agreement was signed with Australia (also a heavily protected economy) in 1983, giving a five-fold increase in the market facing domestic firms. Export activity was common, in part due to intra-industry trade with Australia

(Hamilton and Kniest, 1991); 27 percent of the plants in our sample earned at least 5 percent of revenue from exports. The price transmission elasticity between imports and local manufacturing prices was significantly less than one (0.7), suggesting imperfect substitution (Chiao and Scobie, 1990).

Another important reason for looking towards the declining market literature was the phased nature of the trade liberalisation. Tendering of Australia-only import licenses began in 1981 and then extended to global licenses in 1984. Potential market share for imports was allowed to grow by 5 percentage points per year, until quota premium fell below 7.5%. Thus local firms faced a predictable declining market for several years, until licensing ended in 1988. A staged reduction in tariffs began in 1986.

As a result of this protection reform, the effective rate of assistance to manufacturing fell from 39 percent in 1981/82 to 19 percent in 1988/89. Import penetration increased from around 26 percent in 1982 to 31 percent in 1989. Employment declined (see Table 1), many plants were closed and others were rationalised. By December 1990 there was only 78% of the employment that had existed five years earlier.[2] In our data sample job losses were shared in approximately a 1:2 ratio between plant closings and employment contraction. In February 1986 there were approximately 4000 plants in our dataset, by November 1989 almost one-fifth had closed down.[3]

Table 1

III. Prior Theoretical and Empirical Findings on Exit From Declining Industries

Recent theoretical models suggest that the order of exit determined by market forces is not necessarily welfare optimal (Whinston, 1988; Dierickx, Matutes and Neven, 1991). In these models, plant and firm size, and relative costs influence exit from declining industries. Firm characteristics should not matter in exit from a competitive industry: plants earning the lowest quasi-rents drop out until the remaining, most efficient, plants are able to earn a normal return.

The best known model of exit is the capacity driven model of Ghemawat and Nalebuff (1985). Cournot behaviour in a duopoly facing falling demand causes the largest firm to leave first, if industry costs (equal for both firms) are common knowledge and production is all-or-nothing. It leaves because both firms recognise that the smaller producer will be a profitable monopolist over a longer period of falling demand. Extending to oligopoly, the last firm to exit is again the one with the longest profitable tenure as a monopolist, implying that exit occurs in decreasing order of firm size.

Although large firms appear to be at a strategic disadvantage they are often lower cost producers, either because of the advantages of scale or some inherent efficiencies which enabled them to grow large. Under Cournot assumptions a lower cost firm should have a larger share of the industry, so large firms might exit first for strategic reasons or last for cost reasons. Therefore, an interesting question is, how big a cost advantage does the large firm need to reverse the order of exit? In the Ghemawat and Nalebuff (hereafter G&N) model, with a demand elasticity of -1.5 and a market share of 70 percent, the larger firm will still drop out first unless its smaller rival has more than a 53 percent cost disadvantage.[4]

A subsequent model allowing continuous capacity adjustment predicts that the largest firm reduces capacity until it shrinks to the size of its smaller rival, and the two then shrink together (G&N, 1990). This convergence of market share occurs because the bigger firm has more incentive to reduce capacity given its larger share of any resulting benefits of higher price.

Although interesting, models based on single-plant firms are restrictive.[5] What happens when multi-plant firms are introduced? When plant sizes are unequal and capacity adjusts in plant-sized lumps, there is no simple, size-based rule for predicting exit (Whinston, 1988). The strategic advantage of small plants need not hold with multi-plant firms because all players know that multi-plant owners internalise external benefits from closure of their own plants.

Turning to cost driven models, Reynolds (1988) shows that with equal sized firms, high cost plants close first. Dierickx, Matutes and Neven (1991) contrast a high fixed / low variable cost firm with a low fixed / high variable cost firm under two types of demand decline: (i) a reduction in the customer base, e.g., following population changes, and (ii) a reduction in the willingness to pay (WTP) following the availability of cheaper or better substitutes, e.g., after import liberalisation. Low variable cost firms survive when the population stays fixed and margins are squeezed by falls in the WTP, whereas low fixed cost firms survive when the population shrinks. However, falling WTP may force low variable cost producers out first if the customer base is too small to generate a surplus for paying fixed costs.

Less formal models explore the effect of firm diversification on plant closure. Small, specialised firms may face agency problems if decision makers are called upon to fire themselves, so their plants are less likely to close (Harrigan, 1980).[6] Diversified firms can move workers to other branches to avoid labour termination costs (Baden-Fuller, 1989). Plants owned by diversified firms may thus close, even if they have lower costs than the survivors who remain "stuck" in the industry.

Another important variable is age of the plant's capital stock, which affects maintenance charges while operating and scrap value upon closing. Newer plant should have higher resale value so closure is more likely (Baden-Fuller, 1989). Young plants may also have higher production costs if learning by doing is important (Marcus, 1967) but this can be overcome by multi-plant firms transferring previous production knowledge (Dunne, Roberts, and Samuelson, 1989). On the other hand, new plant may embody more efficient technologies, so Deily (1991) predicts that plants with older capital have to make reinvestment decisions and thus are more likely to close.

The theoretical models have several testable implications for plant exit when demand steadily declines due to falling WTP during a phased trade liberalisation:

1. High variable cost plants should exit (Dierickx, *et al.*, Reynolds).
2. Plants with a large share of the industry should exit if the owning firm is single-plant (G&N, 1985).
3. Plants owned by large firms should exit when they are one of many multi-plants (Whinston; G&N, 1990).
4. Plants owned by diversified firms should exit (Baden-Fuller, Harrigan).

5a. Younger plants are more likely to exit (Baden-Fuller).

5b. Younger plants are less likely to exit (Deily).

Lieberman (1990) characterised 1) and 2) as the "shakeout" and "stakeout" hypotheses and devised tests to assess the conflicting predictions (given the lower cost of large plants). The relevance of 5a) compared with 5b) may depend on the use specificity of capital goods employed in the plant. If outside uses are limited, and the investments are sunk in place, resale values will be low, even for new plant. Once sunkenness has reduced resale values, any technical inefficiency of older vintages looms larger in exit calculations.[7]

Empirical studies provide mixed support for the theoretical predictions. A common finding is that larger plants are less likely to exit. Examples include the U.S. steel (Deily, 1988, 1991), and chemical industries (Lieberman, 1990), and a broad cross-section of U.S. industries (Dunne, *et al.* 1989). But in the U.K. steel castings industry plant size had no effect in a logit model of closure (Baden-Fuller, 1989). These results may show that cost advantages outweigh the strategic disadvantages of size although it is difficult to measure plant cost levels. A related finding is that plants using low cost technology are less likely to exit Deily (1991).

Size of the owning firm had no impact on plant closure in Baden-Fuller's results. Deily (1991) found that (at the mean) increasing firm size *reduced* the probability of exit. Lieberman found that increasing firm size made multi-plant firms more likely to close plants but had no impact on single-plant firms. This supports the G&N (1990) prediction but not G&N (1985). More evidence for G&N (1990) comes from Ghemawat and Nalebuff themselves; industry concentration ratios fell most in decline industries, supporting the prediction of market share convergence.

Diversified firms were more likely to close plants in both Baden-Fuller's and Lieberman's results. However, Deily (1991) found no diversification effect. Multi-plant operation had no direct influence on closure probability in Lieberman's results. Younger plants had higher exit rates in Dunne *et al.*'s study but age of the capital stock did not influence exit in Deily's (1991) results.

IV. Model Specification

A firm facing declining demand is modelled as choosing to either let a plant carry on producing or close the plant down. Firm *i* faces opportunity cost h_{ijm} when continuing to operate plant *j* in industry *m*. The opportunity cost is the sum of three factors:

$$h_{ijm} \,/\, C_{ijm} + rS_{ijm} + E_{ikm} \qquad (1)$$

where C_{ijm} is the production cost, r is the firm's discount rate, S_{ijm} is the current resale value of plant and other assets, and E_{ikm} is the 'external' benefit to the other *k* plants owned by the firm after the closing of plant *j*. It would be profitable for the firm to cease operating the plant when,

$$E(TR_{ijm}) < E(h_{ijm}) \qquad (2)$$

where TR_{ijm} is the revenue earned by the plant and *E* is the expected value. Any factor increasing C_{ijm}, r, S_{ijm}, or E_{ikm} will increase the probability of closure.

The testable implications of the theory models fit into the framework of (1) and (2). C_{ijm} captures the prediction that high cost plants should exit. Younger plants should have low C_{ijm} according to Deily (1991). Conversely, younger plants should have high S_{ijm} and thus be more likely to exit (Baden-Fuller). The G&N (1990) prediction of large firms choosing to make incremental capacity reductions is captured by E_{ikm}, which is also linked with the prediction of multi-plant firms being more likely to close plants (Whinston). The earlier occurrence in time of $E(TR_{ijm}) < E(h_{ijm})$ for the larger of two single-plant firms in a duopoly captures the G&N (1985) prediction.

Regarding the lower likelihood of exit for plants owned by specialised firms, S_{ijm} is often negative in a declining industry, due especially to labour termination costs. The option of moving workers to other branches increases S_{ijm} for diversified firms. With negative S_{ijm}, a higher discount rate makes closure less likely because borrowing, to pay termination costs, is more expensive. Large firms have the advantage of lower discount rates (Baden-Fuller). The specialist firm's agency problem can be thought of as reduced willingness to undertake the calculations embodied in (2).

The empirical model was estimated using a logit specification. The dependent variable equals one if a plant that was open in April 1986 had closed by November 1989. The probability of plant closure is related to the following set of plant, firm and industry characteristics (see Table 2).

Plant Characteristics

The unit cost of production in a plant depends on the technology used, the throughput over which to spread fixed costs, the cost of purchased inputs, and the efficiencies with which productive factors are combined. We use the ratio of expenses on materials and labour to sales revenue, EXPSALES, as a proxy for plant production costs. This variable includes output-invariant period costs of keeping facilities ready for production (e.g., maintenance labour during a mothballed phase). Thus the coefficient on EXPSALES cannot test predictions of the Dierickx, *et al.* model because it includes a mixture of "variable" and "fixed" costs, on their definitions.

However the coefficient should have some bearing on the debate about whether lower cost plants survive trade liberalisation, especially because imports are assumed to be differentiated from the output of local plants. Variation in EXPSALES across plants should reflect technology choices, fixed to variable costs ratios and factor costs, rather than just revenue compression due to prices being forced down by an inflow of perfectly substitutable imports.

Plant size is measured by the variable, SHARE, the plant's share of industry sales. While larger plants may have lower costs when plant utilization is high, they also suffer from strategic liability, particularly in an industry of single-plant firms. Plants with a higher SHARE could, therefore, have a reduced or an increased likelihood of closure and the coefficient should differ between single-plant and multi-plant sub-samples. As well as entering as a linear regressor, a piecewise specification is estimated so that the estimated coefficient can take different values for various ranges of SHARE.[8] This should allow both competing predictions about SHARE to be identified.

Plant age is measured in an inverse manner by the date the plant opened. The variable YOUTH takes a value of zero for pre-1980 plants, rising to a value of six if the plant opened in 1986. If the effect of age reducing S_{ijm} outweighs that of age increasing C_{ijm}, or costs fall with age due to learning by doing, young plants will be more likely to exit and the coefficient will be positive.

If the capital employed is very specific to the plant it will have a low resale value because it cannot be readily adapted to other applications. A low value of S_{ijm} reduces the probability of exit, particularly when exit is measured by its actual occurrence rather than the onset of reduced investment activity (Deily, 1988). The variable used to measure the specificity of capital is based on energy utilisation, using the relationship:

$$F_j = \text{‟}(K_j, U_j) \qquad (3)$$

where F_j is total fuel consumption in thermal units, K_j is the stock of capital and U_j is the utilisation rate (Bosworth, 1979). The variable, CAPSALES, the ratio of fuel consumption to sales revenue, should increase with the specificity of capital.[9] Plants with high values of CAPSALES should be less likely to make observed exits.

Finally, the proportion of the plant's material inputs that are imported, PIMPORT, may affect exit. Liberalisation brought no advantage of cheaper imported inputs because they were already free of licensing and duty. Reduction in protection on outputs might shift cost advantages to overseas plants. Plants with high values of PIMPORT may have been those established to carry out final assembly behind protective walls, so can be expected to close once those walls fell.[10]

Firm Characteristics

Single-plant firms are in no position to reap 'external' benefits from closure of their plant (E_{ikm}=0) so are less likely to close. We measure this effect with MULTI, the number of plants operated by the firm. More plants implies a larger sized firm so a positive coefficient also supports the prediction of large firms making incremental capacity reductions (G&N, 1990).

A dummy variable, DIVERS, is used to test for the effect of firm diversification on plant closing decisions. DIVERS takes a value of one if the firm has plants in other industries. The coefficient should be positive, reflecting the greater ease with which multi-product firms can close plants due to higher S_{ijm} (less negative) and lower *r*, as well as fewer agency problems.

When multinational enterprises (MNEs) close branch plants and replace their market share with imports the external benefit is captured entirely by the parent. This sort of behaviour is likely to be common in New Zealand because MNEs set up affiliate plants to overcome protective barriers (Deane, 1970). Therefore the MNE can probably meet domestic demand from lower cost sources once import barriers are dismantled. The variable FOREIGN takes a value of one if a foreign controlled firm owns the plant. We expect a positive coefficient on FOREIGN.

Industry Characteristics

Exit should vary with the intensity of industry adjustment pressure from trade liberalisation. The variable ERACUT, the change in the effective rate of assistance to the industry, measures this. The type of protection may also be relevant. Firms with plants in quota-protected industries were often given import licenses to complement their product range. Once licensing was abolished any quota rent was lost, as was the considerable protection given, so failure rates are expected to be higher in these industries. We measure this effect with QUOTA, the share of industry effective rate of assistance provided by import licensing.

V. Data and Results

Data was obtained on all accounting units (i.e., firms or business divisions) employing at least 25 workers in manufacturing, using the 1986/87 Economy-Wide Census of New Zealand. Plant-level data is used, together with relevant information covering the enterprise. This was merged with data from the New Zealand Business Directory (collected annually by the Department of Statistics) to see which plants survived in succeeding years (up until November 1989). Of a total sample of 3847 observations, 3216 had complete information on all explanatory variables. Several variables not usually published in the Census were derived from the plant-level data (EXPSALES, YOUTH, SHARE, PIMPORT and CAPSALES). Variables measuring industry level adjustment (ERACUT, QUOTA) came from an extensive study of industry assistance (Syntec, 1988).

The logit estimator in TSP (version 3.1b) was used to estimate coefficients, heteroskedastically robust standard errors and changes in the probability of closure with respect to changes in the explanatory variables (X_i). This 'quasi-elasticity' is calculated as:

$$\partial p / \partial X_i = p\,(1-p)\beta_i \qquad (4)$$

wherep is the predicted probability of plant closure. The derivative of the logit probability is calculated at the mean closure probability.

Table 3 reports the logit estimation results and probability derivatives. Only CAPSALES is not statistically significant (the t-statistic is just outside the 5 percent level). The model as a whole is highly significant and correctly predicts 82 percent of the choices that firms made for their plants.

Table 3

Plants with high production costs, as measured by EXPSALES, were more likely to exit. In the full sample the probability derivative is small: a doubling (at the mean) of the expenses to sales ratio would only increase the probability of exit by 0.6 percent. However the probability derivative appears to be depressed by plants, in the upper tail of EXPSALES, which have expenses to sales ratios greater than two. Removing these 63 observations leaves other coefficient values unchanged but increases the coefficient on EXPSALES to 0.647 (*t*=2.23). The probability derivative at the mean rises to 9.3 percent, which is the most elastic response of any variable. Thus the result for EXPSALES in Table 3 appears both robust and understated.

The SHARE coefficient is negative and highly significant, indicating that larger plants were less likely to close. Increasing SHARE from two percentage points (the mean) to three would reduce closure probability by one percentage point. A similarly proportionate increase in SHARE but at one standard deviation above the mean (from 6 percent to 9 percent) would reduce closure probability to 14 percent.

The coefficient on YOUTH suggests that younger plants were more likely to exit. Splitting the sample in two, based on CAPSALES, showed a stronger relationship between YOUTH and plant closure in the plants using less specialised capital.[11] In the low CAPSALES sub-sample, the probability derivative was 2.9 percent, in the high CAPSALES sub-sample it was 1.6 percent. If the higher salvage value of new capital goods does outweigh lower running costs, resulting from superior embodied technology, the effect is less apparent when the outside uses of the capital goods are limited.

The coefficient on CAPSALES is negative as expected but the probability derivative is small. The high variation in energy intensity across plants gives CAPSALES a large standard deviation (s.d), so the probability derivative is much larger (-2.97 percent) one s.d. above the mean. The PIMPORT coefficient has the expected positive sign.

Of the variables measuring firm characteristics, MULTI and DIVERS were signed as expected and statistically significant, and FOREIGN had an unexpected sign. The predicted probability of closure for a plant owned by a diversified company was 3.3 percentage points above that of other plants. The common perception of closing costs being lower for diversified firms is supported by this result.

The predicted probability of closure for a plant owned by a foreign controlled company (FOREIGN=1) was 4.7 percentage points below that of other plants (FOREIGN=0). Although foreign controlled plants were more likely to import inputs ($r_{FOREIGN,PIMPORT}$=0.30), they did not predominate in quota-protected industries, contrary to expectations of them being final assembly operations. In the sub-sample of foreign controlled plants, EXPSALES had no impact on closure; only locally owned plants seemed sensitive to production costs.

The coefficient on MULTI shows that firms with more plants were more likely to close plants, in line with the predictions of Whinston (1988) and G&N (1990). Adding one plant at the mean of 5.88 plants per firm (a 17 percent increase), each plant owned by that firm would experience an increase in closure probability of 0.4 percentage points. With initially equal sized plants, the firm could achieve the same capacity by doubling the scale of one plant. That lucky plant would see it's closure probability fall two percentage points (to 16 percent) and the closure risk for the other plants would be unaffected. Hence the manner in which the firm configures it's capacity has a major effect on the overall plant closure probability.

The industry characteristics have the expected effects: plants were more likely to close where the cuts in protection were greatest and where the protection had been based on import licensing. The small probability derivative for ERACUT suggests that deeper cuts in protection may not have increased plant closure very much. This must be tempered by the wide variation in intensity of trade liberalisation: for industries where ERACUT was one s.d. above the mean, the probability derivative increases to over three percent.

In general, the results in Table 3 suggest that the plants likely to survive trade liberalisation were larger, lower cost, older, used specialised capital and were owned by specialised firms with few plants. Socially undesirable outcomes, due to strategic behaviour by firms, are not very evident. However the important result that larger plants were less likely to exit may disguise some strategic behaviour. What has been found is the net effect of two conflicting influences, lower cost versus strategic liability, measured from a sample of both single and multi-plant firms.

To disentangle these influences, Figure 1 plots the gross closure probabilities for various size classes of single-plants and multi-plants. For both single and multi-plants, increasing plant share decreases exit probability, in line with the SHARE coefficient from Table 3. However the relationship is somewhat U-shaped with exit probabilities lowest for plants in the 3 to 5 percent size class and rising thereafter. Single plants with a 4 percent share of industry sales have an exit probability of 2.9 percent, compared with 6.4 percent for larger plants. Multi plants have a similar pattern with the increase in exit probability rising from 10.4 percent to 15.2 percent. Hence, Figure 1 may provide some evidence that strategic behaviour is an influence on exit for plants with sales shares of 5 percent or more.

Figure 1

The logit model was re-estimated with a set of plant size dummy variables interacting with SHARE, to see if the U-shaped pattern holds when controlling for other influences on closure. Results of the share-dummy models are in Table 4. Plants with sales shares below two percent form the base group. The dummy variable D_i equals one for plant share *i%* and zero for other values of SHARE (except D5, which equals one for all plants with SHARE$5 percent).

Table 4

The hypothesis of a non-linear relationship between SHARE and exit cannot be rejected in either the full sample or the multi-plant sub-sample. In the non-linear segment $\partial p/\partial X_i$ minimises at SHARE=3%. If a firm increased the size of one of it's plants from 3 percent to 4 percent of industry sales, that plant's probability of exit would fall 6 percentage points. Although the coefficient on D5*SHARE is positive, the implied SHARE coefficient for plants where SHARE $\geq 5\%$ is still negative (-0.071 with standard error of 0.2707). Hence the likelihood of exit decreases, usually at an increasing rate, as multi-plant firms increase the size of their plants. On the other hand, increased firm size, achieved by adding new plants, raises the likelihood of exit by 2.25 percent for a doubling at the mean.

In the single-plant sub-sample plant size has no relationship, either linearly or non-linearly, with plant exit. The prediction of G&N (1985) is not supported. Firm size, as measured by plant numbers, does influence multi-plant exit, which supports G&N (1990). These findings are similar to Lieberman (1990).

The other important result in Table 4 is the insignificance of plant costs, as measured by EXPSALES, for explaining the exit decisions of multi-plants firms. Evidently the significance of EXPSALES in the full sample is driven by single plants, for whom the sub-sample coefficient remains statistically significant (at $p<0.08$). Single plant exit probability increases by 4.8 percentage points for a unit increase in EXPSALES at the mean. For multi-plants the increase is only 0.1 percent. Removing the upper tail of EXPSALES≥ 2, the derivatives become 26 percent and 4.8 percent (and the *t*-statistic on EXPSALES for single plants rises to 3.68).

Single-plant firms gain no external benefits from plant exit so production cost clearly counts more heavily in their closing decision. Other aspects of decision making by the single-plant firm are less clear; capital specificity has no influence but plant age is more important than it is for multi-plant firms. Decision making by the multi-plant firm involves more tradeoffs amongst plant production costs, salvage values and external benefits. The insignificance of EXPSALES suggests that the firm may close a low cost plant first if the larger external benefits or higher salvage values outweigh the cost disadvantage of the surviving plants.

VI. Implications

The evidence presented here shows that larger, lower cost, and older plants survived the New Zealand trade liberalisation. This is somewhat consistent with the Eastman and Stykolt hypothesis that a protected oligopoly reacts to trade liberalisation by closing high cost capacity, reducing product variety and exploiting scale economies internal to the plant. These results tend to favour the optimists, such as Harris (1984), who predict large welfare gains from free trade.

In particular, a variety of tests showed that the probability of plant exit decreased with increasing plant size. The rate of decrease in probability was greatest for mid-sized plants (3 percent share of industry sales). The non-linear relationship was also able to be summarised by a quadratic, whose derivative, $\partial p/\partial SHARE$, minimised at SHARE=51%.[12] There were only six plants (out of 3216) in the region where $\partial p/\partial SHARE$ increases with respect to plant size, and none in the region where $\partial p/\partial SHARE$ was non-negative. For an economy where plant size was well below the minimum efficient scale of overseas producers (Bollard and Daly, 1984), such a result suggests a beneficial effect of trade liberalisation weeding out small plants.

However the characteristics of firms also had important influences on plant closing and to some extent these offset the favourable survival characteristics of plants. First, firms owning many plants made plant closing decisions that did not seem to rely on relative production costs. It seems that a multi-plant firm might sacrifice a low cost plant if other benefits, like the external effect on it's other plants, and the salvage value, are high enough.

Second, firms with plants in several industries were more likely to close plants. Diversified firms who closed plants also made large employment reductions in their other activities. For these firms, employment in their non-closing plants was 2.4 times higher in 1987 than it was in 1989. For diversified firms who did not close plants, employment in 1987 was only 1.4 times higher than in 1989.[13] This evidence of diversified firms being more likely to close plants and to reduce employment could be consistent with those firms wanting to produce a more limited range of products at greater scale. But it is also consistent with specialist firms being unable to muster the resources to quit an industry, in which case, the plants surviving trade liberalisation may not be the fittest.

A previously unexamined characteristic of the firm, it's control by foreigners, had an unexpected influence on plant closure. This poses several questions for research. Is managerial slackness greater in the foreign controlled firm, because of the longer command chain, and if so, does this allow unviable plants to persist? On the other hand, experience in other countries should give the foreign controlled firm a good view of the international competitiveness of local plants. Does the lower closure rate reflect some vote of confidence in the ability of New Zealand manufacturing to become internationally competitive?

Of the capacity driven models of exit, the best supported is G&N (1990). There was also evidence of plant level adjustment following a G&N (1990) pattern of the largest shrinking to the size of their rivals. Between 1987 and 1989 the size of the largest employer and the coefficient of variation (c.o.v) in plant employment for the cohort of survivors declined in 42 industries. However 31 industries (mainly Metal

Products & Machinery) had leading plants respond to the opportunities of freer trade by increasing the c.o.v. of employment and the size of the largest plant.

The available data did not allow a direct test of the Dierickx, *et. al.* cost driven exit model. That model suggests the undesirable outcome of low variable cost plants forced out by falling WTP if the customer base is too small to cover fixed costs. This is unlikely to describe the New Zealand experience of liberalisation given the market expansion created by the free trade agreement with Australia. To the extent that EXPSALES measures variable costs, the empirical results give grounds for some cautious optimism that low variable cost plants survived.

The data also show that the pattern of "infant mortality" for plants cuts across the predictions of strategic behaviour models. A high infant mortality rate is also reported by Dunne *et. al.* (1989). For example, even though a large start-up size might be predicted to increase strategic liability, it is found (in the U.S.) to reduce the hazard rate facing new plants (Audretsch and Mahmood, 1991). The exit of young plants during the trade liberalisation would be a negative outcome if there are strong vintage effects, because the older age of surviving plants would cause technical backwardness. However, Dunne (1994) has shown that strong vintage assumptions concerning technology use are unwarranted. In the U.S. at least, plant age and technology use are relatively uncorrelated, so old plants need not be technically backward.

Finally, it is worth examining the characteristics of successful export oriented plants. The 608 plants who earned more than 10 percent of revenue from exports are larger (mean SHARE of 2.97 percent), average 1.5 fewer plants per firm, use more specialised capital (mean CAPSALES of 4.23 c.f. 0.88), and are also younger (mean YOUTH of 0.51 c.f. 0.41). With the exception of plant age, the characteristics of successful exporters are also the major characteristics of surviving plants. For a small economy like New Zealand, an unprotected manufacturing sector can be viable only if it is oriented towards external markets. The plants surviving trade liberalisation, thus far, would appear to have many of the necessary attributes of successful exporters.

References

VII. Notes

1. However the resulting transfers from protected producers to consumers may be an order of magnitude larger (Pickford, 1987).

2. This refers to all manufacturing plants and not just those in our sample.

3. As a comparison, the average annual gross exit rate was 6% over the 1980-84 period (Bollard and Harper, 1986). This estimate was based on a random sample which included small plants (>1 employee) which have high exit rates and thus overstates the rate comparable to our sample.

4. Although large, such a range of costs might occur within a heavily protected industry with a fringe of small, inefficient firms. For example, in one-fifth of the industries in our sample the 80th-percentile plant (when ranked from lowest to highest) had unit production costs (measured by the ratio of expenses on materials and labour to sales revenue) that were at least 40 percent higher than those of the 20th-percentile plant.

5. For example, only 30 percent of plants in our sample were owned by single-plant firms.

6. This assumes that it is the equity holders making the exit decision, which need not always be the case (Schary, 1991).

7. We are grateful to the editor for discussion on this point.

8. We are grateful to an anonymous referee for suggesting this procedure.

9. Two stylised facts underpin this: (i) the specificity of capital equipment increases with size and capital intensity, and (ii) capital intensity increases with energy intensity. Some indirect evidence for (i) comes from Kessides (1990), and for (ii) from the fact that energy input has been widely used as a proxy for equipment intensity when data on the value of capital stocks are unavailable.

10. This effect would not necessarily be picked up by the change in industry rates of protection. Import licenses and tariff concessions (duty free inputs) were finely targeted in New Zealand, often being restricted to a particular firm. Moreover, industries were protected for a wider set of reasons than just shifting final assembly operations onshore.

11. Full results of split-sample tests referred to in the text are available from the authors.

12. Combining the quadratic and share-dummy models in one model and testing the restrictions to nest each model suggested that the share-dummy model dominated the quadratic model.

13. The difference is statistically significant, and this relationship, for just the sub-set of plants owned by

diversified firms, induces a positive correlation between the employment cut in non-closing plants and plant closure for the full sample. This employment change variable was used as a regressor in early versions of the model but its potential endogenity, conflicting interpretations (prior firm-level inefficiency versus efficient promptness in facing up to the need for rationalisation), and lack of statistical significance caused it to be dropped from the model.