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New Zealand Kiwifruit Export Performance:

Market Analysis and Revealed Comparative Advantage

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Abstract

This paper investigates the spectacular and successful growth of New Zealand kiwifruit production and exports between 1984 and 2009. It explores the evolution, current status, future prospects and challenges facing the industry where more than 90 percent of the output is exported. The study includes a statistical analysis of the production and consumption of kiwifruit in New Zealand and other countries, with a particular focus on Asia. The product life-cycle model is used to examine the pattern of evolution of New Zealand's kiwifruit industry while revealed comparative advantage methodology is used to determine whether New Zealand has a comparative advantage in kiwifruit. Finally, econometric analysis is employed to identify and test the strength of key determinants of kiwifruit exports. Empirical analysis suggests that domestic and trading partner incomes, market size and distance are key determinants of kiwifruit export performance.

Key Words

kiwifruit
Zespri
exports
green kiwifruit, gold kiwifruit
product life cycle
horticulture; agriculture

JEL Classification

D91; Q13; Q18

1. Introduction

In the 30 years from 1990 to 2010, the New Zealand kiwifruit industry developed from a marginal activity to a major export industry. By the 1990s, kiwifruit was being sold to a wide market that included Western Europe, North America and Asia. This growth has continued as the commercialisation of a new variety provided new opportunities.

This paper examines the evolution of New Zealand's kiwifruit industry. It discusses the determinants of kiwifruit export growth and the major challenges that confront the industry, particularly in the export market. Through the use of models and methodologies drawn from trade theory and international business, the study seeks to better understand the development and prospects for the kiwifruit industry. One of the models, the revealed comparative advantage methodology, is used to establish whether New Zealand has a comparative advantage in kiwifruit production and export. Another, the product life-cycle model, is used to examine the evolution of kiwifruit, both the green and the gold varieties. Finally, using selected hypotheses drawn from trade and international business theories, regression analysis is used to identify the key determinants of kiwifruit exports.

2. Kiwifruit and its Attributes

Kiwifruit is a high-quality fruit known for its taste and health attributes. Sliced kiwifruit has long been used as dessert fruit. In many markets kiwifruit is now consumed both as a breakfast fruit and a lunch fruit. It has been suggested that its health characteristics have been critical in its acceptance by consumers.

Paul Lachance (California Kiwifruit Commission 2007) evaluated the nutrient density of 27 of the most commonly consumed fruits. He found out that kiwifruit was one of the most nutrient-dense of all fruits, followed by papaya, mango and orange. His study also revealed that kiwifruit has the highest level of vitamin C (almost twice that of an orange) and magnesium, a limited nutrient in the diet which is important for cardiovascular health.

Kiwifruit contains antioxidants - vitamins and phytochemicals - called flavonoids that may have the power to neutralise unstable molecules called 'free radicals'. Free radicals are thought to be linked to chronic disease, cancer and aging. A recent study conducted by the USDA's Arkansas Children's Nutrition Centre showed that antioxidants in certain fruits and berries are more efficiently metabolised and absorbed into the bloodstream than others. A study comparing kiwifruit, red grapes and strawberries showed the antioxidants in kiwifruit to be the most easily absorbed by the body (Prior *et al.* 2007).

Kiwifruit contains vitamins, minerals and phytochemicals that are known to be important in the functioning of the immune system. A study conducted by scientists at Bioactives

Research New Zealand showed that mice consuming kiwifruit extract had an enhanced immune response to two types of vaccination when compared to a control group. Higher levels of immunoglobulins (antibodies) were produced against the vaccinations in blood and surface cells as well as higher levels of protective innate immunity cells (Hunter *et al.* 2008).

It is also claimed that kiwifruit has laxative effects, making it an ideal dietary supplement especially for elderly people who suffer from constipation (Rush *et al.* 2002). Research conducted by the University of Oslo has also revealed that consuming two to three kiwifruits a day has the effect of thinning the blood, thus reducing clotting and lowering fat that can cause blockage. In short, kiwifruit consumption has similar effects to the daily dosage of aspirin which is often recommended by physicians to improve heart health (Rush *et al.* 2002). A Rowett Research Institute study showed that eating kiwifruit daily can provide substantial protection against the kind of DNA damage that may cause cancer (California Kiwifruit Commission 2006.)

3. The Beginning of the Kiwifruit Industry in New Zealand

Many people, especially in North America, South America and Europe refer to the fruit simply as 'kiwi', which is the name of an indigenous New Zealand bird. Kiwi has also become some sort of a nickname for a New Zealander. (Wikipedia 2005). The industry has passed through structural and development stages. This paper identifies five development stages: the industry's beginnings, the emergence of commercial orchards in the 1940s, exporting in the 1950s and 1960s, a period of rapid growth and the emergence of a new kiwi variety.

First Stage: Beginnings

The New Zealand kiwifruit industry originated from an historic import from China. The kiwifruit is native to the Yangtze River valley of northern China and Zhejiang Province on the coast of Eastern China. The kiwifruit seeds were originally brought to New Zealand from China in 1904 by Isabel Fraser, a missionary and educator. At that time the fruit was known by the Chinese name yang tao. In 1925, Hayward Wright, a New Zealand horticulturalist, produced the well-known green kiwifruit which came to be known as the Hayward variety (Zespri 2007). Initially there was only private production and consumption.

Second Stage: The emergence of commercial orchards in the 1940s

In the 1940s the first commercial orchard started producing kiwifruit for the domestic market. This was followed by an initial exploration of the international market.

Third Stage: The emergence of NZ Kiwifruit exporting in the 1950s and 1960s

The volume of kiwifruit exports rose rapidly during the late 1960s and early 1970. The number of exporting firms rose from four in 1964 to 14 in 1974 (Zwart and Moore 1990). By 1976, the exported crop exceeded local consumption for the first time. It was during this period that the name 'kiwifruit' started being used primarily as an attempt to minimise duties in export marketing.

Fourth Stage: Rapid export growth

Production and export of kiwifruit increased significantly over the next 25 years (1976-2000). In 1975, kiwifruit exports earned $NZ 2.9 million, which was relatively insignificant. By 2000 the industry contributed around 2.5 per cent of New Zealand's merchandise trade and over 60 per cent of total fruit exports (Statistics New Zealand 2006).

Fifth Stage: The emergence of a new variety

In the late 1970s, research was undertaken to develop new varieties of kiwifruit. Progress was slow but there was some success with the *Zespri Gold* production moving from limited trials to exports commencing in 1998. The industry had evolved from a one-fruit to a two-fruit industry.

Most New Zealand kiwifruit is now marketed under the brand name Zespri, which is trademarked by a New Zealand-based marketing company, ZESPRI International. Figure 1 shows that export revenue has generally increased over time, although with some fluctuations and a period of stagnation in the 1990s. Export growth was most pronounced between 1981 and 1990, when the volume increased from 10 million to more than 60 million trays. It further grew between 2004 and 2008.

**Figure 1: New Zealand Kiwifruit Exports, US Dollars (Million) 1984-2009**
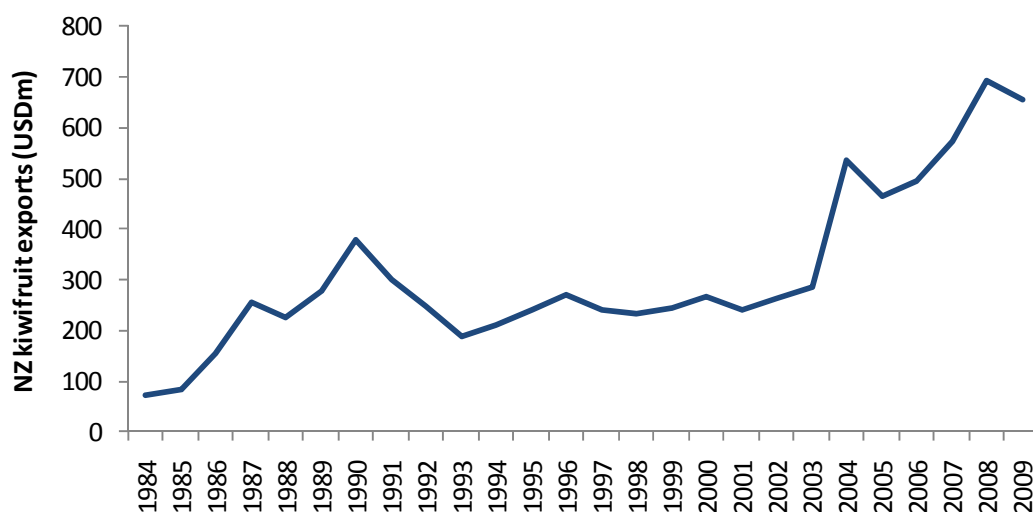
Source: Statistics NZ INFOS database.

Kiwifruit and the Product Life-Cycle Theory

The product life-cycle theory of Vernon (1966) is used to model the development of the kiwifruit industry of New Zealand. According to Vernon, a product undergoes changes as it moves from a new product to a mature one. In broad terms, and as illustrated in Figure 2, there are four stages in the life of any product: initiation, growth, maturity and decline. The initiation period is associated with a high degree of research and development, trial and promotion activity, slow growth and high costs of production. In the second stage, as sales expand and profits increase, a period of growth occurs in the domestic market. In the third stage, firms enter the foreign market and the product becomes standardised and the industry attains maturity. In the final stage, sales tend to level off in the home market. Lower sales reduce profits and product volumes decline. The duration of each stage of the cycle may vary depending on the nature of product, technology used, marketing and management activity as well as activity in the market for complements and substitutes.

Figure 2: The Product Life Cycle Theory
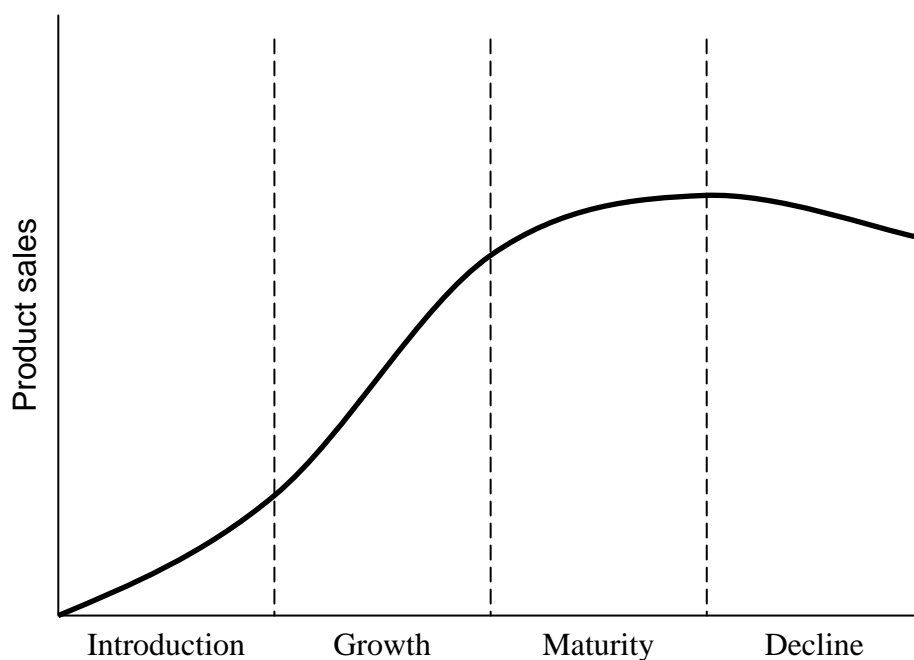
The New Zealand kiwifruit industry's history to date suggests that the industry is still in the growth stage of the product life cycle as it is characterised by falling costs due to economies of scale, increasing sales volumes and profitability, increased public awareness and new players entering the market increasing competition and leading to price decreases (Vernon 1966). Sales volumes of New Zealand kiwifruit have continued to rise, as shown in Table 1, with a production of 224,000 metric tons in 1993-1995, increasing to over 385,000 metric tons in 2008-2011. Profitability has also increased for the industry, as higher sales prices have increased revenue and yield per hectare has increased, thus reducing costs. Earnings per tray in 2007 were NZD86 (FOB), while MAF-estimated earnings per tray was

forecast to reach NZD109 in 2010. Yield in trays per hectare was 6,110 in 1997. In 2007 this yield had increased to over 7,500 trays (Horticulture and Food Research Institute 2007). As discussed in greater detail in later sections, there is increased competition in the global kiwifruit market, particularly from relatively new entrants such as China. Suggested product life cycles for green and gold kiwifruit based on the foregoing discussion are illustrated in Figures 3 and 4.
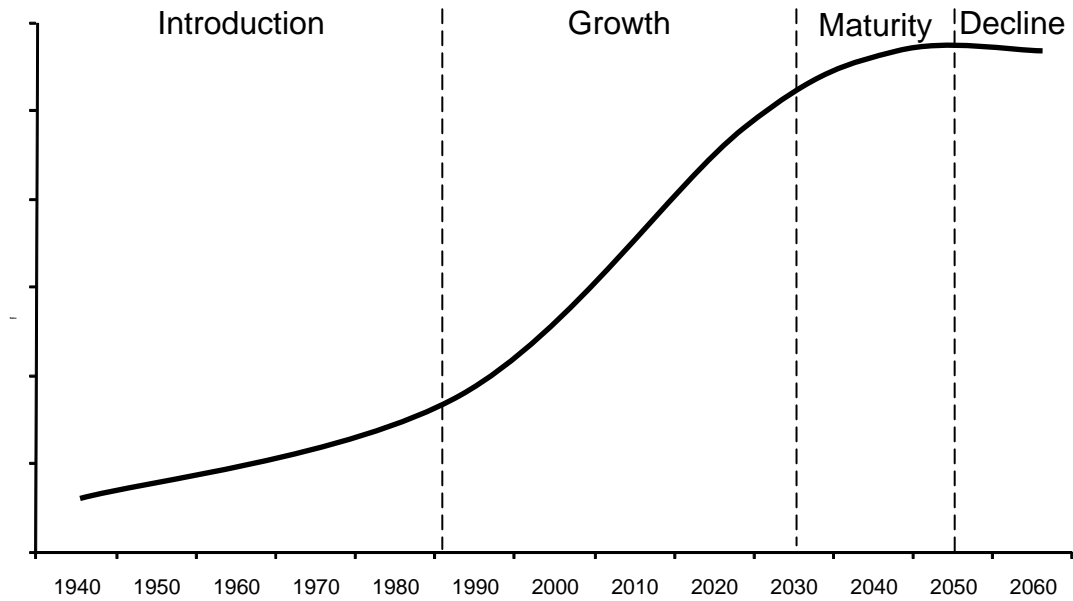
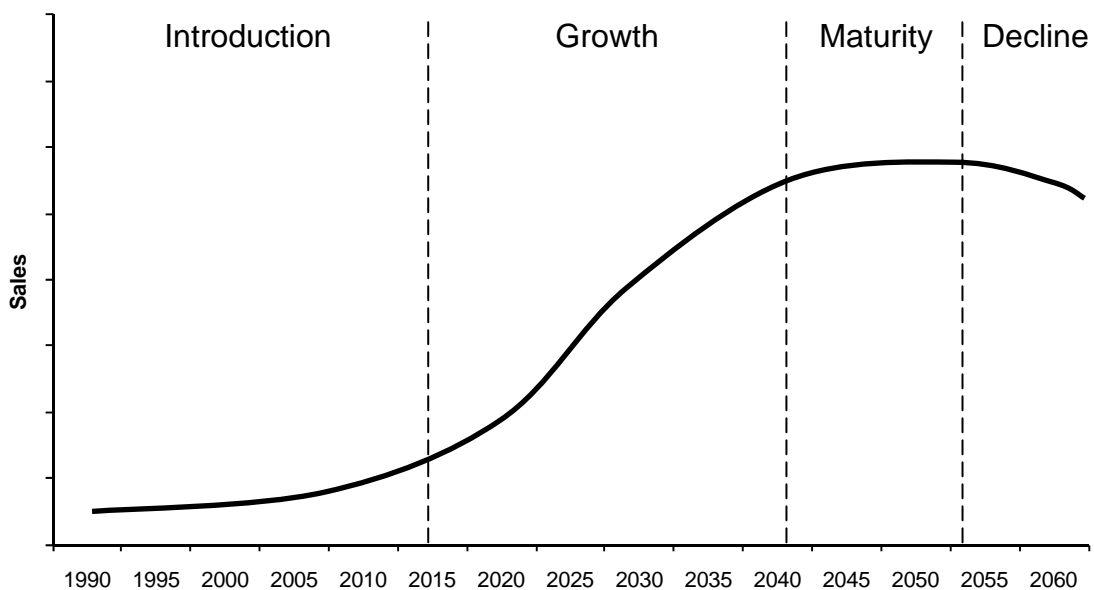**Figure 3: Possible Green Kiwifruit Life Cycle**

Figure 4: Possible Gold Kiwifruit Life Cycle

4. The Development of the Globalisation Market for Kiwifruit

New Zealand kiwifruit production should be considered in its global context. World kiwifruit production is concentrated amongst a few countries, with the top ten producing countries contributing over 95 per cent of world production (see Table 1 below). Traditionally, Italy, New Zealand and Chile have been the largest exporters and have also dominated world kiwifruit production. However, China has joined these three countries as a major producer (World Kiwifruit Review 2006, p. 20).

Table 1: Top Ten Kiwifruit Producing Countries in Metric Tons

	1993 - 1995			2003 - 2005			2008-2011 (p)	
Rank	Country	Production	Rank	Country	Production	Rank	Country	Production
1	Italy	322 730	1	Italy	401 622	1	China	491 667
2	New Zealand	224 000	2	China	341 000	2	Italy	429 885
3	Chile	125 333	3	New Zealand	303 000	3	New Zealand	385 049
4	France	77 570	4	Chile	151 667	4	Chile	186 667
5	Japan	51 267	5	France	76 157	5	Greece	79 433
6	Greece	41 681	6	Greece	50 000	6	France	66 890
7	United States	38 213	7	Japan	38 100	7	Japan	37 467
8	China	23 167	8	United States	28 335	8	Iran	30 000
9	Portugal	9 394	9	Iran	20 333	9	United States	25 371
10	South Korea	8 787	10	South Korea	12 000	10	South Korea	15 833

Source: World Kiwifruit Review 2006 and 2011.

Table 1 shows the volume and rankings of the major kiwifruit-producing countries since 1993. All the countries in the top ten in 2008-2011 (with the exception of France, Japan and the United States) increased production during this period. Portugal dropped out of the top ten despite modest increases in production, while Iran has increase production to move to 8th in 2008-2011.

World demand for kiwifruit increased significantly between 1984 and 2009. World imports of Kiwifruit averaged only 16,300 metric tons in 1982-84, but exceeded 1.1 million metric tonnes in 2009. However, imports of three competing tropical fruits - fresh mangos, fresh papaya and fresh pineapples - increased even more dramatically over this period (World Kiwifruit Review 2006, p.17; *UN Comtrade Database*).

The import demand for kiwifruit remains strong in the EU, with the strongest growth being registered in Spain. As incomes in many countries increased, imports, especially from new emerging markets, also increased, particularly in Asia. In Asia, growth in kiwifruit sales has been particularly strong in South Korea, Taiwan and Hong Kong. Strong growth was also experienced in Japan, New Zealand's oldest Asian market, in 2004 and 2005. Heavy reliance on a few major markets is expected to remain, with the top ten importing countries consistently taking almost 70 per cent of total world imports as shown in Table 2. The

OECD countries accounted for about 85 percent of World imports of Kiwifruit (Belrose 2006).

Table 2: Top Ten Kiwifruit Importing Countries 2009 in Metric Tons

Country	Volume
Spain	137,615
Belgium	133,193
Germany	120,104
Netherlands	65,142
Russian Federation	64,910
France	63,134
Japan	58,501
Italy	54,747
USA	53,550
United Kingdom	37,055
Top Ten Importing Countries	787,951
World	1,189,930
Top Ten (percent of world imports)	66%

Source: UN COMTRADE Database.

5. New Zealand Kiwifruit Exports

New Zealand's world market share in kiwifruit sales has varied over time. With an estimated share of total world exports in 1990 of over three-quarters (OECD 1990, p.12), New Zealand had a dominant market position. However, by 2000 this share had fallen to under a third due to rapid production growth elsewhere (World Kiwifruit Review 2006, p.26). In 2009, this value was approximately 31 percent (World Kiwifruit Review 2011, p.39).

Kiwifruit exports earned $785 million dollars in 2006 and comprised over 30 per cent of New Zealand's total horticultural export earnings (Statistics New Zealand 2006). This value came from the production of 84.7 million trays which were supplied by 2748 kiwifruit growers (Zespri 2006). This significant growth in export value is not common for horticultural products, where there is significant competition from other fruits as well as competition from alternative suppliers of the same fruit.

From Table 3, which reports export growth in five kiwifruit markets, it is clear that Europe and Asia has been the key to industry growth. The European market has sustained itself, although it has declined in relative importance. Key Asian markets have grown significantly. The United States market nearly disappeared - largely as a result of New Zealand losing an antidumping case and the subsequent fallout - and has just survived. The Australian market has developed, but is still relatively small. Other markets, although growing, consist of many small markets which have provided fluctuating revenues. Figure 5 shows the significance of Asian and European demand for NZ kiwifruit exports.

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Table 3: NZ Kiwifruit Export Growth 1984 to 2009

Partner market	Increase in Value (USDm)	CAGR
Europe	248.5	8.2%
Key Asian markets	286.1	11.4%
United States market	15.0	4.5%
Australian market	18.2	8.8%
Other markets	14.2	9.6%
Total	582.0	8.2%

Source: Authors' analysis of Statistics NZ data.

Figure 5: NZ Kiwifruit Export Markets, Percent of Export Value
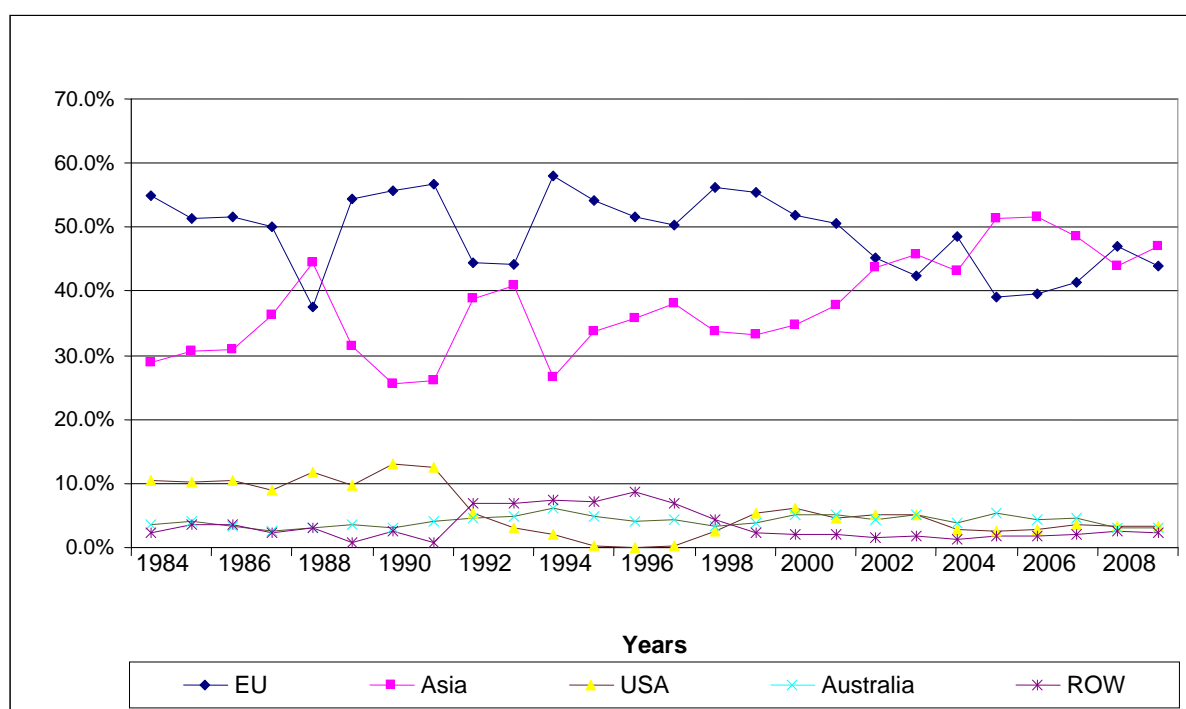
6. Exports to Key Asian Markets

Although New Zealand kiwifruit is exported to many countries in Asia, only five are important. Figure 6 shows the declining relative importance of Japan (although it is still dominant) as China, Hong Kong, Korea and Taiwan have emerged as important markets. Figure 7 shows that Taiwan remains an important export market, but is now only the third biggest market in Asia due to the dramatic rise of Korea since 2000. Hong Kong and China have also emerged as significant markets, but each still comprises only about 4 percent of New Zealand kiwifruit exports to key Asian markets.

Figure 6: NZ Kiwifruit Exports to Key Asian Markets, Percent of Exports to Asia
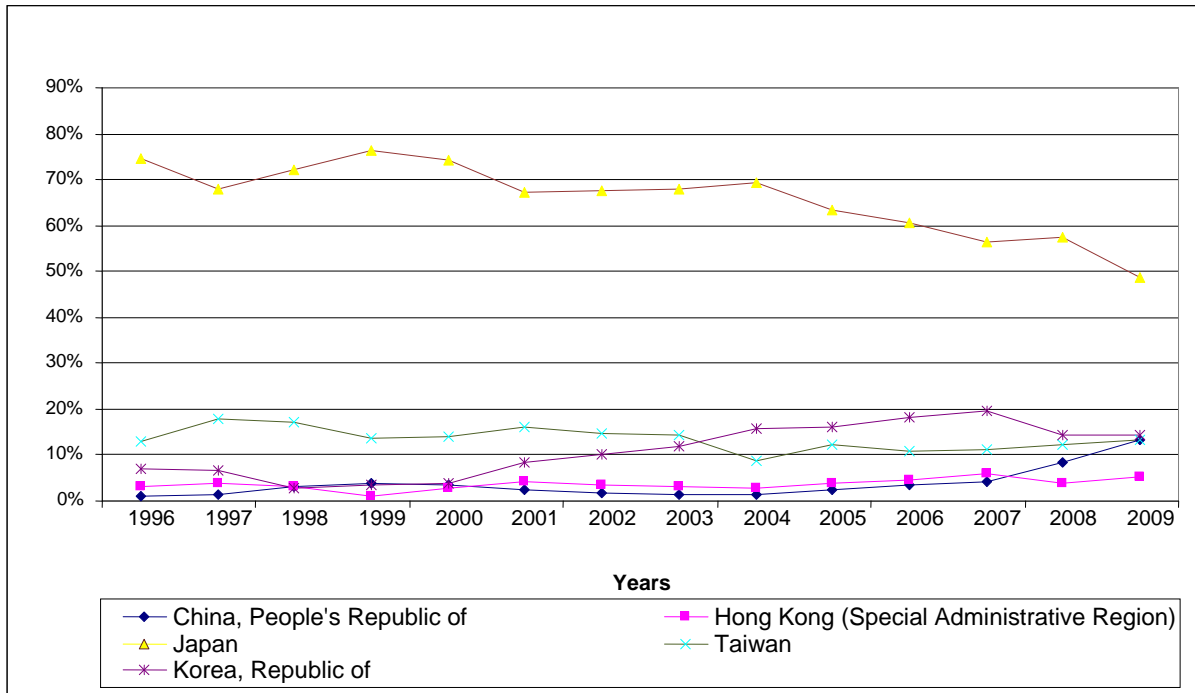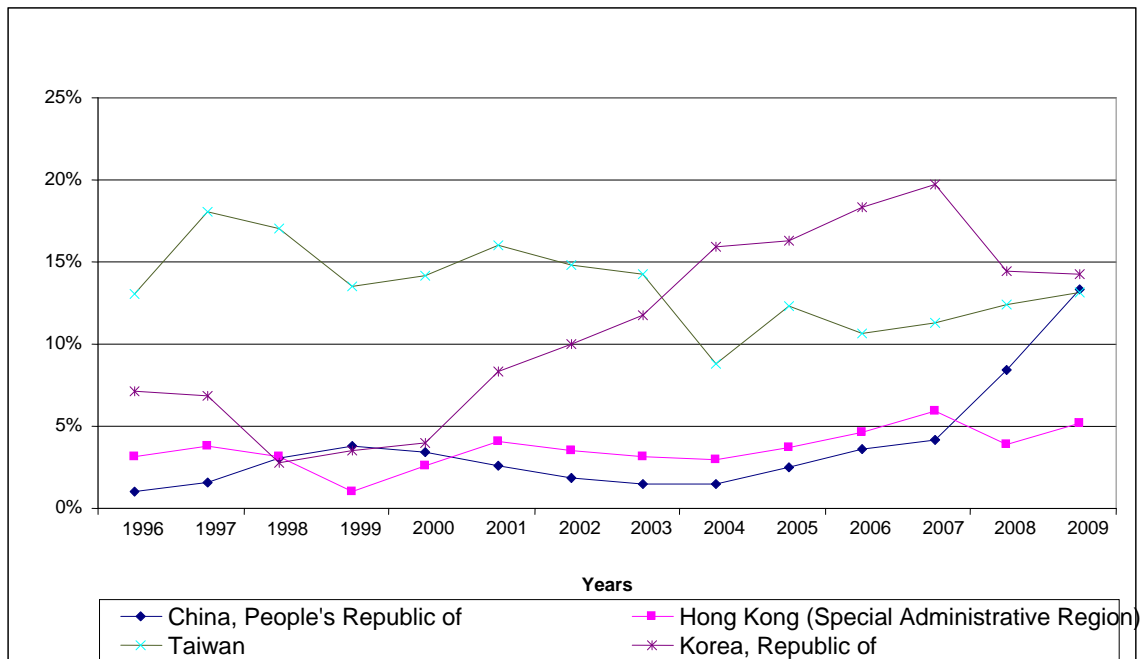

Figure 7: NZ Kiwifruit Exports to Key Asian Markets, Percent of Kiwifruit Exports

It is also important to consider the speed as well as the fluctuations of market growth, as shown in Figure 8. During the last decade, China experienced declines during 2001, 2002 and 2003, as did Hong Kong in 1998, 1999, 2002 and 2003, Japan in 2001, 2003 and 2005, Korea in 1998 and 2005, and Taiwan in 1998, 1998, 2003 and 2004. By contrast, China experienced more than 50 percent growth in 1998, 2005 and 2006, as did Hong Kong in 2000 and 2001, Japan in 2004, and Korea in 2001 and 2004. These fluctuations provide challenges and opportunities to kiwifruit exporters, as discussed below.

Figure 8: NZ Kiwifruit Export Sales to Key Asia Markets, Annual Percentage Change
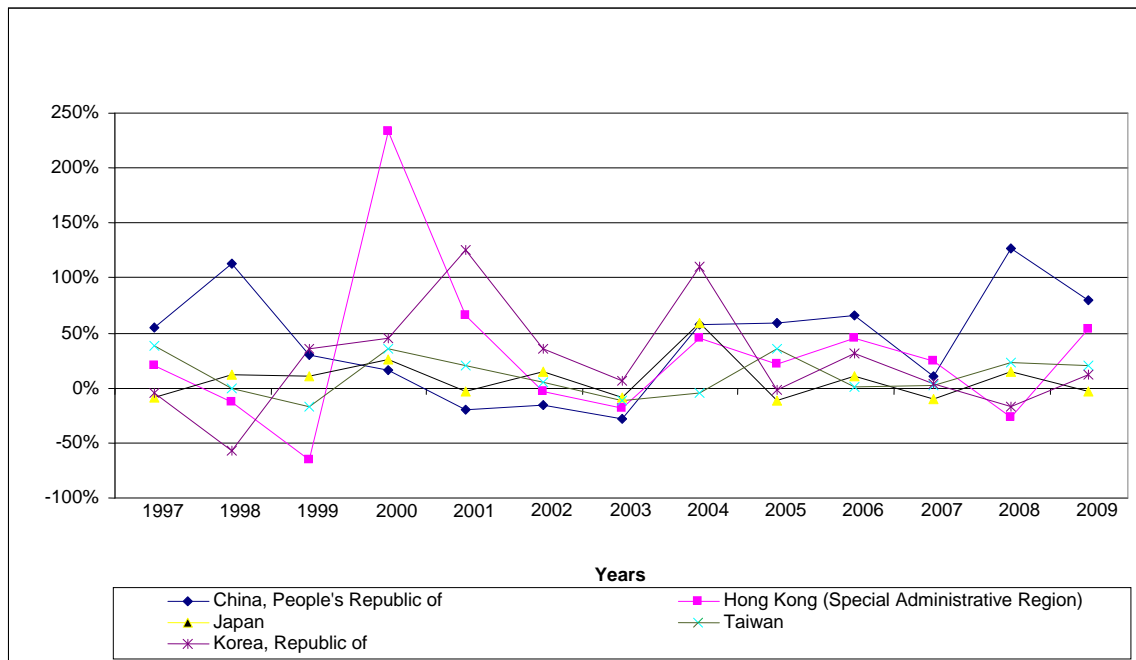
7. Challenges

Kiwifruit exporting from New Zealand has faced numerous challenges during the last three decades. Because of the seasonal nature of the crop, New Zealand exporters have had to complement the production from the northern hemisphere. Providing the product to consumers every week of the year is a continuing challenge for the producers. New Zealand kiwifruit competes with another significant southern producer, Chile, which has lower costs but is arguably not able to provide the same quality. China has also emerged as a significant new player, adding complexity and competition since it entered the market.

New Zealand has faced the challenge of introducing a new product to the market, that is, the Zespri gold. Although the product had consumer appeal, it required different handling systems. The marketing challenge was for the new variety to add market share rather than affect the market for green kiwifruit and for the new product to support the Zespri brand. In this, New Zealand was relatively successful.

World trade in kiwifruit faces various trade barriers, tariff as well as non-tariff. One of the most widely used trade policy measures falls under the classification 'Sanitary and Phytosanitary' (SPS) established by the WTO. This is an important agreement intended to help governments implement appropriate measures to protect their domestic animal and plant health and food safety (World Trade Organisation 2005). These measures help to prevent substandard kiwifruits (as well as other products) from entering markets that are conscious of health, environmental and safety considerations. The significance of international trade rules

cannot be understated given the challenges that New Zealand has experienced in the USA market and the potential impact of the trade agreements that Chile is negotiating with various countries.

8. Revealed Comparative Advantage of New Zealand Kiwifruit

Analysts, governments and business are concerned about future export proposals. One insight into future prospects is revealed comparative advantage. Balassa (1967) developed an approach to measure revealed comparative advantage (RCA). He assumed that a country's comparative advantage is revealed in its exports to the world market. As such, RCA of exports is represented by a country's commodity composition of exports compared with that of the world. The RCA index is defined as:

$$RCA_{ki} = (X_{ki} / X_{ti}) / (X_{kw} / X_{tw})$$

where X_{ki} represents the value of country i's exports of commodity k
X_{ti} represents the value of country i's total exports
X_{kw} represents the value of world exports of commodity k
X_{tw} represents the value of total world exports (of all commodities).

The RCA of country i in the trade of product k is measured by that item's share in country's exports relative to its share in the world exports. The first term in the equation represents commodity k's share in country i's exports, while the second term represents commodity k's share in world exports.

If the value of RCA index is less than unity (indicating that the share of commodity k in i's exports is less than the corresponding world share), it means that country i does not have revealed comparative advantage in commodity k. Similarly, if the value of this index exceeds unity, it implies that the country has revealed comparative advantage in that product.

Export data are measured in US dollars, and have been taken from UN *COMTRADE*, the United Nations Commodity trade website. Global exports of kiwifruit for each year are proxied by the sum of the value of exports from the top ten countries. This should be relatively accurate, as these countries account for 98 percent of global kiwifruit production (World Kiwifruit Review 2006).

The ten countries in Table 4 are the major exporters of kiwifruit. Of these countries, six exhibit an RCA value greater than unity in the production of kiwifruit. New Zealand has a very high RCA in kiwifruit, with values ranging from 206 in 2000, 151 in 2005 and 178 in 2009. This outcome reflects the fact that kiwifruit comprise a significant share of New Zealand's total exports and that the majority of New Zealand's kiwifruit production is

exported. Chile, Greece, and Italy also have strong RCAs in kiwifruit production, with values in 2009, 19, 17 and 9 respectively. The strength of the RCA in kiwifruit has dropped for Chile since 2000, while for Greece and Italy it has remained relatively constant. Values for France and Portugal hover around unity, indicating no real advantage or disadvantage. Values for Iran fluctuated highly between 2000 and 2005 (with no kiwifruit export data available for 2007). RCA values for the US, Japan and China are well below one (no RCA), indicating that although these countries are significant producers of kiwifruit, it makes up only a small proportion of their national exports.

Table 4: Revealed Comparative Advantage for Kiwifruit, Major Kiwifruit Exporters

Country	RCA (2000)	RCA (2005)	RCA (2009)
New Zealand	205.8	150.9	178.2
Chile	35.3	20.4	18.7
Greece	14.1	11.4	17.4
Italy	7.5	5.5	7.8
France	1.0	0.7	0.7
Iran	1.0	23.3	N/A
Portugal	0.2	0.5	0.6
United States	0.2	0.1	0.1
China	0.0	0.0	0.0
Japan	-	0.0	0.0

Source: Data from UN *COMTRADE Database.* RCA values are authors' estimates.

In summary, the analysis above indicates that the five major kiwifruit exporters have a revealed comparative advantage in the production of kiwifruit. Some of the smaller countries, such as New Zealand, Chile and Greece, have the highest levels of RCA for kiwifruit, while larger nations such as the US, China and to some extent Japan have no revealed comparative advantage. This is consistent with larger countries often being more diversified economies. Our estimates demonstrate that New Zealand has the highest degree of comparative advantage in Kiwifruit.

9. Analysis of New Zealand's Kiwifruit Markets: Theoretical Foundation

According to Linder (1961), high income generates demand for high quality differentiated products. The argument is that the higher the income, the larger will be the demand for high quality goods, leading to higher production. Large scale production in turn tends to lower per unit costs of production, which generates economies of scale. Higher income tends to increase consumption, but not equally for every product. Demand for inferior and normal goods is expected to decline or to increase, respectively, as a proportion as income. Conversely, the demand for luxury goods is expected to increase more than proportionally as income rises.

Kiwifruit is a product that displays the characteristics of a luxury good, so demand is expected to increase with income growth in trading partners. In addition, developed and emerging countries' populations are rapidly increasing their consumption of nutritious food as they modify their eating habits from cheaper products like cereals to products with higher nutritional value such as meat, seafood, vegetables and fruits such as kiwifruit. Technology and science have allowed the kiwifruit industry to increase its production to quantities that would have seemed inconceivable 25 years ago.

Given this literature and our observations of the industry, our hypothesis is that kiwifruit imports are a function of the average per capita income in the importing market. It is expected that the demand for quality differentiated kiwifruit will be higher as the per capita income of a country or region rises. Indeed, evidence suggests that the rich and aging populations of Japan, China, India and other emerging countries are demanding highly differentiated health services and health-related products as their incomes increase. Since kiwifruit has high nutritional values, it is expected that the world demand for the New Zealand kiwifruit will grow. This means that the life cycle paths of the kiwifruit could be long.

Testing of country-specific and industry-specific hypotheses can provide insight regarding New Zealand kiwifruit markets. The first two hypotheses are based on Linder's demand and income similarity-based model.

Hypothesis 1 states that kiwifruit export is an increasing function of the average level of development (ALD) of the trading partners, measured as the average per capita incomes of the two countries, i, home / reporting country and j, trading partner, that is,

$$\delta KWFX_{ij} / \delta ALD_{ij} > 0$$

Hypothesis 2 states that kiwifruit export is an increasing function of the average market size (AMS) of the partners, measured by average GDP of trading partners, or average population of trading partners, that is,

$$\delta KWF_{ij} / \delta AMS_{ij} > 0$$

Statistics New Zealand data identified 43 trading partners to which New Zealand exported kiwifruit in 2008. For the purposes of this model, New Zealand is the home/exporting country, and each of the partner countries provides an observation in the regressions. The dependent variable used in each case is the value of New Zealand's exports to each importing trading partner in 2008 US dollars. These values are based on 2008 Statistics New Zealand export values to trading partners converted into US dollars. Population is taken from the *World Development Indicators* (WDI) database and is measured

in thousands. GDP, which is also sourced from the WDI database, is measured in millions of 2008 US dollars. Distance is also included in the models, as this is a common variable used in econometric 'gravity' models. Distance is measured in kilometres and is the straight-line distance between the capital in the home country and the capital of the partner country. The following linear regressions are used:

(1) $X(\text{kiwifruit})_{ij} = a + \beta\text{Average GDP}_{ij}$

(2) $X(\text{kiwifruit})_{ij} = a + \beta\text{Average Pop}_{ij}$

(3) $X(\text{kiwifruit}_{ij} = a + \beta\text{Average GDP/Pop}_{ij}$

(4) $X(\text{kiwifruit}_{ij} = a + \beta\text{Distance}$

(5) $X(\text{kiwifruit}_{ij} = a + \beta_1\text{Average GDP/Pop}_{ij} + \beta_2\text{Average GDP}_{ij}$

Table 5: Kiwifruit Model Estimation Results
Dependent Variable: Exports of kiwifruit from New Zealand, 2008 USD

Regressor	(1)	(2)	(3)	(4)	(5)
Average GDPij (USD millions)	9.35** (2.56)				6.94* (1.73)
Average Popij (000)		19.57 (0.55)			
Average GDP/Popij (USD)			1,221** (2.31)		788 (1.37)
Distance (000 km)				240 (0.26)	
Intercept	4,581,816 (0.96)	9,113,462* (1.84)	-19,101,517 (-1.43)	7,377,573 (0.62)	-12,868,631 (-0.95)
Summary Statistics Adjusted R^2	0.12	0.00	0.09	0.00	0.18
n	43	43	43	43	43

Note: * indicates level of statistical significance. * = 10%, ** = 5%, *** = 1%.

Regressions 1 and 2 test the significance of variables used to proxy average market size of trading partners. In regression 1, average GDP of the two trading partners has a statistically significant and positive effect on the level of exports of kiwifruit from New Zealand (at a 5 percent significance level). Regression 2 uses population, another market size indicator, as an explanatory variable. The result is not statistically significant. Regression 3 tests hypothesis one, which states that the export value of kiwifruit is associated with the average level of development of the trading partners. Average per capita income has a positive and statistically significant coefficient at the 5 percent level. Regression 4 examines whether distance, as a common trade determinant, has an impact on the value of export of kiwifruit; the coefficient was not statistically significant. Regression 5 combines average GDP and average GDP per capita as the two statistically significant variables. The result is that neither variable is highly

statistically significant. The dummy variable representing a free trade agreement was trialed in conjunction with the variables in Table 5, but was not found to be statistically significant.

Overall, the linear model does not explain the export performance of kiwifruit very well. Thus, in the next section we employ the logarithmic form of the same variables to determine if a better fit can be found. The following four regressions are estimated:

(1) $X(\text{kiwifruit})_{ij} = a + \beta_1 \log(\text{Average GDP}_{ij}) + \beta_2 \log(\text{Distance})_{ij} + \beta_3 \text{FTA}_{ij}$

(2) $X(\text{kiwifruit})_{ij} = a + \beta_1 \log(\text{Average Pop}_{ij}) + \beta_2 \log(\text{Distance})_{ij} + \beta_3 \text{FTA}_{ij}$

(3) $X(\text{kiwifruit})_{ij} = a + \beta_1 \log(\text{Average GDP}_{ij}/\text{Pop}_{ij}) + \beta_2 \log(\text{Distance})_{ij} + \beta_3 \text{FTA}_{ij}$

(4) $X(\text{kiwifruit})_{ij} = a + \beta_1 \log(\text{Average GDP}_{ij}) + \beta_2 \log(\text{Average GDP}_{ij}/\text{Pop}_{ij}) + \beta_3 \log(\text{Distance})_{ij} + \beta_4 \text{FTA}_{ij}$

The log of the distance between the trading partners is included in each regression, as well as a dummy variable which indicates whether there is a free trade agreement between the countries. The results are presented in Table 6.

Table 6: Kiwifruit Model Estimation Results
Dependent Variable: log (Exports of kiwifruit from New Zealand, 2008 USD)

Regressor	(1)	(2)	(3)	(4)
log (Average GDPij)	1.18*** (4.09)			0.97*** (3.12)
log (Average Popij)		0.69** (2.68)		
log (Average GDP/Popij)			3.32*** (2.87)	1.81 (1.57)
log (Distance)	1.71*** (2.76)	2.02*** (2.98)	2.00*** (2.98)	1.51** (2.42)
FTA (dummy)	2.29** (2.18)	2.43** (2.09)	2.68** (2.38)	2.19** (2.12)
Intercept	-17.53*** (-3.17)	-12.36** (-2.10)	-38.88*** (-3.33)	-31.26*** (-3.04)
Summary Statistics				
Adjusted R^2	0.49	0.38	0.39	0.51
N	43	43	43	43

Note: * indicates level of statistical significance. * = 10%, ** = 5%, *** = 1%.

In regression 1, the log of average GDP of the two trading partners has a strongly statistically significant and positive effect on the level of exports of kiwifruit from New Zealand: an increase in average GDP of one percent tends to increase the export of kiwifruit by 1.18 percent. The distance and FTA variables also have statistically significant and positive coefficients at the one percent and five percent levels respectively. It is interesting to

note that New Zealand distance seems to be an advantage for New Zealand kiwifruit exports (contrary to conventional wisdom that trade gravitates around closer geographically nations).

Regression 2 uses log population as an explanatory variable. This results in a positive and strongly statistically significant coefficient of 0.69. An increase in population of one percent therefore tends to increase the export of kiwifruit by 0.69 percent. The FTA and distance variables remain statistically significant and positive. The explanatory power of regression 1 is higher than that of regression 2: 49 percent compared to 38 percent.

Regression 3 tests the significance of log average GDP per capita as an explanatory variable. This regression shows a strong positive coefficient 3.32, meaning that an increase in GDP per capita of one percent tends to increase the export of kiwifruit by 3.32 percent.

Regression 4 uses the log of average GDP per capita as well as average GDP, distance and the FTA dummy variable. Average GDP per capita is not found to be statistically significant in this regression, but all other variables are. The regression has a moderately strong explanatory power, with an adjusted R^2 value of 51 percent.

The results from these logarithmic regressions tend to support both hypotheses one and two. The average level of development does seem to have a positive effect on the export of kiwifruit between New Zealand and its trading partners. When both market size and level of development variables are included together in the same regression, the average level of development loses its statistical significance. This may suggest a degree of multi-collinearity of the variables. The average market size variable is strongly statistically significant in regressions (1) and (2) from Table 6, and appears to be stronger than development indicators such as GDP per capita as a factor in kiwifruit exports from New Zealand.

The positive and statistically significant coefficient on the dummy variable for free trade agreements is unsurprising, given that the removal of trade barriers should, in theory, foster higher levels of trade. However, the positive and statistically significant coefficient on distance was somewhat of a surprise. In the context of a gravity model of trade, distance is normally expected to have a negative impact on trade. The coefficients on distance in Table 6 may be explained partially by the fact that the dataset was limited solely to New Zealand exports. The impact from several countries importing a large share of New Zealand's kiwifruit exports may have influenced this result. However, further regressions using a wider dataset produced either positive or statistically insignificant coefficients for distance. This suggests that distance may not be a significant determinant with regard to the export of luxury goods such as kiwifruit.

10. Conclusions

New Zealand's kiwifruit has been an export success during the last three decades. This success has been accompanied by fluctuations and by challenges characteristic of many markets. In particular, we note the following opportunities and threats to New Zealand's kiwifruit industry, some of which may need further study:

- The stage of development, in terms of the life cycle, of New Zealand's kiwifruit industry: how, for example, to stave off decline as the industry matures.

- The significance of Chile as a southern hemisphere competitor.

- The continuing importance of the Japanese and European markets.

- The growing importance of China, Hong Kong, Korea and Taiwan as markets.

Revealed comparative advantage estimates and analysis suggested continuing success for the New Zealand kiwifruit industry, but highlights the importance of Chile and Greece who also have significant revealed competitive advantage. The RCA analysis however, does not seem to distinguish the importance of China where kiwifruit growth has been very large but still remains a very small part of the total economy. It seems China' domestic market is very large so there is no significant export growth and share in the world market.

Linear-type analysis highlights the importance of per capita income growth, the value of Free Trade Agreements and distance key as key determinants of kiwifruit export performance. Distance does not usually show up positive in such models but does so in this case primarily because it is an indication of seasonality. New Zealand kiwifruit is most valuable in the Northern Hemisphere where there is no fresh local kiwifruit. It may also reflect New Zealand's 'clean and green' profile worldwide.

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