Drivers of Demand for Imported Horticultural Commodities: A Cross-Country Comparison

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Abstract

International trade of horticultural commodities is increasingly important in many regions of the world, yet relatively little research has studied import patterns of key horticultural crops. Using data between 1991 and 2005, we find that import demand for horticultural commodities in developed countries has been driven primarily by prices and the level of trade openness while income and diet considerations were more important in emerging countries. Furthermore, our results show that the determinants of import demand differed across the selected crops, and therefore information can be lost if data for horticultural commodities are aggregated.

Keywords: Emerging markets; Horticultural commodities; Import demand; International trade

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Introduction

Over the last four decades there have been significant increases in global production and trade of agricultural products. Myriad studies highlight historical patterns and provide forecasts for production and trade of specific agricultural products; nearly all of these studies have focused on coarse grains and animal products. Horticultural trade patterns have largely been ignored in the agribusiness and agricultural economics literature, yet horticultural commodities represent a large share of the total value of agricultural production and trade in many regions of the world. Horticultural trade has expanded significantly since 1990, and part of this growth has been driven by the use of these crops as ingredients in a wider range of processed food products. The purpose of this article is to estimate the determinants of import demand for horticultural commodities in both developed and emerging countries.[1] Understanding the underlying drivers of trade, coupled with expectations about the direction and magnitude of change among the determinants, will shed some light on future patterns of trade for horticultural commodities in different regions of the world.

Table 1 lists the most valuable traded horticultural commodities in 2005.[2] The total value of trade for the twenty products shown in Table 1 is $73.8 billion; the total value of trade for all horticultural commodities was approximately $96 billion in 2005 (FAO, 2008). In 2005, the value of trade for key meat products (pig meat, chicken meat, and cattle meat) was $21.4 billion and trade in the top grain products (wheat, corn, soybeans, and rice) was valued at approximately $60 billion (FAO, 2008). Although the horticultural sector described here includes many commodities, its importance in international markets is highlighted when compared to traded values of major meat and grain products. The final column in Table 1 shows the increases in nominal value of trade for the selected horticultural commodities between 1991 and 2005; the nominal value of trade increased as little as 26% for tea and as much as 313% for pineapples. On average, the nominal value of trade across the horticultural commodities listed in Table 1 increased by 110% between 1991 and 2005.

Our analysis considers trade in six commodities that are widely produced and consumed in various countries; three of the six horticultural commodities are widely used as ingredients in further processed food products. Based on the ranking shown in Table 1, and to reflect a range of importing countries from different regions in the world, we chose to examine trade patterns for cocoa, coffee, tomatoes, oranges,

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[1] Importers are grouped following country classifications established by the IMF (2008) that separate developed countries from emerging and developing countries. Given the importers included in our analysis, we simply use the term *emerging countries* to describe the second group.

[2] Here *horticultural commodities* includes all fruit, vegetable, and tree crop commodities. Palm oil is not always considered a horticultural commodity; however, we include palm oil in our analysis for three reasons. Palm oil is an important commodity with a significant amount of international trade, it is typically ignored in studies that include oilseeds, and it is the only commodity listed in Table 1 that is heavily traded among emerging countries.

bananas, and palm oil. In addition, for five of the commodities examined, we consider the impact from a change in the price of a related horticultural commodity. As a result, our analysis includes economic information about eleven of the twenty horticultural commodities listed in Table 1.

Table 1: Value of global trade for horticultural commodities

Commodity	Total import value 2005 ($ billion)	Increase in nominal trade value 1991 to 2005 (%)
Palm oil	11.42	284.6
Coffee	10.09	29.4
Bananas	8.32	58.7
Tomatoes	5.04	119.9
Cocoa beans	4.86	102.9
Grapes	4.62	134.2
Apples	4.11	46.2
Tea	3.29	26.4
Oranges	3.11	42.3
Peppers	2.77	188.3
Almonds	2.31	238.3
Tangerines and mandarins	2.26	73.7
Lettuce and chicory	1.78	94.2
Pears	1.62	82.9
Pineapples	1.46	313.2
Peaches and nectarines	1.38	37.2
Cucumbers	1.37	67.7
Lemons and limes	1.36	115.2
Kiwi	1.33	77.7
Strawberries	1.31	78.7
Total	73.81	110.6

Source: FAO Trade Statistics, 2008.

The article is organized into four sections and each section addresses a separate but related objective. First, an overview of previous work that has examined trends, prospects, and forecasts for trade in agricultural markets is provided. Second, for five different regions in the world, horticultural production and trade patterns between 1965 and 2005 are documented. Third, data describing factors that are expected to have influenced horticultural trade flows in developed and emerging countries are collected. Fourth, an econometric model that quantifies the drivers of change in import demand for selected horticultural commodities is developed.

Situation and Outlook Reports for Horticultural Commodities

Much work has been completed that organizes data describing historical production and trade patterns for agricultural commodities (e.g., Koo and Taylor 2007; FAO 2008). There also exists a substantial amount of research that uses historical data to develop outlook reports, or forecasts, for production and traded quantities of

various agricultural products (e.g., Rosegrant et al., 2001; USDA-ERS, 2008). Brookins (2007) examined the major forces that are shaping global agricultural markets and found that changes in agricultural policy, consumer tastes, emerging markets, supply chains, and risk management strategies are the key drivers. Mattson and Koo (2006) examined forces influencing world grain markets; the authors explained how trade liberalization, research and development, ethanol and bio-diesel production, and supply and demand conditions in emerging countries will dictate future changes in production, prices, and traded quantities. USDA-ERS (2001) examined global consumption and trade patterns for food and agricultural products, including horticultural products, between 1970 and 2000. Changes in consumption patterns of fruits and vegetables were found to be associated with urbanization, transportation costs, diet quality, food safety regulations, and availability of organic products.

Each year the Food and Agricultural Policy Research Institute (FAPRI) employs a computable general equilibrium model to provide a comprehensive analysis of the forces affecting global production and trade patterns in agricultural markets. The FAPRI model incorporates macroeconomic conditions with agricultural policy variables to project global production and trade patterns for coarse grains, oilseeds, cotton, sugar, and animal products for a ten-year period. Recent FAPRI projections (FAPRI, 2008) dedicated a significant amount of attention to the impact that energy policies applied in the United States, Europe, Argentina, Canada, and Brazil will have on global agricultural markets. FAPRI (2008) projected higher nominal prices and production levels for all agricultural commodities; however, price increases beyond 2009 are modest for most of the commodities due to increases in stocks, planted area, and yields.

Demand for horticultural commodities has been linked to diet quality and caloric intake levels; this is a research area that is attracting attention among policy makers, nutritionists, food scientists and economists, and is especially important in developing and emerging countries. Consumption rates of horticultural products are expected to increase due to changes in diet quality and nutrition information (see USDA-ERS, 2001; de Haen et al., 2003), and much of the additional import demand for these products is expected to occur in China and Latin America. There is a growing literature on the relationship between trade and the changing composition of diets in the United States (e.g., USDA-ERS, 2001), other OECD countries (e.g., Srinivasan, Irz, and Shankar, 2006), and developing countries (e.g., Huang, Rozelle, and Rosegrant, 1999; Coyle, Gilmour, and Armbruster, 2004; Pingali, 2004). Our research will estimate the relationship between diet quality and import demand for horticultural products in both developed and emerging markets.

Production and trade patterns are well documented for many horticultural products in key global markets outside the United States. For example, Huong and Quan (2008) examined production and export patterns of coffee in Vietnam; Barros (2007)

reviewed the major export markets for Brazilian citrus products, and Beckman and Li (2008) highlighted the quantity of tomatoes that are supplied by, and exported from, China. These studies are representative of research that provides detailed trade flow data, however, does not project traded quantities nor estimate the underlying drivers of trade. Better information about the factors that influence international trade of horticultural commodities will assist in the development of outlook reports for these important yet understudied markets.

Production and Trade Flows for Selected Horticultural Products

Country-level data between 1961 and 2005 describing production and traded quantities for six horticultural commodities were collected. Given the large number of observations in the initial dataset, country-level data were aggregated to highlight general patterns across five regions.[3] An examination of trends between 1965 and 2005 reveals that there have been substantial increases in global production and traded quantities of many agricultural products including horticultural commodities.

Figure 1a, 1b, and 1c outline regional production patterns for the selected horticultural commodities in 1965, 1985, and 2005. Coffee production increased by approximately 50% between 1965 and 2005. For each of the other horticultural commodities studied,
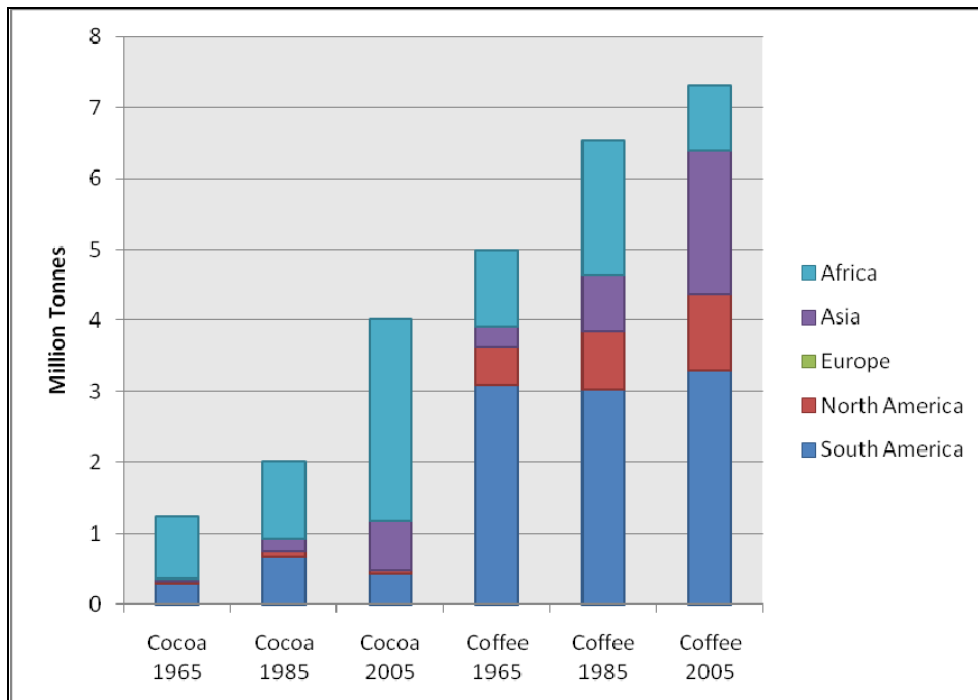

Figure 1a: Production of Cocoa and Coffee: 1965, 1985, and 2005

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[3] The region denoted Africa includes 54 countries; Asia includes the 50 countries east of the Mediterranean Sea plus 26 countries in Oceania; Europe includes 52 countries; the North American region includes 14 countries and includes 9 countries in Central America; South America includes the 14 countries south of Panama and 25 countries in the Caribbean.
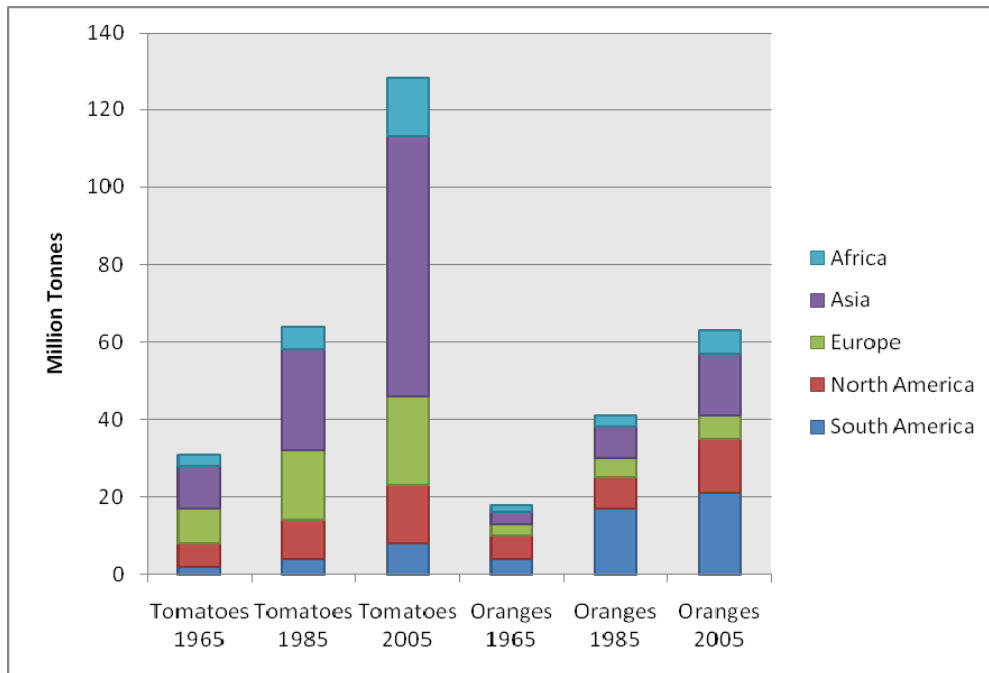
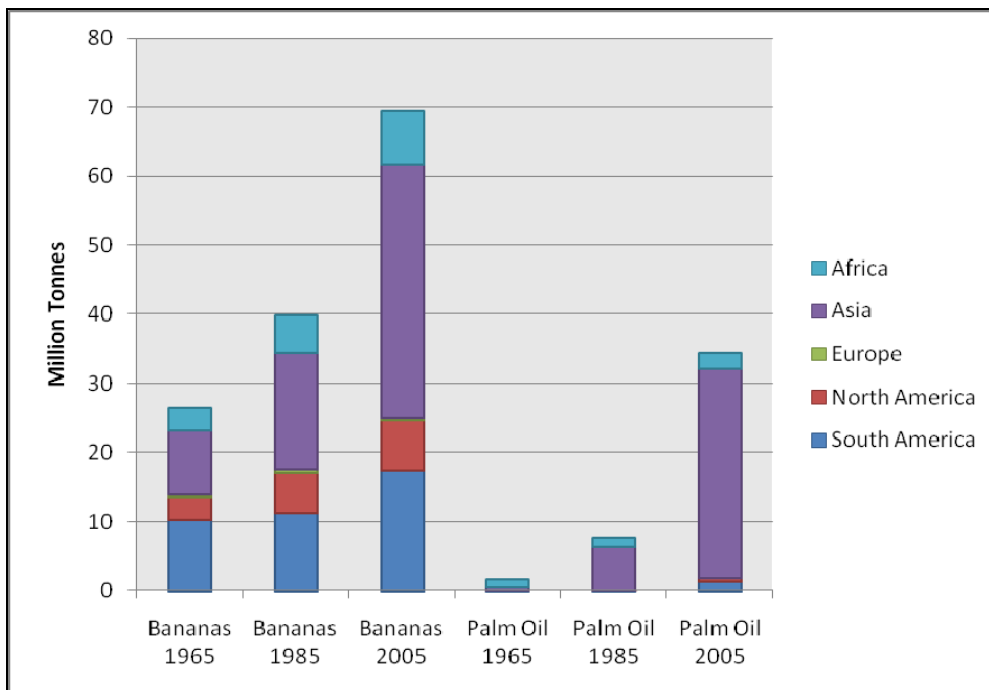**Figure 1b**: Production of Tomatoes and Oranges: 1965, 1985, and 2005

Figure 1c: Production of Bananas and Palm Oil: 1965, 1985, and 2005
Source: Food and Agriculture Organization of the United Nations, Production Statistics.

production increased by at least 160%. Overall, production levels of these commodities increased notably in several regions. Production increases were most significant in Asia and Africa for cocoa while South America experienced the largest increase in orange production. Asia experienced the largest production gains for coffee, tomatoes, bananas, and palm oil. Large production gains also occurred in South America for tomatoes, banana production increased in Africa, and orange production increased in North America and Asia.

Figure 2a, 2b, and 2c show the regional-level trade patterns for the six horticultural commodities. Once again, there have been increases in traded volumes over this time period, yet the increases have been most significant since 1985. Traded quantities of cocoa and coffee have increased, and in the case of coffee, import growth occurred across several regions. Total trade of tomatoes doubled and that of oranges increased 30% between 1985 and 2005; most of the new import demand stemmed from countries in North America and Europe. Substantial increases in the imported quantities of bananas and palm oil occurred between 1985 and 2005. Global trade of bananas rose from approximately 7 million metric tons in 1985 to 15 million metric tons in 2005. The increase in global imports of palm oil was even greater over this time period; total imports of palm oil increased from 5 million metric tons in 1985 to over 24 million metric tons in 2005. Most of the increase in import demand for palm oil occurred in Asia; however, Africa saw the largest percentage increase in import demand for palm oil.
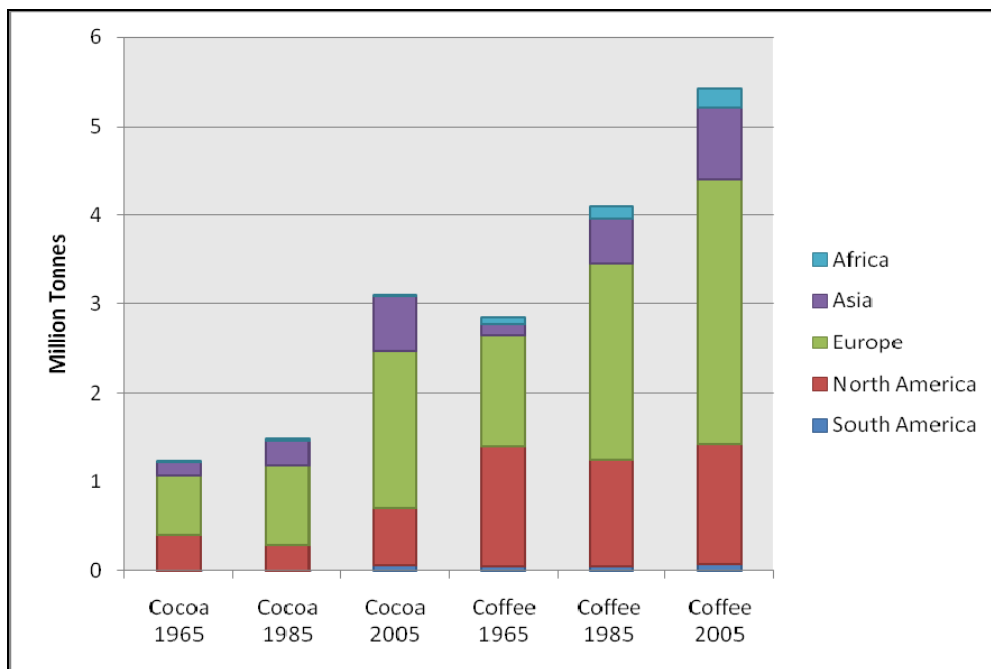

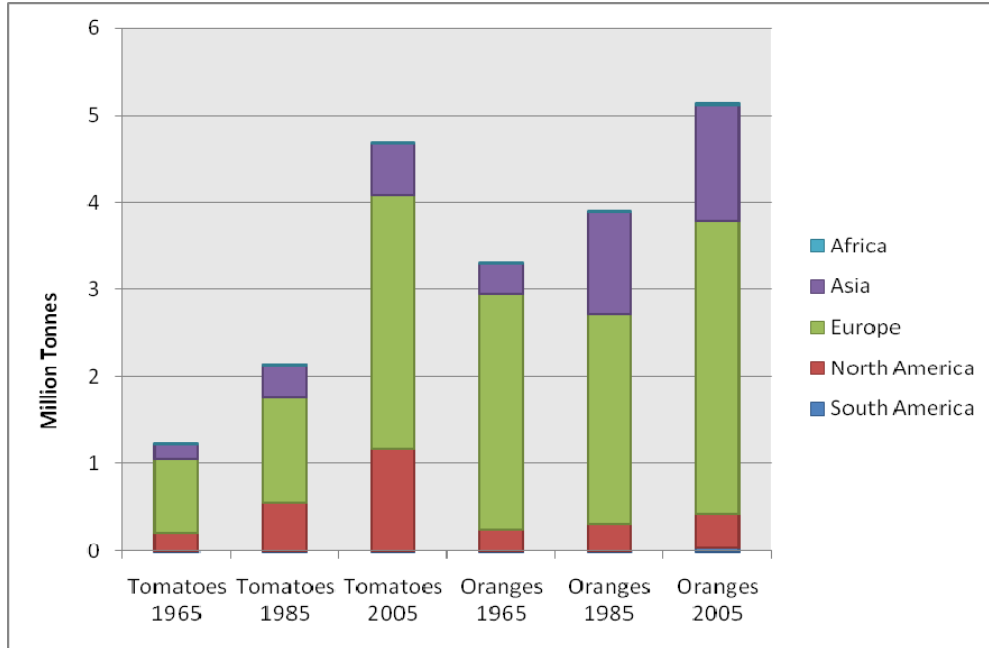**Figure 2a**: Imports of Cocoa and Coffee: 1965, 1985, and 2005

Figure 2b: Imports of Tomatoes and Oranges: 1965, 1985, and 2005
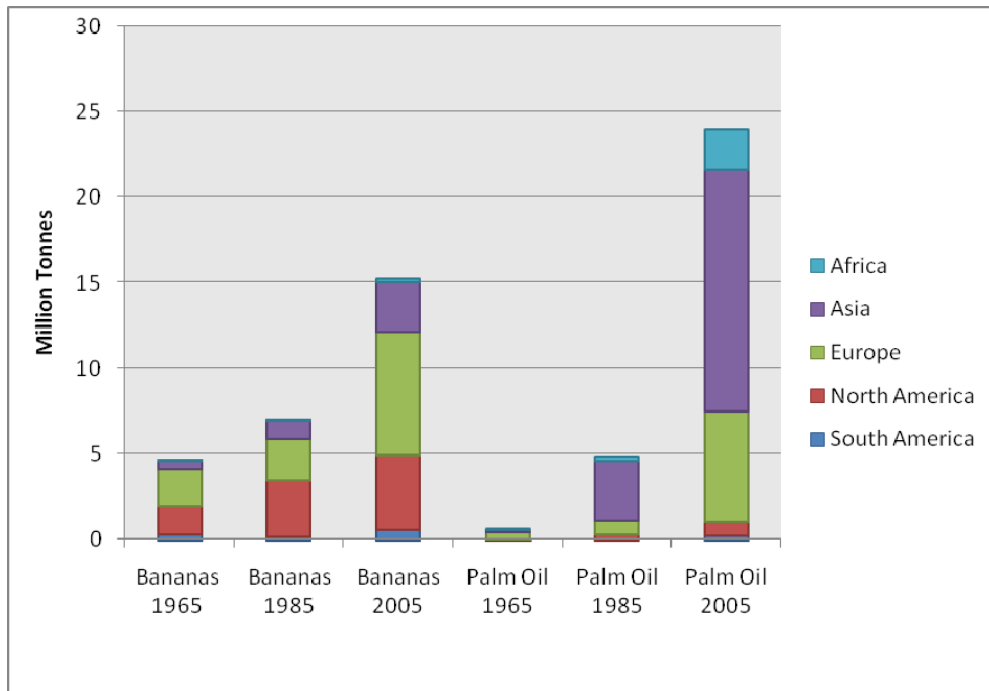
Figure 2c: Imports of Bananas and Palm Oil: 1965, 1985, and 2005
Source: Food and Agriculture Organization of the United Nations, Trade Statistics.

Relative to meat and grain products, increases in the volume of trade between 1991 and 2005 were bigger for horticultural commodities. The average volume of trade increased by 80% between 1991 and 2005 for the selected horticultural commodities; over the same time period, the average volume of trade increased by approximately

66% for meat products and by 73% for grains (FAO, 2008). In 2005, trade's share of total production among the six selected horticultural commodities ranged between 4% and 77%; it was greater than 65% for cocoa, coffee, and palm oil. Trade's share of production in 2005 ranged between 3% and 10% for meat products and ranged between 3% and 30% for grain products. These traded volumes expressed as a share of production reinforce the important role that horticultural commodities play in global agricultural markets.

Drivers of Import Demand for Horticultural Commodities

Various agricultural economists have developed models to estimate import demand of horticultural commodities; much of this work has used import data from developed countries and focused on the effects of generic advertising efforts in foreign markets. Rosson, Hammig, and Jones (1986) studied import demand for apples in Europe, East Asia, and South America; Halliburton and Henneberry (1995) examined import demand for almonds in Pacific Rim countries; Lanclos, Devadoss, and Guenthner (1997) investigated import demand for U.S. frozen potatoes in Japan and other countries in South East Asia; Kaiser, Liu, and Consignado (2003) studied import demand for U.S. raisins in Japan and the United Kingdom.

In addition to estimating the effect of generic promotion expenditures, many of these studies also estimated own- and cross-price elasticities, and income elasticities, for imported products. Earlier work has typically estimated negative coefficients for own-prices and positive coefficients for income. Furthermore, previous results find a negative and statistically significant relationship between import quantities of horticultural products and trade barriers. This area of research is extended here to assess how trade openness impacts import demand for horticultural commodities in both developed and emerging countries.

For six of the most highly traded horticultural commodities, the impacts that five variables have had on per capita import levels across key importing countries are estimated. The countries selected for each horticultural commodity include major importers from both developed countries and emerging countries. Table 2 outlines the importing countries that were included in the analysis. Each model included data for the top five importers from developed countries. Data for tomato imports in emerging countries were not available; however, data for each of the other horticultural commodities were available in at least four emerging countries. Emerging countries such as Kuwait, Russia, and United Arab Emirates are significant importers of horticultural products, but data describing trade activity in these countries were not available. With the exception of palm oil, the global share of trade was bigger for the group of developed countries relative to the group of emerging countries. Overall, the data collected represented between 50% and 74% of global trade activity for the six horticultural commodities.

Table 2: Developed and emerging countries[a] included in the analysis[b]

Crop	Developed countries	Emerging countries
Cocoa	Netherlands (1)	Malaysia (5)
	United States (2)	Brazil (14)
	Germany (3)	Turkey (15)
Global import share (%)	United Kingdom (4)	China (16)
	France (6)	Czech Republic (23)
	63.1	10.5
Coffee	United States (1)	Algeria (11)
	Germany (2)	Argentina (23)
	Japan (3)	Hungary (24)
Global import share (%)	Italy (4)	Morocco (27)
	France (5)	
	59.3	3.8
Tomatoes	United States (1)	
	Germany (2)	
	France (3)	
Global import share (%)	United Kingdom (4)	
	Netherlands (5)	
	61.2	
Oranges	Germany (1)	Saudi Arabia (8)
	France (2)	Malaysia (18)
	Netherlands (3)	Hungary (19)
Global import share (%)	United Kingdom (4)	Czech Republic (22)
	Canada (5)	Romania (23)
	41.2	8.9
Bananas	United States (1)	China (11)
	Germany (2)	Argentina (12)
	Japan (3)	Czech Republic (21)
Global import share (%)	United Kingdom (4)	Turkey (23)
	Italy (5)	
	49.8	6.4
Palm Oil	Netherlands (4)	China (1)
	Germany (5)	India (2)
	United Kingdom (6)	Pakistan (3)
Global import share (%)	Singapore (7)	Malaysia (11)
	Japan (8)	
	19.7	40.1

[a] **Source:** IMF, 2008.
[b] Numbers in parentheses denote overall calculated rankings in terms of the total quantity imported over the period 1991 to 2005.

The variables used in the import demand models were selected to identify factors that help to explain changing patterns of traded quantities; variables included the price of the commodity, the price of a related commodity, per capita income, the level of trade openness, and per capita calorie intake. The quantity of domestic production was considered as a sixth explanatory variable; however, it was omitted for two reasons. First, data characterizing domestic production of horticultural commodities in emerging markets were often limited, and second, top importers of

the selected horticultural products typically did not supply a significant quantity domestically.

Rather than assess the impact that factors have had on total import quantities or the total value of imports, per capita import quantities are examined. Estimating per capita import quantities allows the model to attach more weight to large importing nations with relatively low population levels. The per capita quantity of commodity *i* imported into country *k* in time period *t* is denoted as M_{kt}^{i}. In the import demand specification shown in equation (1), superscripts *i* and *h* denote agricultural commodities where *h* is related to *i* in consumption, subscript *k* denotes a country, and subscript *t* denotes time.

(1) $M_{kt}^{i} = f(P_{kt}^{i}, P_{kt}^{h}, I_{kt}, C_{kt}, O_{kt})$

The price of the imported commodity *i* into country *k* in year *t* is denoted as P_{kt}^{i} and the price of commodity *h*, which is a substitute in consumption, is denoted as P_{kt}^{h}. The related commodity in consumption for cocoa is sugar; it is tea for coffee, cucumbers for tomatoes, tangerines and mandarins for oranges, apples for bananas, and soybean oil for palm oil. All prices used in the import demand models are unit prices and were calculated by dividing the total value of imports by the total quantity of imports (FAO, 2008). In addition to price effects, several other variables were considered including per capita income, denoted as I_{kt}, diet quality measured as per capita calorie consumption, denoted as C_{kt}, and the level of trade openness, denoted as O_{kt}, in year *t* for country *k*.

The per capita gross domestic product (total gross domestic product divided by population) was used as a proxy for per capita income (IMF, 2008). Per capita calorie consumption is the average calories available per person per day in country *k* (FAO, 2008); data for per capita calorie consumption rates were only available from 1991 to 2003, so data between 2000 and 2003 were used to extrapolate rates for 2004 and 2005 in all countries. The level of trade openness was characterized by the total value of imports as a share of gross domestic product in country *k* (World Bank, 2008). All financial data was deflated into real 2000 U.S. dollars using the Consumer Price Index (USDOL-BLS, 2008).

Estimating Import Demand

Single equation models were developed to estimate per capita import demand for each of the six horticultural commodities. Each import demand model included fifteen time periods (1991 to 2005) for up to ten countries. Table 3 shows that the number of observations included in each model ranged from 75 to 150. Two datasets (cocoa and oranges) included information from ten importers, three datasets (coffee, bananas, and palm oil) included nine importers, and the tomato dataset included only the top five importers from developed countries. Our

estimations are based on information from six balanced datasets.[4] All variables used in the import demand models were taken from time period t, the same time period that per capita import quantities were observed.

The model used to estimate the per capita import demand quantity of commodity i is specified in Equation (2) and employs a double logarithmic functional form; this allows the resulting coefficients to be approximately interpreted as percentage changes (or elasticities). Here the estimated coefficients for horticultural commodity i (β_n^i) and the associated p-values were used to assess the statistical relationships that exist between the explanatory variables and per capita quantities of imports in developed countries. The model also included an indicator variable, denoted as E, that was equal to 1 when importer k was from an emerging country and equal to 0 otherwise. The indicator variable was used to construct interaction terms that enabled the model to estimate coefficients that are specific to the group of emerging countries. The emerging country estimates (γ_n^i) should be interpreted as the statistical relationships that exist in addition to the baseline estimates found for the developed countries. Intercept terms were estimated for each importer. In equation (2) α_k^i is the baseline intercept for importer k; the dummy variable, denoted as DV_j^i, is used to identify the other importers of commodity i and α_j^i is the intercept term specific to importer j.

$$(2) \quad \ln M_{kt}^i = \alpha_k^i + \sum_{j \neq k} \alpha_j^i DV_j^i + \beta_1^i \ln P_{kt}^i + \beta_2^i \ln P_{kt}^h + \beta_3^i \ln I_{kt} + \beta_4^i \ln C_{kt} + \beta_5^i \ln O_{kt}$$

$$+ \gamma_1^i E \ln P_{kt}^i + \gamma_2^i E \ln P_{kt}^h + \gamma_3^i E \ln I_{kt} + \gamma_4^i E \ln C_{kt} + \gamma_5^i E \ln O_{kt} + e_t^i$$

It was expected that higher import prices of commodity i would lead to lower levels of per capita imports of commodity i; furthermore, this relationship was expected to be stronger in the emerging countries. The relationship between the price of commodity h (the related commodity in consumption) and per-capita imports of commodity i will indicate whether commodity h is a substitute or a complement commodity. Similar to the own-price effects, the cross-price effects are expected to be statistically stronger among the importers in emerging countries. Higher levels of income and calorie consumption were expected to have a positive relationship with per capita import quantities. However, depending on the horticultural commodity and the importing country, it might be the case that higher levels of caloric intake will be linked to lower levels of per capita imports. The level of trade openness was expected to be positively related with import demand.

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[4] In a limited number of cases, particularly for emerging countries, missing data were imputed to construct a balanced dataset. When data were imputed we used a simple model that considered observations immediately before and after the missing values. Data describing the Czech Republic during the period between 1991 and 1993 were estimated using data from Czechoslovakia prior to 1991 and the Czech Republic after 1993.

Econometric Specification Tests

Error terms from the time series component in our panel data were expected to exhibit first-order autocorrelation; therefore the Lagrangian multiplier test was used to measure the existence of autocorrelation in each import demand model (Greene, 2003). Equation (3) outlines the simple regression model used to examine the statistical relationship between the lagged error, denoted as e_{t-1}^i, and the error in the unrestricted full model, denoted as e_t^i. The estimated coefficient for the lagged error, denoted as ρ, is interpreted as the true autocorrelation coefficient; a statically significant value for ρ indicates the presence of first-order correlation. Tests were performed to check first-order autocorrelation in the six models; in each case country-level data was pooled across the importers from both developed and emerging countries.

$$(3)\ e_t^i = \rho e_{t-1}^i + v_t^i$$

The estimated coefficients for ρ from the Lagrangian tests are shown in Table 3. The null hypothesis is that first-order autocorrelation does not exist; a p-value for ρ that is less than 0.05 indicates that we can reject the null hypothesis at the 95% level. In the import demand models that we estimated, the p-value for ρ was less than 0.01 in five of our import demand models; the value of ρ in the model for oranges was statistically significant at the 10% level. In addition, we checked for, but did not find evidence of, higher orders of autocorrelation in any of the import demand models. To circumvent problems with correlations of errors in import demand models for cocoa, coffee, tomatoes, bananas, and palm oil we employed the Parks Method; this method estimates the coefficients using a two-stage generalized least squares procedure that assumes an autoregressive error structure of the first order and contemporaneous correlation among the cross sections (SAS, 1999). Since first-order autocorrelation was only marginally evident in the import demand model for oranges, the coefficients in the orange model were estimated using ordinary least squares.

Regression Results and Implications

Table 3 also shows the estimated coefficients and the p-values (in parentheses) for the six import demand models. Columns list results for the six horticultural commodities and in each case the dependent variable was the per capita import quantity of commodity i. The explanatory variables that apply to developed and emerging countries are listed in the rows; for each explanatory variable, the estimated coefficients for developed countries are immediately followed by coefficients for emerging countries. Our models capture much of the variation among the explanatory variables as evidenced by Adjusted R^2 values that range from 0.81 to 0.98.

Table 3: Import demand regression results for selected horticultural commodities[a]

Explanatory variables	Dependent variable Quantity of per capita imports for:					
	Cocoa	Coffee	Tomatoes	Oranges	Bananas	Palm Oil
N	120	135	75	150	135	135
ρ	0.697* (0.000)	0.293* (0.003)	0.407* (0.000)	0.135 (0.096)	0.593* (0.000)	0.478* (0.000)
Adjusted R^2	0.978	0.969	0.810	0.988	0.863	0.946
Import price	−0.129* (0.006)	−0.083* (0.000)	−0.193* (0.014)	−0.513* (0.001)	−0.379* (0.000)	−0.165* (0.004)
E*Import price	−0.449* (0.004)	0.024 (0.539)		−0.289* (0.002)	−0.879* (0.000)	−0.403* (0.000)
Price of related product	0.159 (0.068)	−0.173* (0.000)	−0.177* (0.026)	0.511* (0.000)	0.083* (0.000)	0.035 (0.434)
E*Price of related product	0.604* (0.000)	0.001 (0.985)		−0.119 (0.087)	−0.222 (0.053)	0.227 (0.109)
Per capita income	0.175 (0.212)	−0.078 (0.097)	0.627* (0.000)	−0.027 (0.710)	0.418* (0.000)	0.308* (0.002)
E*Per capita income	−0.954 (0.267)	0.340* (0.001)		0.407* (0.000)	1.147* (0.000)	0.297 (0.092)
Diet proxy	−0.358 (0.547)	0.033 (0.099)	0.531 (0.360)	0.375 (0.100)	0.313* (0.005)	−0.114 (0.442)
E*Diet proxy	7.290* (0.000)	−0.698 (0.202)		0.260 (0.592)	−6.457* (0.001)	−0.319 (0.079)
Trade openness	0.298* (0.026)	0.037 (0.201)	0.646* (0.000)	−0.035 (0.611)	−0.118* (0.038)	0.643* (0.000)
E*Trade openness	2.880* (0.000)	−0.111 (0.234)		−0.192 (0.077)	0.262 (0.201)	0.284 (0.127)

[a] The p-value for each estimated coefficient is shown in parenthesis; an asterisk is used to denote statistical significance at the 5 percent level.

The first column of results outlines the estimated coefficients for per capita import demand of cocoa. A negative and statistically significant relationship is found between per capita imports of cocoa and the price of imported cocoa; this relationship is even stronger in emerging countries. The estimated coefficient for the price of the related import product, sugar, is positive and statistically significant

at the 10% level indicating that cocoa and sugar are considered substitute products among the selected importers. Similar to the own-price effect, the relationship between the price of imported sugar and per capita imports of cocoa is stronger in emerging countries. Income and caloric intake do not appear to be statistically important for cocoa importers in developed countries, yet the diet variable is statistically significant for emerging importers. The estimated coefficient for trade openness is positive and statistically significant in developed countries and even more important for importers in emerging countries.

The estimated coefficients in the coffee model indicate that prices are the drivers of per capita import demand in developed countries. The estimated coefficients for the import price of coffee and the import price of the related product (tea) are negative and statistically significant for developed countries; this finding suggests that coffee and tea are complement products in developed countries. Estimated coefficients for the import prices of coffee and tea in emerging countries are not statistically significant. Per capita income is not important for coffee importers in developed countries, yet it is positive and statistically significant for importers in emerging markets. The import demand model for tomatoes shows that prices, income, and trade openness are important factors. Here the related product is cucumbers and our results indicate that imported cucumbers are a substitute product for imported tomatoes in developed countries.

Results from the import demand models for oranges and bananas show similar results. For both oranges and bananas we see that the own price effects are negative and statistically significant while the price effects from the related products are positive and statistically significant. The results show that importers of oranges and bananas in emerging countries are more sensitive to changes in prices relative to developed countries; the own price effect is stronger and the related price effect is dampened in the emerging countries. This indicates that all importers of oranges consider the related product (tangerines and mandarins) to be a substitute; however, this relationship is stronger for importers in developed countries. Similar to import demand for oranges, importers of bananas in emerging countries view the related product (apples) as a weak substitute. Per capita income is an important driver of import demand for bananas in developed countries; it is also a statistically significant variable for orange and banana importers in emerging countries. The relationship between caloric intake and import demand is positive and statistically significant for oranges (at the 10% level) and for bananas (at the 1% level). In emerging countries, the diet variable is statistically significant for bananas but here it becomes inversely related to import demand. Import demand for bananas also shows a negative and statistically significant coefficient for the trade openness variable. Results for the diet and trade openness variables in the import demand model for bananas in emerging countries may not be intuitive. However, it is plausible that import demand for bananas in emerging countries falls

with increases in diet quality or trade liberalization and is replaced by greater demand for other imported fruit products (or other food products such as meat). The final column in Table 3 shows results for the model that estimates per capita import demand for palm oil. The estimated coefficient for the import price of palm oil is negative and statistically significant in developed countries and the effect is stronger in emerging countries. Here the price of the related product (soybean oil) is not statistically significant and this may be due, in part, to the low levels of soybean oil trade in markets that are substantial importers of palm oil. Income and trade openness are important factors to importers of palm oil in both developed and emerging countries. Caloric intake is not statistically significant in developed countries but is negative and statistically significant (at the 10% level) in emerging countries. This result suggests that importers in emerging countries consume less palm oil as diet quality increases.

Conclusion

A review of data for selected horticultural commodities draws attention to the expansion of international trade that has occurred for these crops over the last half century. Most notable in horticultural markets was the rapid rise of trade activity between 1991 and 2005 relative to patterns in various meat, grain, and oilseed sectors, yet few studies have examined the drivers of trade patterns in horticultural markets. Our research begins to fill that gap and provides a careful analysis of the relationships between import demand and prices, income, caloric intake, and trade openness for six horticultural commodities.

Regression results highlight that price is consistently an important determinant of per capita import demand for horticultural commodities. Estimated coefficients for the own price variable were negative and statistically significant at the 1% level in all six models; four of the five models that included data for emerging countries revealed that the own price effect was stronger in emerging countries. Prices of related products and income were often statistically significant determinants of import demand in horticultural sectors. Among developed countries the diet variable was positive and statistically significant at the 5% level in the banana model; it was statistically significant at the 10% level for coffee and oranges. Interestingly, the estimated coefficient for the diet variable in the import demand model for bananas in emerging countries was negative. Trade openness was positive and statistically significant in import demand models for cocoa, tomatoes, and palm oil in developed countries; outside of the cocoa model, trade openness was not a key driver of import demand in emerging countries.

This research examines the drivers of trade in horticultural markets and presents findings that are relevant to food and agricultural industry managers involved in international markets. The results for the trade openness and diet variables highlight some non-trivial differences between the six commodities, and these differences have

implications for agribusinesses. Specifically, trade openness was more important for upstream products (cocoa, tomatoes, and palm oil) and diet was more important for downstream products (coffee, oranges, and bananas).[5] Trade openness was not positive and statistically significant for any downstream products and diet was not statistically significant for any upstream products. This set of findings indicates that trade liberalization has been important for food manufacturers and firms that import horticultural commodities to be used as ingredients. It also indicates that diet quality can be a useful measure of the potential import demand for fresh horticultural products. Overall, changes in traded quantities of horticultural commodities have been influenced largely by changes in prices; however, agribusinesses involved in upstream markets are heavily impacted by trade agreements while those involved in downstream markets should pay close attention to shifts in dietary patterns.

Our results suggest that further research in this area should be conducted with two considerations in mind. First, price and income effects are often statistically significant for most commodities in both regions. Many of the own-price and income effects are much stronger for importers in emerging countries, yet cross-price effects in emerging countries do not always reinforce results found in the developed countries. In the case of oranges and bananas, our results indicate that the cross-price effects were inversely related to what was found in developed countries. Horticultural markets include a cluster of closely related products and additional work that estimates price elasticities will help uncover more of these important substitution effects for horticultural commodities. Second, although many horticultural commodities share similar production processes, the economic conditions in these markets are often very different. Our regression results do not tell the same story across the six commodities and provide a strong argument that information would be lost if horticultural commodities are aggregated. However, based on common patterns found here for upstream and downstream products, some level of aggregation may be appropriate for examining trade issues in horticultural markets.

Acknowledgements

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[5] Upstream products are commonly used as ingredients in further processed foods whereas downstream products require less processing before they are marketed to consumers (for a more detailed explanation see Norwood and Lusk, 2008).

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