Can Local Farms Survive Globalization?

Shawn Arita, Dilini Hemanchandra, and PingSun Leung

Due to expanding trade and increasing concentration of production during the past few decades, small local farms have faced ever-growing competitive pressures. We investigate the impacts of this globalization on production of local food by examining Hawai'i's open island economy and econometrically evaluating impacts of import competition on the growth and survival of individual fruit and vegetable farms. We find evidence that rising levels of imports significantly hinder farm growth in Hawai'i and have a smaller impact on farm survival. Increased foreign competition increases the likelihood of exit for commercial farms but has little effect on small noncommercial farms.

Key Words: import competition, local foods

Today, the vast majority of food in the United States is consumed far from where it was produced. It is estimated that less than 2 percent of all gross farm sales in the United States can be considered as locally marketed food sold directly to consumers or to local intermediaries (Low and Vogel 2011). Even in areas with intensive agricultural production, such as Santa Barbara County in California, more than 95 percent of the fruits and vegetables consumed are imported and 99 percent of the production is exported (Cleveland et al. 2011). With increasing specialization in the agricultural industry and falling transportation costs, today's food system is dominated by large industrialized farms[1] that supply consumers separated by a vast number of "food miles."[2] Put simply, consumers are physically disconnected from their food as a result of globalization of the economy.

Despite increasing concentration of agricultural production, interest in local food among consumers is growing. Local foods—foods grown nearby or supplied locally—are seen as providing greater nutrition, taste, and freshness than nonlocal foods (Martinez et al. 2010). In addition, many wish to keep money in local economies, strengthen social relationships between producers

[1] In 2007, more than 60 percent of U.S. agricultural production (in terms of market value) was produced by the top 3 percent of the country's farms (Hoppe, MacDonald, and Korb 2010).

[2] For example, Pirog and Benjamin (2005) found that the average produce product in a grocery store in Chicago had travelled nearly 1,500 miles.

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and consumers, and minimize food miles while gaining social benefits from preservation of agricultural land. All of these forces have led to growing support for increased "localization" of food production (Halweil 2004, King 2010).

Can local farms survive the growing pressures generated by globalization? In the United States, the number of small commercial farms has been declining sharply (Hoppe, MacDonald, and Korb 2010, Stanton 1990). Globalization has led to an integration of market prices, but production costs remain primarily local because most farming resources are immobile. Among local farmers facing high labor costs, there is growing concern about whether they can remain economically viable in a market increasingly dominated by cheaper nonlocal foods. Nevertheless, even in regions with extremely high wage costs, some local farmers continue to operate despite the inherent production disadvantages. They may be producing high-quality goods and/or have an advantage in terms of better serving consumers; others choose to continue to operate despite suffering financial losses (Arita, Naomasa, and Leung 2012, Naomasa, Arita, and Leung *forthcoming*). In general, little empirical study has been done on how globalization affects the future economic viability of relatively small local farms.

The decline of local agricultural production in advanced economies has received much attention and concern, but its links to international trade have rarely been explored empirically. Our study empirically investigates the impacts of import competition and globalization pressures on local farms using the open island economy of the state of Hawai'i and its fresh fruit and vegetable farms. Linking micro-level farm data from the *U.S. Census of Agriculture* (National Agricultural Statistics Service (NASS) 1997, 2002, 2007) to detailed crop-level information on imports from the U.S. mainland and foreign countries, we econometrically test the impact of import competition on the growth and survival of individual farms.

Hawai'i presents a particularly interesting case for examining the impacts of globalization on the economic viability of local farms for several reasons. Because it is isolated from cheaper sources of labor, Hawai'i faces some severe production disadvantages. Farm labor costs there are 40 percent higher than on the mainland and, on average, Hawai'ian farms are less than half the size of mainland farms in terms of sales and two to three times smaller in terms of acreage (Arita, Naomasa, and Leung 2012). Compared to its export competitors, Asia and South America, Hawai'i suffers from significantly higher labor, energy, transportation, and other input costs (Parcon, Loke, and Leung 2010). The vast majority of the food consumed in the islands is produced elsewhere and imported, and there is increasing concern about the future of the local agricultural industry.[3] Residents have expressed strong support for preserving local production. They are willing to pay a premium of $1 to $3 per pound for local foods (*Ulupono Initiative* 2011),[4] and the state is taking a remarkably active stance in increasing food localization by advocating for it as part of its development strategy.[5]

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[3] The exact percentage of food products imported is unknown. However, it is thought to exceed 85 percent (Page, Bony, and Schewel 2007).

[4] Shoppers were willing to pay premiums of $1.75 for a pound of apples and bananas, $1.69 for a pound of tomatoes, and $2.13 for a pound of locally produced rib-eye steak.

[5] For example, Hawai'i's constitution specifies that "The State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency, and assure the availability of agriculturally suitable lands" (Hawai'i State Constitution, Article XI, Section 3).

In addition, because of Hawai'i's extreme geographic isolation, the vast majority of the state's fresh fruit and vegetable production goes to local markets,[6] allowing us to precisely define and measure local fresh fruit and vegetable farm activity. Food systems tend to be complex, and "local food" has so far been ambiguously defined and proven to be difficult to intractable to measure. Empirical studies that have assessed local food production and consumption have employed ad hoc definitions and generally crude geographic boundaries (Hinrichs 2000, Hand and Martinez 2010, Ostrom 2007).[7] Our definition of local food is conveniently defined by the state's boundaries.[8]

A further advantage for our study is Hawai'i's island economy, which makes it is easier to track the amount of food coming into the state. Hawai'i imports a large number of agricultural products and thus trades openly and routinely with the rest of the United States and with other countries. With detailed in-shipment data, we can account for all fresh fruit and vegetable produce imported from both foreign countries and the mainland to conduct an analysis that includes intra-country food trade.

We econometrically assess how imports have affected individual farm production. To our knowledge, this is the first study to quantitatively examine the impacts of import competition on individual farms. We examine not only how import competition affects farm growth and survival but how it may affect various farms differently. The scale of agricultural operations varies widely—from small family farms to vast corporate production involving thousands of acres. Micro-level data regarding farms' size, productivity, and use of capital allow us to examine farms of various sizes and degrees of commercialization. Small noncommercial farms are generally less profitable and less productive than commercial farms (Hoppe, MacDonald, and Korb 2010). Their operators often view farming more as a way of life than as a business and rely on off-farm income to support their households. Examining how imports affect various types of farms differently allows us to investigate potential structural changes that may occur from globalization.

Our micro-level approach is theoretically motivated by recent models of international trade that have highlighted the important role of firm heterogeneity. The impacts of globalization are mostly conceptually understood in terms of aggregate, top-to-bottom frameworks. Recent theoretical and empirical contributions in the trade literature have focused on the role of producer heterogeneity, a critical component in understanding deeper structural changes occurring in response to globalization. The studies, guided by the work of Melitz (2003), have demonstrated that, with firm heterogeneity in productivity, falling trade costs lead to contraction among less productive firms in favor of expansion by more efficient ones. The resulting reallocation of production generates important aggregate productivity gains. Empirical studies of the manufacturing sector (Greenaway, Gullstrand, and Kneller 2008, Kim, Reimer, and Gopinath 2011, Bernard, Jensen, and Schott 2006a) have found that firm heterogeneity increases openness to trade and exposes firms

6 Hawai'i exports the majority of its other agricultural products. Top export commodities include seeds, sugar, ornamental plants, cattle, and molasses.

7 A commonly accepted definition of locally consumed food is food consumed within a 100-mile radius of production.

8 Our definition is in line with the definition used by many large private food retailers. Wal-Mart defines local food as food grown within the state in which it is sold. Other stores, such as Whole Foods, apply a 200-mile rule (Schmit 2008).

to competition. In the process, less efficient firms are weeded out and more efficient ones benefit through export.

Previous studies have analyzed the impact of globalization of heterogeneous manufacturing firms[9] but not of agricultural producers. As in manufacturing, rising levels of imports may also generate structural changes in agricultural production because imports place greater competitive pressure on some types of farms than on others. The United States increasingly relies on imported food (Huang and Huang 2007), and its agricultural industry has undergone dramatic structural shifts as a result. The number of small commercial farms has declined while the number of very large, capital-intensive farms has grown, a trend that is a source of ongoing concern among policymakers and academics (Aubert and Perrier-Cornet 2009, Hoppe, MacDonald, and Korb 2010, Hazell 2005). Technological improvements biased in favor of relatively large farms and lower average rates of return for relatively small farms have been suggested as causes of the decline (Hoppe, MacDonald, and Korb 2010), but trade may be an important unexamined contributor.

Our empirical results suggest that increasing competition from imports in Hawai‘i has adversely affected the growth of its fresh fruit and vegetable farms. Our estimates of the effect of imports on farm survival are less robust; increasing competition from imports has had little impact on farm exit overall. However, we find evidence that the size and commercial nature of a farming operation influences how the farmer responds to import competition. Increased competition marginally increases the likelihood of a commercial farm's exit but has little or no influence on whether a small noncommercial farm will exit. Thus, operators of noncommercial farms likely base exit decisions primarily on other, nonmarket factors and are less responsive to competitive pressures. Our work suggests that, in a modern open economy that is subject to high labor costs, ongoing globalization will lead to a decline in local farm production but noncommercial farms are less likely to be affected.

Decline of Small Commercial Family Farms in the United States

According to the U.S. Department of Agriculture's (USDA's) farm typology, farms may be categorized as very large commercial farms ($1,000,000 or more), large commercial farms ($250,000 to $999,999), small commercial farms ($10,000 to $249,999), and noncommercial farms (less than $10,000). Hoppe, MacDonald, and Korb (2010) examined the number of farms in each category and their share of U.S. production between 1982 and 2007 and found a steady decline in the share of U.S. agricultural production generated by small commercial family farms and disproportionate growth by very large commercial and very small noncommercial farms. While the share of U.S. farms composed of the largest operations (more than $1 million dollars in annual sales) grew from 24 percent in 1982 to 59 percent in 2007, the share of small commercial farms (sales of $10,000 to $249,999 annually) fell from 41 percent in 1982 to just 14 percent in 2007. Furthermore, while the number of very large farms more than tripled, the number of small commercial farms declined by 41 percent. Meanwhile, the number of the smallest farms (those with sales of less than $1,000 annually),

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[9] One exception is Echeverria et al. (2009), which applied a heterogeneous firm framework to agriculture production. Their work explored the role of firm heterogeneity in participation in export markets. Testing data on Chilean farms, they found that more productive firms were more likely to export.

classified here as noncommercial, more than doubled. Despite the significant increase in the number of noncommercial farms, the share of U.S. agricultural production contributed by such farms actually fell between 1982 and 2007.

The decline of small commercial family farms in the past few decades likely reflects both globalization and simultaneous advances in technology that have made the United States one of the most efficient agricultural producers in the world. However, the spread of agricultural technology to developing countries, combined with those countries' lower labor costs, have increased competitive pressure on U.S. producers. Since technological improvements tend to be biased in favor of very large operations because of economies of scale (Allen and Lueck 1998), small- to medium-sized farms may be more severely affected by expanding globalization. According to Hoppe, MacDonald, and Korb (2010), fewer than half of the smallest farms in the United States in 2007 generated a profit, and the ones that did relied primarily on off-farm income. Farms with sales of $1,000 to $9,999 performed slightly better—60 percent showed a profit in 2007. That same year, 85 percent of the largest farms showed a profit.

The rate of survival of noncommercial farms (those with sales of less than $1,000 annually) likely depends on several factors. First, 50–70 percent of noncommercial farmers rely on off-farm sources of household income (Hoppe, MacDonald, and Korb 2010, Goetz and Debertin 2001). Many of the small noncommercial farms can be classified as multi-income family farms. Operators of such farms are often driven by motives unrelated to profit and view farming as a way of life rather than a business (Blank 2002). These farmers are often descendants of agricultural families who inherited the farms (Blank 1998). A sizeable portion of the production of such farms may be for household consumption rather than for sale. Furthermore, some of these farmers continue agricultural production in large part for tax benefits (Bittenbender 1993).[10] Thus, small noncommercial operators have many reasons for remaining in operation despite increased competitive pressure.

The Case of Hawaii: Surviving Globalization Despite Comparative Disadvantages

Hawai'i is geographically isolated thousands of miles from the continental United States and all foreign markets and thus faces some unique economic challenges that mainland states do not. The cost of labor, land, energy, and transportation is high, making Hawai'i one of the most expensive places in the United States to operate a farm (Parcon, Loke, and Leung 2010, Parcon et al. 2011). The state's small size, and thus smaller scale of farms, further aggravates the cost disadvantage (Arita, Naomasa, and Leung 2012). Today, much of the food consumed in Hawai'i is produced on the mainland and imported, providing Hawai'ian consumers with less expensive food and a greater variety of products. Those relatively inexpensive imports benefit Hawai'ian consumers in general but increase competitive pressures for Hawai'ian producers.

As a small open economy, Hawai'i faces keen competition from both foreign and mainland-U.S. producers. Parcon et al. (2011) found that Hawai'i is at a severe disadvantage in terms of input prices compared to its foreign

[10] In Hawai'i, property tax rates are lower for agricultural land than for residential land. And like farmers in the rest of the United States, Hawai'ian farmers can take advantage of operational tax benefits, such as write-offs for agricultural expenses and reductions in taxable income for net losses.

competitors and that Hawai'i's factor costs for labor, electricity, fertilizer, land, and other inputs are among the highest in the world. Arita, Naomasa, and Leung (2012) found that Hawai'ian farm production is 15–20 percent less efficient, on average, than production by U.S. farms overall. Figure 1 assesses economic and financial performance measures for Hawai'ian and mainland farms of different economic classes in terms of sales. We find that Hawai'ian farms generally do not perform as well as mainland farms. Large commercial farms on the mainland significantly outperform their Hawai'ian counterparts in terms of output-input ratio, return on assets (ROA), and net profit per acre. Hawai'i's small commercial farms perform almost on par with mainland farms. However, since large commercial production contributes the vast majority of overall U.S. agricultural products, the figure indicates that Hawai'i is at a significant efficiency disadvantage.[11]

Figure 1 also shows that both Hawai'ian and U.S. farms exhibit economies of scale in agricultural production. Output-input efficiency, net profit per acre, and ROA are all increasing with farm sales. Small farms tend to be at a disadvantage in input, marketing, and transportation costs and are unable to take advantage of technologies that could reduce production costs (Paul et al. 2004). The average Hawai'i farm produces half the revenue of the average mainland farm because of the relatively small size of island farms (Arita, Naomasa, and Leung 2012). In addition, many small noncommercial farms on the mainland and in Hawai'i routinely suffer net losses that exceed 40 percent. Government payments (Key and Roberts 2006), use of production for household consumption, and other nonmarket factors likely explain why many of these farms remain in operation.

Empirical Approach and Hypotheses

We use Hawai'i as a case study to empirically investigate the economic impacts of globalization and import competition on local agricultural production. We first ask whether increased imports of food products into Hawai'i have had any effect on the number of local farms. Increased imports from abroad may not necessarily lead to a reduction in locally produced products. For fresh fruits and vegetables in particular, many products are imported because they cannot be produced locally. Such products increase the diversity of foods available to local consumers rather than introduce competition. Furthermore, even though agricultural commodities are often defined as homogenous, there can still be considerable product differentiation. Locally produced foods can differ significantly in terms of taste and quality from imported counterparts and may enter the market in a different season. Consequently, local and imported products may not directly compete with each other. Together, these factors suggest that imports do not automatically pose a threat to local production.

We then examine the impacts of import competition on farm survival since farm exits are an important component of the structure of an agricultural industry. As in other industries, entry and exit account for a significant share of changes in agricultural production and are an important aspect of industry growth (Petrin, White, and Reiter 2011). With heterogeneous producers, competition favors relatively efficient firms over less efficient ones. Theory suggests that increasing pressure from imports accelerates this process, forcing

[11] Medium-sized commercial farms ($250,000–$999,999) are comparable to mainland farms in terms of output-input ratio and net profit per acre.

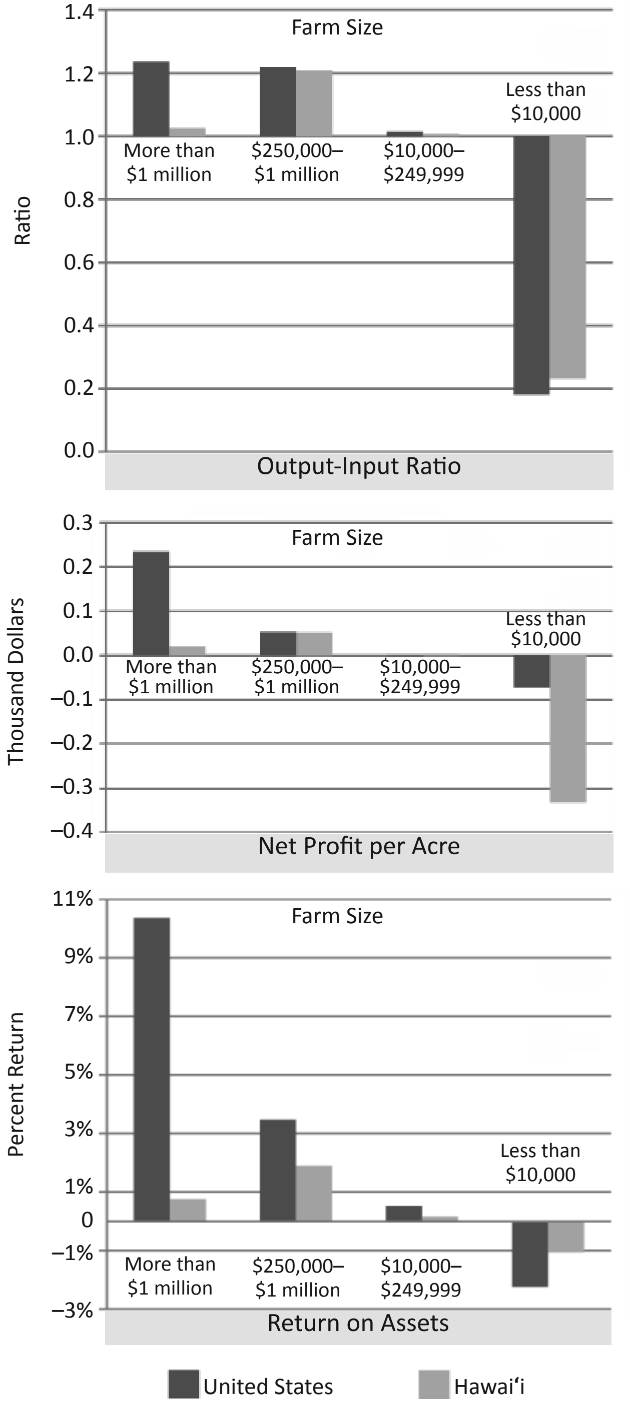

Figure1. Comparison of Hawaiʻi and U.S. Mainland Agricultural Efficiency by Farm Size for 2007

Notes: Output-input ratio = Total Sales / {Variable Cash Expenditures + Fixed Cash Expenditures + Depreciation}. ROA = 100 × {Net Profit + Total Interest Paid}/ {Value of Owned Land and Buildings + Value of Machinery and Equipment}. Net Profit = Total Sales – Variable Cash Expenditures – Fixed Cash Expenditures – Depreciation. Source: Arita et al. (2012). The original source of the data is the *U.S. Census of Agriculture*. Note that the measures include all of the sectors in U.S. and Hawaiʻian agricultural production.

the inefficient firms to shrink and exit over time while allowing the more efficient firms to enter and to expand their operations (Melitz 2003). However, the process is complicated in agriculture because many farm businesses are not fully commercial and thus may not respond in a typical way to market forces.

To assess the impact of import competition on micro-level production reallocations, we test two dimensions—full-time versus part-time farmers and farm size in terms of annual sales. We define full-time farms as ones in which the primary operator reported working less than 50 days per year in an off-farm job and part-time farms as those in which the primary operator reported working 50 or more days in an off-farm job. We use this distinction as an indicator of the farm's level of commercial engagement. Since full/part-time farming may be an imperfect way to classify farms, we also use farm size[12] as a measure of commercial motivation. Following USDA convention, we classify farms with sales of less than $10,000 as noncommercial, farms with sales of $10,000 to $249,999 as small commercial, and farms with $250,000 or more in sales as large commercial. This test may also allow us to examine whether additional trade is likely to force the exit of less productive farms.

We test three hypotheses:

> *Hypothesis 1:* An increase in import competition decreases the entry and expansion of farms.
>
> *Hypothesis 2:* An increase in import competition increases the likelihood of a farm's exit.
>
> *Hypothesis 3:* Import competition asymmetrically impacts farms according to their degree of commercialization and size of operation.

We employ two measures of import competition—import shares and changes in total imports. The literature on import competition has generally relied on shares of imports as the de facto measure of market openness (Chen, Imbs, and Scott 2009, Bernard, Jensen, and Schott 2006b, Greenaway, Gullstrand, and Kneller 2008). Turner (1980) argued that changes in import shares are an appropriate proxy for import competition since they control for the majority of unobserved factors. While many unobserved factors can be controlled for with time and sector effects, the measure nonetheless suffers from endogeneity issues. A positive production shock can be reflected in a corresponding drop in the level of competing imports. For example, favorable weather conditions in Hawai'i could increase local production and thus decrease Hawai'i's demand for imports. Changes in total imports are susceptible to the same endogeneity concerns. Only a few studies have devised instrumental variable methods in an attempt to deal with such issues (Chen, Imbs, and Scott 2009); however, effective instruments are generally not available.[13] Given the endogeneity inherent in available measures of import competition, our estimates should be interpreted as upper bound estimates.

[12] Because farm land varies in quality, production intensity, and variety of commodities produced, the literature has generally favored defining farm size by sales (Hoppe, MacDonald, and Korb 2010).

[13] We attempted to use fluctuations in transportation costs generated by exogenous oil price shocks as an instrumental variable for import competition, but weak variation rendered that instrumental variable ineffective.

Data

We use confidential farm-level data for 1997, 2002, and 2007 for the State of Hawai'i from USDA NASS's *U.S. Census of Agriculture*. The data set contains production information for virtually every farm in the state. Data on shipments of fresh fruit and vegetables to Hawai'i from mainland and foreign sources were provided by the market analysis and news branch of the Hawai'i Department of Agriculture. Virtually all of Hawai'i's vegetable production stays in the state, as does the majority of fruit produced. Only a few fruit products (pineapples, bananas, and papayas) are exported. We are unable to determine precisely how much of the produce represented in the data is nonlocal (exported to the U.S. mainland or foreign countries), but we believe that the amount is negligible (less than 15 percent of all of Hawai'i's produce is exported (Page, Bony, and Schewel et al. 2007)) and that we are thus justified in treating our study as an analysis primarily of local food. Unlike the majority of studies examining the competitive effects of outside sources of production, our model considers both foreign and interstate imports. More than 90 percent of the nonlocal fresh fruits and vegetables consumed in Hawai'i come from the U.S. mainland. Given that most trade in food products in the United States is interstate and not international, we more effectively capture the competitive effects of outside sources of production.

Table 1 displays summary statistics for the fresh fruit and vegetable farms used in our analysis. In 2007, approximately 59 percent of the farms were considered part-time operations, and 52 percent of the farms generated less than $10,000 in sales and thus were classified as noncommercial. The average size of a farm in terms of sales was $82,064; however, the large standard deviation indicates significant heterogeneity in size. Approximately 3.3 percent of the farms were considered to be large commercial operations (generating $250,000 or more in annual sales), but those farms generated 80 percent of Hawai'i's total fresh fruit and vegetable sales.

We observe that the average rate of growth in the number of farms in Hawai'i has declined significantly in recent years—from 4.0 percent for 1997 through 2002 to –0.7 percent for 2002 through 2007. Relative to commercial farms, the number of noncommercial farms grew at a significantly faster rate; however, the high standard deviation indicates that there is substantial volatility and heterogeneity in farm growth. In terms of survival rate, large commercial farms fare much better than noncommercial farms.[14] We find that full-time farm operations are significantly larger than part-time ones, that operators of noncommercial farms have the highest average age, and that large commercial farms have been in operation longer than part-time noncommercial farms. Table 2 reports rates of growth and survival of farms and the average rate of growth in imports for each census period by the crop subsectors used in our analysis. The data reveal significant volatility in imports and a strong degree of variation among the individual sectors. Growth and survival rates also vary significantly across years.

[14] Survival rates were calculated as the percentage of the total number of farms represented in the data that did not go out of business during the following five years denoted by the fact that they were again reported in the next agricultural census. This approach likely fails to include a nontrivial number of farms that were not reported in the next census but did not actually exit. For example, a change in ownership of a farm would assign a new census file number to the farm even though it did not exit and may not have ceased production.

Table 1. Summary Statistics of Hawai‘i Fresh Fruit and Vegetable Farms

Time Period	All Farms	Part-Time	Full-Time	Non-Commercial 0–$9,999	Small Commercial $10,000–$249,999	Large Commercial More Than $249,999
			Number of Observations			
1997	2,967	1,327	1,344	1,428	1,123	77
2002	3,192	1,387	1,805	1,745	1,213	88
2007	2,817	1,666	1,148	1,465	915	93
			Average Growth Rate – Percent			
1997–2002	4.0 (124)	11.1 (130)	–1.8 (118)	52.4 (129)	–41.2 (101)	–28.5 (101)
2002–2007	–0.7 (121)	1.7 (111)	–2.3 (127)	24.8 (121)	–28.1 (115)	–35.6 (109)
			Average Survival Rate – Percent			
1997–2002	54.3 (50)	55.0 (50)	54.2 (50)	48.4 (50)	59.9 (49)	79.2 (41)
2002–2007	44.2 (50)	41.0 (49)	46.4 (50)	40.5 (49)	47.2 (50)	76.1 (43)
			Farm Characteristics			
Average Farm Size – Dollars of Annual Sales						
1997	85,652 (1,057,328)	28,816 (217,042)	133,902 (1,502,063)	3,756 (2,624)	42,845 (42,408)	2,258,840 (5,849,686)
2002	88,660 (1,168,974)	37,018 (556,657)	128,342 (1,474,936)	4,127 (2,737)	40,762 (42,994)	2,572,210 (6,608,131)
2007	82,064 (1,044,362)	50,884 (388,583)	127,183 (1,564,728)	3,634 (2,739)	44,871 (46,672)	1,969,377 (5,421,226)
Average Age of Operator – Years						
1997	55.0 (13.7)	58.3 (14.4)	51.0 (11.6)	56.9 (14.1)	52.9 (13.1)	52.5 (12.0)
2002	56.3 (12.7)	52.0 (10.8)	59.0 (13.0)	57.5 (12.8)	55.1 (12.7)	51.8 (9.7)
2007	59.1 (12.0)	58.4 (11.7)	60.1 (12.2)	60.3 (12.1)	58.1 (12.0)	55.7 (10.4)
Average Age of Farm – Years						
1997	12.9 (11.8)	15.1 (13.2)	10.4 (9.3)	12.7 (11.5)	13.5 (12.2)	15.7 (12.3)
2002	14.0 (11.7)	11.8 (9.5)	15.8 (12.9)	13.3 (11.5)	15.5 (12.1)	14.4 (10.4)
2007	15.7 (12.7)	15.4 (12.2)	16.0 (12.1)	15.4 (11.7)	17.6 (13.0)	17.0 (10.4)

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Table 1. (continued)

Time Period	All Farms	Part-Time	Full-Time	Non-Commercial 0–$9,999	Small Commercial $10,000–$249,999	Large Commercial More Than $249,999
			Farm Characteristics			
Average Number of Crops						
1997	2.38	2.38	2.46	2.40	2.40	3.17
	(2.15)	(2.16)	(2.26)	(2.09)	(2.25)	(2.99)
2002	4.10	3.87	4.26	4.03	4.36	3.24
	(7.09)	(6.26)	(7.61)	(6.73)	(7.92)	(3.87)
2007	3.63	3.86	3.91	3.98	3.77	3.63
	(5.94)	(4.65)	(5.26)	(4.66)	(5.55)	(5.94)

Notes: Average farm size is reported by sales in dollars. Age of farm refers to how many years the current farm has been in operation. Age of operator is the age of the primary operator. Since some farms do not report total sales, the aggregate number of farms by size (noncommercial, small commercial, and large commercial) does not add up to the total number of farms. Standard errors are reported in parentheses.
Source: *U.S. Census of Agriculture*.

Results

To test hypothesis 1, we apply an empirical strategy that augments a model of farm growth to include import competition. Our specification is similar in application to models in Bernard, Jensen, and Schott (2006a, 2006b), Greenway, Gullstrand, and Kneller (2008), and Kim, Reimer, and Gopinath (2011), which tested the impacts of imports and trade costs in models involving heterogeneous firms. In our model, two five-year cohort periods (1997–2002 and 2002–2007) are pooled to generate a larger sample and more robust estimates of the effect of import competition.[15] The econometric specification tests the effect of the five-year change in import competition on the five-year change in farms' real total production sales and includes necessary controls:

$$Growth_{ict} = \beta_0 + \beta_1 \Delta Import\_Competition_{ct} + \gamma Z_{it} + \delta_c + \delta_k + \delta_t + \varepsilon_{it}.$$

The dependent variable $Growth_{ict}$ is the percentage change in real total production sales between years t and $t - 5$ for farm i producing in crop-sector c.[16] $\Delta Import\_Competition_{ct}$ is the percentage change in level of import competition for sector c between years t and $t - 5$ from all foreign and U.S. mainland imports.[17] Following Bernard, Jensen, and Schott (2006b), we code the import competition variable at the sector level and cluster effects may exist within crop groups. We include a time effect, δ_t, to control for unobservable changes across the two periods; a sector fixed effect, δ_c, (identified at the crop level) to control for all unobservable shocks occurring within different crops;

[15] We also tested the different cohorts separately but found that the results were not significantly different.

[16] For farms that produced multiple crops, we assigned the level of import competition associated with the farm's predominant crop.

[17] To smooth import volatility, we rely on two-year-period moving averages.

Table 2. Growth, Survival, and Import Changes by Crop Sector

	Number of Farms			Growth Rate – Percent		Survival Rate – Percent		Import Growth – Percent		
Crop Sector	1997	2002	2007	1997–2002	2002–2007	1997–2002	2002–2007	1992–1996	1997–2001	2002–2006
1. Avocado	104	139	112	–9	17	57	52	–1	7	38
2. Banana	370	345	320	24	–35	51	43	1	–33	26
3. Snap bean	20	14	6	49	–119	35	21	–25	–1	14
4. Cabbage (Chinese)	10	9	10	–78	3	90	56	–11	–43	64
5. Cabbage (head)	20	9	7	–28	12	80	56	–19	–9	44
6. Sweet corn	18	14	10	16	–106	67	36	17	0	–8
7. Cucumber	32	21	6	2	23	34	38	–22	–39	33
8. Daikon	4	9	3	–80	–35	25	56	8	–147	18
9. Eggplant	43	47	13	38	–23	53	26	–1	–4	27
10. Ginger root	99	64	18	–50	–24	38	39	–8	–37	28
11. Guava	106	67	52	34	0	48	41	0	0	0
12. Lemon	5	8	12	220	–18	40	50	–2	0	6
13. Lettuce	38	47	38	–3	33	61	51	–12	–10	–20
14. Lime	40	33	40	35	103	52	38	10	23	25

Continued on following page

Table 2. (coninued)

Crop Sector	Number of Farms			Growth Rate – Percent		Survival Rate – Percent		Import Growth – Percent		
	1997	2002	2007	1997 –2002	2002 –2007	1997 –2002	2002 –2007	1992 –1996	1997 –2001	2002 –2006
15. Mango	30	51	56	55	4	63	33	0	0	0
16. Onion (dry)	33	27	9	14	–84	76	59	0	–1	9
17. Onion (green)	43	38	19	–53	24	58	61	–21	14	23
18. Orange	40	68	70	19	35	58	43	–15	–13	11
19. Papaya	273	226	136	–3	0	54	46	0	0	0
20. Parsley (American)	4	6	8	76	14	50	50	–15	–39	79
21. Herbs	24	38	18	–25	–69	67	45	—	—	—
22. Radish	10	3	5	–28	–15	90	33	–143	48	19
23. Sweet potato	12	26	14	–87	–68	33	21	2	6	–2
24. Taro	152	141	81	–17	–10	47	36	13	31	–8
25. Tomato	41	43	34	68	–38	41	42	–23	–62	20
26. Watercress	14	18	6	31	90	79	11	10	40	26
Average				4	–1	54	44	–8	–10	14

Note: The number of farms represents farms that specialize in the particular crop. Growth rates are calculated based on all sales of the farms specializing in the commodity.
Source: *U.S. Census of Agriculture*.

Table 3. Correlation Matrix

Correlation Matrix	Growth	Survival	Change in Imports	Change in Import Share	Farm Size	Farm Age	Operator Age	Multi-crop Dummy
Growth	1							
Survival	—	1						
Change in imports	–0.0542*	–0.0377*	1					
Change in import share	–0.102*	–0.0134	0.7819*	1				
Farm size	–0.36*	0.1362*	–0.0059	0.0424*	1			
Farm age	–0.0869*	0.0523*	0.0542*	0.0306	0.0753*	1		
Operator age	–0.0218	–0.0239	0.0667*	0.0304	–0.1231*	0.463*	1	
Multi-crop dummy	–0.0402*	0.0272*	–0.0015	–0.0280*	0.0391*	0.0287*	–0.0495*	1

Note: * indicates significance at the 5 percent level.

and a county effect, δ_k, to control for the influence of spatial and geographic factors.[18] The effects are captured through dummy variables.

Z_{it} includes other farm-level control variables. Following Weiss (1999), we include initial farm size and farm age as important control variables for farm growth. Since previous work has shown that multiproduct manufacturing firms have a higher rate of survival than single-product firms (Bernard and Jensen 2007), we include a control variable for multiple crops. Following previous treatments from the literature, we include a dummy variable that equals one for farms that produce more than one crop and zero otherwise.[19] Figure A1 in the online appendix (available from the authors) shows the distribution of multi-crop activity for the farms in the analysis: 39 percent are single-crop farms and there is a highly skewed distribution of multi-crop activity.

The correlation matrix of the variables is provided in Table 3. We find that growth in farms is negatively correlated with our measures of imports, farm size, and farm age and with the multi-crop dummy variable. Survival is negatively correlated with import growth and positively correlated with farm size and age and with the multi-crop dummy. Operator age is negatively correlated with survival but the coefficient is not significant. Overall, the correlation analysis supports use of the variables included in our models.

Table 4 presents the regression results for different specifications of import competition and farm participation—all farms, full-time farms, and part-time farms. Our Breusch-Pagan test rejects the null hypothesis of homoskedasticity for our specifications on all farms and full-time farms. To adjust for the role of heteroskedasticity, we calculate robust standard errors, which are reported in parentheses. Given potential correlation within sectors, we also have to adjust our standard errors for clustered effects. The coefficients on changes in import

[18] Hawai'i's counties are defined by its four main islands: Oahu, Maui, Hawai'i, and Kauai. Maui includes Molokai and Lanai.

[19] Tests of a polytomous variable for multiple crops generated similar results.

competition (total change in imports and change in import share) are negative and highly significant in the all-farms model. A 1-percent increase in imports leads to a 0.437 percent decline in farm production for all farms collectively, and a 1-percent increase in import share leads to a 0.989 percent decline in production by all farms. The effect of import competition on part-time and full-time farms is similar. For part-time farms, the percentage change in imports has no significant effect on production, but the effect of the change in import share is negative and significant. Farm size has a highly significant effect on the rate of growth of both full-time and part-time farms. R-squares from the estimates shown in Table 4 range from 0.144 to 0.281. Given that the model seeks to explain the rate of growth (rather than the quantity of production), the model explains a reasonable amount of variation.

Table 5 reports results for noncommercial, small commercial, and large commercial farms. We find that generally all three types of farms are negatively affected by import competition. Small commercial farms contract the most in response to increasing imports. The effect of import competition on

Table 4. Effect of Import Competition on Farm Growth

	All Farms		Full-Time Farms		Part-Time Farms	
Dependent Variable	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**
Log change in imports	–0.437** (0.218)		–0.461* (0.238)		–0.255 (0.308)	
Change in import share		–0.989*** (0.151)		–1.001*** (0.181)		–0.793** (0.299)
Farm size	–0.296*** (0.025)	–0.292*** (0.026)	–0.197*** (0.034)	–0.197*** (0.035)	–0.409*** (0.052)	–0.405*** (0.051)
Farm age	–0.004 (0.003)	–0.004 (0.003)	–0.008* (0.004)	–0.009* (0.004)	0.006 (0.007)	0.006 (0.007)
Multi-crop dummy	–0.024 (0.104)	–0.025 (0.099)	–0.088 (0.127)	–0.089 (0.122)	0.0583 (0.127)	0.0630 (0.125)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County[a] fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,289	1,289	746	746	521	521
R-square	0.189	0.196	0.144	0.151	0.276	0.281
Breusch-Pagan test statistic[b]	7.14 (0.007)	7.39 (0.007)	4.11 (0.043)	3.70 (0.055)	1.92 (0.166)	2.35 (0.125)

[a] The counties are Hawai‘i, Honolulu (Oahu), Maui, and Kauai.

[b] Chi-square statistics for a Breusch-Pagan test for heteroskedasticity are presented. The probability values are presented in parentheses.

Notes: The dependent variable is the percent change in real total farm sales. Robust standard errors adjusted for clustering across farm crop types are presented in parentheses. The regressions cover two data panels: 1997–2002 and 2002–2007. Coefficients for the regression constant and dummy variables are suppressed. *, **, and *** denote significance at a 10 percent, 5 percent, and 1 percent level respectively.

large commercial farms in our analysis is not significant; that result is likely influenced by the small number of farms in the category. The results of the regression that tests hypothesis 1 show that increases in imports adversely impacted the production of local Hawai'ian farms. Thus, imports do indeed compete with local products despite consumers' potentially higher valuation of local products or preference for variety.

Hypothesis 2 posits that farm survival decreases in response to increased competition from imports. To test this hypothesis, we estimate rates of farm survival in periods t and $t + 5$ in response to changes in imports, $\Delta Import\_Competition_{ct-5}$, from periods $t - 5$ and t using a simple probit regression:

$$\Pr(Survival_{ict+5} = 1) = \phi(\beta\Delta Import\_Competition_{ct-5}) + Z_{it} + \delta_c + \delta_k + \delta_t .$$

We again include farm size, farm age, multi-crop activity, time, crop sector, and county dummy variables. Hoppe and Korb (2006) found that operator age is

Table 5. Effect of Import Competition on Farm Growth by Farm Size

	Noncommercial Farms 0–$9,999		Small Commercial Farms $10,000–$249,999		Large Commercial Farms $250,000 or More	
Dependent Variable	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**
Log change in imports	–0.386 (0.304)		–0.569* (0.342)		0.236 (0.724)	
Change in import share		–0.616* (0.347)		–1.383** (0.227)		–0.395 (1.163)
Farm age	–0.010** (0.004)	–0.010** (0.004)	0.000 (0.003)	–0.001 (0.003)	–0.048*** (0.015)	–0.048*** (0.015)
Multi-crop dummy	0.001 (0.143)	–0.001 (0.142)	–0.060 (0.099)	–0.058 (0.094)	–0.191 (0.586)	–0.144 (0.584)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County[a] fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	539	539	662	662	79	79
R-square	0.098	0.099	0.086	0.102	0.452	0.452
Breusch-Pagan test statistic[b]	1.48 (0.224)	1.73 (0.188)	8.15 (0.004)	9.34 (0.002)	1.59 (0.208)	1.40 (0.237)

[a] The counties are Hawai'i, Honolulu (Oahu), Maui, and Kauai.

[b] Chi-square statistics for a Breusch-Pagan test for heteroskedasticity are presented. The probability values are presented in parentheses.

Notes: The dependent variable is the percent change in real total farm sales. Robust standard errors adjusted for clustering across farm crop types are presented in parentheses. The regressions cover two data panels: 1997–2002 and 2002–2007. Coefficients for the regression constant and dummy variables are suppressed. *, **, and *** denote significance at a 10 percent, 5 percent, and 1 percent level respectively.

Table 6. Effect of Import Competition on Farm Survival

	All Farms		Full-Time Farms		Part-Time Farms	
Dependent Variable	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**
Log change in imports	–0.379 (0.332)		–0.553* (0.334)		0.361 (0.500)	
Change in import share		0.131 (0.940)		0.261 (1.34)		–0.398 (1.260)
Farm size	0.137*** (0.023)	0.138*** (0.023)	0.152*** (0.024)	0.154*** (0.024)	0.117*** (0.032)	0.116*** (0.033)
Farm age	0.007** (0.003)	0.007** (0.003)	0.006 (0.005)	0.006 (0.005)	0.008** (0.004)	0.008** (0.004)
Operator age	0.046*** (0.015)	0.046*** (0.015)	0.0390** (0.017)	0.0390** (0.017)	0.061* (0.033)	0.062* (0.034)
Operator age squared	–0.000*** 0.000	–0.000*** 0.000	–0.000*** (0.000)	–0.000** (0.000)	–0.001* (0.000)	–0.001* (0.000)
Multi-crop dummy	0.099* (0.059)	0.100** (0.060)	0.175** (0.073)	0.180** (0.074)	0.004 (0.084)	0.005 (0.084)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County[a] fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,723	2,723	1,533	1,533	1,129	1,129
Concordance rate	66%	66%	68%	68%	65%	65%

[a] The counties are Hawai‘i, Honolulu (Oahu), Maui, and Kauai.

Notes: The dependent variable is a dummy variable that equals 1 for surviving farms. Robust standard errors adjusted for clustering across farm crop types are presented in parentheses. The regressions cover two data panels: 1997–2002 and 2002–2007. Coefficients for the regression constant and dummy variables are suppressed. *, **, and *** denote significance at a 10 percent, 5 percent, and 1 percent level respectively.

also an important factor that influences farm survival rates. Therefore, we also include the farm’s primary operator’s age and its squared term as additional controls and expect that survival rates will be higher for farms operated by middle-aged individuals.

Table 6 reports the probability of survival under increasing import competition for all farms, full-time farms, and part-time farms. The concordance rates reflect the models’ ability to explain the variation in survival rates. The concordance rates generated in our models exceed 0.6, which suggests that the models adequately explain farm survival. We find that the rate of survival is slightly lower for part-time farms relative to full-time farms. That indicates that our model better explains variation in survival of full-time farms.

As in the model of farm growth, we analyze both changes in total imports and changes in import share to measure import competition. We find little evidence of farms failing at a faster rate in response to increasing competition from imports.[20] Other than for full-time farms, the coefficients for import shares are insignificant. Full-time farm exits are marginally affected by import competition, which suggests that they are more responsive to market forces than part-time farms. Farm size, farm age, and the operator-age-squared term are of the expected sign. The survival rate for multi-crop farms is greater than the rate for all single-crop farms and full-time single-crop farms. These results suggest that import competition does not have a significant impact on farm exit despite its adverse impact on growth.

Table 7 reports results for the impact of import competition on survival rates for noncommercial, small commercial, and large commercial farms. We find no significant effect for noncommercial farms. The results suggest that small commercial farms are significantly impacted by increasing import levels. However, since the coefficients for import share are insignificant, the results are not very robust. The coefficient for import share on large commercial farms is statistically significant but is of the wrong expected sign,

[20] We tested different lag lengths for import share, and the results were not significantly different.

Table 7. Effect of Import Competition on Farm Survival by Farm Size

	Noncommercial Farms 0–$9,999		Small Commercial Farms $10,000–$249,999		Large Commercial Farms $250,000 or More	
Dependent Variable	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**	**1997–2002**	**2002–2007**
Log change in imports	0.130 (0.573)		–0.813** (0.356)		–1.385 (10.191)	
Change in import share		0.049 (1.304)		–0.405 (1.123)		12.954* (7.850)
Farm age	0.002 (0.005)	0.002 (0.005)	0.013*** (0.004)	0.013*** (0.004)	0.023 (0.037)	0.032 (0.039)
Operator age	0.054*** (0.020)	0.054*** (0.020)	0.034* (0.019)	0.034* (0.019)	0.005 (0.256)	0.010 (0.333)
Operator age squared	–0.000*** (0.000)	–0.000*** (0.000)	–0.000** (0.000)	–0.000** (0.000)	0.001 (0.003)	0.001 (0.004)
Multi-crop dummy	0.072 (0.095)	0.072 (0.096)	0.051 (0.065)	0.055 (0.066)	9.535*** (1.110)	9.346*** (0.888)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
County[a] fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Crop fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,325	1,325	1,280	1,280	45	45
Concordance rate	64%	64%	65%	65%	81%	83%

[a] The counties are Hawai‘i, Honolulu (Oahu), Maui, and Kauai.

Notes: The dependent variable is a dummy variable that equals 1 for surviving farms. Robust standard errors adjusted for clustering across farm crop types are presented in parentheses. The regressions cover two data panels: 1997–2002 and 2002–2007. Coefficients for the regression constant and dummy variables are suppressed. *, **, and *** denote significance at a 10 percent, 5 percent, and 1 percent level respectively.

another indicator that small sample bias is influencing the results for large commercial farms.

The results of the survival model suggest a weak relationship between import competition and farm exits and some heterogeneity in the effect for different types of farms. The lack of response to competition by noncommercial farms reinforces the idea that those farmers are not as strongly motivated by profit.

Discussion

Our results indicate that import competition has adversely impacted the growth of farms in Hawai'i's fresh fruit and vegetable sector. Nonlocal products from the mainland and abroad either directly or indirectly compete with Hawai'ian products. Thus, even if Hawai'i farmers produce differentiated products or enjoy advantages associated with local production or higher quality, imported products still have a significant impact.

The results for farm survival are less conclusive. We find some evidence that import competition systematically affects small commercial farms more than noncommercial farms. The results also provide some evidence that globalization is leading to structural changes in the agricultural sector in Hawai'i by favoring large farms over small farms; however, the results are not robust.

The fact that we do not find a significant impact of import competition on farm exit suggests that many incumbent farmers are reluctant to cease operations despite shrinking profits. Nonmarket factors may explain their reluctance. High fixed costs associated with entering agriculture may also contribute to resistance to exiting. Thus, unlike the manufacturing sector, where globalization can have dramatic structural impacts through reallocation of production resources, strong nonmarket forces associated with agriculture may provide a buffer against some of the impacts of competition.

Limitations of our empirical research design may affect the findings. The ten-year period used in our analysis may not be sufficient to capture the impact of competition on farm survival. Since exit decisions typically are based on long-term forecasts, import fluctuations in the short term may have little bearing on those decisions. Additionally, we were unable to control for the endogeneity between imports and production. The lack of an exogenous variation in imports and effective instrumental variables diminishes the confidence of our estimated results. Future work employing a longer data series and instrumental variables will provide a more comprehensive empirical research design to test the hypotheses.

Reallocation of activities within a farm in response to competition may also explain why Hawai'i's farms are relatively resilient to import competition. Farmers may adapt to globalization by changing the crops they produce. Recent studies in international trade have examined multiproduct firms and found that firms may reallocate their production mixes in response to changes in trade. Bernard, Redding, and Schott (2010) and Liu (2010) found that multiproduct firms drop less profitable products to focus on core competencies when faced with import pressures. However, we tested that idea in regressions not reported here and found little evidence that Hawai'ian farmers change their product mixes in response to competition from imports.

We have not econometrically examined the role of farm entry. Today, the average farmer in the United States is approximately 55 years old (NASS 2007). Many began farming at a young age and continue to operate despite declining profits. Given the age structure of U.S. agriculture, a potentially significant challenge for future industry growth is the retiring of these farmers. While many of the farms with older primary operators also have secondary operators or family members who could take over, the likely degree of turnover is unknown. Since our results suggest that increases in food imports will adversely affect entry of new farms, additional research is needed to analyze impacts of competition associated with agriculture's age structure.

Conclusion

Our econometric analysis suggests that the outlook for Hawai'i's farms is guarded. Imports were found to adversely affect the entry and expansion of local farms and to have asymmetric impacts for various types of farms with small commercial farms being most severely affected. Our study provides interesting insight into the economic viability of local farms. Note that our analysis is based purely on the supply side and does not address important demand-side factors related to local food production. Relative to imported products, local foods tend to enjoy important quality and brand recognition advantages. Considering the difficulties of competing in global markets, the future of local farms in Hawai'i and across the United States may depend on cultivating demand preferences of local consumers and enhancing product differentiation. More demand-side analysis is needed to examine the role of these factors in supporting local farms.

While this study is motivated by concern about the decline of local farms, the benefits of trade must also be recognized. Given Hawai'i's high labor cost and scarcity of land, some food must be imported. Any interest or effort to protect local farms must be cautiously weighed against the gains associated with trade and each sector's comparative advantages.

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