Import Survival:
Multiple Entries and Exits by Foreign Suppliers into New Zealand Fresh Fruit and Vegetable Markets

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Summary

This paper explores the patterns of duration and survival of fresh fruit and vegetables import in New Zealand and identifies determinants of survival. Using a discrete-time survival model, we evaluate the impacts of partner-specific characteristics and New Zealand Import Health Standards (IHS) regulations on the survival of trade relationships with 87 economies from 1994 to 2017. Our findings indicate that while more than half of these trade relationships had only survived one year, approximately one-quarter had attempted to enter the market multiple times. Interestingly, the results reveal no evidence that IHS regulations have persistent effects on import survival.

Keywords: Survival, duration of import, horticulture, discrete-time hazard models

1. Introduction

Trade is essential for the New Zealand economy through influencing Kiwis' way of life, the standard of living, and the potential to become a more prosperous country. Fresh fruit and vegetables, specifically, are a dietary staple for most Kiwis. The variable climate in New Zealand allows growing and producing a wide range of fresh fruit and vegetables during the year. Import, on the other hand, provides Kiwis with a large variety of fresh produce commodities to choose from, especially those that they cannot produce. Since the 1990s, New Zealand import of fresh fruit and vegetables continues to rise and now exceeds 178,000 tonnes in 2017. This includes more than 170,000 tonnes of fresh fruit import, keeping the sector on track to meet Kiwis' daily demand. On a value basis, the import more than tripled, increasing from US$79 to US$310 million during the period of 1989-2017 (UN Comtrade). Unfortunately, New Zealand import of fresh fruit and vegetables remains marginal in world total exports and suffers from various vulnerabilities due to New Zealand's small and relatively narrower economic base. To consider the future of trade, many trade streams have only emphasized the important role of productivity as a driver of export decisions, status and competitiveness. While researchers have used both macro- and micro-level data to focus on the issue of what makes countries/or firms start to export, much less evidence has been found to answer the questions related to the survival and failure of imports. Since there is no theoretical framework that directly analyses the duration of trade relationships, investigation of import survival tends to be difficult. Yet, it is important to identify how importing relationships persist and how we maintain healthy trade relationships with our trading partners as failed importing relationships would impose costs on businesses and consumers.

The motivations for this study primarily comes from conflicts within commonly known trade theories and from the possibility of a survival analysis. First, we acknowledge that there is a bi-directional nexus between trade and productivity via a series of profound literature such as Melitz (2003), Helpman et al. (2008) and Bernard (2009). From trade to productivity, the most productive exporters/firms are best able to enter the foreign market since they are capable to overcome the fixed and extra costs of entries. Further, there is empirical evidence of the short-lived nature of trade duration in some countries such as the U.S. However, we lack evidence to explain what kind of uncertainties and shocks made those productive exporters exit. Building on the 'learning-by-doing' hypothesis, a major channel through which productivity gain can be fulfilled is trade. If trade relationships are observed to have a short duration, like only 1-3 years, how could exporters achieve the productivity gain in such a short period? This reality might force exporters to search for other possibilities and effective strategies to maximize their benefits from trade. Second, with several possible exceptions, models of trade dynamics generally predict that trade patterns change slowly as trade is based on differences in factors endowment which are expected to evolve slowly (Hess and Persson, 2011). Therefore, once a trade relationship has actually been established, it should- theoretically speaking- survive for some time at least. Vernon's (1992) seminal product cycle theory also suggest the similar that trade relationships tend to be long-lived. This traditional hypothesis also seems difficult to be reconciled with the observed patterns of trade duration and survival. Third, due to the nature of aggregate trade data itself, duration and survival patterns are hard to be observed via broadly defined categories of the commodity. The comprehensive sources of and public accessibility to detailed trade statistics in recent decades make a survival analysis at disaggregated commodity-level plausible.

Even though the literature on the duration of trade is limited so far, the empirical consensus formed reveals that most trade relationships are indeed short-survived. Tracing its prominent roots, Rauch and Watson (2003) investigate the duration of trade relationships via a search model. The authors predict that the length of a trade relationship is positively affected by the initial amount of the transaction. In their framework, importers start with small purchases due to the uncertainty surrounding the suppliers. Purchases then increase only if their prior orders delivered and satisfied by final consumers' expectations. Following their work, a small but growing number of studies have explored the patterns and determinants of trade survival at the detailed product level. Besedes and Prusa (2006) clearly define the 'failure' of a trade relationship as 'the length of time until the relationship ceases to be active'. In this research, the authors find that trade relationships for differentiated commodities tend to survive longer than for homogeneous ones. In particular, their results indicate that the median duration for the imports of the U.S. is merely 2 years. On the one hand, those findings are later confirmed by more recent studies. For example, Peterson et al. (2017)'s study on the fresh fruit and vegetable export into the U.S. market confirms that trade relationships are often dynamic with multiple entries and exits. On the other hand, focusing on the trade of machinery, Obashi (2010) suggests that trade relationship of machinery parts and components tends to be longer-lived, compared to the trade relationship of finished machinery products. The latter is more sensitive to the level of trade costs and exchange-rate fluctuations. Therefore, it is not difficult to imagine that duration and survival of trade relationships is also closely linked to the nature of commodities. In terms of the factors influencing the survival of trade relationships, Nitsch (2009)'s study on German imports indicates that gravity variables (e.g. distance, GDP, common language, common border, and etc.) have the similar extent of impacts on the duration of trade flows as they have on trade volumes. Hess and Persson (2011) estimate EU imports from the rest of the world and find that export diversification substantially reduces the hazard of trade flows dying. Fugazza and Milina (2011) investigate the bilateral trade flows among 96 countries. Their results suggest that the duration of trade relationships increases with the region level of development. In particular, trade relationships from richer economies face lower hazard rates. However, fixed costs reduced the duration of survival.

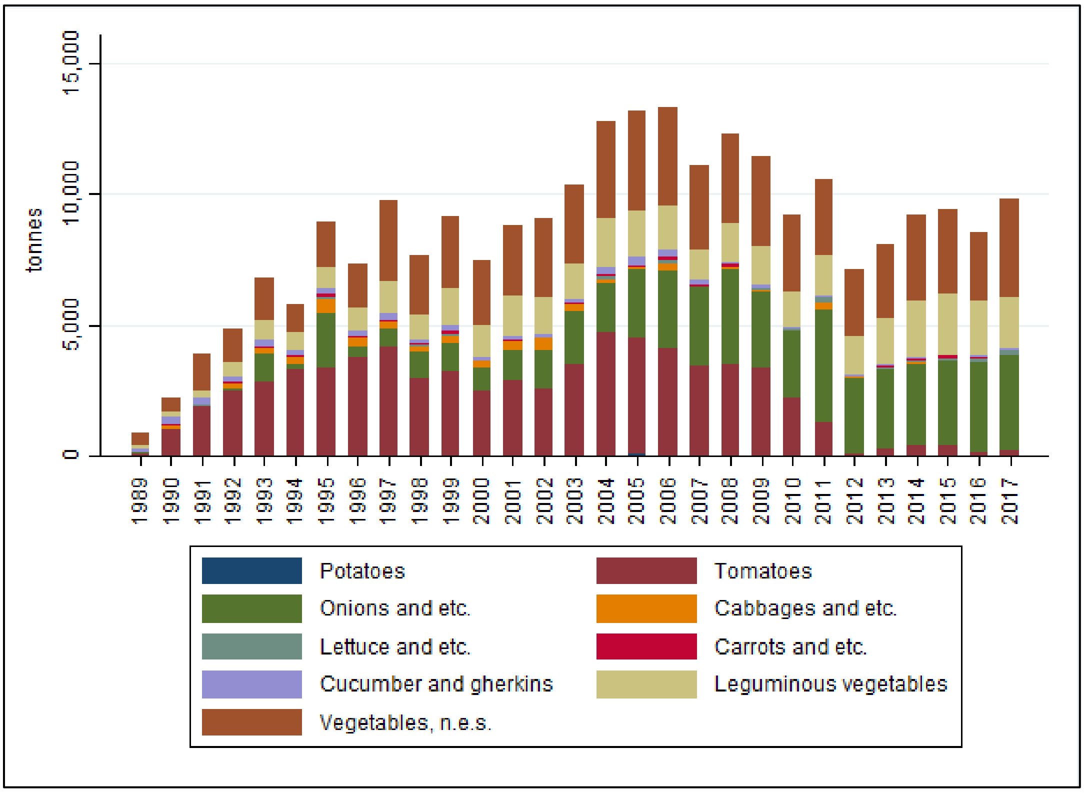
Despite all the development in trade duration and survival studies, relatively fewer evidence explains factors influencing the duration of imports, especially in horticulture trade. One unique characteristic of trade in horticulture commodities, such as fresh fruits and vegetables concerned, is their perishable nature. It requires a closer relationship between importers and suppliers and is likely involves extra sunk and fixed costs. On the other hand, this nature makes trade relationships more vulnerable and hard to maintain. Another unique aspect of imports of fresh fruit and vegetable, in New Zealand particularly, is the significance of the Import Health Standards (IHS) regulations, which are the rules to minimize the biosecurity risks of importing fresh produce from overseas.

In this paper, the purpose is to evaluate the impacts of partner-specific characteristics and IHS regulations on the survival (or probability of failure) of fresh fruit and vegetable trade relationships between New Zealand and its foreign suppliers. The rest of the content is divided as follows. Section 2 introduces New Zealand regulations of fresh fruit and vegetable imports including the IHS. Section 3 describes the methodology and data of estimation. Section 4 sketches the patterns and trends in New Zealand fresh fruit and vegetable import duration by counting the number of trade relationships and years of import survival in each continuous period. Section 5 presents and analyses the estimated results using preferred models. Finally, section 6 concludes with a discussion of the results and their policy implications.

2. Regulations of fresh fruit and vegetable imports

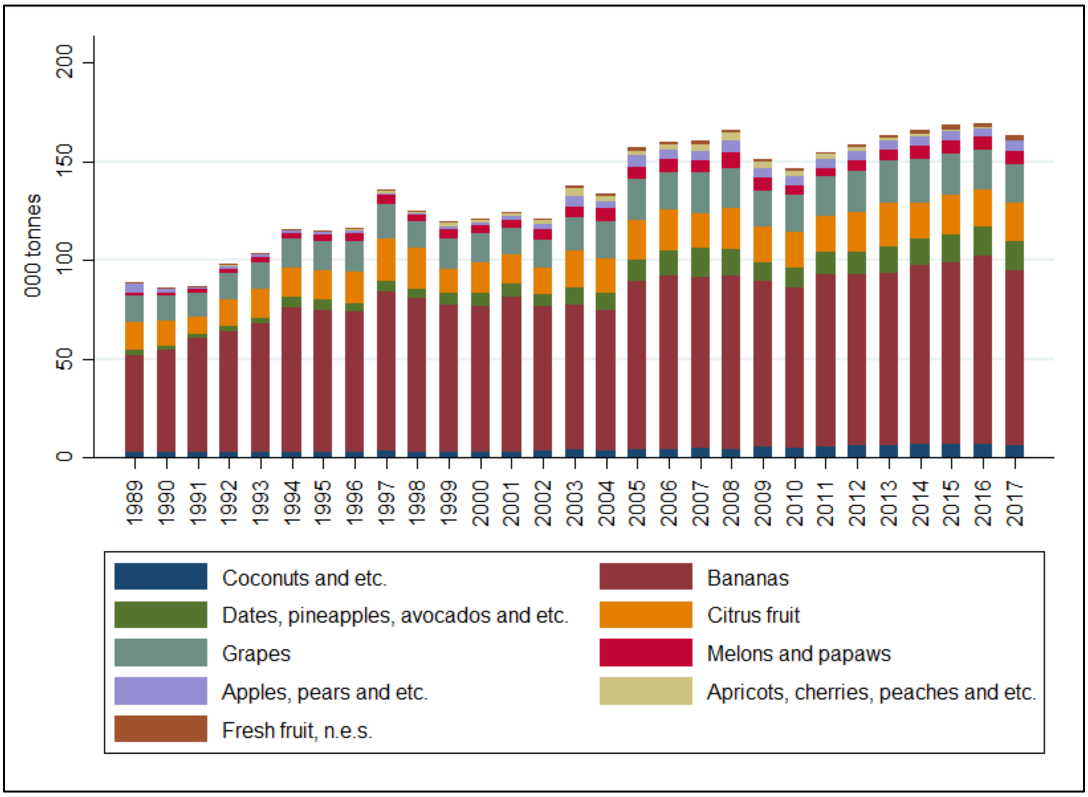
Besides the substantial rise in import values and volumes, New Zealand's composition of fresh vegetable import has experienced a shift from a concentration on tomatoes to a dominated share of import in onions and etc (see figure 1). This fact directly reflects the high-speed development in New Zealand crop-processing technologies, which made the production of potatoes over the last decade increased markedly (Potatoes NZ, n.d.). In terms of fresh fruits, there was no obvious shift in New Zealand's import composition. On a net weight basis, imports of banana have been increasing steadily from 1989 to 2017 and remain the largest category of imported fruits. Other major commodities include citrus fruit (i.e. oranges, mandarins, lemons, grapefruit and etc.), grapes and dates, pineapples, avocados and etc (see figure 2).

Figure 1: New Zealand Import of Fresh Vegetables, 1989-2017



Source: UN Comtrade Database.

Figure 2: New Zealand Import of Fresh Fruit, 1989-2017



Source: UN Comtrade Database.

The rapidly growing imports of fresh fruit and vegetable have increased New Zealander's awareness of the way in which imports are regulated to prevent the introduction of pests and diseases associated with the commodities. The New Zealand Ministry for Primary Industries (MPI) is the lead government agency responsible for maintaining biosecurity standards for the effective management of risks associated with the importation of risk goods into New Zealand. The MPI Import Health Standards (IHS), are the standards describe the phytosanitary requirements for the importation and clearance of fresh produce commodities (for consumption) into New Zealand. The document *Ministry for Primary Industries Standard 152.02 Importation and Clearance of Fresh Fruit and Vegetables into New Zealand* (hereafter, *Fresh Produce IHS 152.02*) was issued as an import health standard pursuant to section 24A of the *Biosecurity Act 1993*. The primary purpose of this document is to consolidate all import health standards and operational standards for the importation and clearance of the regulated commodities.

In order to meet the phytosanitary requirements, all commodities covered by the IHS requires a phytosanitary certificate, which is issued in the exporting country. The requirements vary and are listed by country in *Fresh Produce IHS 152.02 Appendix 1*, or will be listed in the relevant IHS for the species that will be imported. To meet the requirements, importers may need to complete some or all of the following tasks before products are shipped:

a. Source produce from a pest-free area or country,
b. Have the produce inspected for pests and diseases, and arrange fumigation or other treatments, if needed,
c. Use approved packaging and shipping materials that are free of soil or other contaminants,
d. Identify the consignment with its scientific (genus and species) name,
e. Meet any extra requirements listed in the IHS.

For those commodities which are regulated to be treated, nine categories of approved biosecurity treatments on fresh fruit and vegetables are eligible. These include methyl bromide fumigation (*MeBr*), dimethoate dip/spray, cold disinfestation, high temperature forced air (*air*), field control programmes (*field*), irradiation, water treatment, heat treatment, fumigation & cold disinfestation. In particular, methyl bromide fumigation is the most frequently adopted treatment. For example, grapes from Australia, Chile, Italy and USA are regulated to have *MeBr* treatment under normal atmospheric pressure with a dosage of 48 gram/cubic meter at above 12^{o}C for 8 hours, due to the spiders (Araneae) inspected (MPI, 2018). In addition, commodities with different pests inspected are regulated to be treated using various phytosanitary treatments. Even though various treatments generally associated with the different level of costs and processes, all commodities that have entered the New Zealand market are supposed to have met the regulations of IHS.

3. Import duration of fresh fruit and vegetables

We first investigate the patterns and differences in import duration across the New Zealand market and commodity groups. Following the prior literature on trade duration and survival, a few of key terms can be defined. First, a trade relationship, here throughout the article, is simply defined as an exporter-commodity pair relationship that a specific commodity being imported by New Zealand from one specific partner/supplier. A sequence (equivalent to a ‘spell’ in some studies) is referred to the period of time with continuous imports of one specific commodity from a specific supplier. Correspondently, the duration or the length of a sequence is then defined as the counted number of years, a foreign supplier has served the New Zealand market with non-zero import flows. Note that each relationship may involve multiple sequences of import. For example, during the period between 1989 and 2017, New Zealand has imported lemons and limes from Lebanon only in 2012 and again from 2015 to 2017. In this case, the trade relationship of lemons and limes between New Zealand and Lebanon includes two sequences over the 1989 to 2017 time period. Another example is that there are non-zero imports of lemons and limes from the U.S. to New Zealand from 1989 to 2017. This time, the U.S.’ export into the New Zealand market had experienced a single sequence of duration. However, one potential issue is that we are not able to identify what happened to it prior to 1989. This type of trade relationship here is defined as a ‘left-censored’ relationship/observation. Besides statistical errors, it is easy to observe that the simple counting approach is unavoidably subject to the issue of censoring, as illustrated by the second example above. Specifically, left censoring is a common problem in survival analysis and tends to be a major drawback of limited dataset covered by the analysis. Left-censored observations are sequences of import flows that began before the first year of the sample period (i.e. 1994 in this study). According to Besedes and Prusa (2017), approximately 30 percent of their observations were left-censored. This requires researchers to have appropriate strategies to deal with the censoring issue. In this study, the final sample consists of 3712 observations, of which 1021 are left-censored. Statistical methods used to correct for them are presented in the later section of methodology and data.

We sort trade relationships of fresh fruit and vegetable imports based on their duration, number of sequences, and commodity categories. Table 1 shows a summary of the distribution of suppliers' survival sequences for New Zealand imports of fresh fruits and vegetables over the period between 1994 and 2017. We focus on the particular time period because the IHS pursuant to the *Biosecurity Act* was issued in 1993.

First, New Zealand fresh fruit and vegetable market exhibits a sign of fragility with a large number of multiple entries and exits. Of the 540 trade relationships over 1994-2017, multiple entries (i.e. a number of sequences greater than and equal to 2) account for around 42 per cent of the total number of trade relationships. On the other hand, the rest 58 per cent of the trade relationships have a single sequence. However, this finding does not lead to a conclusion that these suppliers tend to have a stable and longer-lived relationship with New Zealand. In fact, it leads to the second observation that New Zealand trade relationships in fresh fruit and vegetable are mostly of short length. In particular, the share of trade relationships that have survived no more than two years is dominated in the total, around 70 per cent. Of which 57.6 per cent have ceased after one year of survival. It can be seen that trade relationship with no interruption (i.e. 29-year duration between 1989 and 2017) account only for a small share- 3.9 per cent in the total observed sequences.

Given those findings, the decision of re-entry into New Zealand fresh fruit and vegetable markets seems to depend on the difference between re-entry costs and temporary losses. If exporters are productive enough to pay the entry costs, once their temporary losses are less than the re-entry costs, they would willing to remain in the market. But due to the large uncertainties in extra costs and demand, temporary costs might outweigh the benefits of staying. Therefore, exporters may choose to enter the market for a testing at first and then to exit after learning that they are not able to profit.

Table 2 presents the survival length and number of sequences for each category of commodities. Clearly, New Zealand has established more diversified trade relationships with its foreign suppliers via the import of beans, capsicum, garlic, bananas, dates, coconuts, mangoes and pineapples. In addition, the longest-lived relationships include the import of Brussel sprouts, lettuce, grapes, strawberries, pears, and grapefruit.

Table 1: Distribution of Survival Sequences across Fresh Fruit and Vegetable Import Market, 1994-2017

Multiple Entries across Relationships			Observed Sequence Length					
No. of Sequences	No. of Relationships	Share (%)	Length	No. of Sequences	Share (%)	Length	No. of Sequences	Share (%)
1	315	58.3	1	580	57.6	16	2	0.2
2	104	19.3	2	142	14.1	17	4	0.4
3	52	9.6	3	62	6.2	18	3	0.3
4	35	6.5	4	37	3.7	19	2	0.2
5	19	3.5	5	37	3.7	20	1	0.1
6	12	2.2	6	16	1.6	21	3	0.3
7	3	0.6	7	10	1.0	22	5	0.5
Total	540		8	8	0.8	23	3	0.3
			9	7	0.7	24	2	0.2
			10	8	0.8	25	4	0.4
			11	5	0.5	26	2	0.2
			12	4	0.4	27	2	0.2
			13	5	0.5	28	1	0.1
			14	6	0.6	29	39	3.9
			15	7	0.7			
						Total	1007	

Table 2 Distribution of Survival Sequences across New Zealand Fresh Fruit and Vegetable Import Market by Commodity, 1994-2017

Fresh Vegetables	Sequence Length (years)		No. of	No. of
1994-2017	Mean	Median	Sequences	Relationship
Aggregated data	3.2	1.0	342	177
Product-level aggregation				
070820 Beans	2.7	1.0	51	29
070960 Capsicum	3.5	1.0	43	25
070320 Garlic	3.3	1.0	46	21
070951 Mushrooms	2.4	1.0	28	12
070310 Onions and shallots	2.8	1.0	20	11
070810 Peas	4.3	2.0	28	11
070920 Asparagus	4.2	1.0	14	9
070952 Truffles	3.1	2.0	11	9
070970 Spinach	2.3	1.0	21	9
070700 Cucumbers and gherkins	4.2	1.0	9	8
070200 Tomatoes	3.8	1.0	10	7
070390 Leeks	1.7	1.0	14	6
070190 Potatoes	2.0	1.0	10	5
070410 Cauliflowers and broccoli	4.6	2.0	9	4
070610 Root, carrots and turnips	2.4	1.5	12	4
070519 Lettuce	5.3	2.0	6	3
070420 Brussel sprouts	6.3	1.0	3	2
070511 Cabbage (head) lettuce	1.9	2.0	7	2

Fresh Fruit	Sequence Length (years)		No. of	No. of
1994-2017	Mean	Median	Sequences	Relationship
Aggregated data	4.4	1.0	665	363
Product-level aggregation				
080300 Bananas	5.6	2.0	64	39
080410 Dates	3.6	2.0	94	38
080110 Coconuts	5.0	1.0	73	38
080450 Guavas, mangoes and mangosteens	5.1	2.0	67	33
080430 Pineapples	3.5	1.0	54	28
080420 Figs	4.6	1.0	46	24
080530 Lemons and limes	3.9	1.0	45	23
080510 Oranges	3.5	1.0	26	17
080710 Melons (including watermelons)	3.2	1.0	25	14
080720 Papaws	4.0	2.0	25	14
080520 Mandarins	5.0	1.0	17	10
081040 Cranberries and bilberries	1.7	1.0	20	10
080610 Grapes	8.6	4.0	14	9
080810 Apples	7.3	1.0	15	9
080820 Pears and quinces	7.8	1.5	12	9
080940 Plums and sloes	4.7	1.0	15	9
080540 Grapefruit	6.6	1.0	10	7
081020 Raspberries and blackberries	1.3	1.0	8	7
080920 Cherries	4.3	1.0	7	6
081010 Strawberries	8.4	1.0	7	6
080930 Peaches including nectarines	3.6	1.0	9	4
080440 Avocados	4.0	1.0	4	3
080910 Apricots	5.0	1.0	4	3
081030 Currants and gooseberries	1.0	1.0	4	3

4. Empirical strategies

4.1. Methodology: a discrete-time hazard model

Following Hess and Persson (2012) and Peterson et al. (2017), this article applies a discrete-time hazard model to overcome the potential biases in the most common used continuous-time Cox hazard model in survival analysis and studies. The terms ‘discrete’, opposite to the ‘continuous’, captures the nature of trade durations that observed trade relationships tend to be discrete units of yearly length. Moreover, many trade relationships tend to fall into the same category of equal length. So in a discrete-time framework, hazard rate (or the probability of failure) for grouped survival length years can be estimated using regression models for binary response panel dataset. As illustrated in Hess and Persson (2012), the core of duration analysis is formed by the conditional probability that a particular trade relationship ceases in a set of discrete time intervals $[t_k, t_{k+1}, t_{k+2}, \dots, t_{kmax}]$ and when $k = 1,\ t_k = t_1 = 0$. Let h_{it} be the discrete-time hazard rate, the probability of failure conditional on its survival up to the beginning of the interval and given the covariates included in the regression model can be defined as

$$h_{ik} = P(T_i < t_{k+1} | T_i \geq t_k, x_{ik}) = F(x'_{ik}\beta + \gamma_k) \quad (1)$$

where T_i refers to a non-negative, continuous random variable that measures the survival time of the i_{th} trade relationship. The subscript i here denotes separate sequences of trade (exporter-product) relationships, $i = (1, \dots, n)$. x_{ik} is a set of time-varying covariates, such as GDP per capita and production in our case, γ_k is then a function of time/interval that allows the hazard rate to very across periods. $F(\cdot)$ refers to an appropriate distribution function that ensures $0 \leq h_{ik} \leq 1$ for all i, k. Since the baseline hazard rate is unknown in practice, γ_k is usually incorporated into the empirical model as a set of dummy variables identifying the duration of each sequence.

Introducing y_{ik} be a binary variable that takes the value one if sequence i is observed to terminate during the k_{th} time interval, and zero otherwise. Therefore, the log-likelihood function for the observed observations can be given by

$$ln\mathcal{L} = \sum_{i=1}^{n} \sum_{k=1}^{k_i} [y_{ik} \ln(h_{ik}) + (1 - y_{ik}) \ln(1 - h_{ik})] \quad (2)$$

To estimate the model parameters, it is necessary to specify a functional form for the hazard rate h_{ik}. The estimation later will adopt the common functional specifications, including the probit, logit and cloglog model. In addition, each sequence is assumed to be independent of all other sequences as there might be multiple sequences and dependencies across commodities from the same supplier or across suppliers of the same commodity.

4.2. Model covariates and data

Through incorporating the explanatory variables into the function, our estimated discrete-time hazard model can be defined as

$$y_{xit} = f(duration_{xit}, censoring_{xi}, gravity_{xit}, supply_{xit}, treat_{xit}) \quad (3)$$

where the dependent variable y_{xit} equals one if supplier x ceases a trade sequence of commodity i to New Zealand in time t and zero otherwise, $duration_{xit}$ is the number of years that the current sequence of the i_{th} trade relationship with supplier x has lasted in time t, $censoring_{xi}$ is a dummy variable that equals one if a particular trade relationship is left-censored. As mentioned earlier, the issue of censoring, especially left-censored observations, are one of the major risks that may bias the estimates. To deal with this problem, two strategies will be used during estimation, following Peterson et al. (2017). First, a sequence of six will be assigned to the beginning year of each left-censored trade relationship. That is because we observe the sequences of a large number of trade relationships were greater than 24 years (from 1994 to 2017) as they were continuously exported to New Zealand since 1989. Therefore, for a left-censored observation, we would expect that it will be less affected by an extra year of service than the non-left-censored sequences of service. This is based on the assumption that a decrease in the hazard rate from an additional year of service should diminish. Second, we allow the intercepts and coefficients of the hazard function for sequence duration to vary between the left-censored and non-left-censored observations.

The covariate $gravity_{xit}$ is a set of gravity-type variables including: log of distance in thousand kilometers between the supplier's and New Zealand's capital $(distance_x)$; Common hemisphere dummy (geo_x) that takes one if a particular supplier and New Zealand are in the same hemisphere and zero otherwise; Common language dummy $(language_x)$ that takes the value one if the supplier has the same language as New Zealand has and zero otherwise; Common colonial history dummy $(colonial_x)$ that equals one if the supplier share the same colonial history with New Zealand and zero otherwise; Free trade agreement dummy FTA_{xt} that takes the value one if a particular supplier has FTA in force with New Zealand at sequence/time t; GDP per capita (gdp_{xt}) of suppliers in thousands U.S. dollars; Bilateral real effective exchange rate $(reer_{xt})$ represents the nominal exchange rate between New Zealand dollar and its trading partner's currency adjusted by the respective consumer price indices.

The covariate $supply_{xit}$ denotes a set of variables that represent the supply-side measures of particular commodia ty. It includes New Zealand's total weight of production of a given commodity in metric tons $(production_{it})$, the total number of suppliers of a given commodity in time t $(origins_{xit})$, and the number of markets to which the supplier ships the given commodity for every year of the sequence $(destinations_{xit})$.

The last covariate $treat_{xit}$ in model (3) refersthe to a series of New Zealand commonly used phytosanitary treatments listed in the IHS and regulated by the MPI. This gives us nine dummy variables- methyl bromide fumigation $(mebr_{xit})$, dimethoate dip/spray $(dimethoate_{xit})$, cold disinfestation $(cold_{xit})$, high temperature forced air (air_{xit}), field control programmes $(field_{xit})$, irradiation $(irradiation_{xit})$, water treatment $(water_{xit})$, heat treatment $(heat_{xit})$, fumigation & cold disinfestation $(combined_{xit})$.

We use the annual import data of New Zealand fresh fruit and vegetables collected from the United Nations Commodity Trade Statistics Database (UN Comtrade) to construct our dependent variable y_{xit} and explanatory variable $duration_{xit}$. Other covariates are constructed using data from various sources, e.g. World Bank's World Development Indicators (WDI), Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), Food and Agriculture Organization of the United Nations (FAO) and New Zealand Ministry for Primary Industries (MPI). Details of variable definitions and sources are shown in Appendix.

5. Empirical analysis

5.1. Estimation results for discrete-time hazard model

Based on prior studies, we include some variables in our analysis that have not previously used. For example, we are able to control for both New Zealand's and suppliers' specific characteristics and the effects of supplier-commodity-specific phytosanitary treatments. Table 3 below provides an overview of all variables and their corresponding sample means and standard deviations. The final sample here is balanced and includes 3712 observations.

Table 3 Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
failed	3712	0.27	0.44	0	1
duration	3712	7.12	6.73	1	28
censoring	3712	0.28	0.45	0	1
distance	3712	9.44	5.22	2.40	19.59
geo	3712	0.39	0.49	0	1
language	3712	0.60	0.49	0	1
colonial	3712	0.58	0.49	0	1
fta	3712	0.28	0.45	0	1
gdp	3712	23.17	20.85	0.09	91.62
reer	3712	3.08	98.81	0.000014	5707.64
production	3712	0.03	0.09	0.000	0.62
origins	3712	8.30	5.61	1	23
destinations	3712	31.46	25.37	1	144
mebr	3712	0.06	0.24	0	1
dimethoate	3712	0.03	0.18	0	1
cold	3712	0.05	0.21	0	1
air	3712	0.01	0.08	0	1
field	3712	0.03	0.16	0	1
irradiation	3712	0.02	0.15	0	1
water	3712	0.02	0.13	0	1
heat	3712	0.05	0.21	0	1
combined	3712	0.01	0.10	0	1
treatments	3712	0.20	0.40	0	1
approved	3712	0.83	0.38	0	1

Following Hess and Persson (2012) and Peterson et al. (2017) and as a comparison, we first estimate the baseline hazard rate function using discrete-time probit, logit and cloglog models. All left-censored observations are controlled and treated specifically using Peterson et al. (2017)'s strategies. In all models, we also include either year or commodity dummy variables to control for the unobserved heterogeneity. Since the coefficients tend to be similar across various estimators, two strategies are adopted to choose between the presented estimation models. First, our appropriate models are given by comparing the differences in the log-likelihood value of models and via the post-estimation diagnostic tests. Second, we restrict our sample data to those observations with scheduled and approved phytosanitary arrangements with New Zealand MPI as an extra model alternative. This allows us to identify the potential and heterogeneous effects of treatments in various groups of the sample.

Prior to the comparison, we first estimate model specifications that include the variables representing the characteristics of import flows (i.e. duration and censoring), the gravity-type impacts and the influence of commodity supplies. We then estimate a full sample with treatment variables as specified in equation (3). The results from the estimations can be found in Table 4. Model (1), (2), (4), (5), (7) and (8) present the estimated coefficients for the models without treatment variables. It is obvious that many of the coefficient signs are consistent with what have been highlighted in previous studies. Specifically, import duration has a significantly negative impact on the hazard rate across all estimators, indicating that longer sequences of import reduce the hazard rate of foreign suppliers. Similarly to the findings in Peterson et al. (2017), we observe that the coefficient of the dummy variable, left-censoring, is consistent with our hypothesis and tends to lower overall hazard rate even more than the duration does. This implies that left-censored trade relationships have a higher possibility of survival than non-left-censored trade relationships. For trade relationships with multiple sequences of service, the hazard rate decreases as prior experience of entry might help re-enter New Zealand fresh fruit and vegetable markets and reduce the extra cost as compared to those had no experience before.

As illustrated in many trade literature, two countries with a shorter geographical distance between them or which share the same location of the hemisphere, common language, or a joint colonial history, are often expected to have a lower cost of trading. It seems reasonable to assume that, everything else being equal, higher trade costs would lead to a vulnerable trade relationship and increase the possibility of exposing to negative external shocks and of failure in foreign markets. Therefore, it is hypothesized that farther distance, opposite geographical location, different language and colonial history increase trade costs and ought to increase the hazard rate. However, our result indicates that distance between New Zealand's and a particular supplier's capital ambiguously affects the hazard rate when the treatment variables were added as the control parameters. Also, in terms of FTA, no significant and negative impact has been found. Despite the marginal inconsistency in the effects of distance and FTA, the coefficients of geographical location, language and colonial history meet our expectation across all estimators.

Further, the supplier's GDP (refers to GDP per capita in context) is included as a proxy for export supply capacity, the corresponding New Zealand's import demand for a particular commodity is captured by the variable- *production*. We expect that greater export supply capacity lowers the hazard whereas more domestic production increases the hazard. This is because the less advanced suppliers with a lower level of export supply capacity produce more homogeneous commodities that are more easily targeted by trade barriers as well as suffering from fluctuations in commodity price. In comparison, the more advanced developing economies are better able to exploit market opportunities via product diversification and differentiation. Unfortunately, this hypothesis is only partially explained and confirmed by the results- New Zealand's domestic production has a significantly positive impact on the hazard while the supplier's GDP tends to positively influence hazard rate. This suggests that New Zealand's trading relationships with relatively larger economies are fragile and less likely to survive in the market. Although this result differs from our hypothesis, it is consistent with Hess and Persson (2011) and Peterson et al. (2017), who also find evidence for a positive relationship between GDP and trade survival. One reason might be the fierce competition across importers in terms of acquiring more differentiated commodities and maintaining a long-run trade relationship with more advanced developing economies. Due to its limited market size, New Zealand is less competitive in maintaining a stable and long-term relationship with larger economies.

Variations in the real exchange rate variables could be another factor which influences New Zealand's import demand and the hazard of trade relationships. It is generally expected that there is a negative relationship between the relative exchange rate and the hazard rate. To control for such impacts we calculate the bilateral real exchange rate between New Zealand and its trading partners. Unsurprisingly, our results confirm that hazard rate is negatively influenced by the real exchange rate across most estimators. This suggests that the New Zealand dollar's appreciation decreases the hazard. Next, we include the number of (supplier's export) destinations and (New Zealand's import) origins as the extra two proxies for export and import diversification. As expected, the effects of the number of destinations are significantly negative. In other words, the supplier's exporting to a large number of markets has a negative impact on the likelihood that a trade relationship with New Zealand ceases. This result may be a partial reflection that suppliers with a more diversified export structure have a better chance to mitigate risks and to maintain a relationship of a given commodity for longer periods of time. Another possible mechanism for this impact could be that exporters that trade with many other countries may have opportunities to learn more experience about how to survive in foreign markets, which would help facilitate and maintain exporting relationship. On the contrary, the number of origins is positively correlated with the hazard rate, suggesting that import diversification leaves pressure on New Zealand's trade relationship and increase the possibility of import failure.

Model (3), (6) and (9) estimate all the parameters including the treatment variables, which are the primary focus of this study. Overall, there are interesting differences in the signs of estimated coefficients for the phytosanitary treatments of New Zealand IHS. First, the result indicates that high temperature forced air (*air*), field control programmes (*field*) and fumigation & cold disinfestation (*combined*) treatment have positive effects on the hazard rate. However, those effects are not statistically different than zero across all three models. Second, the hazard rate tends to be reduced when methyl bromide fumigation (*mebr*), dimethoate, freezing (*cold*), irradiation, hot water dip (*water*) and heat treatment were applied. While not all of them are statistically significant in the specification only the estimated coefficients of methyl bromide fumigation (*mebr*), dimethoate, and hot water dip (*water*) treatment are significantly negative across all estimators. These two findings are inconsistent with previous literature such as Peterson et al. (2017) which finds that the U.S. sanitary and phytosanitary (SPS) treatment requirements have a persistent impact on trade duration and survival.

So far it has described a totally different picture of New Zealand fresh fruit and vegetables import compared to the experience of the U.S. Generally, phytosanitary measures that are required for imports of fresh produce intend to be one important example of non-tariff measures in global trade. However, what we observe in the New Zealand market indicates that these treatments do not act as a 'barrier' while tend to be a 'stimulus' of fresh fruit and vegetables import. On the one hand, it leads us to search for more answers to the role of IHS and phytosanitary measures in New Zealand imports. On the other hand, an important policy question then is not the extent to which treatments act as an impediment or a stimulus to trade, but is if there is an experience threshold in New Zealand market at which treatments no longer have a persistent effect on import. According to Peterson et al. (2013), the estimated threshold experience level is equal to five times for the U.S. market. That is, in order to minimize and avoid the negative influence of treatments, exporters must have been treated five times before the trade-restrictive nature of phytosanitary treatments vanishes. This hypothesis is also reasonable to explain New Zealand's experience since the exporters included in the IHS and have arranged schedules of treatments with MPI are the major trading partners of New Zealand and might be 'self-selected' into the longer-lived trade relationship. If the threshold does exist, these exporters must have met it during their past exports to New Zealand. Therefore, for these exporters/suppliers, no obvious evidence is found that treatments act as a trade barrier.

As we restricted our sample to those observations with approved arrangements only, we basically find the same evidence of a weak and insignificant trade-restrictiveness nature of the treatments. Table 5 presents the detailed estimated results for the restricted sample data. One new and interesting finding is that the estimated coefficient of distance becomes significantly positive across eight estimators in the restricted sample. It partly reflects that distance as a trade barrier plays a more important role in New Zealand's closest trade relationships. When the full sample is used, the influence of distance becomes ambiguous as import diversification was the primary focus of trade policy.

Table 4: Estimation Results for Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Probit	Probit	Probit	Logit	Logit	Logit	Cloglog	Cloglog	Cloglog
duration	-0.805	-0.730	-0.288	-1.392	-1.270	-0.500	-0.787	-0.724	-0.408
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
censoring	-1.060	-0.954	-0.674	-2.41	-2.204	-1.319	-1.394	-1.358	-1.274
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
multiple	-0.275	-0.175	-0.121	-0.442	-0.267	-0.185	0.03	0.163	-0.081
	(0.000)	(0.016)	(0.089)	(0.000)	(0.032)	(0.136)	(0.664)	(0.026)	(0.379)
distance	0.011	0.048	-0.017	0.021	0.084	-0.039	0.031	0.082	-0.09
	(0.288)	(0.000)	(0.881)	(0.235)	(0.000)	(0.849)	(0.003)	(0.000)	(0.574)
geo	0.057	0.142	2.212	0.084	0.235	3.834	0.110	0.197	2.951
	(0.563)	(0.157)	(0.000)	(0.619)	(0.174)	(0.000)	(0.290)	(0.064)	(0.001)
language	-0.098	-0.085	-3.452	-0.126	-0.090	-5.952	-0.151	-0.151	-5.272
	(0.364)	(0.436)	(0.003)	(0.505)	(0.635)	(0.005)	(0.188)	(0.191)	(0.002)
colonial	0.044	-0.032	0.706	0.037	-0.096	1.339	0.115	0.040	1.612
	(0.662)	(0.754)	(0.538)	(0.834)	(0.589)	(0.511)	(0.281)	(0.708)	(0.328)
fta	0.106	0.221	0.370	0.203	0.407	0.635	0.162	0.380	0.360
	(0.238)	(0.018)	(0.002)	(0.197)	(0.012)	(0.002)	(0.074)	(0.000)	(0.017)
gdp	0.004	0.004	0.075	0.006	0.007	0.130	0.006	0.006	0.100
	(0.065)	(0.039)	(0.000)	(0.072)	(0.042)	(0.000)	(0.004)	(0.003)	(0.000)
reer	-0.051	-0.050	-0.209	-0.086	-0.083	-0.376	-0.176	-0.149	-0.233
	(0.197)	(0.214)	(0.065)	(0.204)	(0.225)	(0.083)	(0.002)	(0.006)	(0.163)
production		-0.666	1.159		-1.665	2.110		0.691	2.313
		(0.805)	(0.696)		(0.738)	(0.690)		(0.063)	(0.574)
origins		0.010	0.097		0.020	0.166		0.004	0.116
		(0.540)	(0.000)		(0.478)	(0.000)		(0.586)	(0.000)
destinations		-0.012	-0.021		-0.021	-0.037		-0.018	-0.027
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
mebr			-0.598			-1.212			-1.065
			(0.010)			(0.005)			(0.003)
dimethoate			-1.346			-2.489			-2.052
			(0.017)			(0.035)			(0.055)
cold			-0.176			-0.217			-0.120
			(0.491)			(0.646)			(0.748)
air			0.135			0.426			0.359
			(0.767)			(0.590)			(0.580)
field			0.691			1.231			1.138
			(0.320)			(0.396)			(0.369)
irradiation			-0.231			-0.531			-0.536
			(0.368)			(0.257)			(0.172)
water			-1.082			-1.868			-1.712
			(0.004)			(0.010)			(0.007)
heat			-0.149			-0.196			-0.214
			(0.425)			(0.552)			(0.434)
combined			0.322			0.909			0.890
			(0.517)			(0.322)			(0.225)
Observations	3456	3456	3645	3456	3456	3545	3712	3712	3645
Log-likelihood	-1224.8	-1207.1	-1472.8	-1221.6	-1204.1	-1471.0	-1617.0	-1576.7	-1476.7
Year dummy	Yes	Yes	No	Yes	Yes	No	No	No	No
Commodity dummy	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Supplier dummy	No	No	Yes	No	No	Yes	No	No	Yes
Duration dummy	No	No	No	No	No	No	Yes	Yes	No

Note : P-value are reported in parentheses

Table 5: Estimation Results for Restricted Sample

Variables	(1) Probit	(2) Probit	(3) Probit	(4) Logit	(5) Logit	(6) Logit	(7) Cloglog	(8) Cloglog	(9) Cloglog
duration	-0.471	-0.398	-0.349	-0.822	-1.282	-0.610	-1.114	-1.067	-0.503
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
censoring	-0.744	-0.612	-0.674	-1.472	-2.394	-1.307	-2.422	-2.327	-1.259
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
multiple	-0.191	-0.125	-0.154	-0.313	-0.288	-0.245	-0.257	-0.184	-0.149
	(0.012)	(0.120)	(0.060)	(0.018)	(0.060)	(0.086)	(0.020)	(0.106)	(0.173)
distance	0.420	0.39	0.382	0.723	0.047	0.681	-0.003	0.032	0.547
	(0.000)	(0.000)	(0.000)	(0.000)	(0.091)	(0.000)	(0.836)	(0.118)	(0.000)
geo	4.382	3.375	3.338	7.643	0.144	6.009	0.029	0.112	5.046
	(0.000)	(0.000)	(0.000)	(0.000)	(0.498)	(0.000)	(0.853)	(0.481)	(0.000)
language	-5.977	-5.623	-5.502	-10.460	-0.252	-9.936	-0.135	-0.124	-8.582
	(0.000)	(0.002)	(0.003)	(0.000)	(0.353)	(0.004)	(0.522)	(0.559)	(0.003)
colonial	-3.790	-3.131	-2.979	-6.429	-0.091	-5.278	-0.022	-0.093	-4.249
	(0.000)	(0.000)	(0.000)	(0.000)	(0.734)	(0.000)	(0.916)	(0.653)	(0.000)
fta	0.373	0.454	0.468	0.582	0.299	0.800	0.124	0.224	0.545
	(0.002)	(0.000)	(0.000)	(0.006)	(0.096)	(0.001)	(0.331)	(0.091)	(0.002)
gdp	0.098	0.088	0.089	0.169	0.006	0.156	0.004	0.005	0.127
	(0.000)	(0.000)	(0.000)	(0.000)	(0.128)	(0.000)	(0.136)	(0.115)	(0.000)
reer	-0.389	-0.319	-0.337	0.610	0.023	-0.546	-0.027	0.001	-0.369
	(0.003)	(0.018)	(0.014)	(0.009)	(0.882)	(0.027)	(0.814)	(0.990)	(0.063)
production		0.830	0.464		-3.894	1.057		-3.398	0.602
		(0.778)	(0.878)		(0.458)	(0.852)		(0.442)	(0.897)
origins		0.103	0.097		0.038	0.169		0.028	0.120
		(0.000)	(0.000)		(0.267)	(0.000)		(0.300)	(0.000)
destinations		-0.021	-0.021		-0.014	-0.038		-0.01	-0.028
		(0.000)	(0.000)		(0.004)	(0.000)		(0.006)	(0.000)
mebr			-0.589			-1.195			-1.061
			(0.015)			(0.007)			(0.004)
dimethoate			-1.271			-2.350			-1.960
			(0.028)			(0.051)			(0.072)
cold			-0.185			-0.226			-0.175
			(0.475)			(0.636)			(0.642)
air			0.131			0.416			0.369
			(0.777)			(0.605)			(0.573)
field			0.730			1.355			1.242
			(0.303)			(0.357)			(0.334)
irradiation			-0.274			-0.612			-0.571
			(0.294)			(0.198)			(0.148)
water			-1.031			-1.771			-1.556
			(0.008)			(0.018)			(0.019)
heat			-0.157			-0.185			-0.161
			(0.425)			(0.597)			(0.573)
combined			0.366			0.994			1.008
			(0.466)			(0.284)			(0.173)
Observations	3062	3062	3062	3062	2868	3062	2868	2868	3062
Log-likelihood	-1249.6	-1191.6	-1176.8	-1244.5	-918.7	-1176.1	-992.6	-917.9	-1177.6
Year dummy	No	No	No	No	Yes	No	Yes	Yes	No
Commodity dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Supplier dummy	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes

Note : P-value are reported in parentheses

5.2. Predicted probability of failure

5.2.1. Marginal effects by explanatory variable

In this section, we calculate and predict the marginal effects for each independent variable on the conditional probability that the dependent variable equals one (i.e. when trade relationship failed). This would give us some evidence of how much the hazard rate will change as the independent variables vary across all estimators. As reported in Table 6, there are few interesting differences between the results from the full sample and restricted sample estimations. This can be regarded as an important robustness checking test. Generally, the control for treatment variables greatly affect the marginal effects of the other independent variables on the probability of failure. First, when the treatment variables are included, the sign of the marginal effects of few variables such as multiple sequences, distance, hemisphere location and joint colonial history become their opposites across the estimators using full observations. Second, the extent to which the probability of failure increases or decreases varies as the treatments are under control. It makes sense as all of the estimators applied to estimate our discrete-time hazard function are non-linear in the parameters, the marginal effects of an independent variable on the hazard rate will depend not only on the estimated coefficient for that variable and its standard error but also on the variations in all other independent variables (Peterson et al., 2017).

Specifically, the impacts of sequence duration on the conditional likelihood of failure are lower for the observations/relationships with approved treatment schedules when treatment variables are controlled in the model. In particular, duration reduces the conditional probability of failure by around 10 per cent on the probit model. However, the probability of exit then increases by around 4 per cent as treatment variables are used. In comparison, duration tends to lower the conditional probability of exit by around 7.5 per cent in the restricted sample.

For the impact of left-censoring, results indicate that left-censored trade relationship decreases the conditional probability of failure by an average of 16 per cent. In other words, trade relationships that were continuously exported to New Zealand since 1989 (or even earlier) have 16 per cent lower probability of exit in New Zealand fresh fruit and vegetable markets. Horizontally, suppliers with approved treatment schedules tend to suffer from a higher possibility (around 1 to 2 per cent) of failure than those without. Next, we consider the influence of multiple sequences of trade. Not surprisingly, multiple entries/or sequences of export to New Zealand significantly reduce the conditional probability of exit by approximately 2-3 per cent. Comparing the results for the full sample model with the results for the restricted sample model, the estimated marginal effects for a common language, FTA dummy, GDP and real exchange rate are very similar and consistent with previous observations in Table 4 and 5. First, common language reduces the conditional probability of failure by an average of 0.51. Also, FTA dummy and GDP both increase the possibility of failure. In particular, the positive effects of GDP are very small (on average 0.01) but statistically significant. Real exchange rate, on the other hand, significantly lower the probability of failure by 3-6 per cent.

In terms of the import and export diversification effects, the results remain similar. Although influencing the probability of exit positively, the predicted marginal effects of production tend to be statistically insignificant across all estimators in both full and restricted sample. A number of origins significantly increases the competition in the New Zealand market and the possibility of failure by around 2 per cent only if the treatment variables are controlled in the model. In contrast, the impact of the number of supplier’s export destinations is statistically significant across all estimators but with a small value of coefficient (0.3-0.5 per cent).

Further, there are no obvious qualitative differences between the full and restricted sample estimators in the marginal effects of treatment variables. For instance, methyl bromide fumigation (*mebr*), dimethoate and hot water dip (*water*) contribute to the most significant treatments influencing New Zealand’s trade relationship. Suppliers that have experienced those treatments are 11 to 20 per cent less likely to cease their exports of fresh fruit and vegetables to New Zealand. Despite the possible existence of experience threshold, treatment costs could be one of the determinants. As explained in Ferrier (2010), those treatments generally require a lower cost with an average of approximately $0.01 per pound of the treated commodity. Since all treatments required will be carried out at owners risk and expense, a low-cost pest mitigation option is expected to greatly reduce the cost of trade and increase the possibility of survival. On the contrary, treatments such as irradiation, cold treatment and field control programmes might be relatively costly as the process of treatment is more complicated (e.g. in-field controls programmes throughout the whole production season) and requires more inputs such as particular containers. Therefore, the effect of these treatments on the conditional possibility of exit is likely to be ambiguous and influenced by other partner-specific characteristics. Same as what has been observed in Table 4 and 5, the treatments act as barriers of trade only include the high temperature forced air (*air*), field control programmes (*field*) and fumigation & cold disinfestation (*combined*) treatment. However, those impacts are statistically insignificant at the 5 percent significance level.

Table 6: Marginal Effects on Probability of Failure

Variables	Full sample				With approved arrangements			
	Probit	Probit	Logit	Logit	Probit	Probit	Logit	Logit
duration	-0.104	-0.065	-0.111	-0.065	-0.095	-0.075	-0.101	-0.074
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
censoring	-0.160	-0.153	-0.193	-0.171	-0.149	-0.145	-0.178	-0.159
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
multiple	0.009	-0.027	0.010	-0.024	0.022	-0.033	0.022	-0.030
	(0.558)	(0.089)	(0.483)	(0.135)	(0.175)	(0.059)	(0.157)	(0.085)
distance	0.010	-0.004	0.010	-0.005	0.008	0.082	0.008	0.083
	(0.000)	(0.881)	(0.000)	(0.849)	(0.000)	(0.000)	(0.000)	(0.000)
geo	-0.008	0.501	-0.002	0.496	0.001	0.716	0.008	0.732
	(0.648)	(0.000)	(0.925)	(0.000)	(0.970)	(0.000)	(0.675)	(0.000)
language	-0.033	-0.781	-0.028	-0.770	-0.052	-1.180	-0.049	-1.210
	(0.145)	(0.003)	(0.207)	(0.005)	(0.079)	(0.003)	(0.104)	(0.004)
colonial	-0.020	0.160	-0.018	0.173	0.010	-0.639	0.012	-0.643
	(0.357)	(0.538)	(0.400)	(0.511)	(0.747)	(0.000)	(0.689)	(0.000)
fta	0.059	0.084	0.060	0.082	0.047	0.100	0.048	0.097
	(0.001)	(0.002)	(0.001)	(0.002)	(0.008)	(0.000)	(0.007)	(0.000)
gdp	0.002	0.017	0.001	0.017	0.002	0.019	0.001	0.019
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
reer	-0.041	-0.047	-0.036	-0.049	-0.062	-0.072	-0.056	-0.067
	(0.000)	(0.065)	(0.001)	(0.083)	(0.000)	(0.014)	(0.000)	(0.027)
production	0.133	0.262	0.114	0.273	0.064	0.100	0.043	0.129
	(0.082)	(0.696)	(0.134)	(0.690)	(0.405)	(0.878)	(0.573)	(0.852)
origins	0.001	0.022	0.001	0.022	0.0003	0.021	0.0001	0.021
	(0.299)	(0.000)	(0.452)	(0.000)	(0.797)	(0.000)	(0.962)	(0.000)
destinations	-0.004	-0.005	-0.003	-0.005	-0.003	-0.005	-0.003	-0.005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
mebr		-0.119		-0.134		-0.110		-0.123
		(0.002)		(0.001)		(0.004)		(0.001)
dimethoate		0.211		-0.214		-0.189		-0.192
		(0.000)		(0.000)		(0.000)		(0.000)
cold		-0.038		-0.027		-0.038		-0.027
		(0.473)		(0.636)		(0.454)		(0.625)
air		0.032		0.058		0.029		0.054
		(0.773)		(0.606)		(0.784)		(0.623)
field		0.175		0.178		0.180		0.191
		(0.354)		(0.429)		(0.348)		(0.402)
irradiation		-0.050		-0.064		-0.055		-0.068
		(0.341)		(0.219)		(0.257)		(0.154)
water		-0.182		-0.179		-0.163		-0.159
		(0.000)		(0.000)		(0.000)		(0.000)
heat		-0.033		-0.025		-0.033		-0.022
		(0.410)		(0.543)		(0.407)		(0.588)
combined		0.078		0.129		0.085		0.136
		(0.540)		(0.356)		(0.496)		(0.328)

Note : P-value are reported in parentheses

5.2.2. Marginal effects by commodity

To observe the commodity-specific probability of failure, we compute the average marginal effects for each commodity across observations except HS 081030 currants and gooseberries due to unavailable computation. Table 7 presents the estimated results and differences in both full and restricted sample. Among the categories of fresh vegetables, the probability of failure is 54 per cent of relationships in tomatoes, 42 per cent of relationships in leeks, 40 per cent of relationships in cucumbers and gherkins and so forth. In comparison, suppliers that export truffles, capsicum and lettuce to New Zealand are less likely to survive shortly. Especially, the probability of exit comes from only 3 per cent of the trade relationships in truffles. That is to say, suppliers of truffles are less likely to fail in the New Zealand market. Comparing with the imports of other vegetables, such as capsicum, the probability of exit is three times lower associated with the imports of truffle. This can partly be explained by the extremely perishable nature and unique requirements of a consignment of truffle itself. Thus, it is possible that truffle suppliers have an incentive to continue the export to avoid the extra costs of re-entry into New Zealand once a trade relationship is established. On the contrary, imports of tomato, tend to experience more fierce competition. Failed trade relationships of New Zealand such as with UK and China are less likely to re-enter the market due to the remote distance. According to our statistics for tomato import, only Australia survive in recent years since 2013.

Among the categories of fresh fruit, the likelihood of failure primarily comes from 44 per cent of peach & nectarine, 37 per cent of cranberry & bilberry and 33 per cent of apricot suppliers. Fruit suppliers that are less likely to exit if exporting dates, bananas and guavas & mangoes to New Zealand. In those three categories, no more than 3 per cent of the suppliers are expected to cease their relationship with New Zealand. Horizontally, imports of fresh fruit on average are less likely to suffer from failure than imports of fresh vegetable due to the differences in their perishable nature.

Using the restricted sample, it is surprising that a higher likelihood of failure is observed at the commodity-level. Most categories of fresh fruit are predicted to suffer from a 3 to 17 per cent higher probability of failure as the sample is restricted to those with the approved phytosanitary arrangement only. Similarly, among the categories of fresh vegetable, 1 to 19 per cent higher possibility has been discovered. Those findings are different from what have been found previously and do indicate some evidence of persistent effects of treatment on import survival. However, what we need to emphasize is the significant commodity-heterogeneities that phytosanitary treatments might only influence import survival at commodity-level as all observations are restricted to those with approved arrangements with MPI. When import from New Zealand’s close partners with treatments is compared to those from pest-free areas and had no pests or diseases inspected and regulated, the impact of treatments on the probability of failure tends to be ambiguous and determined by the sample size of regulated partners.

Table 7: Marginal Effects by Commodity

Fresh Vegetables	Probit Full sample		Probit Approved	
070200 Tomatoes	0.540	(0.012)	0.632	(0.001)
070390 Leeks	0.416	(0.008)	0.580	(0.000)
070700 Cucumbers and gherkins	0.403	(0.037)	0.485	(0.004)
070511 Cabbage (head) lettuce	0.296	(0.066)	0.378	(0.008)
070610 Root, carrots and turnips	0.295	(0.026)	0.392	(0.000)
070310 Onions and shallots	0.242	(0.252)	0.383	(0.106)
070920 Asparagus	0.234	(0.039)	0.315	(0.001)
070420 Brussel sprouts	0.181	(0.167)	0.296	(0.044)
070820 Beans	0.171	(0.027)	0.234	(0.000)
070970 Spinach	0.167	(0.063)	0.229	(0.000)
070951 Mushrooms	0.156	(0.056)	0.213	(0.001)
070410 Cauliflowers and broccoli	0.149	(0.093)	0.232	(0.005)
070320 Garlic	0.145	(0.039)	0.227	(0.000)
070190 Potatoes	0.143	(0.669)	0.302	(0.558)
070810 Peas	0.132	(0.057)	0.212	(0.000)
070519 Lettuce	0.109	(0.157)	0.166	(0.031)
070960 Capsicum	0.095	(0.067)	0.149	(0.000)
070952 Truffles	0.032	(0.263)	0.060	(0.131)

Fresh Fruit	Probit Full sample		Probit Approved	
080930 Peaches including nectarines	0.442	(0.009)	0.555	(0.000)
081040 Cranberries and bilberries	0.369	(0.012)	0.446	(0.000)
080910 Apricots	0.325	(0.067)	0.442	(0.007)
080940 Plums and sloes	0.318	(0.025)	0.438	(0.001)
080710 Melons (including watermelons)	0.307	(0.010)	0.408	(0.000)
081020 Raspberries and blackberries	0.295	(0.137)	0.275	(0.139)
080540 Grapefruit	0.282	(0.033)	0.374	(0.001)
080510 Oranges	0.277	(0.016)	0.406	(0.000)
081010 Strawberries	0.264	(0.075)	0.370	(0.008)
080920 Cherries	0.260	(0.068)	0.326	(0.014)
080520 Mandarins	0.239	(0.028)	0.316	(0.000)
080810 Apples	0.214	(0.581)	0.401	(0.428)
080440 Avocados	0.204	(0.164)	0.298	(0.054)
080820 Pears and quinces	0.143	(0.075)	0.236	(0.001)
080720 Papaws	0.126	(0.070)	0.188	(0.001)
080430 Pineapples	0.097	(0.064)	0.182	(0.000)
080530 Lemons and limes	0.065	(0.098)	0.120	(0.004)
080610 Grapes	0.057	(0.651)	0.149	(0.551)
080420 Figs	0.034	(0.140)	0.051	(0.027)
080110 Coconuts	0.023	(0.153)	0.038	(0.020)
080450 Guavas, mangoes and mangosteens	0.021	(0.165)	0.044	(0.020)
080300 Bananas	0.018	(0.178)	0.033	(0.017)
080410 Dates	0.011	(0.198)	0.041	(0.026)

Note : P-value are reported in parentheses

5.2.3. Marginal effects by treatment and sequence

To compute the predicted probability of failure given various treatments and control for the impacts of a particular sequence of survival, we split the multiple sequence variable into four dummy variables- second, third, fourth and fifth sequence. Note that the fifth sequence of trade summarizes the trade relationships that have entered the New Zealand market for at least five times. As shown in Table 8, holding all variables at their mean values, the probability of failure is around 0.02 among those who receive methyl bromide fumigation (*mebr*) treatment, while is 0.07 among those who do not receive the treatment. Imports with dimethoate treatment, in contrast, have the least possibility of failure of 0.002-0.004. Further, the possibility of exit is less influenced by other treatments such as freezing (*cold*), irradiation, and heat. With or without these three treatments do not change the conditional probability largely. Same as the findings in previous sections, high temperature forced air (*air*), field control programmes (*field*) and fumigation & cold disinfestation (*combined*) treatment greatly increase suppliers' probability of failure. In particular, field control programmes (*field*) treatment nearly triple the average probability of failure across all sequences. The doubled possibility of failure is also found when fumigation & cold disinfestation (*combined*) treatment is applied.

Table 8 Marginal Effects by Treatment and Sequence

		Sequence							
Treatments		2nd		3rd		4th		5th	
mebr	without	0.076	(0.056)	0.064	(0.077)	0.072	(0.085)	0.093	(0.085)
	with	0.022	(0.237)	0.017	(0.261)	0.020	(0.263)	0.028	(0.265)
dimethoate	without	0.077	(0.005)	0.065	(0.076)	0.073	(0.084)	0.094	(0.084)
	with	0.003	(0.599)	0.002	(0.614)	0.002	(0.610)	0.004	(0.600)
cold	without	0.072	(0.059)	0.060	(0.080)	0.068	(0.089)	0.088	(0.089)
	with	0.051	(0.192)	0.042	(0.219)	0.048	(0.224)	0.063	(0.214)
air	without	0.071	(0.060)	0.059	(0.081)	0.067	(0.090)	0.087	(0.090)
	with	0.092	(0.293)	0.078	(0.317)	0.087	(0.313)	0.111	(0.290)
field	without	0.068	(0.062)	0.057	(0.084)	0.065	(0.093)	0.084	(0.093)
	with	0.217	(0.314)	0.191	(0.340)	0.209	(0.329)	0.251	(0.295)
irradiation	without	0.071	(0.059)	0.060	(0.080)	0.068	(0.089)	0.088	(0.089)
	with	0.047	(0.205)	0.039	(0.230)	0.044	(0.240)	0.059	(0.231)
water	without	0.073	(0.057)	0.061	(0.078)	0.069	(0.087)	0.090	(0.087)
	with	0.006	(0.454)	0.004	(0.473)	0.005	(0.473)	0.008	(0.464)
heat	without	0.072	(0.059)	0.060	(0.080)	0.068	(0.089)	0.088	(0.089)
	with	0.054	(0.142)	0.045	(0.168)	0.051	(0.172)	0.067	(0.169)
combined	without	0.070	(0.060)	0.059	(0.081)	0.067	(0.090)	0.086	(0.091)
	with	0.126	(0.283)	0.108	(0.308)	0.120	(0.302)	0.150	(0.275)

Note : P-value are reported in parentheses

Vertically, all relationships are less likely to fail if they are in the third sequence of trade or if they have two sequences of export experience in the New Zealand market previously. Overall, the estimated marginal effects of treatments are one per cent lower in the third sequence. This partly reflects the hypothesis discussed previously that an experience threshold might exist as the suppliers subject to treatments continuously.

In the case of New Zealand, the diminishing impact of treatments on import survival is also observed. However, as more entries occur, the same suppliers again may suffer from a higher probability of failure if they have experienced more than five sequences of export to New Zealand. It reveals a U-shaped relationship between the effect of treatments and the failure of trade and a fragile nature of New Zealand trade relationships in fresh fruit and vegetable. Therefore, suppliers might be able to deal with the trade costs at the initial stage but after entering the market and surviving a few years, the cost of regulating these commodities might outweigh the welfare gains from the exports. As a result, we could see there are a large number of short-lived trade relationships with numerous entries and exists in the New Zealand market.

6. Conclusion

In this paper, we provide evidence for the survival of New Zealand importers of fresh fruit and vegetables from 1989 to 2017 in a sample of New Zealand's 87 trading partners. Most importers have encountered survival difficulties, as in many other areas in the world. Overall, trade relationships in this particular market show a short-lived nature with frequent entries and exits. First, trade relationships with multiple sequences account for a large proportion of around 42 per cent in the total 540 trade relationships. Of which 3 trade relationships even have attempted to enter the New Zealand market for 7 times. Second, more than 70 per cent of the sequences of trade had survived no more than two years. We find that this pattern varies across different categories of commodities. Fresh fruit, on average, has more diversified origins of import and survives one year longer than fresh vegetables, which is explained by the differences in their perishable nature.

We also analyze the determinants of the survival of these trade relationships. We find that duration, multiple entries, GDP per capita, number of import origins and number of export destinations explain most of the variation in the survival of fresh fruit and vegetables import of New Zealand. This is consistent with the effects found in other trade studies and indicating that import survival is mainly driven by past experience, economic size of and competition among suppliers. Therefore, an importer with accumulated experience and comparative advantage is more likely to survive in the New Zealand market. Later estimation of the impacts of phytosanitary treatments suggests that the estimated experience threshold which helps importers better survive in the market and less affected by phytosanitary regulations and treatments is 3 sequences of trade. This partly reveals a U-shaped pattern in the relationship between the effects of phytosanitary treatments and import of fresh fruit and vegetables. However, we do not find evidence to confirm our hypothesis that those treatments have persistent effects on imports. When we control for product heterogeneities we find that imports from those economies with pre-entry arrangements of treatments with MPI suffer from a higher probability of failure. This implies that phytosanitary regulations might restrict import only at the product-level. When we treat different products homogeneously in our full sample, trade-restrictiveness nature of these treatments diminishes and tends to be insignificant.

These key results entail some relevant considerations and policy implications. First, given the short-lived nature of trade relationships, investigations in trade flows and volumes are unable to uncover the important role of duration and multiple entries and exits in trade relationships. We are persuaded that trade has great benefit to nearly every party involved. However, it seems that what currently more urgent is no longer how to enter a market. Instead, what really important is helping our business, either importers or exporters, translate their market access opportunities into competitive survival and success against businesses from other economies. Second, phytosanitary measures as a common example of non-tariff barriers, in our case, only show weak and statistically insignificant effects on imports. This would make the fierce debate about the real effect of phytosanitary regulations, especially in the fresh fruit and vegetables market. Given the surprising results, we need to be more cautious when referring to these treatments as 'barriers' to New Zealand trade as we are unable to investigate importers have not been approved by MPI to enter New Zealand market as a preferable reference group. Therefore, future research that could include those particular importers in its sample might provide further evidence of the impacts of phytosanitary treatments on an exporter's decision to enter the New Zealand market. Third, there is also a lesson for New Zealand exporters as they might encounter the similar sanitary and phytosanitary regulations when entering foreign markets. Given our estimates of U-shaped patterns in the trade-restrictiveness nature of phytosanitary treatments, exporters are required to accumulate their experience of entry until the effects marginally or no longer influence their market success. Fourth, governments including New Zealand that eager to maximize the benefits from imports might, therefore, consider supporting a stable business environment first. It is clear whether the government can maintain a healthy and longer-lived trade relationship with partners plays the role in pushing the country's trade composition toward its comparative advantage.

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Appendices

List of Fresh Fruit and Vegetables Commodity Codes (HS 1992)

HS0 code	*Fresh Vegetables*	**HS0 code**	*Fresh Fruits*
070190	Potatoes	080110	Coconuts
070200	Tomatoes	080300	Bananas
070310	Onions and shallots	080410	Dates
070320	Garlic	080420	Figs
070390	Leeks	080430	Pineapples
070410	Cauliflowers and broccoli	080440	Avocados
070420	Brussel sprouts	080450	Guavas, mangoes and mangosteens
070511	Cabbage (head) lettuce	080510	Oranges
070519	Lettuce	080520	Mandarins
070610	Root, carrots and turnips	080530	Lemons and limes
070700	Cucumbers and gherkins	080540	Grapefruit
070810	Peas	080610	Grapes
070820	Beans	080710	Melons (including watermelons)
070920	Asparagus	080720	Papaws
070951	Mushrooms	080810	Apples
070952	Truffles	080820	Pears and quinces
070960	Capsicum	080910	Apricots
070970	Spinach	080920	Cherries
		080930	Peaches including nectarines
		080940	Plums and sloes
		081010	Strawberries
		081020	Raspberries and blackberries
		081030	Currants and gooseberries
		081040	Cranberries and bilberries

List of Partner Economies

Code	*Country Name*	**Code**	*Country Name*	**Code**	*Country Name*
4	Afghanistan	348	Hungary	643	Russian Federation
12	Algeria	699	India	882	Samoa
16	American Samoa	360	Indonesia	682	Saudi Arabia
36	Australia	364	Iran	694	Sierra Leone
48	Bahrain	368	Iraq	702	Singapore
50	Bangladesh	376	Israel	703	Slovakia
56	Belgium	381	Italy	90	Solomon Islands
68	Bolivia	392	Japan	706	Somalia
76	Brazil	400	Jordan	710	South Africa
100	Bulgaria	404	Kenya	724	Spain
124	Canada	414	Kuwait	144	Sri Lanka
140	Central African Rep.	422	Lebanon	752	Sweden
152	Chile	450	Madagascar	757	Switzerland
156	China	458	Malaysia	760	Syria
170	Colombia	484	Mexico	764	Thailand
184	Cook Islands	504	Morocco	768	Togo
196	Cyprus	508	Mozambique	772	Tokelau
208	Denmark	528	Netherlands	776	Tonga
218	Ecuador	540	New Caledonia	780	Trinidad and Tobago
818	Egypt	579	Norway	788	Tunisia
242	Fiji	512	Oman	792	Turkey
246	Finland	586	Pakistan	804	Ukraine
251	France	591	Panama	784	United Arab Emirates
258	French Polynesia	600	Paraguay	826	United Kingdom
583	FS Micronesia	604	Peru	842	USA
276	Germany	608	Philippines	548	Vanuatu
300	Greece	616	Poland	704	Viet Nam
320	Guatemala	634	Qatar	894	Zambia
344	Hong Kong	410	Rep. of Korea	716	Zimbabwe

List of Variables and Data Sources

Variables	**Definition and sources**
Trade duration	Length of trade sequence in years.
	Constructed using the UN Comtrade data
Gravity-type variables	
Distance	Log of distance in thousand km between New Zealand's and a particular supplier's capital city.
	Data from CEPII, http://www.cepii.fr
Common hemisphere dummy	Takes the value one if a supplier is in the southern hemisphere.
	Data from CEPII, http://www.cepii.fr
Common language dummy	Takes the value one if a supplier speak the same language as New Zealand.
	Data from CEPII, http://www.cepii.fr
Common colonial history dummy	Takes the value one if a supplier had the same colonial history as New Zealand had.
	Data from CEPII, http://www.cepii.fr
FTA dummy	Takes the value one if a supplier has signed FTA with New Zealand.
	Constructed using the MFAT information
Total import value	The total value of imports by NZ for the given product and every year of the spell.
	Constructed using the UN Comtrade data
FTA dummy	Takes the value one if the trading countries have an signed FTA in force.
	To be constructed using the WTO and national info
GDP per capita	A given supplier's GDP per capita in thousand US dollars.
	Data from the World Bank’s World Development Indicators (WDI) database
Bilateral real exchange rate	Nominal exchange rate (importer currency/exporter currency) adjusted by the respective consumer price indices and normalized by the average real exchange rate of all exporting countries against the importing country.
	Constructed using US exchange rates and national consumer price indices from the World Bank’s WDI.
Supply-side variables	
Production	New Zealand’s total weight of production of a given commodity in metric tones (MT).
	Data from FAO, http://www.fao.org
Number of origins	The number of suppliers of a given commodity for every year of the sequence.
	Constructed using the UN Comtrade data
Number of destinations	The number of markets to which the supplier ships the given commodity for every year of the sequence.
	Constructed using the UN Comtrade data
Phytosanitary treatments	
Import Health Standards (IHS) treatments	Various treatments/measures to prevent entry into NZ market.
	Constructed using New Zealand Ministry for Primary Industries (MPI) info, http://www.mpi.govt.nz